The Sense of My Screaming Skin.

An investigation into the colouring process of Amalric Walter (1870-1959) using metallic salts in pâtes-de-verre.

by

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Abstract.

The research undertaken in this PhD builds on a previous study into the lost methodology and techniques of the French pâtes-de-verre artist Amalric Walter (1870-1959). This PhD clarifies those working methods, develops his guiding principles, and moves forward the techniques into the 21st century.

My research takes three simultaneous paths of investigation: Historic, Scientific and Personal. As well as being individual studies in themselves they inform and illuminate each other.

In the attempt to clarify the original subject matter, more questions are raised about the development of the late French Art Nouveau pâtes-de-verre movement, and why Walter's techniques differed so greatly from those employed by his fellow artists. The research also investigates the historical accuracy of the creative world from which pâtes-de-verre sprang, and offers an alternative view of a process that has continued unbroken across two millennia. The results and their conclusions are laid out in the form of three separate books that culminate in a body of my own personal art work. Ultimately the study increases our knowledge of what pâtes-de-verre is, how it can be made, and confronts accepted artistic boundaries of what pâtes-de-verre can illustrate.

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Introduction to the Research

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1.1 Introduction.

In the field of pâtes-de-verre research the work and life of Amalric Walter has remained something of an enigma. At the height of his career in the 1920s Walter was hailed as the leading glassmaker of his generation (Vallieres, April 1925). Yet, since his death in 1959, Walter has come to be thought of by glass historians, particularly in France, as a lesser figure than his contemporaries in the pantheon of the great and good. In his thirties Walter was openly credited with discovering 'certain processes' in the manufacture of pâtes-de-verre, and was amongst a very few group of artists who produced saleable work on a continuing basis. Despite having been considered an important player in the extraordinary developments in glass during the late French Art Nouveau, and especially that of pâtes-de-verre, Walter has never been awarded a solo retrospective of his work in his native France. The first such exhibition occurred in 2006 at the Broadfield House Glass Museum, Kingswinford, in the West Midlands.

Noel Daum, a glass historian, has reinforced this subdued view of Walter in his two books on pâtes-de-verre and the history of his family's glass manufacturing factory ('Daum Brothers') in Nancy, France where Walter was employed. Both books have been the continuing reference points on the subject for subsequent glass historians and interested academics. In the index in Daum's first book entitled 'La pâte-de-verre', Walter is awarded the epithet of 'L'artisan'. This is translated into English as 'the Craftsman', a somewhat humble term (Daum, 1984b). Henri Cros (1840-1907), acknowledged as the 'father' of the rediscovered technique of '*Pâtes-de-verre*' is awarded the title 'Le precursor' (or 'The Pioneer') and stands alongside the names of other significant contributors to the craft. Albert Dammouse (1848-1926) (Walter's tutor) is given the title of '*The Ceramicist*', Georges Despret (1862-1952) (Cros' collaborator) '*The Independent One*'. Two of Walter's contemporaries Francois Decourchement (1880-1971) and Gabriel Argy-Rousseau (1885-1953) are respectively described as '*The Glass Maker*' and '*The Scientist*', both titles of honour (Daum, 1984b). Yet amongst these masters, Amalric Walter has been ennobled not as an artist, but, instead, is given the backhanded, the downgraded, compliment of a craftsman. And a craftsman is not the same thing as an artist.

In the Daum Factory's early output of pâtes-de-verre (between 1904 and 1914) Walter's name is rarely acknowledged on work he did for the company, either inscribed on the work itself or in the photo-credits. Henri Bergé's (Walter's designer and sculptor) on the other hand, is mentioned in those credits, but Walter's is not. In Noel Daum's earlier book on the history of his family's factory, '*DAUM: Maîtres Verriers*' the story is similar, with photographs of pieces clearly by Walter, (and which are now housed in the Broadfield House collection) have no authorship other than '*Daum, Nancy*'. The Daum family naturally took the credit for their factory's artistic success, yet none of the Directors of the company were artists (Daum, 1980a).

This subtle demotion of Walter's position has affected the way many French academics have historically viewed him alongside the others, not as the artist as the others were, but as a 'mere' technician. The fault lies, it would seem, in the fact that while the others designed their own work Walter hired sculptors and designers to produce sketches and model forms for his products (Daum, 1984b). This apparent omission on his part from the artistic process thus removes from him the term *'auteur'*, which the French consider the true mark of the artist (Olivié, 2006). Another important consideration, which removed Walter from the group of pâtes-de-verre makers of that period was that it had also been suggested in France the decorative details of Walter's work were enamelled on the main body of the glass after it had been cast. This cast doubt as to whether his work was pâtes-de-verre at all (Daum, 1984b) despite the obvious declaration of the artist himself (see Fig i, below). My research at the University of Wolverhampton proved that Walter made what he said he made, and was what his fellow makers regarded him to be.

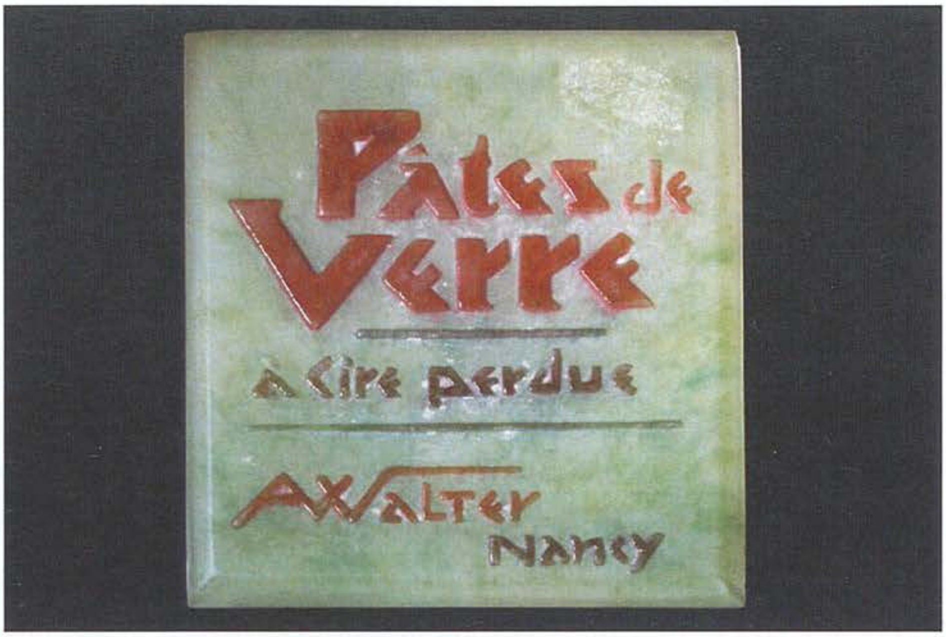

Fig i. Walter's point-of-sale nameplate. Cat. No. 5.

One other reason sometimes given to doubt the veracity of his work, making Walter 'suspect' as an artist, is that from about the mid 1990s forgeries of his work have appeared on the open market. How this questions his stature as an artist I do not understand, but it seems to have lessened the appeal of the man and his work in French academic circles. Yet, if the exorbitant prices of Walter's pieces at auction are anything to go by, the buying public (both in France and abroad) think otherwise. The fact that there is at least one forger attempting to manufacture reproductions of his work using the original moulds would suggest there is a demand for examples of Walter's work whether he is an artist or not (Bassand, 1989).

This cultural snobbery has been shored up in part by the apparent loss of all records of his studio practises shortly after his death in 1959. It seemed all knowledge of his techniques disappeared when he died, and scant records of his processes remain. Unlike Argy-Rousseau or Decourchement no notebooks or studio techniques have ever been published on Walter. In 2006 I briefly saw a modern, handwritten copy of what was claimed to be Walter's notebooks. The three or four pages written in blue ballpoint pen and were almost indecipherable. They did not contain formulae or sketches, nor gave detailed clues as to his process, all of which characterise the notebooks of Walter's contemporaries such as Argy-Rousseau and Decourchement. It may be that Walter did not keep notebooks on his processes, relying instead on his memory and practical skill alone carried through each process. An account given by one of Walter's assistants some 60 years after he worked with

Walter, and relayed to me via the French art dealer Xavier Eury (who had interviewed him), suggests this may have been the case. The assistant stated that Walter 'attended to all the processes himself' (Eury, 2006). Crudely put: if you know what you are doing then there is no need to keep notebooks.

This absence of detailed note keeping would explain why one forger in Italy has not been so successful in trying to reproduce Walter's work. His forgeries are easily spottable if one knows what one is looking for. This confirms that an analysis of Walter's techniques is not a superficial process. As my research shows, Walter's processes are simple once they have been deciphered. It has taken me less than three years to unravel Walter's techniques and methodology and to be able to say with certainty 'this is how he worked.' Yet when trying to recreate a piece of Walter, something of his hand is missing, as I showed in earlier research. The technique is not as simple as it looks.

Apart from the accompanying catalogue by Professor Keith Cummings to the 2007 exhibition of the Broadfield House collection of 161 pieces of Walter no serious assessment of his oeuvre or his processes has ever been written, either in France or elsewhere in the world. Noel Daum's analysis of Walter's contribution is somewhat mealy-mouthed in its reporting, too (Daum, 1984a). The fact that he rarely gives Walter credit in either of his books suggests the Daum Brothers factory and Walter were uneasy bedfellows, despite Walter's contribution to what has since become the Daum 'house style' (Daum, 1980b). My searches in libraries and museum archives in France (the archives in Le Musée de l'École de Nancy, Le Musée de Beaux Arts Décoratifs, Nancy and the Archives General de Lorraine, Nancy) and at the Rakow Research Library at Corning in New York State in America confirm there is little tangible knowledge about Walter that can be gleaned from literature review.

All this has led to the neglect of any serious analysis of Walter's contribution, with the result that his position in the world of glassmaking, and in particular that of pâtes-de-verre, has generally been marginalised. One of my attempts in this study is to rectify that. I am equally aware that in the attempt to answer the questions thrown up by my research, and its subsequent publishing, help may be given to his forgers to make better forgeries. But I believe it is better for glass artists and historians to have that knowledge, utilise it, and to be able to make new forms in pâtes-de-verre, rather than to remain in ignorance. And as makers and developers of pâtes-de-verre we have remained in ignorance of Walter's processes for far too long.

Walter took a simple established principal of making colour in glass by introducing metallic salts and created what all the other makers had been looking for. It was the same method of creating a truly self-colouring, polychromatic sculptural technique that Henri Cros had searched for, as he tried to recreate the techniques of ancient glassmaking (de Ville, 1873, Pliny, Healy, 2004). It was the Grail, too, of the ancient Greek sculptors who resorted to colouring their marble sculptures with coloured wax in their attempts to achieve a Pygmalion-like naturalism. Thus it may be argued that Walter should be regarded as the true inheritor of Henri Cros, not the lesser figure as he has become to be known.

In 2005 the British Arts and Humanities Research Council (AHRC) financed an investigation under the direction of Professor Keith Cummings, Professor of Glass Research at the University of Wolverhampton. The enquiry ran alongside the first solo showing of Walter's work anywhere in the world. The exhibition was held at Broadfield House Glass Museum, in Kingswinford, Staffordshire, UK between August 2006 and February 2007, and was curated by Roger Dodsworth. The catalogue for the exhibition was compiled and written by Professor Cummings. I was privileged to have been the assistant to Professor Cummings from October 2005 through to January 2007 during that research. I was also fortunate in that I was allowed a certain liberality in the way the investigation developed. Professor Cummings let me drive the investigation in the way I wanted to, firstly by experimenting with the same metallic salts Walter may have used in the late 19th century, and then by the visiting of archives and museums in France, where it was thought there may be clues to processes. Time (15 months) and a generous budget allowed for the research to be properly thought through and assembled.

Walter's work had been one of the reasons I had turned to glass as a career when I lived in New Zealand, and the opportunity to investigate his techniques came at a good time in the development of my own work. My experiments in manipulating colour had reached an *impasse*, and I by frustrated with the lack of tangible knowledge available to me. When showing images of Walter's work to established New Zealand glass artists it was even doubted that Walter's work could be considered as pâtes-de-verre. The investigation at the University of Wolverhampton gave me a chance not only to explore his hidden techniques, but also to open up new avenues of artistic approach that could be applied to my own work. My mind was excited and very quickly good results were achieved. The findings were published in a booklet financed by the AHRC and authored by me (Stewart, Cummings, 2007). They have since been quoted in Professor Cumming's book 'Contemporary Kiln-formed Glass. A World Survey' (Cummings, 2009).

By the time the project was in its final months in 2006 Walter's lost code for making his type of pâte-de-verre was effectively cracked, although much remained to be deciphered. Given the possible artistic developments resulting from the success of the research it was suggested by Professor Cummings I undertake a practice-led PhD to expand the work further. This would give me the chance to spend some structured time developing the questions, which had inevitably arisen from the Wolverhampton research. There was the dawning realisation that in order to crack codes and find hidden truths a detailed scientific analysis had to be undertaken, and every avenue of enquiry needed to be gone down, however general or slight. As a result, I began to develop my own methodology of approach, which involved not just historical research and enquiry, but an embracing of scientific analysis. I became interested in not just the 'How?', but the 'Why?' of research. The question and argument 'do historical, technical publications exist and, if so, let us use them?' is certainly pragmatic and valid, but by understanding why the knowledge contained within them has been assembled in a particular way gives a greater understanding of what the artist can achieve in the future. Base knowledge can be taken and manipulated. The rules governing certain criteria can be questioned and adapted to meet other circumstances. The individual can break the rules and push boundaries. This is what I have done.

The original investigation at the University of Wolverhampton firmly established that the work of Walter undoubtedly sits in the canon of the extraordinary inventers and makers of glassware across Europe during the late 19th and early 20th centuries. What that enquiry also confirmed was that Walter did not develop in isolation. He was part of a much broader quest to unravel lost working practices and improve on what had gone before. Although there were more artists working in the field of pâtes-de-verre than the six artists mentioned above, it is generally accepted that from these six most of the principles of modern kiln forming and glass casting, and importantly, what we have come to call 'pâtes-de-verre' derive (Mannoni,). For the understanding of the research here in this study it is important to acknowledge all of them were researchers and experimenters. Amongst the foremost was Walter, as I show in

Book II. These men spent much time analysing and adjusting the techniques and methodology they found and invented. In their desire to discover the secrets of previous generations they had to deal with hidden or mythical organising principles. They had to trade with conjecture, deliberate and/or accidental misreporting, and in many cases had to rely on their own knowledge of ceramic studio practise to work out the details. In the end science always came to their rescue whether in the laboratories of the porcelain factory of Sèvres or in the crucibles of their own studios.

My journey on this study at Edinburgh College of Art has followed a similar path.
I chose to transfer my study and registration to this art college, not just because of the reputation of its glass department, but also because of the links the college has with the University of Edinburgh. What emerged towards the end of the study at the University of Wolverhampton was that both the practical creative work and the material science were inextricably linked. To understand Walter's creative approach I needed to understand the pure chemistry behind his processes. As such the resources and help of the Department of Engineering and Material Science at the University of Edinburgh have proved invaluable. The scientific analysis has not only answered my research questions it has revealed knowledge we thought did not exist and did not know to ask. Walter's work is more unusual than we thought.

Ultimately, I have translated all that I have learnt into my own methodology to develop my own personal glasswork. As such this thesis is just one study in a long historical analysis of glassmakers' techniques, which has been ongoing since before the advent of the studio glass movement in the 1890s, or the1960s, depending on your view of when that particular movement was established.

My research had used direct chemical formulae or 'recipes' from the hand of one of one of Walter's fellow pâte-de-verre artists and contemporaries, Gabriel Argy- Rousseau. He followed Walter through the Sèvres training scheme two years before Walter left Sèvres for Daum, so he would have encountered both Walter and his experiments. Although there is no direct evidence in archives there is the distinct possibility that Argy-Rousseau's pâtes-de-verre methods paralleled Walter's and may well have derived from his. Argy-Rousseau's meticulous studio notebooks were of immense value as they detailed not just ways to colour glass with their respected formulae, but they described his entire methodology (Argy-Rousseau,). They are as close to Walter's set up as I could possibly get.

These notebooks had been discussed and disseminated in 1978 during a seminar of glass artists at the Royal College of Art given by Professor Keith Cummings (Frantz, 2005). They were (and still are) held in trust by the famous Rakow Research Library in Corning in New York. Despite that, a polite request to Argy-Rousseau's family to allow me access to the original French notebooks of their ancestor for research on my PhD was refused and the library reluctantly had to withdraw its access of the notebooks. I had wanted to view the original notes, as there are sometimes misinterpretations in translations. Having worked in France as a stage designer in the 1980s I know the French have a more vibrant way of describing and naming colour. I thought there might have been clues as to why some of my previous experiments in colouring glass using his notebooks did not match the English descriptive term. 'Brown', for instance, means little descriptively, as there are myriads of 'brown'. 'Caca d'Or' (trans. 'golden shit'), on the other hand, reveals a context, which means everything in the French world.

The reason given by Argy Rousseau's family for their refusal of access was that forgers have now started to reproduce some of his work and they felt my research would only help more forgers. Perhaps so, but their confidence in their ancestor's creativity and the desire to share his techniques should have overcome their doubts, especially as they had donated his notebooks to the Rakow Research, the world's largest library concentrating on the history and technology of glass. Forgers are already making replicas, which are easily detectable with the will of auction houses. All the refusal did was to make my job slightly harder, but not impossible.

Similar problems continued to cast their shadow on my early investigations in France. I was told anonymously that some of Walter's important studio artefacts were in existence and being used by a forger in Europe to recreate his work. A French museum director agreed and reliably told me that a flood of them arrived in auction houses from the mid 1990s onwards, and they keep reappearing. That there are occasionally forgeries of Walter's work coming on the open market is common knowledge. Who is making them and how he/she is financed is not. Fortunately, the study of the 161 pieces of Walter held at Broadfield House, and which have a good provenance have trained my eye, giving me as a result the visual touchstone on which to make tests..

Glass making has a long, hidden and often dirty past. Its history allies itself with the heretical dabblings of the alchemists of medieval Europe, the vagaries of despotism in ancient Rome, the competitive trading routes that encompassed the pre-Classical world, and always it is involved with the professional, petty jealousies of the artist-salesman. Still today there is a deep vein of secretiveness running through its practice and practitioners. That Walter died leaving no published notebooks can be viewed as simply part of a tradition of glassmakers preferring not to reveal their knowledge in an attempt to defeat competition. For many the idea of sharing long, hard fought-for knowledge is anathema, whether 100 years ago or today.

Two thousand years ago hidden secrets for making glass were being searched for. By then glass making was already ancient and its origins were simply conjecture, shrouded in myth. The searchers for knowledge then, as I, and other modern day researchers are doing, were looking for a Grail, or at least its trail. Sometimes radical discoveries were made and lost again in the same generation. Sometimes the discoveries were enough to change the way whole bodies of work were made and came to be appreciated by a wide and modern audience. New vocabularies were defined and artistic languages developed.

That scenario is the same today. In 2005 an exhibition entitled '*Particle Theories: International Pâte de verre and other Cast Glass Granulations*' was held at the American Museum of Glass, Wheaton Village, Millville, New Jersey NY in 2005. Susanne K. Frantz curated it. The exhibition and its accompanying catalogue made a good attempt to discuss the nature of pâtes-de-verre and to define it (Frantz, 2005). What that particular exhibition showed was that contemporary pâtes-de-verre is not a singular thing, but rather is a collection of processes, an umbrella term that allows for development. It can be defined as having as a basic technique, the placement of coloured glass into a mould in a refined, organised way and which allows for the prediction of result. That, in itself, is a philosophy, a set of basic principles that underlies practice and knowledge. But here definitions and relationships between the subtleties of manufacturing end. The hand of the artist applies, and with each artist and each change of application, pâtes-de-verre itself changes. It becomes an organic thing. It constantly grows, evolves and extends.

Discovering how Walter made his pieces has been a revelation. Discovering how his techniques and methodology work for the modern glass artist is exciting. Despite the forgers and the secret-keepers this thesis is my attempt to change the way pâtes-de-verre can be created and the subject matter can be addressed.

In deciding on a plan of action to tackle the wide area of research this study has been separated into three areas of investigation. They are broadly Historic, Scientific and Personal. Their findings have been documented in three separate books. Each Book goes hand-in-hand with the other two. The first two Books, however, have flowed directly into the third. Their pursuits, historic and scientific have changed my way of thinking as an artist. The personal body of work that arises in Book III is therefore directly coloured by the knowledge gleaned from the other two. Below I lay out the objectives behind the three Books.

Book I: The Historical Background deals with the historical review of Walter's particular work within the period he operated, as well as discussing how 'pâtes-de-verre' emerged. It analyses the understanding Walter and his contemporaries had when they referred to 'pâtes-de-verre', and offers an explanation from where the various processes involved in the colouring of glass pastes derived. By looking at other forms of glass objects made using pastes of glass in the immediate preceding centuries the research questions the validity of Henri Cros' claim to be the 'father' of pâtes-de-verre, and shows that pâtes-de-verre was a continuing method of expression over the course of two millennia. Thus, it places Walter in a setting of continuous artistic development combined with scientific enquiry, which coloured the period of the late French Art Nouveau. It also gives an explanation as to why Walter should be considered the true inheritor of Henri Cros.

Book II: The Scientific Background analyses and deconstructs Walter's methodology, using the same research techniques the early developers of the medium of pâtes-de-verre practised; observation, literature review, and chemical analysis. By using modern non-invasive scientific analysis and controlled kiln experiments an analysis is made of the exact organising principles behind his glasswork. It shows that Walter was a chemist with a full knowledge of scientific codes and principles, and reveals that he was colouring glass in a way hitherto unknown in pâtes-de-verre, and is one that has not been discussed in any real depth when it comes to lead crystal. The analysis of four pieces of Walter's glasswork using modern using Scannin Electron Microscopy, X-ray Fluorescence and Raman has produced results, which have been used to develop a set of 224 formulae to colour glass at around 800° C.

Book III: My Personal Work brings together the themes in the previous two books to show their applications to my own contemporary sculpture. It also discusses the credo of my work, its antecedence and places the works in a contemporary setting. A photographic body of completed sculptures are illustrated with a set of related appendices that explain the methodology and techniques used to create them, as well as a contextualisation and definition of each work.

The set of appendices follows the Books I, II and III. They contain various areas of research and its outcomes, which are discussed and referenced in each book.
Through this research a greater understanding of the processes involved in Walter's glassmaking has been achieved, so filling in one of last pieces of the great jigsaw of the work of the early exponents of pâtes-de-verre. Since the advent of the Studio Glass movement in France in the 1880s pâtes-de-verre has meant, and has come to mean, many things with each new generation. The late 19th century practitioners of the process of using pastes of glass mixed with metallic salts to create colour during the casting process of glass were never working in a strict definition of methodology or technique, nor were their predecessors one hundred and fifty years before them, nor their predecessors two thousand years ago. To the French glass artists of the 1880s and onwards it was a philosophical approach of enquiry that derived from a series of diverse techniques partially discussed in the writings of classical authors and French historians. The analysis of products by British gem makers in the 18th century, such as James Tassie, suggests they were doing something similar. One hundred and twenty five years after Cros began his forms of methodology the term 'pâtes-de-verre' has once again begun to take on its original sense. The control and decision-making, which the artist has in the placing of colour directly into the mould an manipulating it is his and his alone. When the many various principles are applied, the techniques change with each hand, and the end results are sometimes subtly, sometimes radically, different. The dearth of formal knowledge of what constituted 'pâtes-de-verre', which exemplified the post-war period through to the 1970's, is long over, but the misunderstandings of what is 'technique' and what is 'theory' remain. Through my research this thesis sets out to disperse some of those

miscomprehensions. The result is a contribution to the continuing re-definition and clarification of the term *pâtes-de-verre*.

1.2: What the investigation is about.

At the heart of this investigation lies the simple technical process of colouring glass with metallic salts. It is a procedure that has been involved with the manufacturing of glass since the first glazes on steatites were developed in Ancient Mesopotamia some 7000 years ago (Cummings, 2005). Metallic oxides, or rather 'salts', as the strict chemical term is, are mixed into the glass's raw ingredients and the whole batch is heated to founding temperature, which is between 1180° and 1270° centigrade. As the ingredients heat they combine into a glassy mix, and the metallic salts are readily incorporated into the complex matrix of the glass to produce characteristic colours. The end product is what we sometimes know as 'stained glass'.

The metallic salts can also be added to pre-made glass (clear or coloured), and then heated up to the same high temperature with the same end effect. But it must be emphasised that it is only when the glass batch is at these very high temperatures that the complex matrix of the glass breaks down so allowing the metallic salts to diffuse and be incorporated (Weyl, 1999). Densities of colour are dependent on the glassmaker's recipes (or formulae) and the characteristics of the salt(s). Sometimes fluorides and/or phosphates such as calcium fluoride (CaF_2) and calcium phosphate ($Ca_3(PO_4)_2$) are added to the colour recipe and, acting as an opacifiers or inhibitors to the transmission of light, make the glass appear opaque or translucent.

From my previous research at the University of Wolverhampton it was thought Walter took formulae for making colour at founding temperature and applied them instead to the glass during the kiln casting process at around 800° C. This produces a very different result from stained glass. Because the applied metallic salt remains outside the matrix of the glass a natural opacity occurs. Colours are also produced which sometimes do not have the same vibrancy if that formula were made into stained colour at founding temperature. Sometimes translucency can be achieved, particularly with the metallic salts of copper (Cu) and chromium (Cr). Higher temperatures and different sized frit (or particle size of the glass) also produce slightly different results. More or less light is able to pass through these frits depending on their sizes, and the gaseous volatility of a specific salt also plays a part in the end result. In all these events what has occurred at around 800° C is the equivalent to a ceramic glaze. Whether the particle of glass is less than 0.25mm or greater than 3mm the metallic salts sits on its surface and remains there. All this was broadly established in the research I did at the University of Wolverhampton.

Fig ii. Colours in pâtes-de-verre from metallic salts,
(Detail from *A Duality of Sorts No. 2*, Max Stewart, 2009).

While the investigation of colouring glass with metallic salts is not new it is the particular application of Walter's methodology that has covered new ground in this PhD. Unravelling Walter's process has allowed a way of introducing colour in glass that has not been generally encountered since he died, and one which certainly has not been discussed in academic research outside the investigation of the AHRC funded project at the University of Wolverhampton. While Sylvie Vandenhourke started to produce some results in her M.Phil at the Royal College of Art in 2001, and Heike Brachlow is currently investigating something similar at the same college, neither has specifically aligned their work or results to a unique methodology or a particular artist (Vandenhourke, 2003, Brachlow,). By contrast, my research has taken the basic known formulae for producing colour in glass at founding temperatures and, together with the understanding of ceramic glazing, created a new set of formulae for the colouring of glass at around 800° C which any artist may use in his/her pâtes-de-verre work.

1.3. <u>How this investigation builds on the AHRC funded project at the University of Wolverhampton.</u>

There were three basic questions that were asked at the University of Wolverhampton, and three objectives for the project there. They are quoted below:

1. How did Walter achieve his unique mastery of colour and detail?
2. What methods did he employ to produce his trademark palette of colours?
3. How did his background at Sèvres and his sojourn at Daum contribute to his development?

The objectives were threefold:

a. To contribute to a greater understanding and knowledge of the complexities of pâtes-de-verre in general, and the work of Walter in particular.
b. To generate and present an account of Walter's probable procedures, illustrated by examples and supported by data, in a form that enabled their replication.
c. To estimate the contribution to Walter's technique of his background at Sèvres and time at Daum.

All the questions were successfully answered and the objectives met to a greater or lesser degree. As a result the ARHC funded the publishing of a booklet, which explained the project and presented the findings (Stewart, Cummings, 2007). However, given the time scale and level of funding involved, not everything I wanted to explore was revealed. There were some discrepancies and anomalies in the data that had appeared, which cast doubt on some of my findings. These needed to be looked at in greater depth. Also, as the investigation matured, other questions arose and new avenues of enquiry opened up. Areas of historical placement began to intrigue me, as it seemed that the early exponents of pâtes-de-verre seemed to have arrived in a lump directly from the workings of Henri Cros. French tales of the restitution of pâtes-de-verre as an artistic form not seen since the Romans made little sense when placed next to what we know about Anglo-Saxon and Byzantine glass, the '*de Artibus Romanorum' of Eraclius*' of the 10^{th} century, and the gemmological glass pastes in the 18^{th} century (Raspe, 1786). A series of objectives were thus laid out for my studies:

1. A revisitation of the original findings and a retesting of their results would be carried out to establish their veracity and to further the research.
2. A completion of Walter's colour range would be undertaken, establishing exactly what he used to make those colours and under what conditions.

3. A review of how much of Walter's methodology was influenced by ceramic technology, rather than by glassmaking methods of colouring of glass.
4. What were the background influences on Walter's artistic approach, and how much was it based on the 16th century ceramicist Palissy, as has been sometimes suggested?
5. Where does Walter really sit in the canon of the great and good of the early pioneers of pâtes-de-verre?
6. Were those pioneers resurrecting something that really had been dead for two thousand years? Or were they working in a tradition of glass making that had been an ongoing process for all that time?

A final 7th question then arises, which is the most important one in this study and that is 'how can I use any or all of the above to inform and develop my own personal glasswork?'

The exploration, discussion and the results of these seven questions form the basis of the three Books in this thesis. Questions 4-6 form Book I. Questions 1-3 Book II, and Question 7, Book III. These initial objectives are examined below:

1. A revisitation of the original findings and a retesting of their results would be carried out to establish their veracity, and to further the research in this study.

Although the principles of the Walter's general methodology had been established, some of the original findings needed to be re-tested if they were to be applied to a modern glass studio setting. Some of the later results in that study, such as the placement of some metallic salts next to another, questioned earlier findings. Laying one salt next to the other did not always produce a happy combination in the end product of fired glass. Potassium dichromate ($K_2Cr_2O_7$), for instance, which on its own produces a brilliant yellow at around 800° C, and is identical in colour to that which is seen in some of Walter's pieces, produced a violent gaseous reaction when laid next to other salts and heated to 800° C and produced a blackened or grey effect. Neither of these results is seen in Walter's work. Clearly, then, Walter did not use potassium dichromate at 800° C. It seemed that some details were missing from the use of metallic salts in order for them to work in the process of 'making a Walter'. This then has a direct bearing on the next question.

2. A completion of Walter's colour range would be undertaken, establishing exactly what he used to make those colours and under what conditions.

I felt a completed colour range had not been finished. Although 13 clear colours were identified in his palette there seemed to be greater subtleties within this group. They needed identifying and exploring. How they and other colours were made also needed to be investigated as the substance of the yellow-orange-amber range had been calculated guesswork, rather than applied analysis. The simple process of introducing a metallic salt into a quantity of glass and expecting a colour to emerge after heating it up to around 800^{o} C did not always prove to give accurate result, so in a few cases supposition was used to give a possible answer. The comparative lack of a red colour range in Walter's work, too, was another area I wanted to explore. The rest of the Gabriel Argy-Rousseau formulae, which I had originally utilised to work out some of Walter's colour palette needed to be revisited, and tested again, to ensure the results were correct.

3. A review of how much of Walter's methodology was influenced by ceramic technology rather than glass making methods of colouring of glass.

In the time between finishing the study at the University of Wolverhampton and beginning the research in this study I had begun to develop a suspicion that Walter's own style of working was more akin to the ceramists of Sèvres, than the processes of the other pâte-de-verre artists. The fact that part of his unique process involved the grinding of coloured pigment in lead crystal suggested a knowledge and application of enamelling, for which Sèvres was famous. The suspicion was that Walter used enamelling techniques, and that this suspicion was used not as a way of explaining his work, but as a way of downgrading him as a *bone fide* pâtes-de-verre artist (Olivié, 2006).

4. What were the background influences in Walter's artistic approach, and how much was it based on the 16^{th} century ceramicist Palissy, as has been suggested?

The background of artistic influences upon Walter's style had not been part of the general remit of the original research at the University of Wolverhampton, although I touched briefly on them. The comparison of Walter's work with Palissy's was a constantly arising theme, but there seemed to be more to it than just a statement of 'He was influenced by the work of the

16th century French ceramist, Bernard Palissy' as both Noel Daum and Jean-Luc Olivié suggest (Frantz, 2005, Daum, 1980c).

Fig iii. *Plate*, workshop of Bernard Palissy circa 1565-70, Musée National de Ceramique, Sevres, France.

The ceramic dish seen in Fig iii, above, is a characteristic example of Palissy's work. The stylistic approach is one of embroidered cloth, typical of mid-16th century France. Contrast this dish with the one in Fig iv, below, by Walter, which is representative of his work.

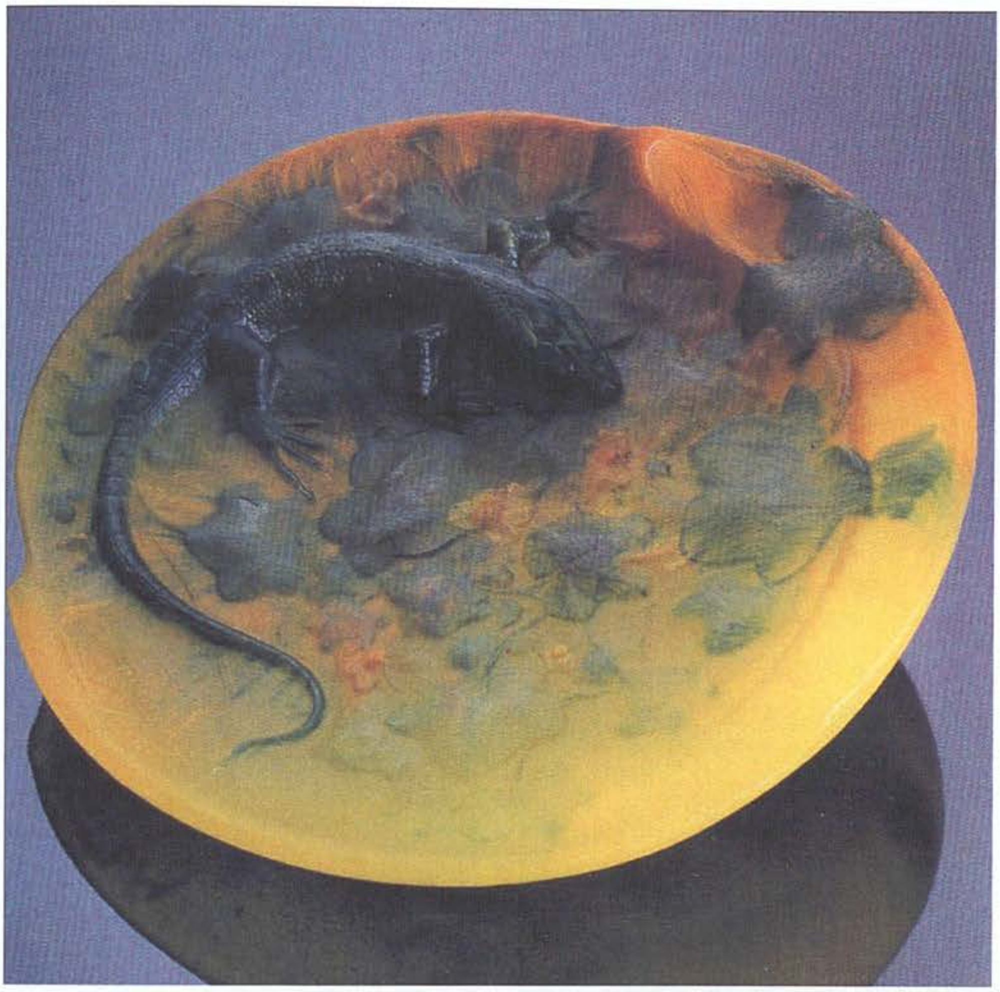

Fig iv. *Dish with Lizard*, Walter.

The relatively static poses of Palissy's dead nature are not seen in Walter's piece. His style is more fluid in both form and line, and colour is allowed an expressive freedom. On closer examination Walter's flora and fauna proved to have been modelled too, not taken from life casts as Palissy's were. Walter's glasswork then sits more happily in the age of the French Art Nouveau than the 16th century. However, the analogy that Walter is similar to Palissy does have credence, and I explore this idea in Chapter 8 later in Book I.

In my early searches in France in 2006 I had come across an exhibition catalogue detailing the work of the artist Charles Schneider who Walter assisted as technician at Daum in 1908, on a pâtes-de-verre work entitled *'Coupe au Serpent avec Branches de Murriers'*. In the catalogue were some photographs of small bronze cast vide-poches made in Nancy between 1906 and 1909. One example is shown below in Fig v.

Fig v. *Vides poche*, Charles Schneider, Bronze, 1908

Fig vi. *Chameleon dish*, Cat. No. 48.

In comparison to some of Walter's glasswork, especially his *Chameleon dish* (seen in Fig vi, above), they look remarkably similar. Some research showed the modelling of the vides poches did indeed come from the hand of Henri Bergé, Daum's resident designer/sculptor, and Walter's friend and collaborator.

The originality of Walter's work came suddenly into doubt. The question arose as to whether some French historians were right in their dismissal of him as a mere technician. Walter's chameleon dishes, which are now generally regarded as his 'signature' work, are amongst the most expensive of the pieces purchased in the Broadfield House Collection of Walter. If they were not his original designs why did he use them? In asking these questions I wondered what else could be discovered about where Walter's subject matter came from? And would there be any implications from this information to my research?

And then there is my own work. In light of what I was discovering about Walter, the artistic influences on his studio output, as well as his practical techniques, I wanted to develop my own personal work in a way that I had not explored before. What I did not want to do was to reproduce copies of Walter. I came to the conclusion that I needed to make it the antithesis of what Walter's subject matter was about. The work I have developed through this study while it does not sit quietly on a dressing table or mantelshelf screams out its inheritance. An example of it is seen below in Fig vii.

Fig vii. *And So I Press My Lover's Palm to Mine.*

5. Where does Walter really sit in the canon of the great and good of the early pioneers of pâtes-de-verre?

To my mind Walter stands alongside Cros, Dammouse, Despret and the others practitioners of that period. His glass has a quality to it that still speaks to an audience nearly one hundred years after it was made. From the little contemporary literature review that exists there is no doubt his work was highly considered and in one article review was hailed as 'great artist', succeeding where Dammouse, his tutor, did not (Vallieres, April 1925). That same article places Walter and his work above that of Decourchement and Argy-Rousseau. He was also openly credited with inventing new forms of the pâtes-de-verre processes. When he left the Daum factory the business he set up became as successful as a studio-based manufacturing operation could be with up to ten assistants working with him at its height. It is hard then to understand why Walter/ his work has been downgraded to that of a much lesser player. The test of quality i.e. longevity in the collectors' market, suggests otherwise.

6. Were those pioneers resurrecting something that really had been dead for two thousand years? Or were they working in a tradition of glass making that had been an ongoing process for all that time?

This is a question that has not been formally asked before. In composing an overview of pâtes-de-verre it became clear that statements made about the historical aspect of what Henri Cros had achieved was incorrect. Certainly he created a form of self-colouring polychromatic sculpture using glass (which was termed 'pâtes-de-verre), but other forms of it have existed throughout the previous two thousand years of glass making and can be easily identified. The need for a rethink of our perceptions and knowledge rapidly emerged. The unearthing of this new knowledge shores–up my view of where Walter sits in this pantheon of the great and good of his contemporaries, and what his historical contribution is.

1.4. From out of the above objectives a set of research questions were arrived at. Their conclusions are discussed in the Conclusion section of this thesis. The Research questions therefore are as follows:

The Research Questions:

1. By examining an overview of the history of pâtes-de-verre in which Walter worked what conclusions may be drawn?
2. What were Walter's own artistic influences and how did they fed directly into own his artistic portfolio?
3. Is Walter the true inheritor of Henri Cros in his creation of a self-colouring polychromatic sculptural technique?
4. Did Walter colour his glass with an historically known band of metallic salts?
5. Did Walter use a 50% lead content crystal within his glass work?
6. Is it possible to establish principles for colouring glass at around 800° C, which utilises the technology of ceramic glazing to fix the salts, thus making reliable the use of those pigments? And if so is there a new colour palette from which glass artists may draw upon?
7. How does my personal work change as a result of questions 6 and 7?
8. What new studio practices can be established, which will influence the way other pâtes-de-verre artists and other glassmakers can address their work?
9. What other areas of research can be opened out other areas that academics may wish to investigate?
10. What other areas of research can be opened out that others may wish to investigate.

Book I: The Historical Background

Chapter 1: An overview of pâtes-de-verre.

The term 'pâtes-de-verre' did not begin with the French sculptor Henri Cros (1840 – 1907) although in modern times we seem to have come to the conclusion that it did. Similar terms had been used and bandied around Europe for a century or more before Cros began his studies, and there was a clear recognition that 'glass pastes' or 'pastes of glass' and products made from them had been around and used continuously since at least 1450 (Millin, 1806a). There is good evidence that something similar was in existence a long time before that too (Raspe, 1786). The earliest known piece of pâtes-de-verre is held in the British Museum. It dates from the 8th century BC and is a *balsamarium* of light green translucent glass engraved with the insignia of Sargon II, who reigned from 722 – 705 BC in what is now modern day Iraq. Similar vessels were found in Syria, which date from the 6th century BC and are made from an opaque blueish or greenish colour ground powder, which was presumably mixed into a paste with an adhesive medium. They show evidence of having been shaped either free hand or on a wheel like pottery before being fired to a fusing temperature to preserve the shape (Neuberg, 1962). Analogous types of these vessels (called Hallstat Cups) and dating from the 5th century BC have also been found in graves in Santa Lucia di Tolmino near Triest in Upper Austria. All these products predate the Roman world's imperial influence and suggest that where glassmaking existed so could pâtes-de-verre. Leaving aside its aesthetics, the methodology surrounding pâtes-de-verre is an economical way for glassmakers to reform broken (and expensive) glass.

'Enamel paste' or 'Vitreous enamel' was the most popular label and was associated with the 18th century technique of making reproductions of Roman intaglio glass or cameos. Sometimes these 'pastes' were coloured with metallic oxides before being firing into small shallow sheets and then pressed into *bas-relief* moulds (Smith, 1995b). Other times, particularly with the *crystallo-ceramies* of Apsley Palett (1791-1863) (see Fig 14, below), the process involved mixing ground up glass with water and a gum medium before pressing the mix into a mould (Smith, 1995b).

Fig 1.
Medallion Head of Catharine the Great
Attr. Aspley Pallet.

Fig 2.
Multi coloured 18th century 'gems' by
James and Edward Tassie.

Although we think of their work as being white against a coloured background (an aesthetic which had become synonymous with the age) the gem makers of the 18th century were adept at colouring their glass to give the impression of precious and semi-precious stones. The two images above in Figs 1 and 2 illustrate how refined and polychromatic their work could be.

While this shows a desire of the 18th century customer to purchase objects other than imitation of white marble and plaster, it more importantly reveals that the 'gem' makers had a clear understanding of the chemistry of the glass with which they were working. The use of metallic salts to change the colour of their glass is not a haphazard one. To imitate carnelian, or sapphire, or agate to the point of deception one has to adhere to scientific formulae and understand its rules.

Before he moved into the field of glass making in the 1870s, Henri Cros studied the writings of Pliny (Pliny, Healy, 2004) and the newly published French work '*Histoire de la verrerie* *dans l'antiquité'* by Achilles Deville (de Ville, 1873) and was fascinated by both the texts (Mannoni, , Olivié, 2005). Cros apologists often cite these two sets of writings as being the tomes of knowledge that allowed Cros to 'rediscover' a (supposed) long-lost technique. Unfortunately, for our understanding of the arrival of pâtes-de-verre in the late 19th century directly from the Roman world neither of the works give any indication as to its technique or methodology.

The writings of both Plinys (in particular Pliny the Elder) have a romance to them second to none from the Roman world. Pliny the Elder's volumes of '*Geography'* and '*The Natural World'* read as immediate thought. Even in the roughest of translations his voice and certainty shines through, and the reader is pulled into a world some two thousand years old. However, they have for a long time been the subject of much mistranslation and misunderstanding. Pliny the Elder's writing, on which we rely most to discuss the foundation of Roman glass, is composed in a subset of literary Latin, a shorthand as it were. On his death the works had not been edited and sources not checked (Healy, 2000). Translators of Pliny have not always understood his shorthand, and neither have those translators been scientists or technologists who understand either the chemistry or physics of what they are discussing. Historians therefore have relied on a set of writings that are not necessarily correct or understood. Within his notes on glass and its manufacture there are truths to be found, but they need to be considered cautiously to understand them. John F. Healy, Professor of Technology at Oxford University has written a book that investigates the technology of Pliny '*Pliny: Science and Technology'* (Healy, 2000). He makes a good attempt at understanding Pliny's descriptions and tests his statements under laboratory conditions. Unfortunately, like those translators, Healy is not a glass expert and his chapters on Pliny's understanding of glass remain somewhat underdeveloped. Pliny's famous tale of the hapless maker of a soft unbreakable glass is given little credence. My first impression of reading Pliny's account was that a Roman glassmaker had stumbled across some form of borosilicate glass not unlike 'Pyrex'. However, C.W King in his book '*The Natural History of Gems or Decorative Stones'*, published in 1867, delivers the evidence that the substance was, in all likelyhood, a plastic made by boiling amber in turpentine (King, 1867). The result King says is a flexible amber-coloured glass. He suggests it is the *scypus* of the Romans and gives an example of a ring found in an Egyptian mummy, which has the look of glass and all the flexibility of India rubber. In his earlier work (King, 1865) King also cites some recipes/formulae derived from the Romans of how to colour glass pastes, and catalogues work made in Anglo-Saxon times from similar products

Deville gives a good analysis of the writings of Pliny as well as illustrating a history of faience. He also discusses the processes of glass pastes and the discoveries of the scientists in the 18th century. Deville's work is an encyclopaedia of ancient techniques and terms describing glass making in antiquity. Interestingly, it does not once use the term *pâtes-de-verre*. Importantly, it mentions scientists such as the German Martin Heinrich Klaproth (1743 –1817), who was the first to discover Uranium, Zirconium and Chrome (Klaproth, 1789, Hoppe, Damaschun & Wappler, 1987), and the British chemist and inventor Sir Humphrey Davy (1778-1829). He also mentions Guilliame (Wilhelm) Homberg (1652 – 1715), a German chemist who worked in the court and laboratories of the French Duke of Orleans (Holmes, 1993). All three these scientists had made enquiries and important discoveries in the analysis and reproduction of Roman glasses, Davy and Klaproth publishing papers on how percentages of elements could be extrapolated from a piece of glass dissolved in an acid (Klaproth, 1789, Davy, 1815). Davy was celebrated in France, and in 1813 (at the height of the Napoleonic Wars) had been awarded with a medal for the advancement of science by Napoleon. Deville also mentions the findings of R.E. Raspe (1737- 1794), who was a scientist as well as a celebrated author of '*Baron Munchhausen*'. Raspe had created the definitive catalogue of all 20,000 pieces of glass paste made by the Scotsman James Tassie and which was orderable from his workshops in Leicester Square (see Appendix 10: James Tassie (1742-1798). The catalogue was published simultaneously in both French and English and widely circulated throughout Europe (Raspe, 1786). In his introduction to the catalogue Raspe discusses his own enquiries and research in the history of glass pastes. It is an eye-opening account of what was readily known at the time and is worth examining here. That Cros, in his letters, states he did not know anything about the 18th century methods or techniques (Olivié, 2005) suggests either a laziness in his researches, or he was being evasive in how he really 'reinvented' or 'resuscitated' the technique, as Raspe opens the door to centuries of previous knowledge. The catalogue does not fail to impress, as it formed the commission from Catherine the Great of Russia in 1778 to Tassie for sixteen thousand pieces of his pastes.

At the same time as Deville published his work the archaeological explorations of Herculaneum, Pompeii, and other ancient sites, and the exhibition of contemporary enamelled artefacts derived from Islamic art in the Exposition Universal in Paris in 1878 fired Cros's imagination. The display of glass at the Exposition inspired by Roman cameo glass and copies of mosaic glass made by fusing sections of polychromatic glass rods then layered and wheel carved, also suggested that the French technicians of the second half of the 19th century were approaching mastery of ancient methodology and in some cases surpassing it.

'Gems', or rather cameo and intaglio cut seals and rings from the ancient world, were collected as souvenirs by 18th century visitors to Italy on their Grand Tours, and displayed in their fashionable cabinets of curiosities when they returned to England, France or Germany. These items proved to be a mixture of semiprecious stone and glass made by Roman craftsmen, the glass versions emulating the qualities of the stone. As the supplies of originals were diminished then reproductions from glass were made, sold and collected as both fakes, but more significantly, as authentic reproductions. Italian craftsman in the 17th and 18th centuries knew of methods of producing glass pastes that once fired could deceive the purchaser or viewer into thinking he was buying a cameo gem made from semi-precious stone. Raspe reports all of this and gives examples through the previous 1000 years of pieces of glass paste that have been passed off as genuine precious stones. He also makes a good attempt to understand what the manufacturing processes were and gives a fair account of how glassmakers over the centuries carried on their tradition of paste making. Importantly, for a 21st century understanding of where pâtes-de-verre comes from, Raspe describes and publishes in his catalogue a copy of the *De Artibus Romanorum,* a 9th century Latin manuscript, which details the methodology of making what is in effect pâtes-de-verre. It is placed in his 'Critical essay on Oil Painting with Theophilus de Arte pingendi and Eurcelius de Artibus Romanorum', (by R.E. Raspe, London 1783. 4to Cadell) (sic). The original manuscript of Eracelius is now held by the British Library, The only English translation to have been made to date was in 1849 by a Mrs Mary P. Merrifield (Merrifield, 1849). However, importantly for this part of the research, a French translation of it was made as early as 1774 under the commission of Louis XVI th, when the manuscript was still held in the Wren Library of Trinity College in Cambridge (Raspe, 1786). The French translation was housed in the French Royal Library (later in the Louvre Museum). Presumably Charles Henry, the French archivist who worked at the Louvre and who collaborated with Cros on his encaustic enquires, would have known (and had access to) this document (Vaillat, 1907) as it is acknowledged Cros also had access to Haudicquer de Blancourt's *De l'art de la verrerie* (trans. *The Art of Glass*) published in 1697, which ' shew[s] how to make all sorts of glass, crystal and enamel, likewise the making of pearls, precious stones, china and looking glasses...' (de Blancourt, 1699, Olivié, 2005).

Raspe also acknowledges that making objects from glass pastes is clearly traceable back to Milan in 1450. He also quotes cases of church reliquary and treasury objects being made in glass and being passed off as precious stones in much earlier periods. Two notable ones were 'the famous emerald of the abbey of Reichenow near Constance, though a present of Charlemagne, has of late proved to be a piece of glass.' (Raspe, 1786). Charlemagne was Holy Roman Emperor between the 8th and 9th centuries. The second piece was:

> 'the equally celebrated emerald vase in the cathedral of Genoa came into the possession of the Genoese as an equivalent for a great sum of money in the year 1101at the taking of Caesarea in the Holy Land; nor was any imposition suspected, for in the year 1319 they pawned it of 1200 marcs of gold; and yet it is a lump of glass... [Raspe goes on to say] In these times the art of making glass was not lost, but the knowledge of its principle and the taste in its application.' (Raspe, 1786).

And that probably is the point. It is the philosophy behind the making of glass pastes that disappeared. Instead of relishing the fact that glass is a man-made material, which can be made reproduce the original, it was the disguise, the chameleon nature of the substance, and the act of deception that became the principle-guiding factor.

The final word goes again to Raspe. He finishes his essay on the history of paste making with:

> 'The restoration of its learning, sense and taste of the ancients, and chiefly in the times of Lawrence de Medici and Pope Leo X... To this period belong the various mechanical and chemical trues and false directions for making coloured glass, which are collected in Boetius de Boot in his Gemmarum and Lapidum Historia, Lugd. Bat. 1647 p66 and which father Kircher has inserted with some improvements in the XII. Book of his Mundus Subterraneum, in the sub-division of the same inscribed de Arte Vitriuvia. Neri, Klunkel and Merret, in their respective treatises on the art of making glass, so far from neglecting this branch have given such instructions upon it a were consistent with the then state of chemical knowledge and taste: and if but very few men of taste or artists of the XVIth and XVIIth century such as Francisco Vicecompte (Mariette Tr. De Pierres gravee Vol.I p93) have made themselves conspicuous by collections of pastes of ancient gems, it proves no more than that the art of making them was carried on secretly, or had not sufficient encouragement, till the late Duke of Orleans's exquisite taste for the polite arts gave it, in the earlier part of this century, a kind of well deserved fashionable sanction; by amusing himself and employing that celebrated chemist Mr Homberg, in making pastes from the King of France's, his own and other collections of gems.' (Raspe, 1786).

It is clear then that Cros was working in a tradition that went back centuries. If Cros had read Deville, as it has been stated, then he would have surely been in aware of Raspe's work and would have retraced Deville's researches himself. Deville also mentions the discovery of the process of ancient glassmakers made the 1806 French publication of the 'Dictionnaire des Beaux-arts' by A.L Millin (Millin, 1806b).

Amongst this dictionary's definitions and descriptions of art and artists is a section entitled *'Paste, Pate'*. It is this one section that makes nonsense of Antonin Daum's claim of French supremacy and authority. In the section Millin gives a detailed description of the rediscovery of the ancient world's techniques of making glass pastes to imitate natural gemstones. Millin states that the discovery of the technique was made in the 1500s by a Milanese painter called Franc. Vicecomite (sic) (presumably the same Francisco Vicecomite that Raspe gives) (Millin, 1806b). In his account Millin asserts that 'the secret of colouring the glass pastes was discovered by Alb. Neri and Clunker (sic)'. It was Neri, Millin goes on to say, who gave name to the expression 'Pastes', with the significance that it meant ***ground up (or powdered) glass held in a aqueous medium.*** Millin also lists the name of Guillaume Homberg (the German scientist, discussed above) and cites his work, the *'Manière de copier sur le verre coloré des pierres gravées'* with the epithet that 'he made the most perfect of pastes' (Homberg, 1712).

Later in the section on *'Paste, Pate'* is the mention of the work *Traite de Vettori, de Septemdormientibus*, published Rome in 1741, which gives the processes of manufacturing glass pastes (trans. French.'ou trouve une instruction sur la maniere de faire des pâtes'). He recommends the work of one Mariette, which is simply entitled *'Pierres gravées'* (published in Paris in 1750) as being the best source of information, quoting page 209 as the place to find 'observations sur les pierres gravées factices, et la manière de les faires' (trans. in English as 'factual observations on engraved gems and the manner of their making'). It is quite probable that the second of these two publications also informed the work of Quin and Tassie as they mastered the methodology of Homberg. The next line in Millin's essay is striking as he lists a group of 'exponents of the art of making gemmological pastes in the fashion of the Romans'. They include the names of Clachant, Dehn, Reifenstein, Lippert and Tassie. These makers were all celebrated antique gem makers. Christian Dehn (1699-1770) and Philipp Daniel Lippert (1702-1785) of Dresden, both had work that was held in collections throughout Europe. All of these makers were regarded for their ability to accurately mimic Roman and antique glass to the point of deception (Smith, 1995a) although deception was not their point (Raspe, 1786).

In these two publications, the '*Histoire de l'art de la verrerie dans l'antiquité'* of Deville and the catalogue of Raspe, lie all that is needed to discover how Roman glass pastes were made (along with their 18th century counterparts) and what could be done to remake them in a modern studio or laboratory. For someone with an inquiring mind like Cros there was plenty of hard scientific evidence around for the production of glass pastes without having to blindly stumble upon the technique.

Much more archival research needs to be done on how Cros came to his experiments in pâtes-de-verre as in my researches I have not identified one book, either in French or English, devoted to his working practises or life. The Rakow Research Library in Corning confirms this. It seems a huge gap is missing from the history of 'who' and 'what' that generated this new art, this '[great] discovery of our time…never before hinted at…' (Klein, 1992). I would propose, therefore, that in order for Cros to make the leap from glass enamels (which Klein suggests he did) he must have had knowledge of the work and processes of other makers of glass pastes. In particular, I would suggest he was well aware of the 18th century gem makers who responded to the 18th century taste for classicism by reproducing and copying, as well as making new 'modern' versions, of Roman medallions, cameos, and intaglio seals, and all from pastes of glass and developing the craft.

A copy of Tassie's work was held at the Manufacture de Sèvres in the form of a portrait medallion of the Count Rumford in white on a blue background (see Fig 3, below). This has significance in that his work was known at the Sèvres porcelain factory for almost a century before Cros and Decourchement arrived (Smith, 1995a).

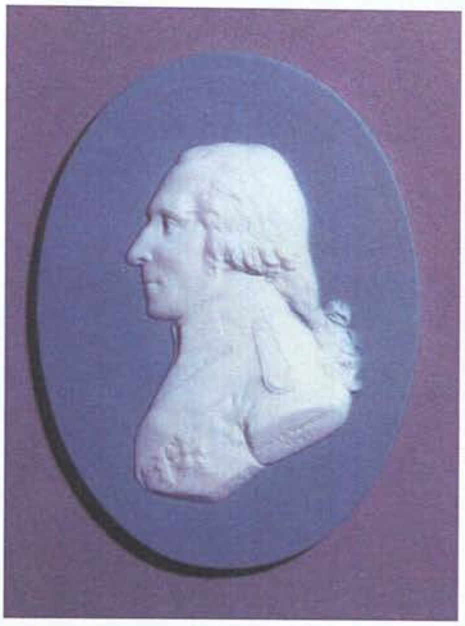

Fig 3. *Medallion of Count Rumford* by James Tassie.

If Cros knew of James Tassie's work then he would also have been aware of the output of his French contemporary, Mademoiselle Feloix, living and working in the rue de l'Abresque in Paris, and from whom Tassie had purchased 200-300 gems and 'sulphurs' on a visit to her studio in 1784. Feloix had been taught her craft by her father who had been employed by the French Duke of Orleans (the younger brother of Louis XVth) at the same time as Guilliame Homberg (Smith, 1995a). As significantly, Cros would also have been aware of Aspley Palette's techniques, which were used and copied by the modeller Pierre Honore Boudon de Saintes-Amans. This Frenchman was in the employ of Palett around 1821 and was significant enough to be mentioned by him in his second volume of memoires in 1849. Interestingly the porcelain factory of Sèvres employed Honore Boudon de Saintes-Amans between 1818 and 1826.

Whilst Cros's knowledge of their work could be regarded as supposition, there is one piece of evidence, which suggests the above to be true. In checking online for background material to Cros I came across an electronic auction site. It listed for sale, in 2008, a collection of pieces by Cros, which he made with Georges Despret (1862 – 1952) another renowned pates-de-verre artist of the period, and were made presumably at his time at Sèvres (see Fig 4, below).

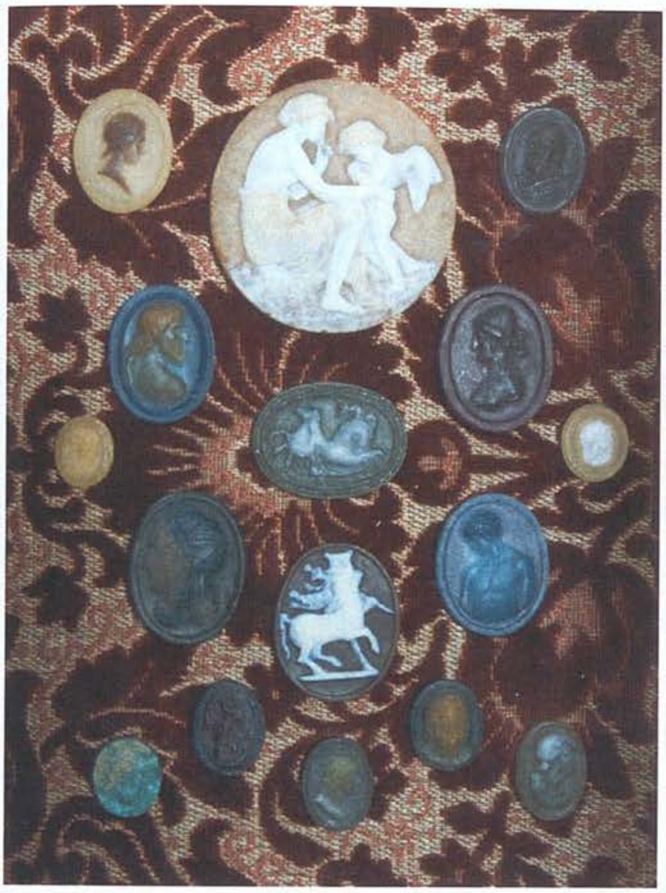

Fig 4.

Collection of sixteen medallions and badges. 'Henri Cros, Georges Despret, e.a. Dia. 2.2-8.3 cm. Pate de verre, reliefed pattern. From the estate of Yehudi Menuhin, mounted in a show case'.

Fig 5.

Tassie medallions in various colours representing Roman precious and semi-precious stones.

These are 18th Century antique gems, or rather Cros and Despret's version of them. It would appear Cros's cameos and medallions (on the left) have been moulded from 18th century originals, which, themselves perhaps, have been taken from Roman originals. The work, its detail, colouring and finesse, is definitely Cros's hand as the auction house's provenance states. But the pieces are less refined and are rather poor in manufacture when laid next to Tassie's (on the right, Fig 5). Compared to the medallion of Catherine the Great (Fig 4, above) the layers of colour blend unsatisfactorily one into the other, and the flesh tones are muddied and indistinct. It would be interesting to know what Cros and Despret (and Tassie) would have thought of the results as no doubt they thought they had made a breakthrough in the methodology. If nothing else the production of these 16 pieces show Cros was aware there was a long tradition of making objects from pastes of glass. Why else try to copy the masters? With this wealth of evidence against him it is hard to imagine that Cros (and

Despret) casually stumbled upon the craft of making reproductions of Roman pastes from an exhibition of ancient glass bowls or the odd mention of the technique in an antiquarian book.

That there were makers and artists and scientists in the 18^{th} century who were analysing ancient glass-making methods is not new knowledge as their efforts are well recorded, but the connection that they were producing an equivalent of pâtes-de-verre in both scientific terms and artistic endeavours is. If one is to accept the generalised terms or definitions of modern pâtes-de-verre as supported by Susanne Frantz (Frantz, 2005) then we have to include the 18^{th} century exponents of the craft. This then pushes back the date of commencement of pâtes-de-verre to at least the mid eighteenth century and quite probably earlier. In Britain and France and Germany, a century and a quarter before Cros and the others developed their work, artists were producing the same type of glass pastes. At that time they called their product *vitreous pastes*, *glassy pastes*, or *enamel pastes*. In the 1890s Dammouse termed his pâtes-de-verre '*pâtes-de-email*' or enamel pastes (Mannoni,). Terminology may have been different, but the methodology and techniques were similar.

It is apparent then that Cros, Walter, et al, were working in a tradition of exploration, rediscovery and development. All the clues as to how to make glass objects derived from the study of ancient Roman glass (other than blown objects) are readily available from the publications quoted above. What is crystal clear is that their manufacture was not a lost art, but was instead something specific that had been carried on in Europe from one century to another through to the late Art Nouveau. Its techniques and methodology metamorphosed to fit the tastes and requirements of a buying public and the ability of the artist or craftsman. All Cros did was to take up the batten and run with it, before passing it on to Walter, and then he, through this study, to a new generation.

Since the passing of the pioneering artists of the French pâtes-de-verre in the years following the Second World War, there has been an explosion of the technique, as well as a muddling of terms. The short dry period of some 20 years between the 1950s and 1970s (when little was known of the exact techniques) gave way to great experimentation and invention. At the same time because of the lack of hard-core literature or written explanations from the historical personalities, a curious telescoping occurred in what constituted 'pâtes-de-verre'. This was partly as a result of the rise of the development of 'cast glass' as a completely separate term of use and study (Cummings, 2002). Although I have found no evidence in literature review, from my own observations this probably started to arise when Despret (See Fig 23, below) before 1914, and Argy-Rousseau, during the 1920s, started to use much larger culets of glass mixed with either metallic oxides or glass powders in order to emulate the *myhrrina* vessels of the Romans (an example is seen in Fig 6 and 9). Those carved vessels were made from fluorspar or fluorite, a mineral composed of calcium fluoride (CaF_2) (Westropp-Hodder, 2001). The *myhrrina* bowls, in turn, curiously derive their name either from the resin which held the chunk of uncut fluorspar whilst it was turned on a wheel (Dana, 1985), or more likely, as Pliny described, the smell given off when Fluorspar is broken. The Emperor Nero famously chewed on the rim of a favourite bowl so addicted was he to its fragrance (presumably similar to that of myrrh) (Healy, 2000). Fluorspar has a relatively low melting point and was used a flux in smelting, and so may also give of fumes similar to that of myrrh (Dana, 1985).

What Despret and Argy-Rousseau were creating then was the stuff of myth and legend, and there appears to be nothing like their work in the intervening years between them and the myhrrina of the Romans. The following images (Figs 6-10) show the success they had.

Fig 6. *Lighting Plate*. Pate-de-cristal, G. Argy-Rousseau, circa 1928.

Fig 7. Cabochon of Blue Fluorspar.

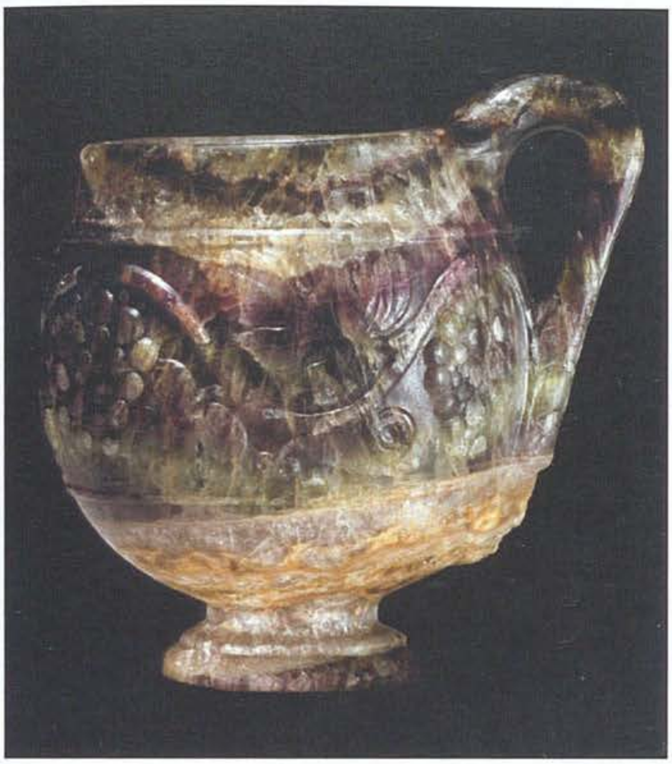

Fig 8. *The Barber Cup.*
Carved Fluorspar. Roman, circa 1st century A.D.
British Museum.

Fig 9. *Dancing female.*
G Argy-Rousseau.
Pâte de Cristal. Circa 1930.

Figs 6 and 9 show how close Argy-Rousseau came to reproducing the effect of fluorspar (figs 7 and 8) in his work. Similarly Despret's *Vase* in Fig 10 emulates it.

Fig 10. *Baguier*, Georges Despret, 1902, h: 9.5 cm.

The results in all three of these examples are more transparent than other types of pâtes-de verre seen at the time. It has been achieved by the use of larger pieces of glass, which, when melted in the kiln, lessen the entrapment of tiny air bubbles. The use of small frit, as we see in most of Walter's work tends to produce translucent end products. With the more transparent effect they began to call these finished pieces 'pâtes-de-cristal', the word 'cristal' having its historical association with the clarity of rock and lead crystal (Rapse 1786). In order to recreate the effect of the fluorspar's veining the various colours of glass need flow in a random way.

The culets and glass powders, therefore, would have to have been held in a reservoir above the opening to the mould or loosely packed in the mould cavity. The length of time the glass was held at top temperature would also have had to have been increased to allow the bubbles between the glass to escape, and so achieve the relative clarity seen here. This then heralds a subtle change in process and a change in terminology. The fabrication of these three pieces has a direct connective lineage to the manufacture of the famous emerald of the abbey of

Reichenow, the celebrated emerald vase in the cathedral of Genoa, and the rest of Raspe's discussion on the historical fabrication of glass that emulated precious and semi-precious stones. Both these glass artists have shown how easy it is to do. In my piece '*And So I Press My Lover's Palm to Mine* ' I have experimented with powders and frit in the same way to produced for its tongue element a piece of glass that mimics rose-quartz. An image of the piece is below (Fig 11.)

Fig 11.
Tongue element for '*And So I Press My Lover's Palm to Mine*'.
Lead crystal and ceramic powder.

The production of this piece was easy to do. A description of its formation process can be found in Appendix 7.

Walter, on two of his business cards from the 1920s, which I was able to see in Nancy, describes his work as 'Cristaux' (trans. Cristal ware) and 'Pâtes-de-cristal', although none of his work at the time remotely resembled anything like the above works by Argy-Rousseau or Despret. The term 'Pâtes-de-cristal' may have been a nomenclature idea, which was being experimented with along with the change in fabrication of the glass. Larger culets of glass, of course, cancel out the term 'pastes'. More investigation needs to be done on this area of development, but my suggestion that that there were attempts to emulate the myrrine vessels of the Romans goes along way in explaining this piece of historical development.

As a result of this confusion in terminology of processes trying to unravel 'what-is-and-what isn't' pâtes-de-verre has been complicated. The term 'pâtes-de-verre' has narrowed and 'cast glass' has begun to mean something different, and yet the practitioners of the early 20th century did not ever refer to their works a cast glass. That confusion has continued to widen still today.

In New Zealand and to an extent in Australia, for instance, I have found the term is generally applied to a rather ridged expression of lightly fused and sugary or crystalline products. Penny Fuller's *Palm Leaf Vessel*, a detail of which is seen below in Fig 12, is a good example of this.

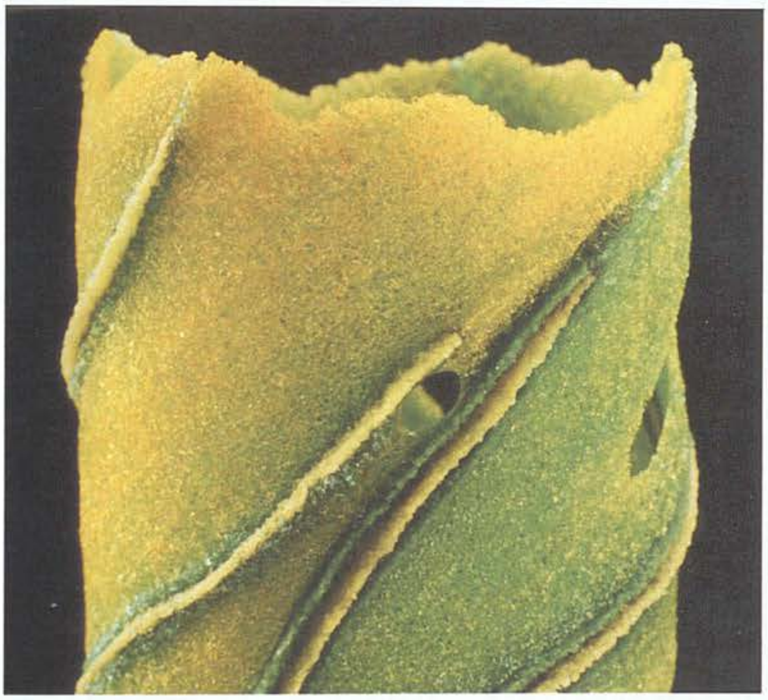

Fig 12. *Palm Leaf Vessel*, Penny Fuller, 2005 Dia. 3 ¾".

Certainly anything that has been melded into a more cohesive body of solid glass is now regarded as 'cast glass'. It may be something to do with their relative geographical isolation and small glass community that keeps this promotion of clear narrow division. Or that for the Antipodeans studio glass is a relatively new movement, which has been devoid of European historical influence that makes specific terms so important.

In Britain, pâtes-de-verre has a wider term of expression that derives from the experiments, workings practices and developments of Martin Hunt, Keith Cummings and Diana Hobson, and is one that encompasses all that we know of Cros and his followers.

Fig 13. *Ember*, Keith Cummings, 2007.

Cumming's piece above (Fig 13) expresses all that we have come to understand about modern cast glass and pâtes-de-verre in the UK. Its form and identity challenges the viewer to look beyond what we expect or know. The piece crosses boundaries as to what is cast glass and what is pâtes-de-verre, what is 'glass as a decorative object' and what is 'sculpture'.

In America the expression has grown to become, as Suzanne Frantz has described in her previously discussed essay an umbrella term that encompasses all that can be made with coloured frits and powders (Frantz, 2005). For me this umbrella term allows in too much that I do not necessarily regard as pâtes-de-verre. The works of the following two artists are case in point.

Fig 14. *Unicyclist triptych*, Catherine Newell, 2005.

Fig 15. *The Snow Queen's Realm*, Steve Easton, 2004-5.

To my mind, Catherine Newell's work in Fig 14 is more akin to fused glass, as that is its process. Newell uses powders and frits fused onto sheet glass. But then some pâtes-de-verre historically (Cros for instance) utilises the simple process of fusing glass, and that is Frantz's point. Similarly, Steven Easton's work (Fig 15) I would regard as cast glass, as on the surface there is nothing there, which immediately suggests the direct intervention and manipulation of colour by the artist. Yet, a definition that came out of a panel discussion (of which I was a participating member) in July 2006 at Broadfield House as part of the Walter Exhibition and the International Festival of Glass, agreed wholeheartedly with Keith Cummings's definition that pâtes-de-verre is the process of placing colour in the mould where you, the artist, determines it should be. The work of both artists, above, would therefore conform under this definition. In fact, all of the artists the chapters above fall into this description. That knowledge makes for a very liberating thing for those who follow.

Chapter 2: An Introduction to Amalric Walter.

Amalric Walter was born in Sèvres in on the 19^{th} May 1870. His father Josephe Walter (1834 – 1871) had died when Walter was one, but had taught at the l'Ecole de Sèvres. When he was 15 Walter's mother (who had worked as a porcelain painter at the Manufacture National de Sèvres) wrote to the school asking he be enrolled in the technician's course, as his father and grandfather had been. He was accepted, and a long training process began. The students at l'Ecole de Sèvres, whether destined to be designers or technicians, were given a gruelling regime of practical and theoretical studies. Mathematics, anatomy, chemistry, history of art, technology, mould-making, modelling and turning, drawing, watercolour painting and decorative composition were all expected to be undertaken. More importantly for Walter's development, after 4 years of study, successful students were introduced to 'the decorative elements that sculpture could contribute to ceramics … students learned to make up paste and to glaze it, and to appreciate the relationship between the two' (Bloch-Dermant, 1991a). This telling phrase is key to the cracking the code of Walter's work and is discussed in Book II. Without the development of Henri Cros's pioneering work at l'Ecole de Sèvres and before, we might never have heard of Walter. Walter arrived on the scene of a fledgling technical and artistic development at the right time. He was young and intelligent, and clearly something of a good jobbing artist.

What is known is that while he was at Sèvres Walter came under the influence of Gabriel Levy, the assistant to Edouard Dammouse (Cummings, 2006a). He became sufficiently engrossed in the new material technique of 'pâtes-de-verre' to be credited with 'the invention of certain processes' unique to the material (Daum Freres, 1904). was there for fifteen years (until at the age of thirty) when he was, as what we in the modern-day commercial world would call, 'head hunted'. Daum Brothers asked for his contract with Sèvres to be exchanged with them. Walter was established in his own studio at the Daum factory, and was given all the resources the company offered. The fact that his 'invention of certain processes' was important enough to be mentioned in his letter of contract suggests he was highly thought of.

Walter was given great liberty in manufacture when he first arrived at Daum, but it seems that the processes he had been sought out for did not suit the expectations of the Daum family. Early accounts of his success are enthusiastic; with journalists' articles (according to

Bardin) producing good and eager reviews, but the relationship with Daum appears to have become an uneasy one (Bardin, 2006).

Years after Walter left the factory, Michel Daum, the son of Antoine Daum, was scathing in his opinion of him. He is quoted as saying that despite all the help and backing of the company, and the six years of experimentation between 1904 and 1909, Walter never quite achieved what Daum was looking for in their quest for a manufacturing process for pâtes-de-verre (Bardin, 2006). During the commission of the *grand salon* interior of Leon Losseau, a French barrister, Daum had to confess to their client that the wall tiles and plaques that Walter had made would not work as envisaged, due to the fact that natural light could not pass through the body of the glass. The only solution was to backlight the panels with artificial light. Fortunately for Daum, Losseau was an electric light enthusiast and readily agreed to the solution (Bardin, 2006). It appears though for Daum this issue of transparency would be a sticking point in their relationship with Walter.

Walter, when faced with the criticism, would respond 'the process is not quite at the point yet' meaning it was not at the final stage of development (Bardin, 2006). For Michel Daum 'the process never arrived at the point' even after Walter left the company's employ, and was successful in his own right. Looking at the *Dish with red crab* in Fig 16, below, I am confused as to what the exact problem was.

Fig 16. *Dish with red crab – matt*. Daum, Nancy, Cat. No. 32.

Judging from one account in Bardine's analysis it can be taken that Daum were looking for a transparency in the work that was never to appear in Walter's pâtes-de-verre until the 1930s when his buying public's deserted him. Then he was forced into a change in style of production to maintain his studio (Bloch-Dermant, 1991c). By the very nature of what comprised Walter's earlier methodology Daum's demands were never going to be achievable. Yet Daum were more than happy to continue commissioning Walter with his pâtes-de-verre products well after the left them, as well as labelling them their own.

It is hard to imagine how Walter could improve on the quality of the technical aspects of the pâtes-de-verre piece above, nor improves on the mastery of the *'Coupe au Serpent avec Branches des Murriers'* (see Fig 27, p77 below). But then Daum were, and remain, manufacturers of glass products, that deal with the complex nature of light passing through bodies of glass.

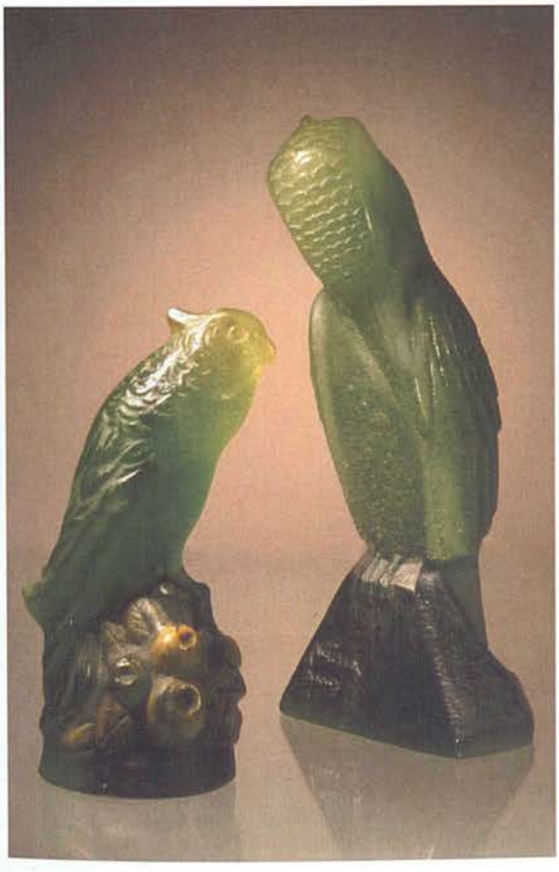

Fig 17.
Two birds: Parakeet and Kingfisher.
Cat. No 105. circa 1930s.

Fig 18.
Perroquet de G. Petitfils.
H. 36cm, 1970.

The glass works in Figs 17 and 18 show not dissimilar themes. The bird on the far left in Fig 17 is a parakeet by Walter in the 1930s. In it the matt and translucent qualities so typical of his hand, have been joined by an area of transparent yellow glass in the head of the bird. A similar quality of approach was adopted when Daum started to modernise their manufacturing processes in the late 1960s and reintroduced pâtes-de-verre. Petitfil's *Perroquet* imitates Walter, but without the by-then lost technique of the matt detailing. Nevertheless, the attempt is a good one, and suggests Daum realised what they had misplaced.

The piece in Fig 19, below, shows too how the modern Daum factory have further utilised that very quality that was originally complained of as they have adopted new shapes and ideas.

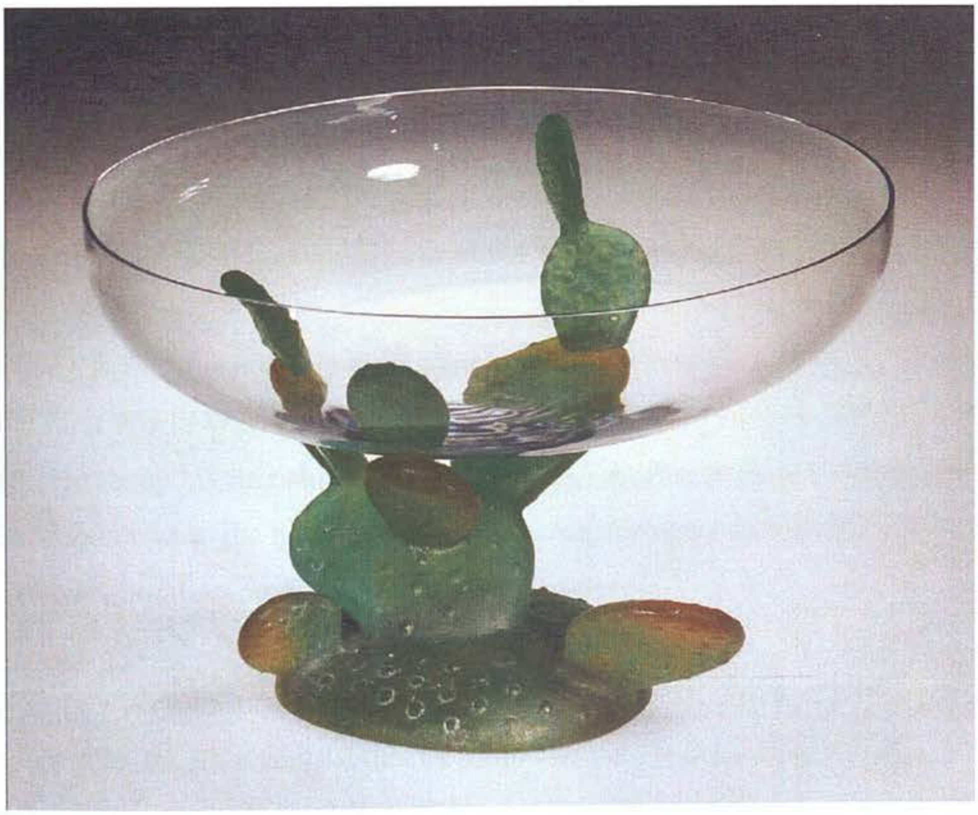

Fig 19. *Nevada Bowl* from the *Cactus* Series,
Hilton McConnico for Cristallrie Daum, 1987.

Despite a gap of some 50 years McConnico's *Nevada Bowl* would not be out of place amongst the work of Walter. It depicts a cactus plant, its plump branches supporting a mirage-like shimmering pool in which to dabble one's fingers. Like Walter's pieces the modelling is accurately taken from life, and the use of the coloured frits mimic the colours and texture of its subject. The direct contrast between the two elements of the subject matter, the translucency of the plant form and the transparency of the blown dish are well realised, and it maintains the subtlety and symbolism of the French Art Nouveau in Nancy. It also challenges Michel Daum's complaint that Walter never achieved an end point in his technique. Here Daum are happy to uses that supposed 'fault'. In this case McConnico's *Nevada Bowl* it is pure Walter.

Walter's work in the *'Coupe au Serpent...'* has the element of ceramic to it, which necessitates a conversation with light and colour remaining on the surface of the object. If his work were developing along that route, it would be at conflict with his masters. However, there is a telling line in Walter's contract with the Daum Brothers, which may have added to Michel Daum's snide tone about Walter's technical abilities. Walter's contract states firmly that the 'certain processes' belong solely to him. If either party were to break the contract Walter's copyright would not be infringed and Daum would not be able to use any of the processes for a further 10 years from the separation date. This ownership of the processes he had developed at Sèvres must have piqued the Daum organisation as it must have been equally galling for Walter never to be credited with an *auteur's* mark on his work.

Given these issues it is not hard to imagine why Walter was keen to set up his own studio after the First World War, and why the Daum Brothers were happy to release him from their contract. He set up his first studio in Nancy in 1919, in Rue Eugene Ferry, and with mounting success, due in part to the help from Maison Jacout, his agent in both Nancy and Paris, he then moved to another large premises in Rue Claudot.

Xavier Eury's verbal accounts taken in around 2000, and the few images he possesses of Walter's studio, together suggest that its setup was very much like any studio, which a moderately successful modern glass artist would employ. It differs to Gabriel Argy-Rousseau's premises greatly. At the height of his powers in 1925 Walter employed no more than 10 assistants. Argy-Rousseau, on the other hand, had a factory employing many technicians and assistants. Unlike Argy-Rousseau, Walter was a hands-on practitioner. The unique qualities of his products lie in the fact he made the job of detailing the works his priority (Bloch-Dermant, 1991c). While Argy-Rousseau's success lies in his designs, which he had faithfully translated into glass by technicians and studio assistants, the hand of the master is always there in Walter's glass. Walter placed the powdered colours into the moulds himself allowing his assistants to work only on the general aspects of the works, the back filling with glass, mould making and polishing. It is this knowledge that makes owning and handling a piece of Walter's electrifying. One is holding the very piece the maker envisaged and worked on. His eye saw what you see and had planned. In this sense he is one of the fathers of the studio glass movement, which is defined by single artists working in their own studio away from the manufacturing process of mass production of machinery and many hands. Conversely, under this definition, Argy-Rousseau was not part of that movement.

After he left the Daum factory Walter spent the next twenty years collaborating with artists and friends he had made while at Daum. The longest working relationship was with Henri Bergé, and they made pieces until Bergé's death in 1932. Their style, however, had to adapt to the more fashionable taste of the 'Jazz Moderne' (or Art Deco) style, which was predominating towards the end of the 1920s. The floral and crepuscular qualities of Bergé work were perhaps less sought out as there is a definite shift in design and detail in the pieces Walter produced at this time. As Bergé's designs faded from Walter's portfolio other artists replaced him and they inevitably changed the way Walter worked. With few exceptions such as J. Cayette and J.B. Descomps the subject matter moves towards singular mammals and birds, and a shift to a much more simple range of products. I have gathered a small sample of each of their styles in the montage of images in Fig 19 below. That Walter used at least 9, and possibly more, artists and sculptors to inject a new vigour into his work, says quite a lot. It suggests he either preferred to work briefly with new people and then let them move on, or he was aware that he needed to branch out to attract a wider and more fickle audience. The 1930s were, out of necessity and fashion, a period of cheaper mass production in luxury goods. The ideals of Gallé, William Morris, and the Arts and Crafts movement were long gone. The pieces illustrated here seem to have that quality about them. Although they definitely exhibit a charm, I cannot help feeling that Walter would have preferred to continue the type of work he made with his friend of over 30 years, Henri Bergé. The montage shows a range of work associated with each designer/sculptor who Walter collaborated with. They are all to be seen in the Broadfield House Catalogue contained in Appendix 1.

Lizard dish by Walter and Bergé

J. Cayette

Lejen

George Conde

A. Houillon

H. Mercier

J.B. Descomps

E. Royer

M. Corrette

Max-Blondat

Fig 20. Montage representing the various designers who worked with Walter.

As can be readily seen the complex detailing in the lizard dish by Walter and Bergé at the top of this montage has almost vanished in the rest of the pieces. The animalia have shifted from the fauna of the French hedgerow (insects and small reptiles) and crustacea, to larger birds and beasts. They are depicted either in perfect 1:1 scale, or in slightly smaller forms giving them an appeal not seen in his earlier work. The influence of the Arts Deco style is obvious (it was at Argy-Rousseau's recommendation that Walter change his focus from the Art Nouveau patterns to this new style. But there is something else attached to these creatures that is not obvious at once. These pieces are beginning to look like cast glass. The ceramic glazed quality that characterises his earlier work has started to disappear. Whether this is as result of a new stylistic approach forced on Walter by financial concerns, i.e. he had to work faster with fewer assistants to help him, or whether he embraced a new approach in his artistic work is not known. I suspect the former to be true. There is also another note, which has crept into his work. I accept that I have been selective in my choice of pieces, but there is an almost cartoon-like quality in their appearance. These animals are cute, perhaps in the vein of early Walt Disney. The shape and form, the line of drawing and the modelling are no longer realistic. Even the colourings are in blocks of flat colour, with little detail to determine them. The turtledove of Lejen, the fox of H. Mercer, and the bunny of Max-Blondat would not look out of place in an animated tale of 'Snow White', nor would either of the two birds in Figs 21 and 22.

Fig 21.
Hollow pelican light-fitting. Cat No 97.

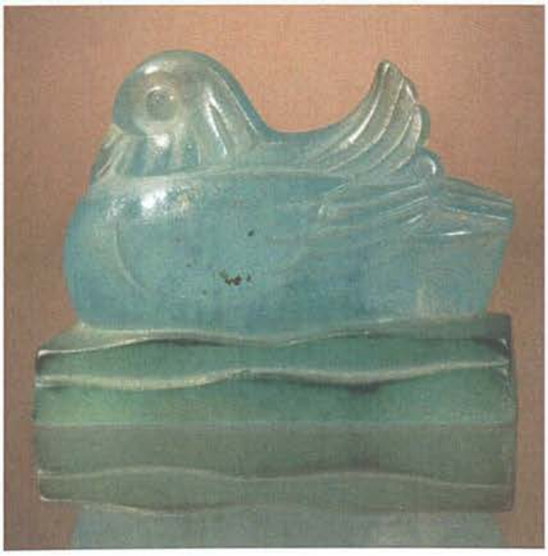

Fig 22.
Duck paperweight. Cat. No 102.

Despite this stylistic change, what has not altered is Walter's familiar colour palette. The same greens, blues, oranges and browns remain. It is this that perhaps kept him focused as an artist as he was forced to change into, sometimes, infantile subject matter.

Both Argy-Rousseau and Walter fell foul of the financial crisis of 1929, which put paid to the luxury market across all fields of the decorative arts both in Europe and America. It is well documented that Gabriel Argy-Rousseau was badly hit (Bloch-Dermant, 1991c). What is not known is how Walter survived. In a letter to Maison Jacout, (his agents) from the Paris firm of 'Rosiere et Bheud' who represented various factories it was recommended that Walter follow Argy-Rousseau's example and change styles to the more modern and saleable Art Deco influences (Bloch-Dermant, 1991b). By 1932 Argy-Rousseau's business had regained its financial health. Rosier et Bheud's suggestion was a generous one and helped to solve the problems Walter was encountering. The colours styles they suggested he consider were black and white, green, turquoises and gold. From what can be seen in some of the pieces immediately above, Walter picked up on their suggestion and ran with it. At the very least it allowed him to carry on working and maintain a living.

Chapter 3: Where Walter sits as an artist.

In the harsh definitions of what constitutes Art, glassware comes a long way down the list, as it is a decorative art, not fine art. That Gallé and others were turning it into a mode for expression does not mean glass had become a sculptural medium, or was considered as such by the turn of the 19th and 20th centuries. In these terms it can be said Walter was not a 'player' on the European art scene like the Nancien artist Victor Prouvé. As far as Walter was concerned he would have considered himself as a maker of luxury glassware goods, and was working within the movement of the Nancien Art Nouveau. In the narrow, refined world of French pâtes-de-verre he was well known, and possibly had some celebrity in Nancy.

One hundred years later it is clear the style of his work is easily recognised and sits comfortably in the context of the French Art Nouveau. The subject matter throughout his oeuvre is charming and well considered, and echoes the sentiment carved above Gallé studio lintel: '*Our roots are in the depths of the woods, on the edge of springs, on the mosses*' (Cummings, 2006b). The end products are finished to a high standard, and consequently have an immediate appeal to the eye. They are unlike much of what had gone before or since in glassware. In that respect he is unique.

I have stated above that I adhere to the view that Walter should be placed next to Henri Cros in his achievements, and is the true inheritor of Cros. Put some of Walter's better pieces, such as the lizard dish at the top of the montage in Fig 19, next to any of the other pâtes-de-verre artists and you have a work to rival theirs. Of course, this is a subjective view, but in technical terms Walter matches all of them, and in terms of what Cros was attempting to achieve (the revival of a truly polychromatic sculptural technique) he masters the technique and improves on it (Daum, 1984b).

Below are four images of Henri Cros' work (Figs 23-26).

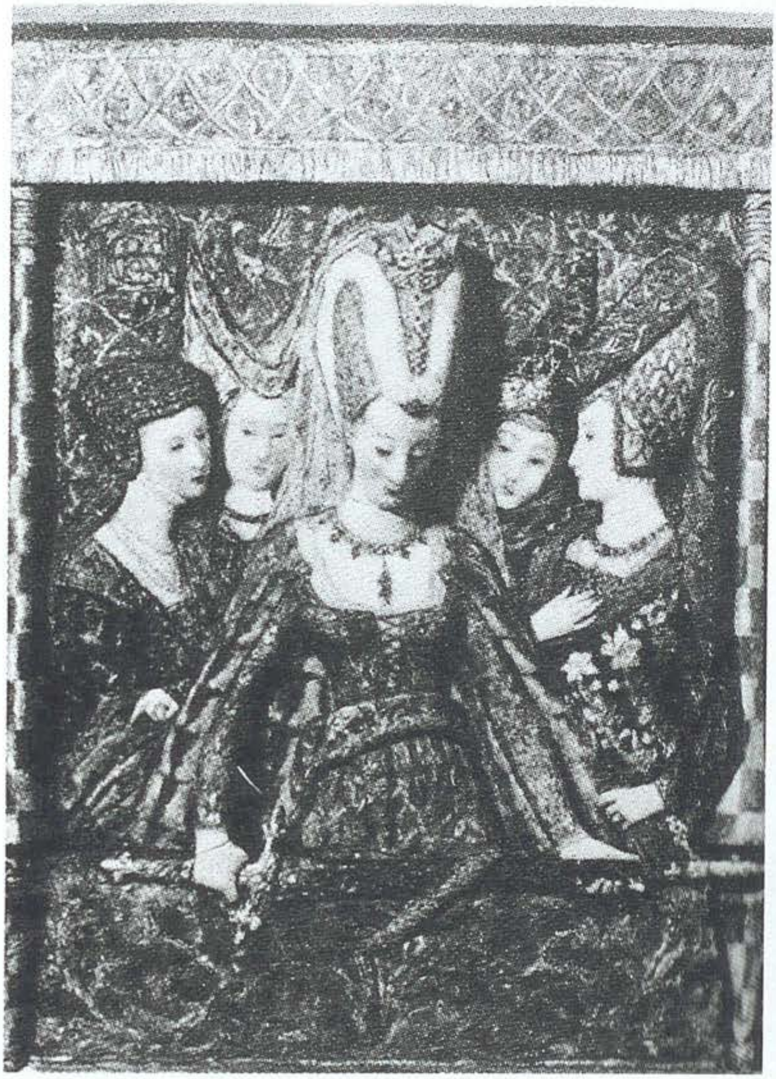

Fig 23. *Le Prix de Tournoui*, Henri Cros, encaustic wax 1873.

Fig 23, above, is of the *Le Prix de Tournoui*, a large work he made in encaustic wax, in an attempt to understand the 'lost' methods of the Greek sculptors in the way they created a polychrome sculpture and to rehabilitate its aesthetic status (Daum, 1984b, Olivié, 2005). Compared to his glasswork in Figs 25 and 26 I find the wax sculpting more successful. Even in this black and white image the modelling is finer and the result more satisfying.

However, this interest in polychrome sculpture together with his desire to find a method of producing a self-colouring, polychrome technique pushed Cros towards experimenting with glass. He had been driven on with his ideas after seeing the 1878 Paris Exposition Universelle where he had encountered Roman glass and pieces of enamelled ware that were derivative of

Islamic art (Olivié, 2005). His subsequent experiments were informed by the Pompeian art he was trying to emulate, and which had been so praised in Achilles Deville's analysis of glass in the Ancient world (de Ville, 1873). His pieces varied in size, but eventually became monumental in scale, always pushing the boundaries of what could be achieved in pâtes-de-verre. The piece 'Histoire de Feu', (seen in Fig 24. below) for instance, is nearly 3 metres in height.

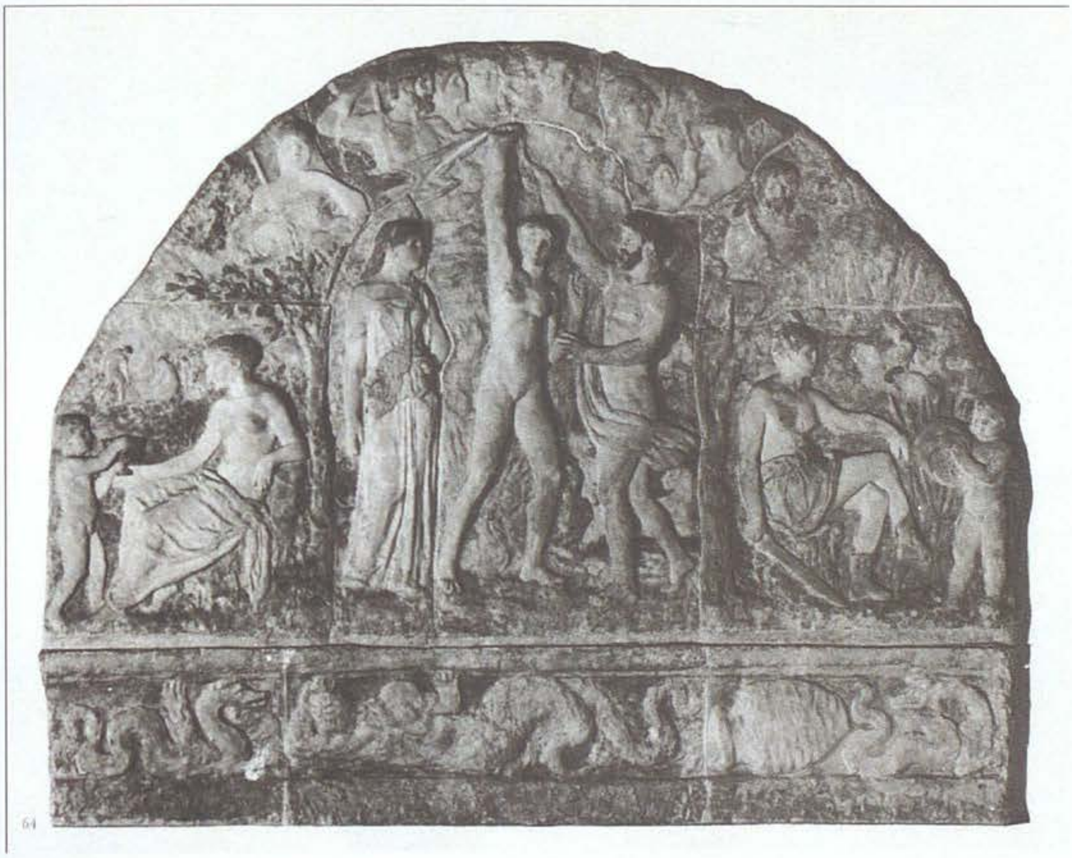

Fig 24. *Histoire de Feu,* Henri Cros, 1900.

It has to be said, however, and it is something he acknowledged himself, Cros never achieved clarity of texture and body in his making (Klein, 1992). His crushed glass remained as such, and the resultant works always were imitations of marble, plaster or wax. To me the end results of his glasswork lack a quality of expression, which is present in Walter's work.

Fig 25. *Tete de Medusa*, Henri Cros, Salon de 1906.

The modelling, for instance, of the *Tete de Medusa* (Fig 25, above) is clumsy for such a study. Compared with the dish Walter and Bergé produced at Daum at about the same time Cros' sculpture falls short.

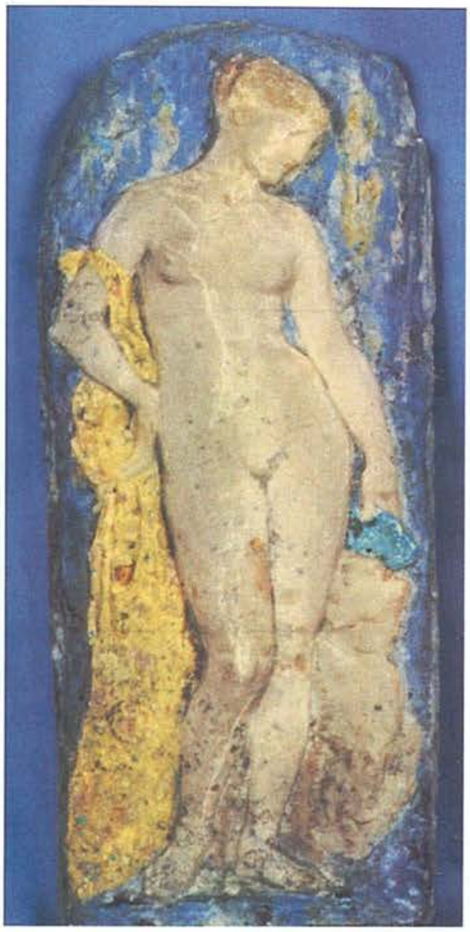

Fig 26. *Circe,* Henri Cros, 1891.

The study of *Circe* (Fig 26), too, seems to lack a quality that is always found in Walter. That is, the detailing of the main part of the glasswork, i.e. the figure (or in Walter's case, the insects, beasts, the part the eye is drawn to) is just another part of the overall panel. In a way, Cros has achieved what he set out to do, to use glass pastes to imitate other materials. Until Cros, glass pastes had always been used to imitate gemstones and other semiprecious materials. I find it curious he took a revived knowledge and made it look like decaying plaster. Walter on the other hand embraces the various qualities of glass and makes bejewelled works of art. This does not mean to say Cros was wrong in his approach, and one should acknowledge his mastery, but if one were to compare any of the three glass pieces above, with the two images below (Figs 27 and 28), one can see how Walter took what he had begun to create and pushed it towards a new horizon.

The piece is Charles Schneider's famous *'Coupe au Serpent et branche de Murriers'* (trans. 'Plate with Snake and Branch of Brambles') now housed in the Musée des Beaux Arts in Nancy.

Fig 27.

Coupe au Serpent et branche du Muriers. Designed by Charles Schneider, fabricated by Amalric Walter, modelled by Henri Bergé, 1908, Daum, Nancy.

Fig 28. Reverse angle of the same dish.

This is a piece of pâtes-de-verre that Walter was working on just a year after Cros died. Although the work is a plate, it can nevertheless be regarded as a piece of polychrome sculpture, and it has a semblance much to that Cros did.

The history of the piece is this. In 1908 the artist Charles Schneider (1881-1953) was working at Daum as one of their major designers. He created this dish for them as a 'one-off' piece. How it was received I have not been able to find out, but as it remains as a one-off, I would suggest it was not hugely well received by the directors of the firm. It is undoubtedly, though, one of the pieces Walter worked on. He was in charge of Daum's pâtes-de-verre and there was no-one else in the employ of Daum with the necessary skills to produce such a work. It is piece atypical in the manufacturing of Daum at that period in the sense that it is a plain piece of ware, which utilises none of the intensities of colour palette usual in Daum's output at the time. Nor does it use the phenomenon of light passing through the body of the glass to illuminate the subject matter. It relies on the subject matter itself to do that, just as Cros has done.

On the surface it is a simple platter and is the depiction of a viper entwining itself through a branch of a blackberry bush. At first glance one could be forgiven for thinking that this is not a piece of glass at all, but a finely glazed dish of ceramic in the vein of Bernard Palissy, or perhaps his Revivalists (Katz, Lehr, 1996). It is hard to conceive it as anything else. It is only on closer inspection that one realises this dish is created from glass, and created from pâtes-de-verre at that. Light passes through the object only on the deep sides of the dish. The fluidity of paintwork is one that seems to ooze with the sensuousness of oil. Through it a startling simple depiction of nature is conveyed, and that is where Cros and Walter embrace each other and diverge. In this piece Walter has achieved finesse over Cros's desire to create a truly self-colouring, polychrome technique. He has mastered the technique. The detailing of the snake alone, compared to those on the *Tete de Medusa*, shows that.

Despite the fact that Schneider designed it, and Bergé modelled it, the work would not be anything like as successful without Walter's hand. The leaves of the bramble are depicted in low bas modelling, but it is Walter's use of mottled colour, which catches our attention. We are immediately enchanted by the depiction of autumnal undergrowth. The thorns are contrasted in brown-reds against a yellow and signal the danger of the viper, which in turn is green with evil. In another's hand it could all to easily become the Rustic Ware of the Avisseaus or Palissy, but here it stands as unique exploration of shape, form, symbol and, importantly, technique. The message conveyed is greater than its parts, and is all the more extraordinary in that it is a relatively small size, just 32 cm square. In this work Walter relies on the application of ceramic technology to transform glass into something else, just as Henri Cros transposed glass into peeling plaster frescoes.

This is where Walter and Cros depart. The monumental scale of some of Cros's later work seems to take precedence over his mastery of technique in a way that tries to disguise his poor making skills. The inability of Cros to develop his style beyond that of the Pompeian fresco or unearthed marble slab is clear when his work is placed next to Walter's, particularly this work (Daum, 1984b). I have no issue with the fact Walter did not design the *Coupe de serpent...* as its splendour lies with how that is realised in glass. Walter here is the genius. Here Walter has trumped the master and succeeded him.

In practical terms and in the development of Walter's own personal work the *Coupe de serpent* piece is of huge significance. It is the first example of the refinement of the techniques and imagination, which he was to pursue throughout the whole of his career. Here, Walter's fascination with the crepuscular also begins to emerge. He technically triumphed for the designer Schneider, and it is no wonder he carried on with the success. The fact that this piece of glass can be mistaken for ceramic is also important in the unravelling of Walter's techniques. The knowledge he brought with him from Sèvres was to be incorporated into the manufacture of his glass products. Clearly what he had begun to do in the *Coupe au Serpent*... was to take the traditional ceramic glazing and enamelling techniques and employ them within the (glass) casting process.

The works of other pâtes-de-verre artists from the time Walter was working have been well documented too, so also allowing comparison. Dammouse, Decourchement, and Despret's are the best-known precursors and colleagues of Walter. They are heralded as the developers of the medium in what is regarded as its purest form (Daum, 1984b, Mannoni,). That being said, I find that Walter to be as good as they, but what becomes clear is that is his work is singularly different to the others. It makes him unique and worth studying as a fellow artist. I have drawn other comparisons between Walter's work and Argy Rousseau's in Book II.

On the following pages are four typical examples of each of their work ranging from the start of the 20th century through to around 1938. In certain cases the date of manufacture and the dimensions of some of the pieces is unknown, but that does not prevent a comparison.

Albert Dammouse:

Fig 29. *Bol aux Libellules.*
(date unknown)

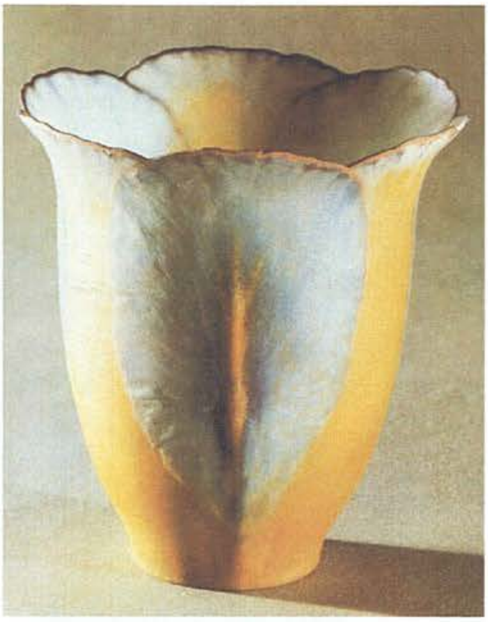

Fig 30. *Fleur coupee en pate de verre,*
1910.

Fig 31. *Coupe de Dammouse,* 1905-1910.

Fig 32. *Anemone.*
(date unknown)

Georges Despret:

Fig 33. *La Vague,* 1902-1903.

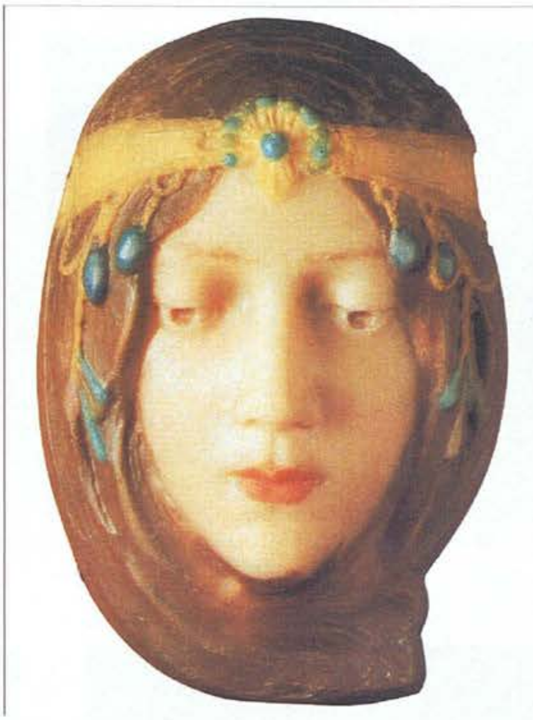

Fig 34. *Cleo de Merode,* 1907.

Fig 35. *Baguier* 1902.

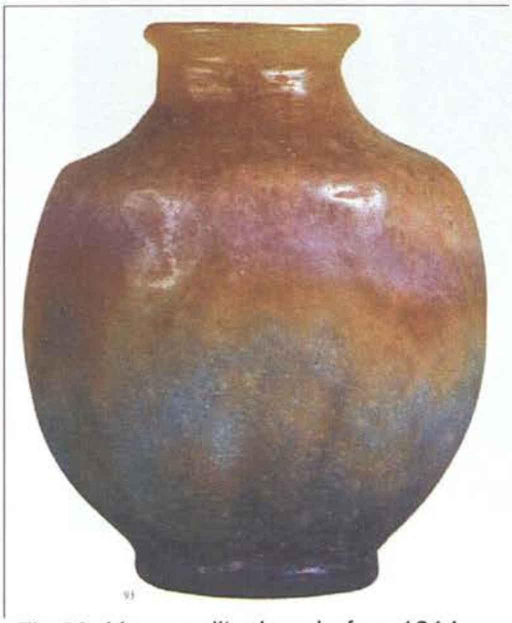

Fig 36. *Vase mulitcolore,* before 1914.

Francois Decourchement:

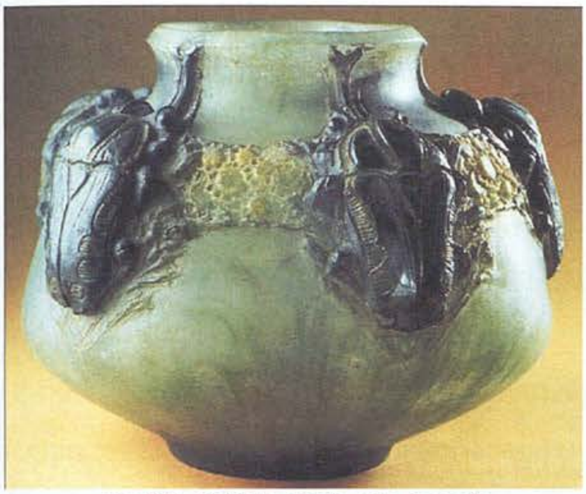

Fig 37. *Potiche verte aux insects.* (date unknown)

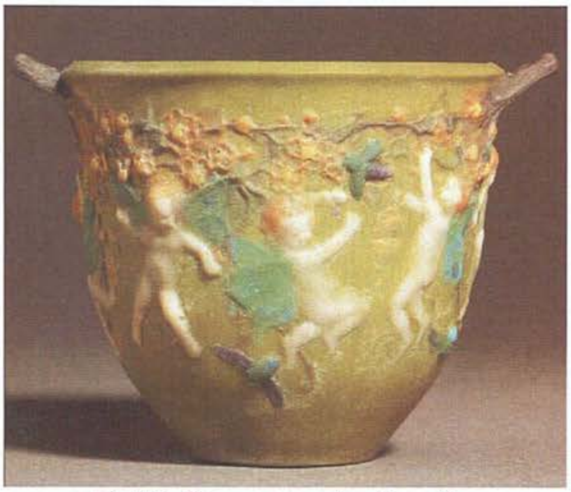

Fig 38. *Coupe en pate d'email.* (date unknown)

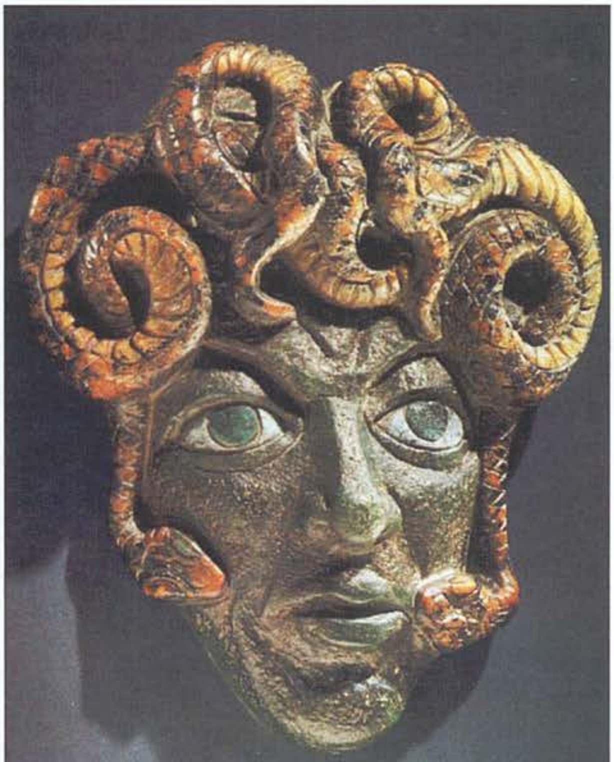

Fig 39. *Tete de Gorgone,* 1938.

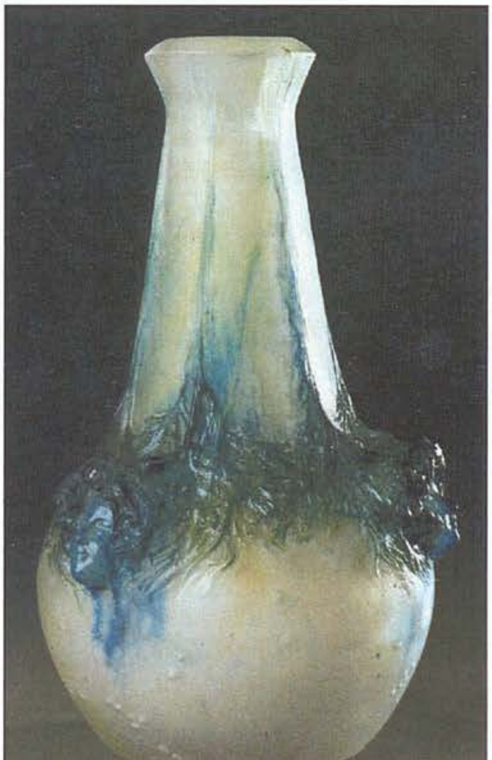

Fig 40. *Vase a long col. Masques,* 1908-1910

If one looks closely at all the works made by these three precursors and contemporaries of Walter there is no doubt they are of fine quality and manufacture. Delicate vessels, vases bowls, modelled heads and figurines are all made in polychrome glass, and follow Cros' ideas and develop his methodology. There is no doubt that technique has been mastered and pushed forward. Noticeably, the variation of technique is wide.

Dammouse makes objects that ranges from a Walter-like vase (Fig 29) to enamelled cloisonné ware (Fig 30) to translucent paper-thin products of Fig 30 and 32.

Despret makes works of similar variety. The first two fall into the category of polychrome sculpture (Figs 33 and 34), their surfaces are dense and light repelling. Fig 35 however, is a complete contrast. It is transparent and has the depth of crystal. It also reminds one of some of the later works of pâtes-de-crystal of Argy-Rousseau. In contrast his *Vase Multicoloure*, (Fig 36) harks back to the myrrhine objects of the Romans.

Similarly, Decourchement makes work of great beauty and variation. His three vases (Fig 37, 38 and 40) are translucent and elegant using the glass to trail into the form and become part of the design. His *Tete de Gorgone* (Fig 39) reminds one of both the *Head of Medusa* by Cros and the *Coupe de Serpent*... Despite the stylistic differences (possibly requiring a slightly different approach) I cannot help thinking Water's efforts to define the quality of the snakes have had a more successful result. The kingfisher light fitting below (Fig 41) shows what I mean.

Fig 41. *Kingfisher hollow light-fitting*, Cat. No. 52.

The markings of the snake are carefully detailed and in contrast with the generality of colouration of the bird. Here, Walter's artistry makes the defeat of the snake the important aspect of the scene. And in turn, it makes Decourchement's depiction of the tragic Medusa seem slightly comical. This is where his personal style throws up some of the limitations of the others.

The 12 above works of Walter's colleagues fall into two categories. Either they are transparent/translucent, or they are solid and opaque, with a vinyl, wax-like quality about them. Detail is rarely depicted by the contrast between translucency and opacity. Decourchement comes close to succeeding in both his *Potiche verte aux insects* (Fig 37) and *Vase a long col. Masques* (Fig 40). In them he utilises the softness of the translucent pale background glass and contrasts it with the dense polished green black of the scarab beetles or the masks. But despite this, something is still lacking. By using all the techniques of the other pâtes-de-verre artists, Walter produces three-dimensional pictures that have their own independent language of textures and contrasts. He has overcome the problems of making a light-filled translucent piece of glass, which has also dense, matt areas and detail highlighted by opacity. He either polishes that detail or leaves it matt, not just to scintillate the eye, but to further the visual vocabulary. Combined with Bergé's modelling, Walter's works tell a story, which the others lack. Each piece of 'Walter' has a tension to it. Whether it is a crab in a few strands of seaweed (Fig 42, below) or an ivory white mouse confronted by a chorus of grey, Walter's work has a tale to tell (Fig 43).

Fig 42. *Oval dish with crab.* (Reverse image), Cat. No. 30.

Fig 43. *Mouse group with carved ivory mouse*. Cat. No 38.

These mice, immediately above (Fig 43), are reminiscent of Beatrix Potter and are from the same period as her work. The group indignation of the grey mice is almost palpable in their confrontation of the white. He, in turn, is seems to be saying "Actually, yes, I do mind." Again it is not hard to imagine the crab in Fig 42, above for instance snapping at the digits of a light-fingered guest who has eyed his host's writing pen. Even Walter's insects are elevated above being mere decorative detail. They are posed to reveal a charming snapshot of working nature. The dish below is fine example of this (Fig 44).

Fig 44. *Leaf with Cockchafer.* Cat. No 2.

This piece, like so many of his, works on two levels. Firstly, as practical object (it is a pin dish), and secondly as a sculptural work. But, when one first looks at the piece, the eye does not register it is made from glass or designed to hold pins, but instead takes in its charm and physical presence, i.e. the sculptural form, the subject matter, the colours.

Henri Cros's work was an attempt to reproduce lost or imagined techniques of antiquity. To an extent he managed to do that, but Classical, polychrome sculpture is more than just a mode of material expression. It tells a story. Palissy in his ceramics told a story too. So, did the Avisseaus and the Palissy revivalists in their work. And Walter fits alongside these artists and their work. He is following a tradition of makers whose work has a relationship with their audience that goes beyond the decorative. It is precisely what I try to do in my work. Engage the viewer and hold his attention for as long as possible. In that respect Walter can be deemed to be the inheritor of Cros.

Chapter 4: Walter's subject matter.

In the introduction I have briefly alluded to the possibility that the background influences on Walter's artistic approach had been made by the French ceramic master Bernard Palissy (Daum, 1980c, Olivié, 2005). Certainly, there are some similarities to make the claim as the two images show below (Figs 45 and 46).

Fig 45. *Basin*, Bernard Palissy, circa 1580.

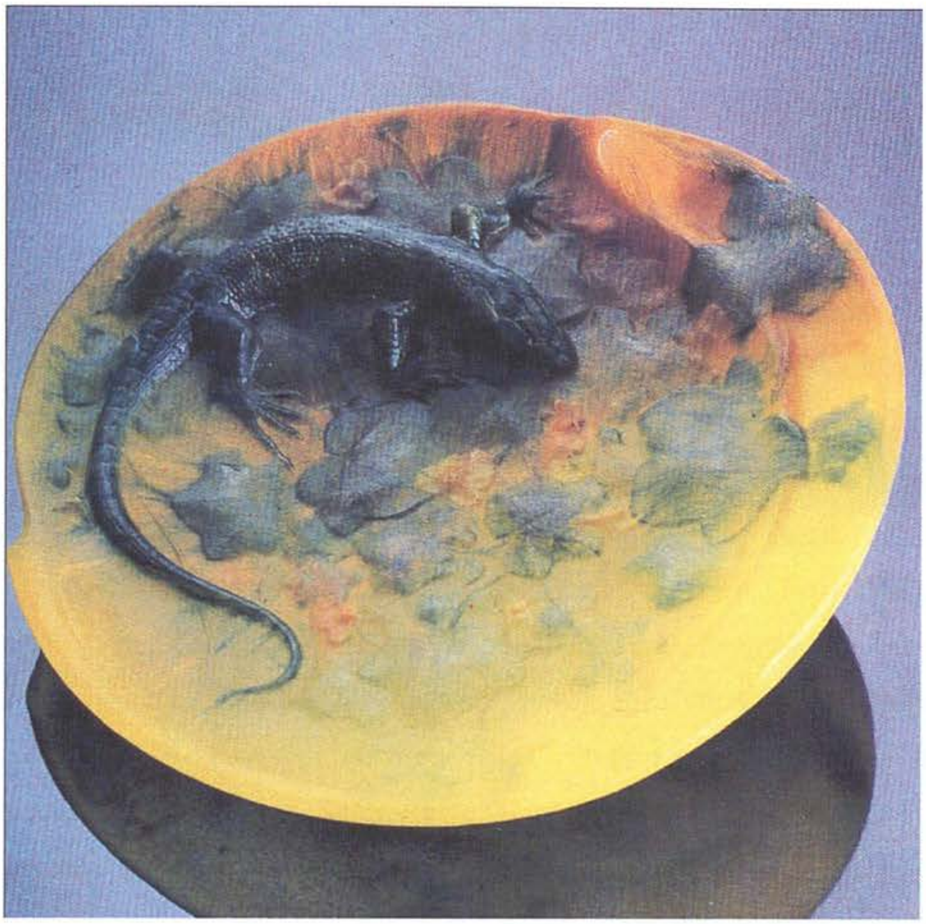

Fig 46. *Dish with Lizard.* Walter, Nancy.

At first glance Walter's immediate subject matter does seem to owe its origin to Palissy's work. Both these two works, immediately above, utilise very similar imagery. Although Palissy depicts several reptiles and creatures, the image of a green lizard amongst countryside flora is there. Walter uses a similar pose to a lizard found on the Palissy dish above it. It can be seen lying on the left of the central coiled snake, albeit in reverse. The most obvious connection between the two pieces is in the colouration. The yellow background is a foil to the creatures and leaves. But when more of their work is compared though it soon becomes apparent that both Olivié's and Daum's suggestions are incorrect. Even with the simple placing together of the two above works it is clear that the mode of expression is very different. Palissy's work has a static quality to it, while Walter's is permeated with life. Palissy's process of taking casts from the dead animals and plants he collected to use as models produces a quality of lifelessness (Katz, Lehr, 1996). Life/death casts tend to produce a copy, not an expression. Walter's creatures were not taken from life/death casts, but instead were modelled from life, so producing life-imbued forms. It is this methodology of creation that separates them, and suggests that the claim it was solely Palissy who informed Walter's oeuvre is incorrect. From my investigations I can state there is an intermediate stage of influence that informs Walter's decorations.

Before discussing this it is worth mentioning here that I have found there is a curious mirroring of the career path of Walter and Palissy. Palissy set out as a painter on glass as his father and grandfather had been before him, before turning to his own unique form of ceramics and inventing his own processes of glazing with lead oxide. Walter, on the other hand, started life following in his father and grandfather's wake as a ceramicist before turning to glass for his own unique artistic expression. Like Palissy, Walter was instrumental in the development of his own inimitable processes that involved the use of lead glazing technology. Both artists used familiar flora and fauna of the French hedgerow and countryside for their decorative elements, and both men spent about 15-20 years perfecting their techniques and methodology (Katz, Lehr, 1996). Like Walter, when Palissy' died, many of the secrets associated with his techniques died with him and his studio rapidly closed. And both men had imitators who tried to recreate their techniques and works, but with only limited success.

For two and half centuries many ceramicists in France tried to unravel Palissy's methods and techniques. In around 1843 a French ceramist called Charles-Jean Avisseau, already a respected ceramist from Tours, cracked Palissy's glazing code. Copyists followed in Avisseau's wake and several successful studios set up business in competition with him in Tours and Paris. Their work energised a movement that would last 50 years and engage many skilled artisans and ceramic factories in across Europe (Katz, Lehr, 1996). The image below (Fig 46) is just one example of many that illustrates the Avisseaus family's work.

Fig 47. *Basin*, Edouard Avisseau, 1867.

This group of ceramicists are generally known as the Palissy 'Revivalists', and it is actually their work that informed and inspired Walter and Bergé in their creations. Like Palissy's creations their work is sometimes known as 'Rustic Ware'. While Avisseau and his copyists gathered flora and fauna from stream and hedgerow to use in their works, they by and large, like Walter and unlike Palissy, modelled their subjects from life. Their glazes are fresher, brighter too, suggesting a more complex or wider understanding of glazing technology than Palissy knew. This gave their finished works a greater life-like expression and illusion to it than anything Palissy did.

When the Revivalists work is examined much of Walter's early menagerie can be found within their ceramics. The lizards, chameleons, dragonflies, moths, fish, crabs, sea weed, crayfish, even an upright water nymph, echoing Walter's drowned one has been copied.

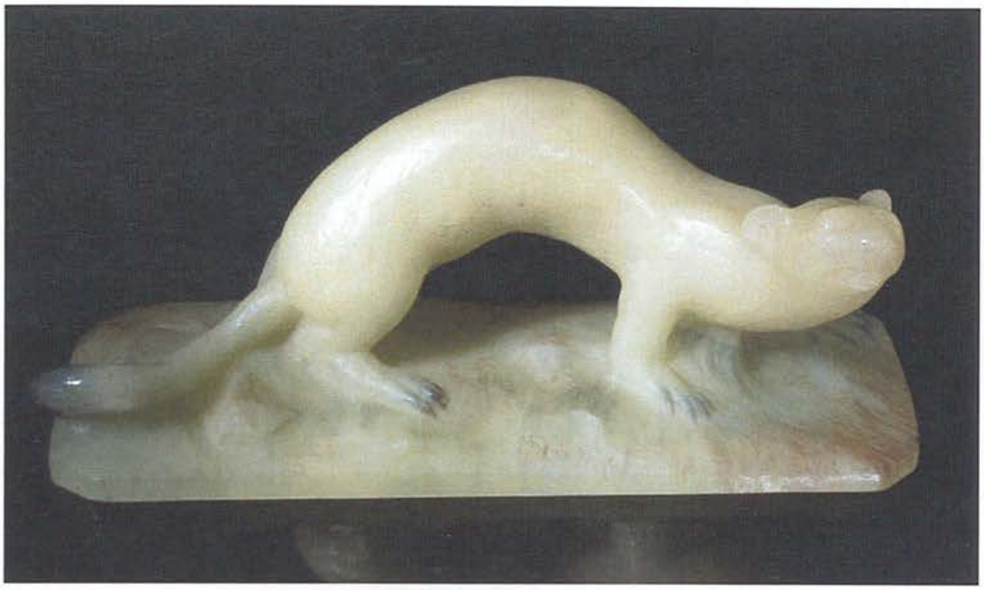

Fig 48. *Ring stand with Stoat (Ermine)* (Cat. No.39).

Fig 49. *Wine jug and grotto*, Charles-Jean Avisseau,1850-55.

Walter's stoat (seen in Fig 48, above), a copy of which is part of the Daum display in the Musée de Beaux Arts in Nancy, has a similar stance as one standing atop the lid of the large wine jug in Fig 48.

In Fig 50, below, a water nymph is repositioned by Bergé in Fig 51 onto her leaf.

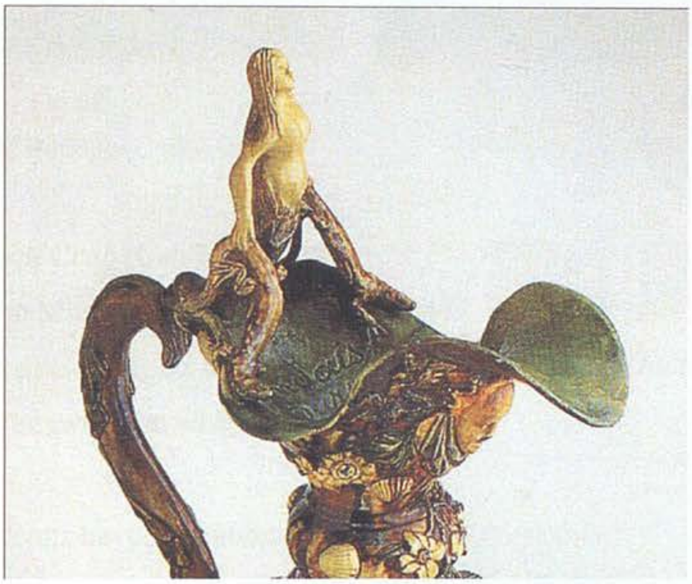

Fig 50. *Large Pitcher* (detail), Joseph Landais, c. 1850-70.

Fig 51. *Reclining Nude paperweight*, Walter, circa 1920.

Fig 52.
Platter, A. Renoleau, 1891-5.

Fig 53.
Dish with red crab, Cat. No. 32.

Walter's *Dish with Crab* (Cat. No. 32) in Fig 53, which he made whilst at Daum and its copy (which also in the Musée des Beaux-Arts in Nancy), seems to have it origins in the Renoleau's crab dish in Fig 52 above. The green and rust combination of colours is echoed, as is the plate of seaweed on which it sits.

Walter's chameleons have a combined inheritance that derives from both Schneider's bronze vide poches (see Fig v, p21, above) and the ceramics of the Revivalists. The chameleons of the *vides poches* possibly have the same inheritance from the Revivalists as well. The chameleon in Fig 55, below, has a similar stance and position as central motif as the one in the platter by Pull in Fig 54, below. As Bergé was responsible for the modelling of Schneider's vides poches and Walter's chameleons too, the idea behind both may have derived from the same ceramic sources.

Fig 54.
Platter, Georges Pull, circa 1860.

Fig 55.
Chameleon dish, Cat No. 24.

Fig 56. *Tobacco Jar*,
Attr. Thomas-Victor Sergent, c.1870-80.

Fig 57. *Covered box with rose-hips and snail finial,* Cat. No 85.

It appears too in Fig 57 (above, right) that this covered box has its origins in Sergent's tobacco jar on the left (Fig 56). Bergé has turned the seashell finial into a live garden snail and has modelled not-too dissimilar leaves, which support berries in the way that Sergent's leaves support his shells. Ignoring the difference in material both jars employ a similar use in their glazing/paintwork effects. Walter has managed to make his powdered glass behave in the same way as the mottled ceramic glaze on the tobacco jar. He draws the eye in with an intense red rather than a highlighted white, and decorates the edges of the jar and lid with a similar yellow-ochre that Sergent employs.

Again, (in Figs 58 and 59, below) Walter and Bergé have taken Sergent's frog sitting on a rock (again another tobacco jar) and turned the lid into a paperweight.

Fig 58. *Tobacco jar*,
Attr. Thomas-Victor Sergent, c.1870-80.

Fig 59. *Large Frog paperweight*,
Cat No. 19.

This direct lifting of themes and imagery carries on throughout the works associated with Walter and Bergé and there are many more examples contained in the Broadfield House Collection of Walter. But there is another use of the qualities of the ceramics from the later Revivalists, particularly the group called the 'Paris School' (Katz, Lehr, 1996), which Walter has incorporated into the glass itself and made his own. That is the abstract feature of glaze effects.

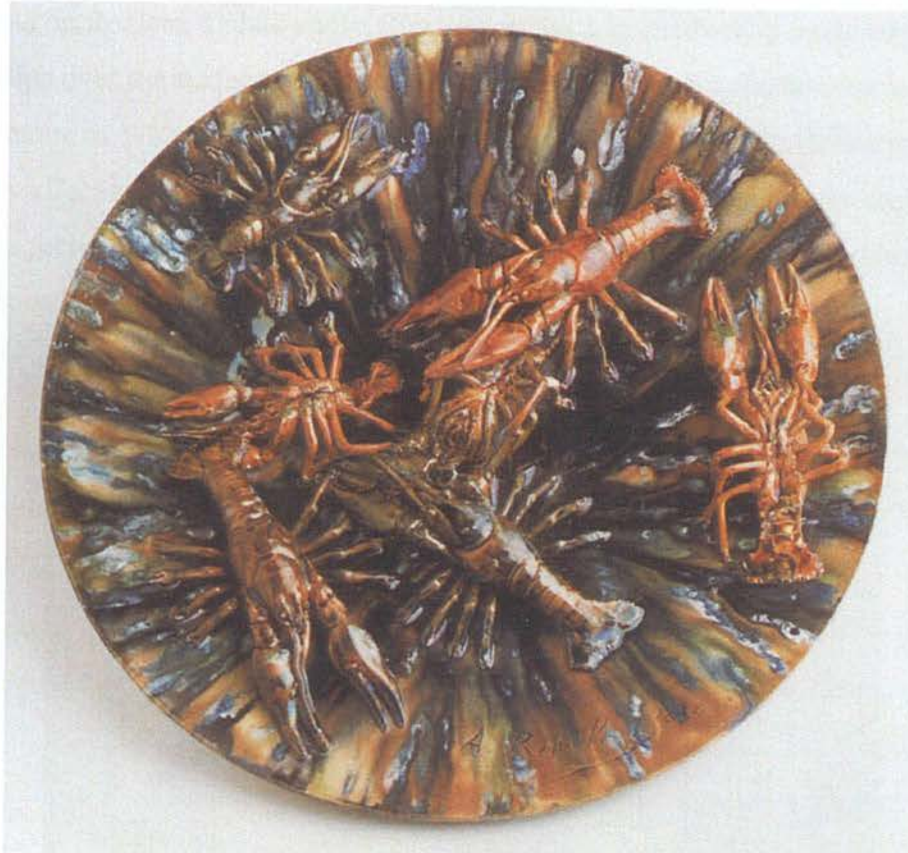

Fig 60. *Plate*, A Renoleau, 1890.

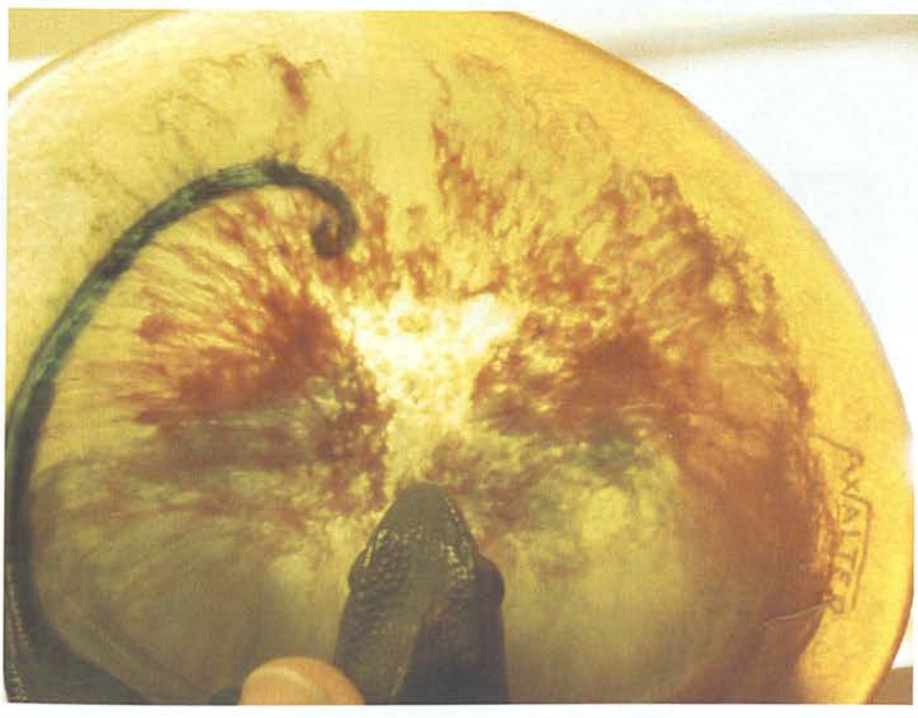

Fig 61. *Chameleon dish*, (detail), Cat. No. 29.

The glaze on Renleau's plate above (Fig 60) on has a striated effect made by running the liquid slips over the surface of the ceramic. Those same results can be seen in the opaque yellow ochre in Walter's Chameleon dish seen in Fig 61, above. The difference is that Walter's effect is held within the body of the glass instead of lying on the surface. This use of colour is there not just to define detail but to express an abstract thought. This motif is carried throughout Walter's work.

Fig 62. *Platter*, A Renoleau, 1887-88.

Fig 63. *Oval dish with goose*, Cat. No.4.

For instance the mottled effect of the green glaze seen in Fig 62, above, is replicated in the 'Dish with Goose' in Fig 63. In it Walter has used the dappling green-yellow glaze effect to partially describe the goose and the pool. The body of the goose is made out in pale yellows and the same green as the rest of the pool. Little details, such as the worm and the leaves, are detailed in a more naturalistic way, but like the fish and their leaf in Fig 62, the goose and its pool inhabit an expressionist colour world. This extraordinary effect of allowing the colour to speak for itself within a small confined object is remarkable. It presence suggests that alongside the experiments in glazing the later Revivalists of the Paris School were undertaking, Walter was (like many artists) was influenced by the Fauvist Movement. Despite the limited colour palette he employed (see Book II) Walter certainly was not afraid to use colour in his work. The two images below (seen in Fig 64 and 65) show this boldness.

Fig 64. *Platter*, Jean-Baptiste Gambut, c. 1860 -1870.

The glaze work in Gambut's *Platter* (Fig 64, above) is remarkable in the sense it adheres to none of the traditional methods associated with the depiction of naturalistic life by the Revivalists. In his platter Gambut has poured off a puddle of blue glaze across the rim of the yellow. It is a shock to see and at first glance one assumes the yellow glaze rim has been spoiled. But in making such a visual statement Gambut has intensified the imagery of the grapple between the snake and the lizard. Not only does the blue glaze suggest a running stream, it also puts into the viewers' sub-consciousness the notion that the life force of the lizard is eking away. Gambut has turned a lesser piece into a sensation of the visual senses.

Fig 65. *Chameleon dish,* Cat. No. 48.

Walter does something similar in his Chameleon Dish (Fig 65, above). Although the subject matter is entirely different, Walter's chameleon is very much in charge of its environment. There is a tension (and confrontation) between the blue green of the reptile and the intense sunshine yellow of the dish. Rather than picking out the various pieces of the composition in clear detail Walter has allowed the blue-green glass to suffuse through in the yellow. The solid world of Chameleon metamorphoses into amorphous light.

These effects are also represented in other creations by Walter in the Broadfield House Walter collection, and can be seen outside of it such as the '*Dish with Lizard*' and the orchid bowl seen in Figs 16 and 17 in Book II: Chapter 2. In these works Walter was following the Revivalist's tradition of mastering a technique from a previous generation and improving upon it.

Who instigated the idea of using the ceramics of the Revivalists is unknown. Bergé was already employed at Daum when Walter arrived and it was he who either designed or at least modelled the '*Coupe de Serpent...*'. However, some of Daum's other glassware, blown and hot moulded and acid etched, and made around 1900, is remarkably similar to Walter's early work at Daum. It suggests that the sensibility of the reinvention of Rustic Ware by Walter and Bergé was also part of Daum's manufacturing efforts.

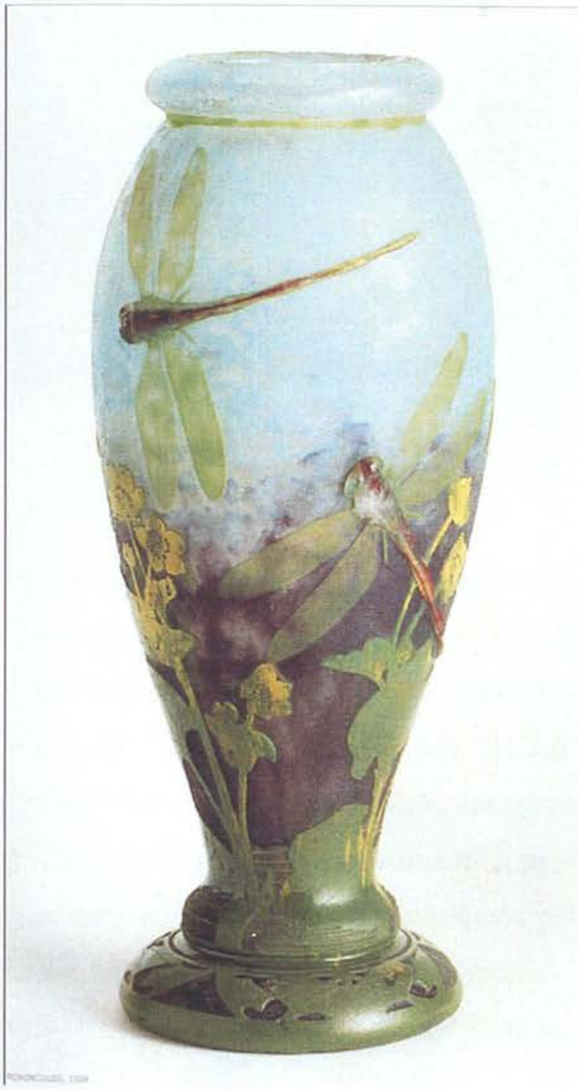

Fig 67. Cat. No. 103.

Fig 66. *Vase aux Libellules et Renoncules,* Daum blown glassware from 1904.

Fig 68. Cat. No. 8.

The piece on the left in Fig 66 lives in the same pictorial world as much of Walter's. Although it is of blown and hot-worked glass it has the same sensibilities of design, colour and texture as the two pâtes-de-verre pieces seen next to it in Figs 67 and 68.

What is also of significance in the examination and comparison of the Revivalists and Walter's work is the placing of their signatures. The signatures of Avisseau and his followers are placed on the decorative part of dishes and sculptures not hidden underneath as ceramicists often do. They are a declaration of the artist as the creator of the work, just as a sculptor or painter declares his ownership of the work with his signature.

Fig 69. Signature of Avisseau.

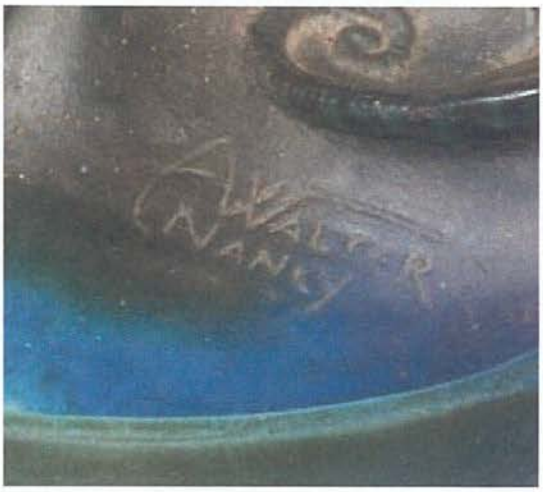

Fig 70. Signature of Walter.

Palissy placed no signature on his work and it has always been hard to determine which pieces are his and which are those of his assistants (Katz, Lehr, 1996). Walter adopted the same placement of the Avisseaus' moniker ensuring his name (and that of his collaborator) was clearly shown (see Figs 69 and 70). Like Avisseau Walter also included the town (Nancy) where he worked. This is unique amongst the other pâtes-de-verre artists, which further strengthens the association with the Palissy Revivalists. Even Cros places no such signature on his work. This method of signing a piece of pâtes-de-verre work arose first at Daum with the *'Coupe de Serpent aux Branche de murriers'* of Charles Schneider around 1907/8. 'Nancy' can just be made out in the curve of the neck of the snake in Fig 71, below.

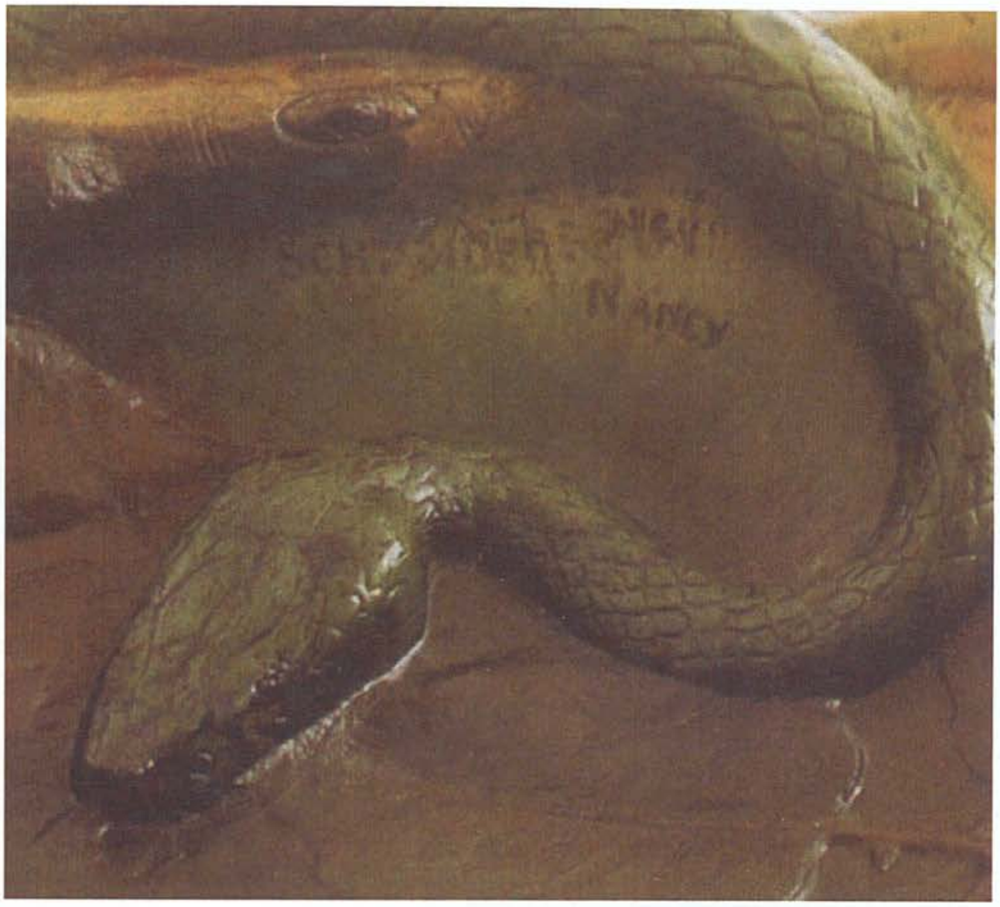

Fig 71. Signature of Schneider/ Nancy, *Coupe de Serpent aux Branche du muriers.*

Some other lettering is also there, which may be that of Bergé and Daum, but its form is indeterminate. It is not 'Walter' though. The honour of a signature was not given to Walter while he was working at Daum. It was only when he left their company in 1919 that he was able to his sign work. For Walter, the declared signature did two things. Firstly, it stated the work as his. He was the author of the piece and its unique techniques. Secondly, it elevated in the mind of the buyer the presence of Walter as an artist, not as the employee or technician as Daum had obviously regarded him. It also reveals the psychology behind his thinking, and how he regarded his role in the creation of his work. The purchasers of the Revivalist's Palissy Ware appreciated that their examples technically surpassed those of the original master and had no objection to owning an obviously signed piece of work (Katz, Lehr, 1996). As a trained ceramicist Walter would have recognised Avisseau's extraordinary abilities. By placing his signature in full view for his clients to see, as the Avisseaus and the other Revivalists did, Walter was firmly aligning himself with them, their heritage and with Palissy.

Chapter 5: The Snake Motif.

There is one area, however, that differentiates Walter from Palissy and the Revivalists. In the many platters and decorative objects of both his forerunners there are many snake motifs. As can be seen in both Palissy's rustic ware and that of his Revivalist's the snake features as a central theme, but in all of my research on Walter I have only come across two representations of snakes in his work, three if one includes Schneider's *'Coupe de serpent...'*

On the surface the snake is just one of many creatures depicted by Palissy. But when studying his own personal psychology the snake and its central role take on a potent meaning. The 16th century in France was a period of religious extremism and upheaval. Palissy was an ardent Protestant with a reforming zeal and his religious views clashed violently with the Medici court, his Catholic employers (Katz, Lehr, 1996). Symbolism then was everything, and for Palissy and the world he lived in the snake was a direct allusion to the fall from Grace of Adam and Eve (Adam being the first rustic). In Western art the image of the snake has many interpretations, such as divine intelligence, folly, healing and death, heaven and earth. It is in effect an intensified duality. In such a context Palissy's serpent represents all of these, including earthly temptation. Its presence at the centre of Palissy's work is therefore an offering, quite literally on a platter, of the current condition of Humanity, which Palissy saw in the French court. That he uses French flora and fauna would be recognised by his audience as a comment on the moral state of France.

In the ceramics of the Palissy Revivalists, however, it would appear that the inclusion of the snake was less a direct message of Eternal Damnation than a decorative item and conversational selling point. In my researches I have found no religious zeal that Avisseau or his competitors adhered to other than to make extraordinary works and to make money from them. The snake certainly links them to Palissy, but it is their superior material techniques in glazing and modelling that is on show, not their faith. However, where the snake is used its presence creates a pictorial tension between hunted and hunter as can be seen on Avisseau's '*Wine jug and grotto*' in Fig 49.

It would appear too that Walter generally had no taste for Palissy's overt metaphors. Walter's animalistic works by and large make no statement other than that of decorative *joie de vivre*. It is known he did make images of the Crucifixion and other New Testament scenes, but these are messages of hope and redemption rather than the illustration of Old Testament Original Sin. However, of the three snakes found in Walter's work two do have a message Palissy would understand. They are to be seen in the images immediately below (Figs 72, 73 and 74).

Fig 72. *Coupe de Serpent aux Branche du muriers*, Charles Schneider, Daum, 1908.

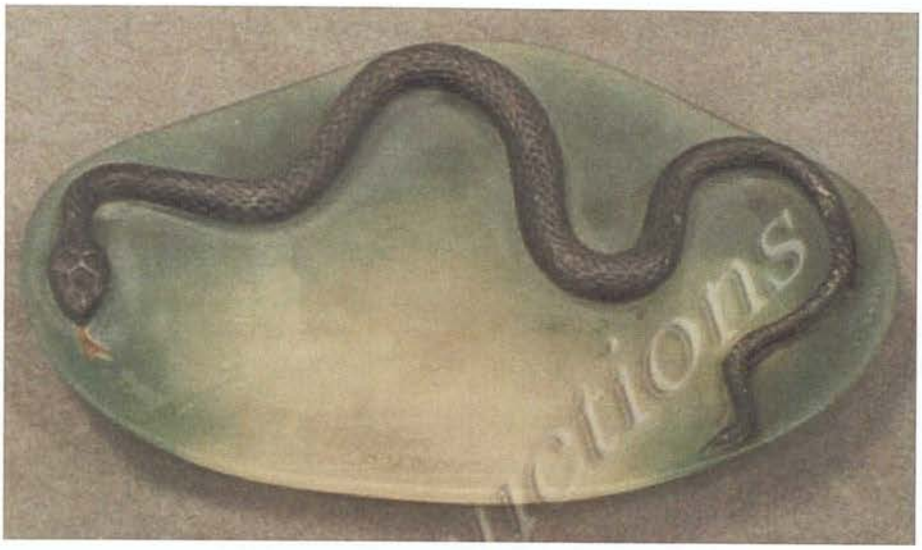

Fig 73. *Dish with Snake*, A Walter.

Fig 74 a.

Hollow nightlight with Kingfisher. Cat. No. 52.

Fig 74 b.

Hollow nightlight with Kingfisher. Cat. No. 52.

The first snake is depicted in the '*Coupe de Serpent...*' in Fig 71, above. It has its direct inheritance not from the Palissy Revivalists, but from Palissy himself. And its metaphors are those that Palissy would be able to read. The form is that of a circle contained within a square. The circle represents God's majesty and creation, and the square the earth and Man's efforts. The circular body of the snake undulates over the leaves of the angular branches of the blackberry, which in turn emerge from the body of the dish. Although no literature exists specifically on this piece my reading of it is as follows. The palette has been deliberately chosen to represent 'Autumn'. Not seen here are Palissy's bright hedgerow and stream, nor the Revivalist's multi-coloured glazes. The three muted colours (green, yellow and brown) reek of Gallé's dank mosses and undergrowth (Cummings, 2006b). The snake's presence suggests evil: It is a metaphor for the Human condition, the Fall and Earthly Temptation, and Satan, too. The blackberries represent the Crown of Thorns, the ripe berries dark with Christ's blood. In Western Christian folklore brambles are also a reminder of Satan's expulsion from Heaven, his landing being softened by a bramble patch, onto which he then peed, thus rendering the berries inedible after the 29th September, the date he fell to Earth (Bennett, 1994, Simpson, Roud, 2003). Their presence echoes St Matthew's gospel warning of sloth and false prophets (Matthew, 1611), but also of hope: Revelation 2:10 'Be thou faithful unto death, and I will give thee a crown of life' (John, 1611).

In comparison, the snake on the dish in Fig 73 seems to have little meaning or context, especially in the symbolist world of the French Art Nouveau from which Walter came. I cannot find any significant symbolism in it use in this work. It is a snake on a dish, with little value to it metaphorically or artistically.

The only other time that I have found that Walter uses such a direct metaphor as contained within the '*Coupe de Serpent...*' comes late in his career. It can be seen in the image of the nightlight in Figs 74a and b. The piece depicts a Kingfisher, a Paradisal bird of luck and charm associated with Noah and the Flood and the royal funeral regalia of the Plantagenet Kings at the abbey of Fontevraud in France (the divine colours of red-orange and blue) (Kingfisher. , Richter,). Walter's kingfisher is confidently devouring a small snake. Like Schneider's work the piece is approximately life size. The sculptor's name attached to this design is A. Houllion, a late collaborator working with Walter. Within this relatively humble sculpture Eden's Serpent is firmly put in its place. The Assaulter of Heaven is relegated to a diminutive worm (or elver), triumphed over by a determined (and hungry) thing of beauty. That suggests a New Testament message of hope and redemption. The message being that the refugees from the Garden of Eden will triumph over worldly coarseness. The analogy is a good one for the artist in any age.

Chapter 6: Definitions.

Pâtes-de-Verre.

The constant questions arises 'what exactly is *pâte(s) de verre*?' Pâtes-de-verre is in effect a self-colouring polychrome sculptural technique utilising crushed glass as its basic medium. Part of its technique involves a process of directly placing crushed glass pastes into a mould before firing in a kiln in a creative process that marries the traditional translucency of glass-art technique to the chemistry and opacity of ceramic glazing. This process has many forms and its originators understood it not just as a process of manufacture, but also as a 'general principle' from which other techniques, their processes lost in translation or through the march of time could be linked (Olivié, 2005). This philosophy was understood by the early practitioners and allowed the term to be used to describe what we in the modern world would call 'cast glass', 'fused glass' and anything and everything that comes out of a kiln using these processes.

The process of pâtes-de-verre is a simple one and can be defined like this: Coloured pastes of glass are placed into a mould made from a refractory mix and are heated in a kiln until the particles of glass melt and are fused. Its nature differs though. The processes and forces that collectively control the phenomena of fused glass are violent and disparate giving rise to subtleties in finish and demanding tortuous technique.

The term 'pâtes-de-verre' quite literally translates from French into English as 'pastes of glass'. Its practical application is the process by which particles of either clear or coloured glass, usually of a small and granular quality are combined with an organic glue-like medium (water and gum Arabic for instance) into a malleable paste and then incorporated into precise areas of a mould before firing in a kiln. Depending on the desired end-effect the temperature of the kiln may be regulated to create a fused, sugar-like quality to the surface of the glass or a totally cast-like piece that allows light to penetrate to the heart of the object and through to the other side. Or the artist may choose the creation of any effect that lies between. What is important is that the hand and purpose of the artist is seen in the end result.

The organic nature of the 'glue' is significant, as this substance has to burn away leaving no deposits. Over a period of time I have experimented with different substances and found that inorganic or plastic based glues such as wallpaper pastes, which also contain fungicides tend to leave a black residue.

Key developers and practitioners of the art at the end of the 19th and through to the first half of the 20th century understood this completely, and employed a variety of techniques together with a variety of kiln temperatures, to achieve their own individual results. Thus Henri Cros' work is densely fused with a powdery surface reminiscent of peeling Roman frescoes, Georges Despret's is sometimes transparent and liquid, and Amalric Walter's, the centre of this study, utilises the sublime phenomenon of light bleeding through mist, or the encroachment of twilight. All are expressions of, and are accepted as, 'pâtes-de-verre'.

The modern difference between cast glass and pâtes-de-verre is quite simple. Cast glass is when the body of the glass is held in a reservoir (usually within a ceramic flowerpot, though sometimes within a reservoir built into the mould's opening) above the cavity of the mould. The glass is heated to a temperature around 800^{o} (or higher) and then is allowed to flow into the mould without much control as to where the colour will travel or end up. Pâtes-de-verre is a precise, controlled way of introducing coloured areas into the mould and keeping it in the place one where wants it to remain. Walter was master of this.

Faience/ Egyptian faience.

What pâtes-de-verre is not is faience. That is a type of pottery, which is now associated with the term 'majolica ware'. Majolica ware is a richly coloured (often blue) glazed pottery that was made in Italy from the medieval period onwards.

Pâtes-de-verre is not Egyptian faience either, which is a glazed non-clay ceramic material (Gifts of the Nile: Ancient Egyptian Faience. 1998). Egyptian Faience has been described as the 'first high-tech ceramic' (Nicholson, 03-05-2009). It is composed mainly of crushed quartz or sand, with small amounts of lime and either natron or plant ash. The shaped body of it is coated with a soda-lime-silica glaze, which is brushed on in its raw state. Egyptian Faience often uses Copper oxide (CuO) to give it its characteristic blue colouring (Gifts of the Nile: Ancient Egyptian Faience. 1998). The whole ceramic piece (that is the non-clay ceramic body and glaze) is then fired in one go. Ironically, this is precisely what Walter did when he developed his unique glass processes, but he used glass not ceramic, and ceramic technology, not Egyptian faience.

Pâte-de-Cristal.

'Pâte-de-Cristal' was the term used in France during the early 20[th] century when the pâtes-de-verre process started producing works with a greater clarity in the use of glass. Figures 7 and 9 (above) show examples of it characteristics, which generally appears to be contain no areas of applied colour, but allows the kiln firing process to move the colours around the glass shape in amorphous forms. The word 'cristal' – or 'crystal' suggests clarity of vision (a high refractive index') as in 'rock crystal' and 'lead crystal'. In my searches I cannot find a clear definition of the term in an early 20[th] century context. Even Suzanne Frantz in her defining 'Particle Theories' suggests the term pâte-de-cristal 'muddies the water' in defining what pâtes-de-verre is (Frantz, 2005). My assessment of how the myrrhine ware was copied by Argy-Rousseau, along with the example of the vase by Despret in Fig 10 are the best definitions I can give

Generally Walter used the term 'pâtes-de-verre' to describe his work. For a short period Walter advertised his wares as 'pâtes-de-cristal'. This was evident on a business card of Walter's I was able to view. Whether this was as a result of a new term that had started to be bandied around as a possible fashionable selling point I have not been able to ascertain, and needs to be further researched.

Daum's modern cast glassware now describes itself as 'pâte-de-cristal' (note the singular term) where once in the 1980s similar objects were described as 'pâte-de-verre'.

Lead Crystal.

Lead crystal is called 'crystal' for the simple reason it was a glass that was developed to emulate rock crystal (SiO_2). In the ancient world rock crystal was considered to be a substance with magical properties. In Pliny we have an explanation as to its value and its nature (Pliny, Healy, 2004). It was its ability to transmit light all the way through its body with a remarkable clarity that gave rock crystal its value. For millennia it was thought to have metamorphosed from ice, the crystals being found in Alpine regions. The origin of the word 'crystal' comes from the ancient greek *Krystallos*, meaning 'ice' (Dana, 1985). I have been told apocryphal tales of its core temperature being two degrees lower than the surrounding ambient temperature, hence its continuing association with ice. But I have not been able to verify them. If one could it might explain why young women at balls in the early 19^{th} century held eggs made of rock crystal to ensure their hands would remain cool and dry in a humid room. When the Romans discovered a way to make colourless transparent glass the quality of rock crystal was emulated, with the Venetians in the 1450s eventually creating a type of glass called 'cristillo', which was a soda-based glass (MacFarlane, Martin, 2002).

Lead has been known to have been introduced into glass in earlier periods outside of Europe having been found in high quantities in glassware made in China in the tenth century (MacFarlane, Martin, 2002). The English merchant George Ravenscroft (1632-1683) is considered the first to 'invent' a lead crystal glass in 1667, although that is disputed as glassmakers in England and Venice were already putting lead oxide into the glass batch at that time (Klein, 1992, MacLeod, 1987). Nevertheless, he obtained a patent for its manufacture in 1674, and by introducing a substantial amount lead oxide content into the melt (32%) gave the finished product a higher refractive index, so making the glass appear sparkling, bright, and brilliant in light with a similar high refractive index to rock crystal (Cummings, 2002). The inclusion of lead also gave a lower working point of around 800o C, and a softening point around 600o C (Douglas, 1972, McCray, May 1998).

The higher the lead content the softer the glass is when cold and is therefore easier to work and polish. Maximum clarity is achieved with the introduction of lead oxide at 32%. Lead at 50% content makes for a very soft glass and the surface can be scratched all to readily (Newton, Davison, 1989). Introducing lead also increases the solubility of tin, copper, and antimony, leading to its use in coloured enamels and glazes (Newton, Davison, 1989).

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Book II: The Scientific Enquiry

Introduction.

There is no doubt that Walter's work has a distinctive 'look' which separates him in style and substance from his contemporaries and predecessors. Glibly put, Walter's work is very 'Walter', and it is not difficult to define what makes it so. Ignoring for a moment that his work is in glass, important aspects of it leap out as being both idiosyncratic and refined. While his contemporary, Gabriel Argy-Rousseau, and the others from the Sèvres stable, use a wider range of images in their work such as classically derived Nymphs and Greek theatre masks, Walter generally stuck to the stream and hedgerow for his inspiration. The modelling style for the first 28 years remained naturalistic in the French Art Nouveau tradition, until Henri Bergé, his friend and collaborator, died 1932. From then on Walter worked with other sculptors and designers whose approach was clearly influenced by the then established Art Deco style. Nevertheless, a solid and distinct visual quality was kept that said 'these pieces are made by Walter' (Cummings, 2006).

The one source of identity that links 30 years of practice along with changes in form and subject matter and half-dozen or more changes of designer is colour. It is not the unique manipulation of the glass, or any conversations it may have had with light, that features prominently throughout his work, although that undoubtedly plays a part in Walter's work. Instead it is the adherence to an established palette, which distinguishes Walter from any other glass artist of his period. To my thinking this is the first time a glass artist made a conscious decision to limit his palette, using it to define himself as an artist, and thus to have works associated with him, not his salon, factory, or outlet. His idiosyncratic colour palette is the most visual feature of his work. I realise that without a more detailed and comprehensive examination of all the pâtes-de-verre artists' work of the period it is a huge statement to make, but in all my studies of this artist, it appears that Walter arrived on the Nancien glassmaking scene as fully formed 'Walter'. The other makers of the period manage to utilise a rainbow of available colours to explore their techniques and to enchant their audience. Walter did not, and it is his consciously limited palette, which defines him: it is what contributes to his visual language and identifies a piece of Walter as 'a Walter', as clearly as a Van Gogh painting is 'a Van Gogh', or a piece of Palissy ware is 'a Palissy'.

Sometimes, in trying to understand an artist it is easier to say what he or she is not. When dealing with someone whose work reflects his personality it is good to have a comparison. In the following discussions about Walter's colour palette, I make direct comparisons with his contemporary Gabriel Argy-Rousseau. As I relate later in that section of Book II the only available studio notebooks from that period come from Argy-Rousseau's hand. These have had a major influence my research as well as informing my own practical design work. Using the notebooks I was able to recreate how the methodology and techniques of the period worked. They also have given me an important understanding of the science of not just what made Argy-Rousseau's glass possible, but what makes a piece of Walter 'a Walter', and that is the unique point of their study.

Walter's basic methodology and techniques have been described now in two publications. They were first published in 2006 in an Arts and Humanities Research Council funded booklet to which I contributed (Stewart, Cummings, 2007). They have been again discussed, most recently, in Keith Cummings' latest book entitled 'Techniques of Kiln-formed Glass' (Cummings, 2005) where he quotes from the booklet. I have placed facsimiles of the relevant pages in Appendix 11 along with another page from the catalogue accompanying the exhibition of Walter at the Broadfield House Glass Museum, and which illustrates Walter's technique of placing his glass into his moulds (Cummings, 2006a).

Chapter 1: The Colour Palette Examined.

If one groups together a random selection of his work the singular nature of the colour palette Walter comes to the fore. The same blues, greens, yellows, browns and purples are repeated time and again in works that span over a quarter of a century (Cummings, 2006). The catalogue in Appendix 1 clearly shows this. Below are two images, which exemplify my point. One is of a collection of Walter's work (Fig 1.) and the other (Fig 2.) is work of his contemporary, Gabriel Argy-Rousseau.

Fig 1. A display of Walter's pieces in the Broadfield House storeroom.

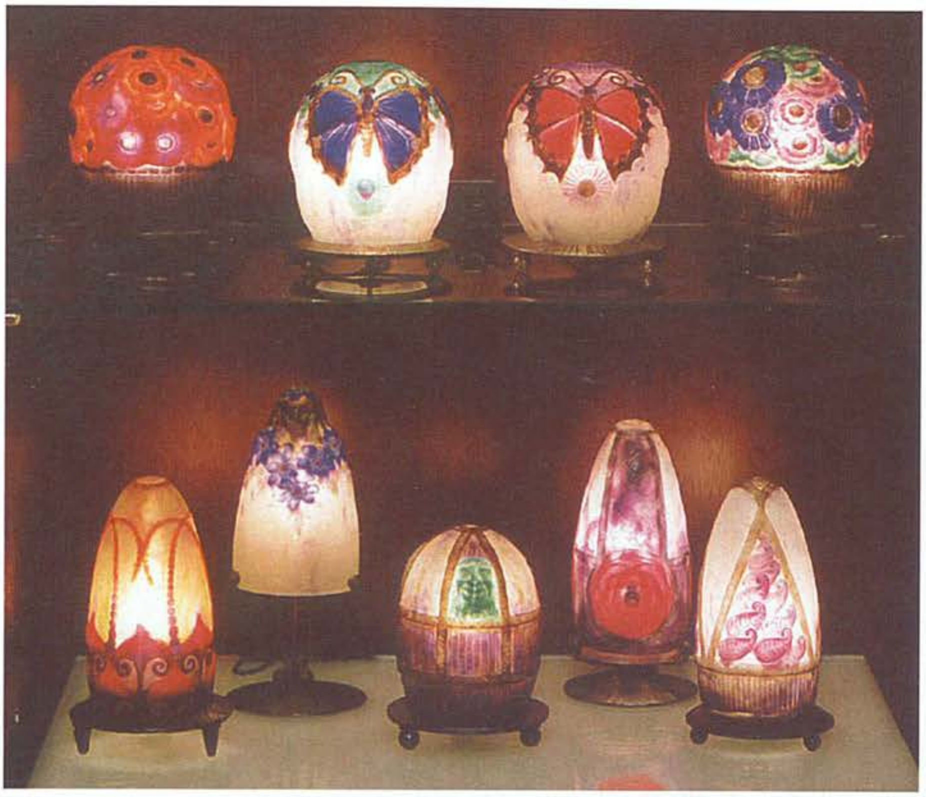


Fig 2.

A collection of nightlights designed and made by Argy-Rousseau.

The photograph in Fig 1. above is how I first encountered the collection of Walter pieces in a storeroom at Broadfield House. They were arranged in no particular order having being recently delivered to the museum for a forth-coming exhibition. Fig 2. is a photograph taken from a comprehensive biography and review of Argy-Rousseau's life and work (Bloch-Dermant, 1991). The image is a series of nightlights from a private collection, which have been arranged and illuminated with transmitted electric light.

At first the comparison seems to be an unfair one, but there is something within the works in each image that makes the contrast between them pertinent. The palette we see on in Fig 1. is mute and quiet. There is a limited range of colours and effects in what is delivered to the eye. Not seen is the intense palette of Fig 2. Those objects are deliberately illuminated to display the effect of light travelling through coloured glass. Their textures and colours rely on a source of light brighter than daylight to make them appear like jewels or stained glass, and the colours are chosen for maximum visual impact. While the works in Fig 1 are lit by natural daylight it is obvious, even to the uninformed eye that the colours in both images belong in separate colour worlds. The works in these two images are not by the same hand, or by two people with the same visual approach. Although it can be argued that the collection of Walter, held at Broadfield House, are the choices of a single collector, which may reflect his personal tastes of style, subject matter, colour, etc, a quick survey of some of Walter's other works either in or collections in other museums or auction catalogues, prove it to be otherwise.

Fig 3.

Lighting Panel of Clematis, circa 1905, held at the Musée de l'Ecole de Nancy. An identical one is also in the private Daum factory collection, Nancy.

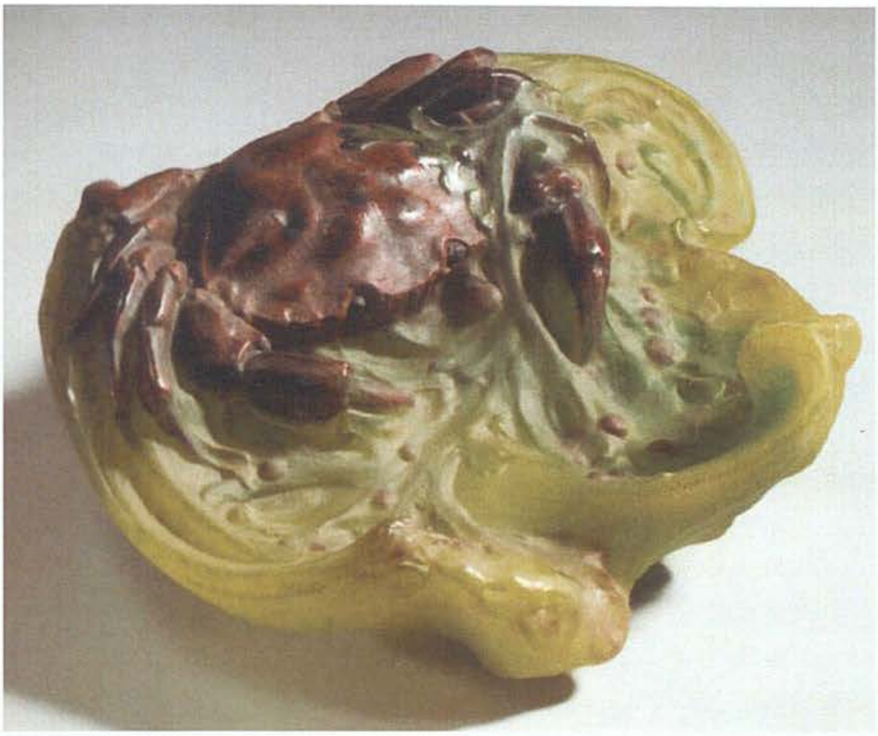


Fig 4.

Crab dish, circa 1910. Daum Collection, Musée des Beaux-arts, Nancy.

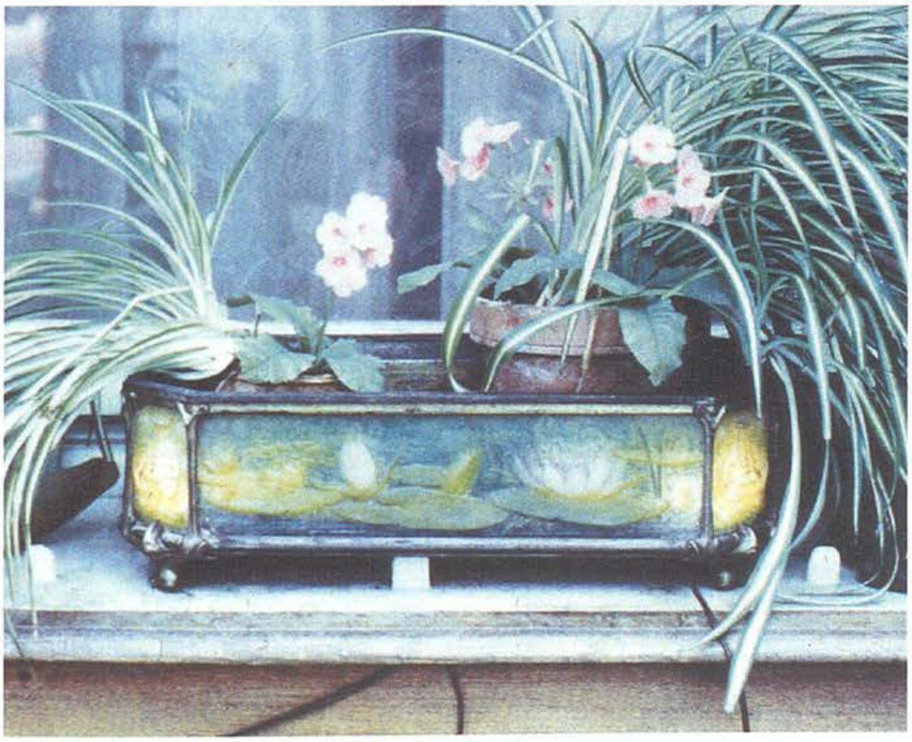


Fig 5.

Planter, (pre 1914). The photograph taken in the conservatory of the Daum family's house in Nancy in about 1980.

Fig 6.
Reclining nude paperweight. Chrysler Museum of Art, Norfolk, VA, USA.

In the four images above (Figs 3-6) it apparent that Walter's work has an idiosyncratic homogeneity. There is a language of colour that marries them, and its grammar is distinctive and clear.

In direct comparison, Argy-Rousseau's work belongs to quite another visual world. It is clear he constantly changes designs, patterns and colourings, throughout his working career showing that he is not necessarily fixed into one methodology of producing glass pieces. New ideas from a wider circle of artistic development are embraced, and he experiments with newer ways of portraying colour in glass. He treats his works as bodies in which to express an idea of what coloured glass could be (Bloch-Dermant, 1991). In his works there are hints at what the later 20^{th} century's studio glass movement would become.

In any discussion on the use of colour by any individual glass artist the use of light, and how the work is designed to utilise or embrace it, comes to the fore. Taking the broad view of both Walter's and Argy-Rousseau's work it becomes apparent that Walter's works were not necessarily designed to transmit light. It is known he made lighting panels and nightlights (Fig 3 is one such panel), but generally Walter's work was made for other reasons. The glass is not transparent and the objects are of a less practical nature, albeit offered up as practical objects. Would one really want to stub out a cigarette, or allow pins and coins to scratch the dish of Fig 4? I think the answer is 'no', and successive generations who have owned Walter's pieces would agree. Their ownership has been to protect the pieces and there is remarkably little wear and tear on any of the 200 or so Walter objects I have come across, yet the *Planter* in Fig 5 was clearly designed to be used. However, direct lighting and illumination is therefore not on Walter's mind here. Light is not necessarily used to reveal the inner qualities of the glass, but instead, to highlight each piece, and to show the translucency of areas of the works. The kingfisher nightlight (Cat. No. 52) discussed in Book I, Chapter 10 (Fig 69), for instance, does not need internal illumination for its qualities to be appreciated. Each one of the pieces in the Broadfield House Walter catalogue has been lit for its photograph in the same way one would light a piece of porcelain or marble, not in the way the Argy-Rousseau's nightlights in Fig 2 have been lit.

As I have discussed in Book I each work in this collection is by and large shallow-formed, which itself is part of the nature of his manufacturing process. Walter's dishes, paperweights and *vide-poches* are works created from a solid, sometimes translucent glass, which tends not to transmit light very well. The works sit on a table or shelf: they are not designed to be elevated to catch the light. The paintwork-like detailing is dense and opaque, almost like oil paint or thick gouache. It absorbs light, so pulling the eye towards those details. Walter uses the colour of the glass to describe the object; flora and fauna are defined by it, and the very quality of the glass itself (lead crystal) takes second place.

In all his work it seems Walter used a high lead content crystal (see Chapter 8: Uranium into Glass, below). It is a product, which was developed partially for its high refractive index. Walter ignores this quality, and instead deliberately disguises it with chemicals to produce opaque colour, which he grinds into a powder to create a dense paint. He also reduces the transparency of the main body of the glass piece by using tiny pieces of frit, which trap tiny air bubbles, so blocking the flow of the transmission of light (Stewart, Cummings, 2007). He has therefore chosen the crystal for other purposes; its softness and low working temperature perhaps, not its light bearing qualities, the very complaint Noel Daum made about his work (see Book I, Chapter 9).

It is clear then that Walter and the designers he worked with tended to produce objects that sat on their own as decorative-functional pieces (Cummings, 2006). Outside the photographer's studio the nature of each piece lends itself to being lit by ambient natural light, or highlighted with perhaps a desk lamp. The subject matter, deriving as it does from the crepuscular, combines with this quality to allow the works to be casually displayed on a dressing table, desk, or hidden in a shadowy corner. Transmitted light (as seen in Fig 2, above) does not come into the equation. Therefore the colours are chosen to work in their own right, with little help from refraction or the then newly invented light bulb.

Argy-Rousseau's work on the other hand seems to call out for the interaction of light with the glass to display his pieces. Certainly, as with the nightlights above, the use of electric light succeeds in making the decorative colours jump forward to reveal all their glory. The colours are burnt into the retina and remain in the imagination. The piece in Fig 7, below, on the other hand uses the quality lead crystal was developed for and shows off its worth.

Fig 7.
Luminous fountain. Gabriel Argy-Rousseau.

Certainly, without some sort of a relationship with a light source the *Luminous fountain* would not be so successful as a work of glass or art. The shape of the object has been pared down to a semi-classical or Romanesque shape. If it were made in marble or another fabric it would almost be lumpen. It is the way the glass itself is coloured with metallic salts or pre-made colour that transforms the piece. An emerald-green ink appears to swirl as in water. The eye becomes fascinated by its effect, not the body it is confined in. The result is that the glass is the subject matter; the shape is secondary. The combination of these elements, together with the way the piece has been cast (a lost wax method with glass cullet), is clearly designed to mimic Fluorspar, a mineral whose quality is only seen with the advancement of light through its crystalline form. Few of Walter's pieces display any of those qualities. It is a subtle, but important difference, in trying to understand what each artist was trying to achieve within his work.

There is one other aspect of both artists' approach, which also needs to be borne in mind when considering their works. And that is the way both men saw the world through their own personal lenses. Argy-Rousseau was a proponent of early colour photography, and the photograph is all about the process of working with light. Much of what we see in his work relates to the way he saw the world through the camera's eye, or at least the result that his camera achieved. In turn, those colour photographic effects informed his glass designs and in his glassworks (Bloch-Dermant, 1991).

Fig 8. *Anemones.* Photograph by Gabriel Argy-Rousseau.

Fig 9. *Tree's in Bloom vase*, 1920s.

Fig 10. *Anemone bowl*, 1920s.

Fig 8. Shows one of Argy-Rousseau's early colour process photographs. It has had a direct bearing on how he produced his pâtes-de-verre. The examples in Figs 9 and 10 show this close relationship between research material and end product. The colours are as vibrant, and the design is just as hazy and slips in focus. These products exist in their own visual world. They must have been a shock when first viewed, as must have been Argy-Rousseau's coloured photographic images. They are, too, the antithesis of Walter's work.

Walter, on the other hand was a painter (in both oils and watercolour) throughout his life. The little evidence we have of his artwork tends towards the naturalistic and an academic approach to depiction, rather than any mode of expressionist form.

Fig. 11. Preparatory sketches by Henri Bergé for the '*Coupe au Serpent...*'

In Fig 11 Henri Bergé, his long-term collaborator and friend, echoes Walter's personal style in the preparatory drawings for the famous Schneider '*Coupe au Serpent...*' (see Book I: Chapter 10). In his work Bergé depicts nature as Nature.

Walter's artist's oil palette, which was on loan to the Broadfield House for their Walter exhibition in 2006 (given by David Hargis, in Arkansas, United States) was another interesting insight as to how Walter described in paint the world he saw around him. Unfortunately, for this study no images are available, but I can report that the colours were exceptionally muted, generally in tones of yellows, browns and creams. There was nothing *fauve* about his personal approach. Oil requires no real transmitted light to make the substance work on canvas, just as the detailing on Walter's pieces require nothing but the eye and their paler backgrounds to illuminate them.

The fact that Walter did not design his glass pieces undoubtedly fed into the way his work looked. Walter's unique approach was to collaborate with other artists and designers who made watercolour designs of the piece he was to create (Daum, 1984). Fig 12. (below) is a good example of what was on offer, showing how the colours were defined and with a good anticipation of the end result.

Fig 12.

Henri Bergé watercolour design for a chameleon clock.

Fig13. *Triangular dish with Chameleon*. Cat. No.111.

The resulting effect is that most of Walter's glasswork has the quality of the watercolour; a technique that requires light to bounce back off the paper through the pigment to make it effective. This triangular dish (seen in Fig 13) is in the same vein as the watercolour in Fig 12. It is not hard to imagine it as pigment on paper.

Fig 14. Four *Chameleon dishes* from the Broadfield House collection of Walter. They are, from left to right, Cat. Nos. 48, 49, 16c and 60.

Walter did vary the colouring production methods from the design of the watercolour original, making each piece a unique item (Cummings, 2006, Vallieres, April 1925). The four *Chameleon dishes* in Fig 14 have similar forms and use the same components, yet the colouring varies greatly. Even with the relative primitiveness of my photography it is not hard to envisage these pieces as three-dimensional watercolours.

Working with a range of different designers also had an effect on Walter's manufacturing process, especially towards the latter half of his creative life. New designs came into his studio, which reflected the public's taste in the Art Decoratives in the early 1930's. Changes in the way the public bought luxury items such as jewellery were startling. A palette of black, gold, emerald green and white pave-cut diamonds entered into consciousness of the fashionable salons. Fortunately for Walter, animalia was still fashionable, and his designers reflected that (Fig 15, below).

Fig 15. *Green panther.* Cat. No. 101.

While Walter seems to have accepted that he needed to keep up with changes in fashionable tastes, the artistic change was reflected only in the designs (Bloch-Dermant, 1991). It would appear he deliberately kept to his tried and trusted colour palette, using it to create homogeneity through his work. Any piece of Walter from his early period at Daum, when he was working with his friend and colleague Berges, is as recognisable as his work 25 years later when he was working with other designers. The style of the designs may have shifted from the Art Nouveau to the more fashionable Art Deco, but the feel and look of the pieces make the works readily identifiable as Walter's. For example, although their shapes and sensibility of form are worlds apart, Cat. No.s. 7 and 8 live in the same colour world as Cat. No.s. 99 and 109 (Appendix 1). It is the adherence to the same colour palette, which gives the effects of continuity.

Until now no-one has questioned whether this limited palette was simply a safe and familiar method of producing difficult objects or was chosen as a recognisable 'house-style'. Having unravelled Walter's techniques and methodology in this and earlier research I think the true answer it is a blend of the two. If one has spent years experimenting with colour chemistry to create a network of usable colours then it is unlikely that those colours will be discarded for a new set. Walter was in his forties when he struck out on his own. It is not an age when one readily changes, nor does one risk everything with unknown quantities. He had been experimenting and refining his work for nearly 20 years by the time he parted from the Daum organisation in 1919. The use of colour, its hues, and how its chemistry translates into translucency and opacity in glass are critical choices for any glass artist who wishes to succeed in selling his/her own work to the general public, then or now. If one is wise, choices are carefully made to appeal to the current fashionable taste, the purse and pocket of those buyers, and which separates one's work from competition, and by the look of things Walter made his choices as carefully as did Argy-Rousseau. To make a good living and to maintain the niche which both men carved out for themselves it seems likely that they both went with what each knew would work and make money (Bloch-Dermant, 1991).

This rough comparison of each man's work gives us a glimpse into the personality of the two men. Argy-Rousseau, by all accounts was extrovert and vivacious, some one who mixed with the family of the great experimenter Henri Cros, and had the rationale of 'the designer', used in France to describe someone who takes a wider view of their work (Bloch-Dermant, 1991). Argy- Rousseau's work certainly reflects all those aspects of his personality.

Walter, on the other hand was considered to be quiet sort, somewhat a loner in Nancien society, with just a small tight-knit circle of friends, and in a way his work reflects that. He was described by Noel Daum as an 'artisan' in his complaint about Walter's personal style (Daum, 1984). It seems to be a condemnation that still dogs him today. The description smacks of mediocrity when compared to the epithet 'artist'. It suggests cottage industry and toil, and touches on the debate of what is Craft and what is Art. Certainly after Walter left Daum he never had the financial setup and manufacturing operation that Argy-Rousseau had, but at the height of his success he was employing 10 assistants, a number few glass artist's could manage to afford to employ today. Walter's pieces are simple and well crafted, and to some extent they are humble offerings. But without doubt, though they have an artistry that is as good as anything his contemporaries had to offer at the time and they exemplify the artistic world of the Ecole de Nancy from which they came.

Chapter 2: The Colour Palette Broken Down.

From a detailed examination of the Broadfield House Collection Walter (Appendix 1) a comprehensive colour list can be made. In all 161 pieces there are only 29 clearly defined colours. This is the same the number of formulae for the production of colours listed by Argy-Rousseau's in his notebooks (Appendix 3).

These 29 colours, may be broken down into two sub groups:
The first is a group of 16 translucent colours, which mainly form the body of the piece Walter is describing in glass. The second group comprises 14 dense, opaque colours creating a visual effect similar to oil paint or gouache, they are used for details such as body markings on insects or creatures, leaves, florets and pattern. This opaque quality is sometimes used within the body of the translucent glass to produce extraordinary effects. The images below in Figs 16 and 17 show one such result.

Fig 16. *Vessel of thrilobate flower.*

Fig 17. *Vessel of thrilobate flower* (detail).

This piece defines how Walter utilised the combination of opacity held within a translucent base. The suffusion of the yellow ochre is akin to a mass of ink starting to unfurl in water or like smoke or clouds. In it Walter captures perfectly the very idea of an Asiatic flower depicted in watercolour. One senses the exoticism of the Orient in this rare piece. With the use of the pale, china-white glass within a form, which echoes the flesh of Phalaenposis orchids, a deep stamen-like turbid flow is produced from the familiar yellow-ochre glass.

The piece was in all certainty never designed to be so strongly lit from its base as it is shown in Fig. 1b, but in doing so one can clearly see how Walter manipulated his glass during the casting and firing process in the kiln. Like images given to us from the Hubble telescope we are looking at a moment in time. Instead of the vastness of space, we see captured here the movement of particles of molten glass as they flow into the cavity of the mould at around 800° Celsius. The effect has been 'frozen' when the temperature of the kiln is dropped and the glass become solid once more. This piece cannot have been at its top temperature for a very long period, as the colours appear to be still moving.

Some of these colours, the cobalt blue, chrome and emerald greens for instance, straddle both categories. But in terms of working with glass, colour is dependant on light to reveal its quality, and it is obvious that an opaque colour is not the same as a translucent one. The range of colours is thus divided into two sub categories: translucent and opaque colours. I have included in the translucent list a range of colours that are also 'semi-translucent'. These semi-translucent colours are vital to the way Walter produces his colouring effects throughout his work. They are used to make his glass appear denser, and so help to define the way his objects carry light.

The choice of the pigment (either metallic salt or powdered coloured glass) and the way the glass frit for the body of the work is manufactured produces effects of opacity. As fritted coloured glass is ground down to a more powdery form the denser the colours appear, and the more opaque the glass becomes. Light passes into the body of the glass but gets scattered by the multitude of the different particles and air bubbles trapped between them. Clear glass appears white and transparent colour becomes opaque. If these glass pigments are then placed within a body of translucent glass and fired to around 800° Celsius they fuse with it to produce the effects of semi-translucency. The opacity of the pigments becomes partially lost and the effect is semi-translucent. This is what we see throughout Walter's work. If one were to raise the temperature of the kiln to around 840° C and to hold the kiln programme for a much longer time a greater degree of translucency/transparency is regained. Cat. No. 72 (Fig 18, below) is a good example of this phenomenon.

Fig 18. *Dish with fish breaking through wave*, Cat. No. 72.

With just two blues, the turquoise and the cobalt, the effect of swirling water is deftly depicted. The cobalt-coloured pigmented glass on the right of the dish is held in a dark turquoise base, which in turn suffuses into its paler hue, and then to almost white in areas. Elements of the fish that have surfaced from the water are depicted in a painted, almost enamelled, way to define detail. The relative thicknesses of the form allow light to pass into the glass to further enhance those relative densities of the blues. The outcome is of light passing through water. This characteristic is generally used for the main bodies of Walter's glass objects and can be applied to most of what we see in his work. Thus these dense, but not opaque, coloured areas are labelled 'semi-transparent'.

The blue pigments are made either from finely ground glass frit or metallic salts, and these sit in a body of other finely ground glass frit. The firing process has trapped miniscule air bubbles between the particles of coloured glass. These two elements, the pigments and the air bubbles, join together to impede the flow of light through the general body of the glass, thus adding to the overall effect of the piece. If one were to slice the piece in half one could see the effect. This I have done with one of my pieces that copies Walter's style (Figs 19 and 20, below). It is in the shape of one of his chameleon dishes. The slice I have taken is triangular in form, the apex starting at the lower pale yellow section in Fig 19a and widening towards the denser chrome green on the upper left of the image.

Fig 19a. A slice of chameleon dish.

Fig 19b. The reverse view.

Fig 20. A close-up view showing the trapped bubbles amongst the glass.

Fig 20 (above) shows the effects of pigment and bubbles. Throughout the section tiny air bubbles have been trapped and one can see the way they have moved through the glass. The colours here have been created using oxides of chrome (green) and copper (blue) during the kiln firing process at around 800^{o} C.

Each colour patch in the tables has been taken from one of Walter's works in the Broadfield House Walter collection in Appendix 1, and has been labelled with its catalogue number for direct reference.

Table 1: Walter's colours: The 16 translucent colours:

1. Pale Turquoise
   (Cat No. 53b)

2. Dark Turquoise
   (Cat No. 53a)

3. **Cobalt blue**
   (Cat No. 29)

4. **Chrome green**
   (Cat No. 101)

5. Pale champagne yellow
   (Cat No. 43)

6. Leaf green/ pale chrome green
   (Cat No. 73a)

7. Tangerine
   (Cat No. 51 -)

8. Purple
   (Cat No. 20)

9. Amber
   (Cat No. 74)

10. Emerald green
    (Cat No. 6)

11. Golden yellow
    (Cat No. 47)

12. Grey (semi-translucent)
    (Cat No. 42b)

13. Olive green (semi translucent)
    (Cat No. 112)

14. Fawn
    (Cat No. 41b)

15. White
    (Cat No. 39)

16. Rose-brown
    (Cat No. 116)

Table 2: Walter's colours: The 13 opaque colours:

1. **Cobalt blue**
(Cat No. 9)

2. **Chrome green**
(Cat No. 8)

3. Emerald
(Cat No. 88b)

4. Pale-yellow
(Cat No. 109)

5. Mid-yellow
(Cat No. 58a)

6. Scarlet-red
(Cat No. 44)

7. Berry-red
(Cat No. 84)

8. Orange-brown
(Cat No. 32)

9. Orange
(Cat No. 12)

10. Caramel
(Cat No. 101)

11. Yellow ochre
(Cat No. 85)

12. Brown
(Cat No. 27)

13. Black
(Cat No. 10)

14. Purple
(Cat No. 62a)

All of the translucent colours above sit in a clear glass base that allows for tints to be extrapolated. The process of grinding the clear base into a powdery frit and then re-firing it gives an appearance of a thin milky-white. Light is scattered as passes through the glass producing an opaque effect. Tests in earlier research proved this. An example of it in Walter's work is illustrated below in Figure 5.

Fig 21. *Triangular chameleon dish* (Cat. No.111).

I have produced a similar effect in one of my pieces in the works *The Standing Men* (see Book III) using finely powdered clear frit. A detail of it is seen in Fig 22, below.

Fig 22. Detail *Standing Men No.2.*

The degradation of colour into the clear glass increases the resemblance to the

water-colour designs from which Walter worked. Fig 22 above shows how the fired glass looks like that of watercolour inks or paints. The effect gave rise to the earlier hypothesis of Professor Cummings that Walter coloured his glass during the kiln firing process. During that study (at the University of Wolverhampton) we were also given a then recently published calendar illustrating Walter's early work. In it was the image in Fig 23, below.

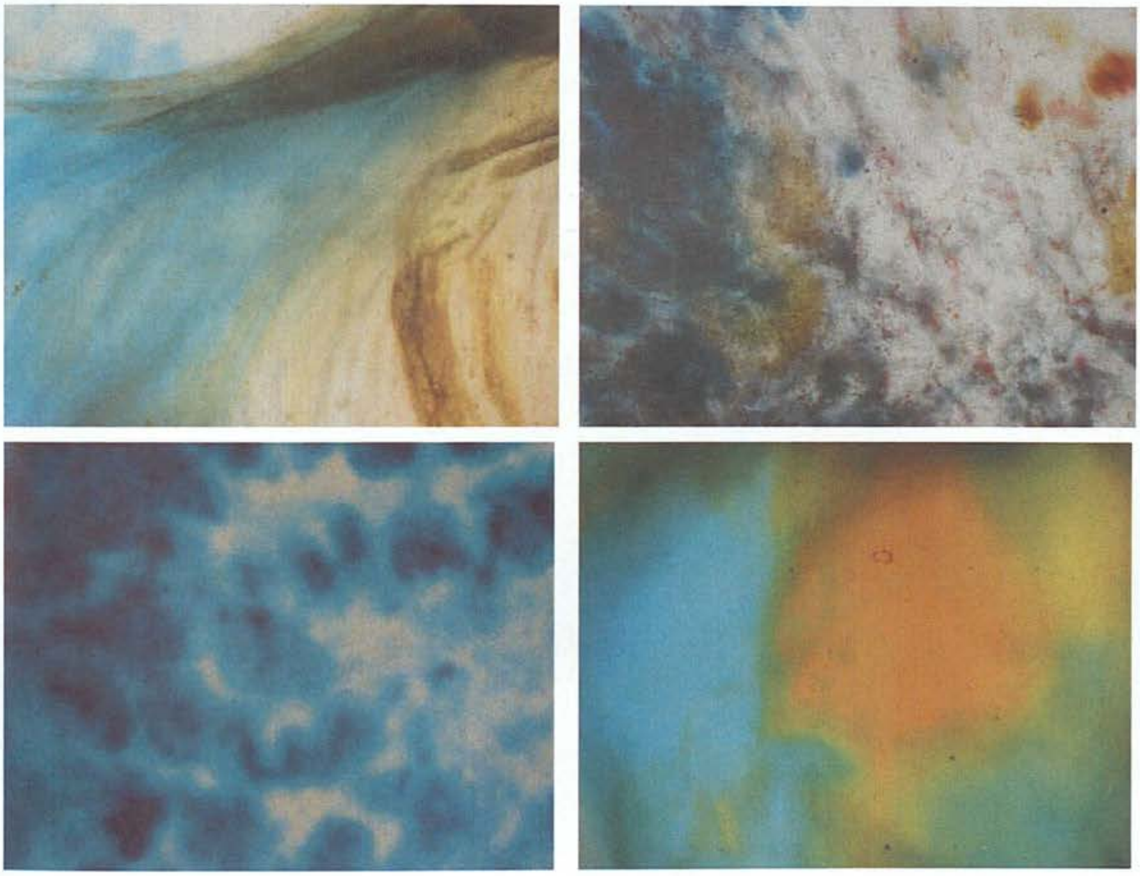


Fig 23.

Four-quartered images taken in close-up of Walter's glass.

These four images show cloudy suffusions of glass, blobs of colour, and what appear to be miniscule amounts of impurities emanating colour.

It was deduced at the time that some of these impurities were metallic salts held in the body of the clear glass. It is not known from which pieces these four images are taken, but they do show that in Walter's pre-Art-Deco work colour is expressed not as a uniform base, but is instead used as a pigment similar to water colour. Some of what we see may simply be accidental contamination by metallic salts or other unknown pigments, but the fact that some of this colouration seems deliberate suggests otherwise.

Coupled with this is the 1925 article in the 'Revue Mensural' where Walter is described a great "chimiste", and which describes the 'eureka moment' in his life when he realised he could produce a type of stained glass without the supporting structure of leading (Vallieres, April 1925, Daum, 1980). This picture effectively wraps around Walter the mantle of the legendary alchemist, who produces from out of the drab, base material of metallic salts, artistically and chemically ingenious multi-coloured glass products. And much of this representation is true.

Having isolated the colour range in Walter's palette, the next step forward was to find what metallic salt matched which colours. The initial steps were fairly simple, as five of his colours are seen elsewhere in glass and ceramic making. This is fully discussed in the next chapter.

Chapter 3: Walter's 5 basic colours.

It is well known in the glass making industry and the ceramics industry that a particular rich lapis blue is made from an oxide of cobalt (CoO),

Fig 24 a. Cobalt blue.

a leaf green is from chromium (chrome) (Cr_2O_3),

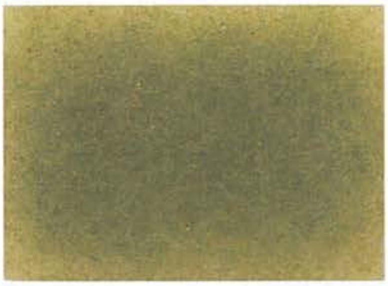


Fig 24 b. Chrome green.

turquoise is from copper (CuO),

Fig 24 c. Copper Blue.

and purple or brown from manganese oxide (MnO_2) (Weyl, 1999, Hamer, 1991).

Fig 24 d. Manganese purple/brown.

These 4 basic colours and their associated metallic salts have been traditionally used to produce a range of colours in glazes, faience and glass, and they are clearly seen in Walter's palette.

A fifth one, iron oxide (Fe_2O_3) is also used in glass and ceramics for colours and glazes, but has properties that are slightly different to the other four when making colour.

Fig 24 e. Iron red.

All five of the above colours in Figs 24a –Fig 24 e can be identified in the four images in Fig 23 in the previous chapter.

There are various forms of iron oxide, which come in several colours each producing differing colours dependant on temperature and application. Iron oxide also has the characteristic (unlike the first four) of being an anti-flux, so proving difficult to work with as a pigment at around 800° C (Hamer, 1991). The likelihood that Walter used iron oxide as a colourant was high as the rich brick red, which the yellow and red versions of the oxide produce, is to be seen throughout his work. But the validity of the results in my earlier research at the University of Wolverhampton were questionable, as the colour produced by iron oxide appeared unstable when it was either re-fired or painted next to another colour. There was the question too, of whether the reds seen in Walter's work had been produced by another oxide/salt that makes a red colour, selenium oxide for instance.

At the outset of my research on this study I felt it was important to understand the methods of creating colour in glass in late 19th and early twentieth century terms. It seemed a sensible notion to use the natural salts and minerals that would have been available to Walter and which may have been used by him, (as well as the other pate-de-verre artists of that period). I strongly held the belief that any modern colouring compound may not match what was being used 100 years ago.
I had earlier searched amongst the technical data sheets of the industrial firm of Johnson Matthey who produce glazes for ceramicists. They had revealed that there were indeed other elements, which had been introduced in the modern era to make the colours consistent and stable. Any use of them would have been an incorrect approach to understanding how Walter coloured his pâtes-de-verre.
In trying to understand that process, I have resorted to the notebooks made by Walter's contemporary Gabriel Argy–Rousseau. As part of a grounding in the general subject I had been given a copy of them to read when I started my original research at the University of Wolverhampton. They have proved invaluable and have remained an important document on the production of colour for pâtes-de-verre in this study.

The notebooks, entitled 'The Production of Pâte de Verre', were held by the family of Argy-Rousseau until 1976, when they were donated to the Rakow Library in Corning. Following their gift a symposium was held at the Royal College in 1978 where a few copies of the released notebooks were translated into English and circulated (Argy-Rousseau, 1978). The symposium was held partially to discuss the techniques and methodology revealed in them, with a view to advancing the knowledge of how pâtes-de-verre was made (Frantz, 2005). I have one of those copies and they have given valuable insight into a lost and misunderstood technique. In my reading and use of the notebooks I, too, have discovered things, which have improved the methodology of making pâtes-de-verre. The application of shellac into the mould, for instance, which few pâtes-de-verre artist utilise, certainly improves the textural surface of the final product (Stewart, Cummings, 2007). These notebooks are as valid now as they were then. There are several important things that have governed my continued use of them.

1. The general methodology and techniques described by Argy-Rousseau (in his notes) are familiar to the modern pâtes-de-verre artist. Whether this is because after their publication in 1978 studio glass artists began to use his notes to develop and establish their own working methods, or whether similar conclusions have been arrived at from personal experiments is debatable. Nevertheless, his techniques are understandable, usable, and, when tested, work. In any analysis of how to produce a piece of pâtes-de-verre (whether then or now) there are a finite number of techniques. His notebooks list them and therefore can be used to assess and compare processes and methodology unravelled from other sources.
2. We do not have Walter's own actual notebooks. It is therefore very hard to say definitively how Walter made his pieces. The Argy-Rousseau notebooks are the next best thing, comprising as they do detailed knowledge of what is after all a relatively simple method of making a glass object. They clarify techniques and methodology 100 years ago when (modern) pâtes-de-verre was relatively new and experimental.
3. Argy-Rousseau was a contemporary of Walter's, and trained at the same school. They knew each other and, although in competition with him, Argy-Rousseau advised Walter in the early 1930s on how to solve his financial problems through a change in artistic approach (Walter started using other designers who were more attuned to Art Deco motifs) (Bloch-Dermant, 1991). If their processes were so different it is doubtful that Argy-Rousseau would have been able to give adequate advice, nor Walter to take it.
4. The notebooks list formulae for producing colours specifically for pâtes-de-verre, and (despite the sometimes pedestrian English translation) the description of the colours in the notebooks can be read as being similar to those seen in Walter's work.
5. The notebooks also describe the formulae for making the founding of glass batches in which to put colour. One in particular is for a lead crystal 'fondu', or batch, that incorporates 46% lead oxide. This is a crystal similar to that

used by Walter. This means the colours produced from those formulae would give an accurate comparison to the colour spectrum of Walter.

6. It is not known when Argy-Rousseau's notebooks date from, but, as they relate to established techniques and not to experiments, it must be assumed they were written around the early 1920s when Argy-Rousseau had left the Ecole de Sèvres and had begun successfully manufacturing pâtes-de-verre (his business was flourishing at the same time as Walter). It is likely therefore that his formulae for making colour derived from his tuition at Sèvres, or at the very least, were generated whilst he was still there. Sèvres was famous for its manufacture of colour in enamels, the process of which is very similar to that of making glazes for ceramics and colour in glass (Bloch-Dermant, 1991). And because of his association with Jean Cros, Henri Cros's son (they were firm friends at Sèvres) (Bloch-Dermant, 1991). Argy-Rousseau's colours and production methods of making pâtes-de-verre may also derive from the work of Henri Cros, Decourchement, Dammouse and Walter. It may be surmised then that these colour formulae were something that Walter would also have known about while he was at Sèvres, incorporated into his early methodology, and manipulated to produce his own spectrum of colours when later at Daum.

All this being said, Argy-Rousseau's notebooks are not Walter's notebooks, and that knowledge has governed my treatment and use of them. In the context of this study they are a tool only, not the answer, but they have proved to be a very useful tool.

Chapter 4: My Use of the Notebooks.

Unlike Argy-Rousseau in Walter's work there is an area of detail on every plate, dish, or paperweight that looks like flat painted colour. It is what defines his work as his. The three images (seen in Figs 25, 26a and 26b) show this disparity between the two artist's finished styles.

Walter's technique of making a paint-like paste with finely ground glass and fat-oil, produces sharp detail that clarifies what it is describing. It 'pulls the eye' in a vital way, and is clearly depicted in Fig 26a and 26b.

Fig 25. *Chrysanthemums Vase*,
Gabriel Argy-Rousseau.

Fig. 26a. *Dish with hermit crab* (detail)
Cat. No. 21

Fig. 26b. *Dish with Lizard*,
A Walter.

It is the fat oil that makes the powdered glass adhere to the mould's detail and forces it to stay in place (Bloch-Dermant, 1991). Argy-Rousseau, on the other hand, achieved his version of opacity by taking the same transparent colour (grinding it down to a fine powder), which was then mixed with water and gum Arabic, before being placed into the detail in the mould. The differing result is that the Argy-Rousseau detailing takes on an homogeneity with its surrounding glass (Fig 24), where as the Walter detail is clear and sharp (Fig 25 and 26).

Argy-Rousseau also used asbestos to back fill his moulds to achieve a fire-polished finish on the inside of his vases, such as this one in Fig 1. Unlike Walter, who used shallow open moulds, this method allowed the glass to run slightly down the inside of the mould. The combination of this with the lack of fat-oil in his colours, made for the hazy effect we see here (Argy-Rousseau, 1978).

It was Walter's production of flat colour for detailing, along with the idea that he may have produced colour in the mould during the firing process, that gave me the impetus to test Argy-Rousseau's colour formulae at around 800° C. Without a comprehensive set of notes from Walter himself (or anyone else from that period citing methodology of making colour at 800° C in lead crystal) the Argy-Rousseau notebooks were the next best thing.

Initial tests had been made by me to vary the temperature in the kiln from 795 - 820° C with no apparent variation in visible results of colour. The higher end of the temperature range (i.e. 820° C) did slightly affect the way the glass melted depending on the size of the frit, but at that stage it was colour that was being investigated. As discussed earlier, this temperature range was considered to be the one Walter used to melt his glass in the mould without affecting the paintwork detailing. So 800° C was adopted as a good firing temperature. All subsequent tests were made at this temperature.

An analysis of Argy-Rousseau notebooks 'On the Production of Pâte de Verre' shows that there is a limited range of metallic salts utilised by him. These total 9 and they produce 29 colours (Argy-Rousseau, 1978).
The list below is from his notebooks, but the chemical formulae have been corrected. Where necessary I have indicated the common potter's term for the salt (Hamer, 1991).

Table 3: Colours, Names and Salts.

Colour	Salt	Chemical formulae
1. Turquoise blue	cuprous oxide (black copper oxide)	CuO
2. Cobalt blue:	cobaltous oxide (cobalt oxide)	CoO
3. Chrome green	chromium oxide (chrome oxide)	Cr_2O_3
4. Dark brown /purple	manganese dioxide	MnO_2
5. Yellow	iron oxide (yellow)	Fe_2O_3
6. Olive green	potassium dichromate	$K_2Cr_2O_7$
7. Rose\ pink	gold chloride	$AuCl$
8. Orange yellow	uranate of ammonia (ammonium uranate)	$(NH_4)_2U_2O_7$
9. White	tin oxide	SnO_2

In the 29 formulae quoted in his notes Argy-Rousseau uses these single salts in either varying degrees, or as a composition of 2 or 3 of the first 5 listed above. I have placed a copy of these formulae in Appendix 3. They include the various colour samples made directly from them and are cross-referenced with the colour samples in Appendix 2.

In my earlier research I had chosen a small selection of 8 of Argy-Rousseau's founding formulae and made batches of coloured glass in the kiln at 1270° C. Six of the formulae are simple recipes and use the first six salts listed above. The other two were chosen to give a wider sense of what could be achieved when two salts were combined. These experiments have been revisited in this study with the same colour results. They are quoted below. The last three salts in the above list (No.s 7, 8 and 9) were not tested for the following reasons:

a. In previous research the tin salt had not produced the predicted result of an opaque white. The glass at 1240° C remained a clear colour. A dense opaque white is not seen in Walter's work. A white effect is simply created by the crushing of the lead crystal frit to produce a translucent effect (see the above chapter on the Colour Palette Broken down). The only piece that is in opaque white is a mouse (Cat. No. 38), which on inspection is made from carved elephant ivory.

b. Gold chloride has a prohibitive cost. At the time of this research it was costing £95 for 0.25 g. The rose colour in Walter's work is rarely seen, being only in one piece in the Broadfield House collection, Cat. No.26 'Dish with Stag beetles'. Even then the colour seen is not the true rose pink indicative of gold chloride.

c. The uranate of ammonia was unobtainable at the time of this research. Later, however, a quantity of it was created. The results of that experiment are discussed below in the chapter on uranium.

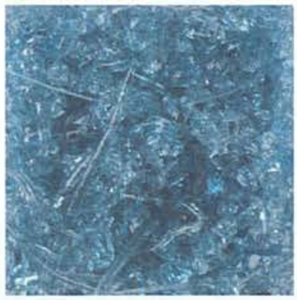
A brief explanation on the quantities in the founding formulae.

The amount of salt used in all his formulae is per 100g of glass (42% lead crystal). I have followed directly the methodology of Argy-Rousseau's instructions, which advises 'X' grams of salt/oxide <u>per 100g of glass</u>. In other words, a given amount of salt/oxide is added to each 100g of the glass batch. In Argy-Rousseau's first quoted formulae he asks for 100g of glass, plus 0.02g of copper oxide. This produces a batch of coloured glass weighing 100.02g. The alternative method would be to take 99.98 g of glass and 0.02 g of copper oxide, making an exact 100g of product. Visually, the end results are very similar (as was shown in earlier research), and for the lay man/artist it is easier to follow Argy-Rousseau's instructions, treating it as one would a simple food recipe.

Argy-Rousseau's founding formulae also require that the salt/oxide be added to the raw ingredients of the glass batch before being heated up to around 1240° C. This allows the oxide/ salt to be incorporated into the matrix of the glass as its component parts meld together. Once a batch of glass is fully heated and then cooled the oxide/salts are fixed into the matrix. Richard Beadman of Plowden Thompson assured me that if I added the salt/oxide to it in a crucible, and took the temperature up to 1240° C or over, the molecular structure of the glass's matrix would be sufficiently opened enough to accommodate the salt (Stewart, Cummings, 2007).

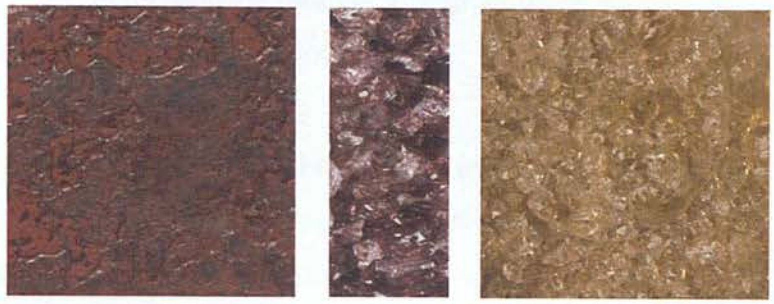
Richard's assurance proved correct as all the predicted colours were produced, except in the case of the iron salt. At 1240° C a purple colour is made, not the predicted yellow colour below. It was clear that the glass matrix was not open enough to allow the salt to dissolve sufficiently to produce the yellow colour characteristic of iron (Weyl, 1999). Richard suggested that I raise the kiln temperature to 1270° C. and try again. At that temperature the glass matrix should be sufficiently open to allow the iron salt in. His advice was taken, and a good yellow was produced (see table below). After that, all glass samples produced at founding temperature were made at 1270° C to ensure a uniformity of result. The results of the tests are detailed in the table below.

Table 4: Test results for colours.

Predicted colour at 1270° C	Made at 800° C	1240o C	Made at 1270° C
1. Turquoise copper oxide (CuO) @ 0.2g			
2. Green chrome oxide (Cr_2O_3) @ 0.4g			
3. Blue cobalt oxide (CoO) @ 0.7g			

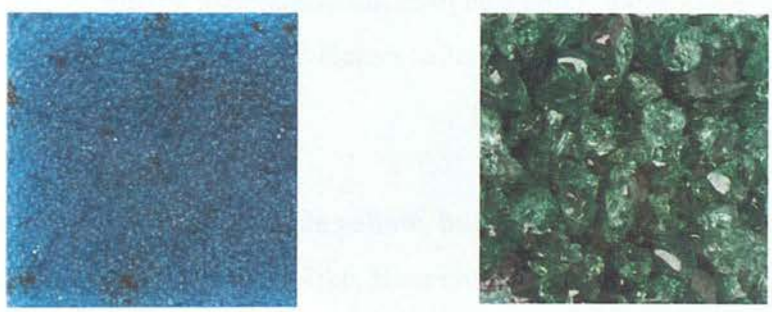
4. Purple
manganese dioxide
(MnO_2) @ 3g

5. Pale yellow
iron oxide (red)
(Fe_2O_3) @ 3g

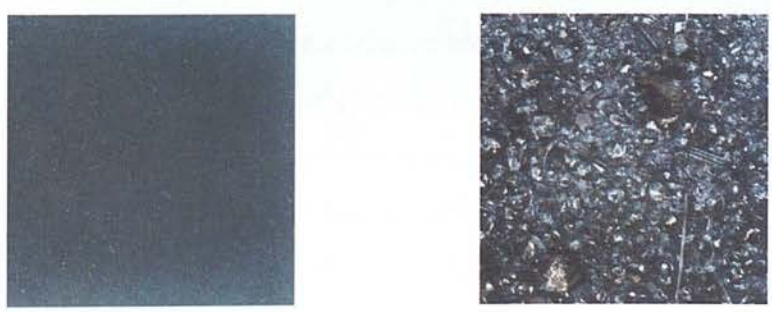


6. Olive green
Potassium
dichromate
K_2CrO_4 @ 3g

7. Emerald green
copper oxide
(CuO) @ 0.8g +
iron oxide (Fe_2O_3)
@ 1g



8. Grey-blue
chrome oxide (Cr_2O_3)
@ 0.014g +
cobalt oxide (CoO)
@ 0.1g



Results of the above colour tests.

The comparative samples in Fig 27 above show there is generally a correlation of hue between the results at 800° C and 1270° C. The colours made at 800° C have a tendency towards the dull, while those made at 1240° C have a vibrancy related to their transparency. They also appear slightly paler in tone even though they hold the same amount of salt. This is due to the amount of light passing through the transparent glass, making it appear paler. Even in these few experiments anomalies appear. The iron salt, the potassium dichromate and to an extent the manganese dioxide can produce different colours at the two differing temperatures. The chrome and copper salts and the potassium dichromate produce a brighter more intense colour at 800° C. A more detailed description follows.

Tests 1 and 2. The salts made from copper and chrome have produced a translucent effect in the glass, at 800° C, with a similar hue to their tests at 1270° C respectively. This effect is seen sometimes in Walter's glass works.
Tests 3 and 4. While the cobalt and manganese salts produce colour at 800° C that match with the ones made at 1270° C, the effects are dense and opaque. Both these colours are also seen in Walter's detailing. The salts, however, have produced volatile gases within the body of the glass. An aerated glassy body is formed that is similar in appearance to pumice. This phenomenon is not seen in Walter's glass. However, an earlier test with the unfired manganese salt used as a paint did produce an effect similar to that of a dish in the Broadfield House collection (Cat. No 62a). This is discussed in a later chapter.

Test 5. The red iron salt at 1270° C produces a pale yellow, but at around 800° C the colour is a dense, opaque red and the effect brick-like. Both colours are prevalent in Walter's work. At 1240° C, however, a purple colour has been formed. In earlier research both the red and yellow versions of the salt were tested at 1240° C. There are no perceivable differences at this founding temperature. At 800 ° C, however, the yellow iron oxide produces a slightly redder result as a pigment, whereas the red iron oxide gives a slightly duller result. Since then I have used the yellow version in most tests at 800° C (see Fig 65, 67 and 68, below).

Test 6. Potassium dichromate at 800° C is a golden yellow; while at 1270° C it makes an olive green (described as 'Chrome of Kali' in the Argy-Rousseau notebooks). Both these colours are seen in Walter's work. However, the salt producing this golden yellow was later proved to be uranate of ammonia $(NH_4)_2U_2O_7$, and it is discussed in Chapter 8 later in this Book.

Test 7. The emerald green. At 1270° the colour has come out as predicted. It looks like a good replication of Walter's emerald colour. It does not match exactly as it had a slightly duller quality to it and its background colour has a colder blue tinge to it. When used is a good stable colour. This emerald green colour is certainly seen in Walter's work, but like the golden yellow of the potassium salt it turned out to be a mix of uranium oxide and copper oxide.

Test 8. The grey-blue. At 1270° the predicted grey-blue colour is there in a transparent form. At 800° C it is similar hue, albeit denser in shade and more opaque.

Initially two of the remaining other salts quoted by Argy- Rousseau, the gold chloride and uranate of ammonia, were not tested due to expense of obtaining those salts. Towards the end of this study some uranate of ammonia was converted from some uranium oxide, by the Chemistry laboratories of the University of Edinburgh. A golden yellow glass was created at 1270° C. This is discussed later in this Book in Chapter 8: 'Uranium in to Glass'.

Conclusions.

The colours made at 1270° C are transparent, attractive and refract the light well. The colour produced matches its formal description in Argy-Rousseau's notes, and later, when used in pâtes-de-verre, retains their colour: See Appendix 9: *The Mayan Christ*. The colours above can be seen throughout Walter's work. Therefore it can be concluded that the formulae are reliable and sound, and are possibly the same ones, or at least are very similar to ones, Walter may have used himself. The formulae were not designed to be used at 800° C however, but the results were both useful and surprising. Following some initial experiments with colour bars (as discussed below), and a further investigation into the use of zinc oxide with iron oxide, I devised a set of experiments to produce colour in glass batches at around 800° C for use in pâtes-de-verre, as well as completing the full range of Argy-Rousseau's formulae started in my investigations at the University of Wolverhampton. The full set of results can be viewed in Appendix 2.

Anomalies.

In my previous research some anomalies emerged surrounding the production of colour.

1. In a test to reproduce a Walter-type dish the expected yellow produced by the potassium dichromate came out grey and black. There was no sign of the golden yellow previously seen in the single test. A blue band has remained true to colour. This was a paint made not from colour produced by a salt, but from a premade ceramic glaze bought off the shelf.

Fig 27. A small test dish being prepared with pâtes-de verre. 2006

Fig 28. The final cast dish being polished on a brush wheel.

In Fig 27. it can clearly be seen at the top right hand of the mould curve a yellow pigment. This is the potassium dichromate in a glass frit base. Two other salts have been laid in with the glass pastes along the same curve, and a chameleon's tail shape has been painted in with a fine cobalt coloured glass mixed in with fat-oil. The rest of the cavity of the mould was filled with a glass frit containing copper oxide and a pre-made cobalt blue ceramic glaze.

In Fig 28 it can be clearly seen that some sort of chemical reaction has taken place preventing the salts/oxides from making their true colours. A possible re-oxidisation of the salts may have occurred and produced the grey effect. The only colour to have emerged as predicted is the pre-made cobalt blue ceramic glaze. The conclusion was that in a semi-enclosed mould the potassium dichromate was unstable when placed next to other salts and heated to around 800o C. As Walter made his pieces in a similar vein it was therefore concluded he would not have used this salt.

2. In the piece shown below in Fig 30 I have attempted to make a copy of Walter's chameleon dish (Cat. No.48) (Fig 29) using some premade coloured glass from Argy-Rousseau's formulae.

Fig 29. *Chameleon dish*, Cat. No. 48.

Fig 30. A reproduction of the Chameleon dish (Cat No. 48).

The differences in the end results are quite obvious.

a. The yellow of the glass in Fig 29, which I had originally thought was made with potassium dichromate, has been replaced in Fig 30 with a pale yellow colour made from a iron salt. The colour is paler than the intensity of the original.

b. The emerald green colour in Fig 30, made from Argy-Rousseau's founding formulae quoted earlier in the previous chapter is less intense, too, than the colour seen in Fig 29.

c. The turquoise blue in the snout of the original Chameleon (and again seen in Fig 33 a and b, below) has become muddied even though it was made from a pre-made founding colour produced at 1270° C. The head of the chameleon has become a pale chrome green. This green colour was made in the mould during the firing process from chrome oxide.

Fig 31 a.

Fig 31 b.

Fig 32 a.

Fig 32 b.

In a similar version (Figs 32a and b. above) made at the same time as the one in Fig 30, I had slightly altered the composition of two of the pastes. The green of the body of the chameleon and the turquoise blue of the snout were made with oxides of chrome and copper respectively. They had been mixed into the glass frit before firing at 800° C. The copper oxide has produced its colour. From this result it is clear that the copper oxide can produce its predicted turquoise colour when placed next to the chrome salt. However, the chrome salt will pollute the colour effect of the founding turquoise colour at 800° C.

e. In Fig 33. (below) a corrosive effect on the surface of the glass has occurred during the firing of my version of Walter's dish. This had to be polished off with quite an abrasive action, which subsequently damaged the surface detailing and the surrounding paintwork. There is an appearance of a yellow-dust like substance sitting on the surface of the corrosion (presumably yellow from the chrome oxide). Even with the protective layer of the shellac it appears there has been an interaction between the chrome oxide and the plaster.

Fig 33. Detail of chameleon head.

The yellow was identified later to be a form of chrome oxide ('Chrome yellow'). However, the corroded surface effect is not seen on any of Walter's work that contains the same chrome green colour. This would suggest chrome oxide was not used directly into the mould, but a similar colour was made instead at founding temperature before being fritted and turned into pâtes-de-verre.

e. The berries, a brick red colour in the original and thought to be made from a iron salt, have blackened here and the colour dissipated. The coloured paint was made by grinding up pre-made colour formed from a single iron salt that had been mixed into some glass frit and fired to 800° C. The paintwork of the leaves, too, has suffered during the firing. The glass paints seem to have formed a grey/black residue.

Chapter 4 conclusions.

It is clear that something in the processing of the possible colours has been either missed or mistaken. The individual colours do not always match to Walter's colours in his glass. At least four of the colours made at 800° C (chrome green, turquoise, yellow and red) from metallic salts and oxides are not stable enough to produce the same effects as seen in Walter's work. Their chemical effects (Figs 28, 30 and 33) when laid next to each other within a semi-open mould are unpredictable. Fired on its own in a glass batch each salt produces a genuine colour sometimes seen in Walter's work. But in the presence of another salt or even pre-made founding colour, chemical events occur that spoil or discolour its neighbour. While it may be that Walter did not use metallic salts to create colour directly into his moulds a possibility arose from out of this research to start producing colour for my use in my own work and for the general use of the pâtes-de-verre artist. If a series of usable and workable colours could be made an extension of the colour vocabulary might be attained. That colour is produced from metallic salts is well known, but there appears to be little formally presented in literature review for the glass artist to use at around 800° C.

Even though there were doubts as to whether Walter did use salts to produce colour at 800° C I decided I would make a further series of tests by placing each of the salts quoted in the Argy-Rousseau notebooks next to one another in shallow open moulds. This was to simulate a possible mix of Walter's colours and to see how each possible salt would react to another when fired at around 800° C. The tests and their results are discussed in Appendix 4.

I decided too to re-visit all the 29 Argy-Rousseau founding formulae, but using those formulae to create colour at 800° C. This I have done. The results are to be seen in Appendix 3.

Chapter 5: Uranium in Walter's work.

In my earlier experiments to make colour in lead crystal at 800° C there was a particular range, which had proved elusive, the yellow/orange/amber range. The premise that Walter made colours across the range of his palette, especially the opaque ones, at around 800° C was proving difficult to argue. While chrome and copper can produce translucent colours specific to their salts at 800° C, I found the translucent amber colour that is throughout Walter's work was impossible to create at that temperature. So, too, had been the opaque, ochre colour that is often associated with this amber glass. One piece in particular, that of Cat. No 24, (see Fig 34, below) exemplifies Walter's use of the amber-ochre combination. It held my attention throughout the research as I tried to create the yellow/orange/amber range. Its colouring is very simple and, once understood, tells us a great deal about Walter's methodology and use of metallic salts.

Fig 34. *Chameleon dish*, Cat. No. 24.

The translucent amber colour, seen on the left of the dish (Fig 35, above) dissipates into the pale yellow translucent glass seen on the right. An opaque, yellow-ochre colour is contained within both colours. Its tones subtly change, sometimes appearing as an opaque orange (in the amber base) or as a mid yellow (in the translucent, pale yellow glass).

When the dish rests on a flat surface the colours of the amber and ochre are less intense and look muddied. The majority of any direct light is absorbed either by the opaque detailing or moves through the glass and is not returned, thereby making the dish appear slightly dull. However, when the dish is held up against transmitted light, the effects of Walter's handling of the colours are more readily seen (Fig 36, below).

Fig 35. The Chameleon dish with transmitted daylight. Scale 1:1.

Although the colours are somewhat skewed by the yellowness of the daylight illuminating the dish, the opaque, ochre colour stands out from the other colours. The striations and flow of the ochre colour show where the glass was introduced into the mould and where it flowed during the firing process. This effect is seen constantly throughout Walter's work. What is also of note is how transparent is the blue and green colouring on the tail of the chameleon. In this image it appears transparent. In direct lighting, as seen in Fig 34, it appears opaque.

It was this piece I had in mind when I discussed my issues around the creation of colour in Walter's work with Dr Andrea Hamilton and Professor Chris Hall, and then later with Robert H. Brill, Research Scientist at the Corning Museum of Glass. From those conversations an avenue of research was opened up, which has proved enormously fruitful in understanding Walter's colouring methodology. It has answered many of the questions surrounding the manufacture of his pieces, and at the same time has raised many more questions than it answered. Importantly, it has led my study into an area that little has been discussed or written about before.

For clarity in reading the remainder of this chapter a definition of X-ray fluorescence (XRF) and Scanning Electron Microscopy (SEM) is to be found in Appendix 5.

The background to the testing of the *Small Square Covered Box, Cat. No. 86b.*

During my research at the University of Wolverhampton a conversation occurred with Jean-Luc Olivié, Director of the Centre du Verre, Paris. In it he mooted the idea that some of Walter's pieces could be tested using X-ray fluorescence (XRF) and/or Scanning Electron Microscopy (SEM-EDS). The suggestion that both mechanisms would produce data that could be easily interpreted to determine what elements were in the physical body of Walter's glass. At the time there were no funds to employ either the machines or the assistance to do the tests. In a subsequent conversation about my research with Dr. Hamilton and Professor Chris Hall the idea arose again.

Testing a piece of Walter's work using X-ray fluorescence (XRF) and Scanning Electron Microscopy (SEM) with an energy dispersive spectrometer (EDS) (SEM-EDS).

In that discussion my supervisor Dr Andrea Hamilton and advisor Professor Chris Hall agreed these two methods of investigation would be the most appropriate. Taking a sample of glass from one of the Walter pieces and examining it in the laboratory, was not a valid option. Therefore the XRF and the SEM-EDS equipment would give a good non-intrusive reading of what was contained within the body Walter's glass. The decision was made to try to make a test using the these methods on a '*Small Square Covered Box'* from the Broadfield House Collection (Cat. No. 86b) (see Fig 37, below).

Fig. 37. *Small Square Covered Box*. Cat. No 86b.

The *Small Square Covered Box* was selected for several important reasons.

1. Primarily, it displayed some of the colours in the yellow/orange/amber range, and would therefore in all likelihood give the results that I was searching for. When held up to transmitted light an effect similar to the Chameleon dish above was clearly to be seen (Fig 38, below).

Fig 37.

The box seen in transmitted light. A chip is on the right front side of the lip. The dark cloud-like, areas at each corner are formed from the opaque, yellow ochre glass.

Fig 38.

The chip is more clearly seen in the centre of the lip. The yellow ochre colour can be seen just below the surface of the paler, translucent yellow glass.

Thus, the box was representative of several of Walter's pieces. There stood a good chance that any results drawn from its analysis would also give an indication what also occurred in other pieces in the collection.

2. On the lip of the powder box (seen in Figs 38 and 39) there was small chip, which revealed the opaque ochre colour. The colour was under the surface of the pale yellow glass and, without the presence of the chip, would have been difficult to read using the SEM-EDS. This chip allowed for unique investigation within the body of the glass, thus potentially producing a wider set of results.

3. The box also had several other colours, which were used as detailing effects on the design (red, black and green) and all of which are used on other pieces of Walter's work. Any analysis and information on these colours would be interest for understanding the whole collection and Walter's processes. The red colour was of particular interest to me as I had had some difficulty in earlier tests in making the iron oxide stable when introduced to other colours made either directly from metallic salts or in pre-coloured glass. When used as a paint, I had found it either coagulated or 'travelled'. The red colour moved across the body of the glass and sometimes appeared black.

4. The final practical reason for picking the powder box was that the piece was small in size. It measures approximately 10 cm by 10 cm wide and is about 8 cm in height. This meant it would be able to be placed with ease into the cavity of the XRF machine without danger of damage to either the machine or the piece itself.

The powder box was collected from Broadfield House Scotland in January 2008, and taken to the National Museum of Scotland to be examined under the guidance of Dr Andrea Hamilton and Dr Lore Troalen of the National Museum of Scotland.

The colours on the box that were to be examined are as follows:

1. The pale translucent yellow base glass.
2. The opaque, yellow ochre coloured regions.
3. The black within the yellow ochre coloured regions.

4. The green leaves.
5. The black-mauve on the beetles' heads.
6. The red of the berries.

At the time of examination of the powder box a third method of testing was considered. This was Raman spectroscopy, but was not available to us. Raman spectroscopy works by exciting the sample using a laser beam and measuring the energy of the scattered photons. This shift in energy from the original laser beam gives information about the molecules present in the sample and their chemical bonds. A definition of its system is explained in Appendix 5. It is a more complex system than SEM-EDS and XRF, and while more time has to be given over to the interpreting of the data, a greater depth of information can be extrapolated. Following the successful recording of the data on the powder box and its conclusions, it was proposed by Dr Hamilton and Professor Hall to test more pieces using Raman Spectroscope. The result was that 3 much larger and more artistically significant pieces from the Broadfield House collection of Walter were examined. The examination of these pieces is discussed in Chapter 7, below.

The three methods of analysis.

All three methods draw accurate results, and the analysis of their readings reveals the composition of the glass. XRF gives immediate results, which, while not being complete at the time of its reading, does give an indication of what is being seen. Percentages of each element are also given, and therefore summations can be made. The results mirror those of Homberg's, Klaproth's and John M. Grey's investigations into historic glass (Homberg, 1712, Holmes, 1993, Hoppe, Damaschun & Wappler, 1987, Smith, 1995). Their particular processes of examination, however, were destructive in the analysis of the composition of antique glass. Glass was literally ground up and dissolved in acids in order to discover its composition. Although Raman, SEM-EDX and XRF seek to deliver the same form of information, such as elemental composition, these methods are non-destructive and therefore more suitable for analysis of historic objects.

The report on the powder box is documented in full by Dr. Andrea Hamilton and Dr. Lore Troalen in Appendix 6. While the report gives strong data and makes observations, I have been able to draw my own conclusions. The examination has revealed a wealth of information, but it is how this information is interpreted in terms of how it relates to what we see and know of Walter's work that is of interest here.

Below are two images of the box and its lid being tested in the laboratories of the National Museum of Scotland.

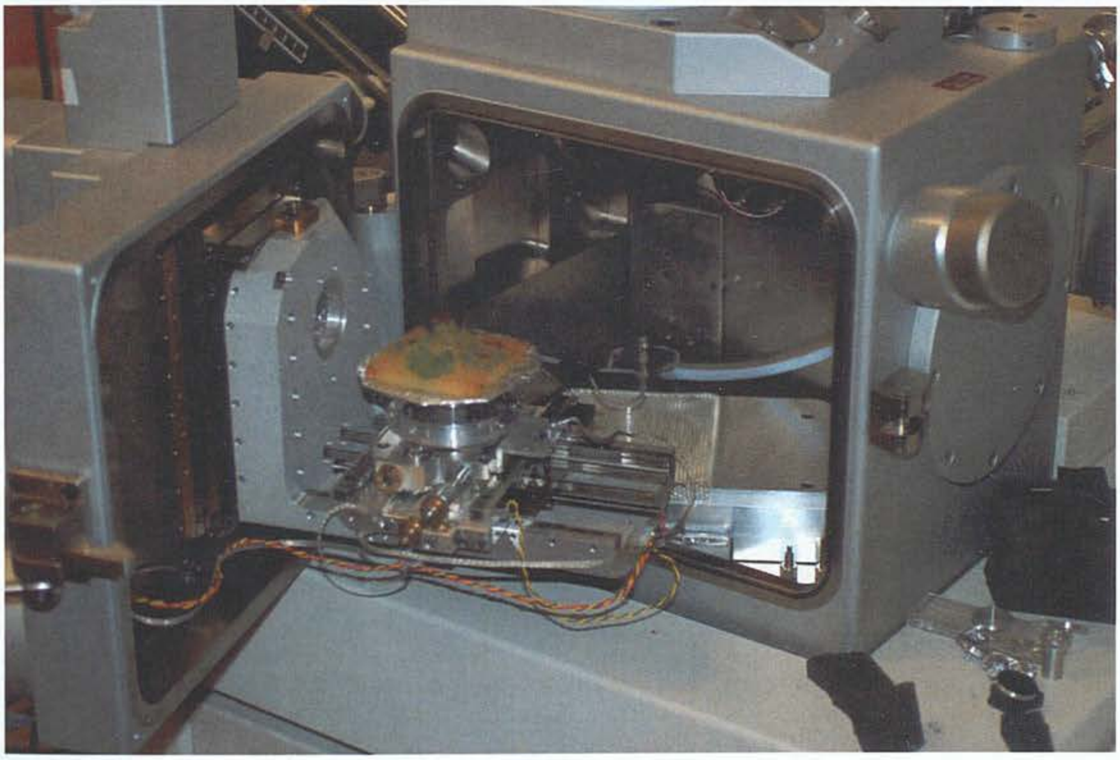


Fig 39. The SEM-EDS machine at the National Museum of Scotland.

Seen above, in Fig 39, is the lid of the box sitting on the platform of the SEM-EDS machine. The machine's cavity is relatively small and it cannot take objects much larger then this lid.

Fig 40. The box in position on the X-ray Fluorescence machine.

The powder box was positioned on a platform out side of the XRF machine (Fig 40, above). Two laser beams were shone on the specific part of the glass to be examined, and met at a fixed point, giving a marker for the X-ray beam. The gauze-covered detector is seen in the left hand middle distance. These fixed machine parts are delicate structures and cannot be moved. This sometimes made for a challenging alignment of the two beams, as we were to discover later when the investigation moved on to three larger, less regularly structured pieces of Walter's work. Here the beams were relatively easy to align, as the box is cuboid in shape and the detailing fairly flat.

The results of the report.

A table of elements found in the glass's composition isolated by the SEM-EDS details what was found throughout the glass. The SEM relies on a calibration file to produce accurate quantitative results (i.e .percentages). As the SEM was not calibrated for glass on the day we used it the values below are a rough guide only. The percentages given percentages, do help in the understanding of what Walter used and in what quantities he used it. By subtracting those elements that were most likely used for the base glass, i.e. lead (PbO) and silica (SiO_2), the remaining elements can be considered and assessed as to what they are doing within the glass's composition. This table is quoted below:

Table 5: SEM-EDS results.

Elements as oxides %	**Green**	**Red**	**Violet**
Na_2O	0.84	0.97	1.57
K_2O	**3.97**	**3.61**	**5.01**
CaO	0.53	0.33	0.30
MnO	0.00	0.01	0.00
Fe_2O_3	0.53	0.41	**0.43**
Al_2O_3	2.01	0.36	1.31
SiO_2	**44.85**	**43.89**	**46.17**
Cl	0.37	0.25	0.25
PbO	**32.26**	**39.97**	**40.39**
BaO	0.00	0.07	0.03
SnO_2	**3.23**	**3.70**	0.32
Sb_2O_3	**1.30**	**0.73**	0.04
CuO	0.03	0.01	0.00
TiO_2	0.15	0.03	0.09
P_2O_5	0.05	0.00	0.03
SO_3	2.86	0.38	0.13
MgO	0.82	0.34	0.45
As_2O_3	**6.05**	**4.79**	**3.35**
Cr	**0.15**	0.14	0.13

The data showed several interesting and unexpected results, the most remarkable of which was the indication of what percentage of lead was contained within the glass. It would appear that the percentage of lead contained within the glass is lower than was expected. There are also, in the first two lines of the table, the presence of sodium

(Na_2O) potassium (K_2O) and tin (SnO). All four elements are considered in the discussion below.

The **XRF** analysis showed elements that were found by in the various colours:

1. Pale yellow background: uranium (U) and iron (Fe).
2. Opaque, yellow ochre regions: iron (Fe) and uranium (U, traces)
3. Black: iron (Fe), zinc (Zn), chromium (Cr) and cobalt (Co).
4. Green: iron (Fe), chromium (Cr), Uranium (U, traces), zinc (Zn) and cobalt (Co)
5. Black-Mauve: zinc (Zn, strong peak), iron (Fe), chromium (Cr) and uranium (U, traces)
6. Red: zinc (Zn, strong peak), iron (Fe), chromium (Cr) and uranium (U, traces)

From the combined data I have extrapolated out 7 of the more significant findings. They are:

1. The lack of any signs of cadmium
2. The limited presence of antimony
3. The presence of uranium, sodium, potassium and tin.
4. The presence of zinc
5. The presence of iron
6. The presence of zirconium
7. The presence of chromium (and cobalt)
8. The lead content.

Analysis of the data in the report on the powder box (Appendix 6).

1. The lack of any signs of cadmium.

From the analysis above it is clear there is a complete lack of any cadmium in the pale translucent yellow glass or in the opaque, yellow ochre colour. Dr Hamilton's analysis of the data shows that both the opaque yellow ochre and the pale, translucent yellow colours seems to have been made with salts of iron, and in the case of the pale translucent yellow there was a significant appearance of uranium. This too was a surprise.

Dr Hamilton reports there was 'a tenuous peak' of cadmium in the red areas (of the berries) alone, but one that was unclear. This means that any cadmium that may have been used was in the red of the berries alone. Given the levels of other elements in other historical formulae, a 'tenuous peak' is not enough to confirm it was used to produce colour at all, and its presence may have therefore arisen from contamination.

In 2006 I had made a batch of a similar colour to the pale yellow glass we see in the powder box in Fig 36. It had been created at founding temperature of 1270° C. The result below, in Fig 41, is an early attempt of mine to reproduce a version of one of Walter's chameleon dishes, using the batch of pale yellow glass.

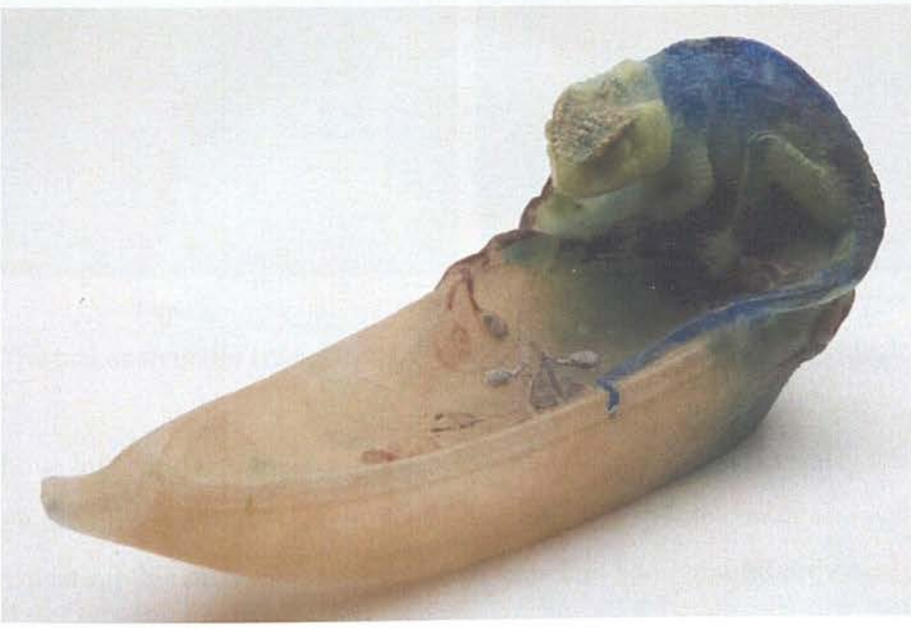


Fig 41.

This pale yellow glass (in the foreground of the boat shape in Fig 41, above) is remarkably similar in tone and hue to the pale yellow colour seen in Walter's *Small Square Covered Box* (seen in Fig 36) and the far right hand edge of the rim in Walter's chameleon dish in Fig 34. It is a colour that reoccurs throughout his work in the Broadfield House Walter collection. The colour I produced here was made at founding temperature according to an Argy-Rousseau formula using 3g of red iron oxide per 100g of lead crystal.

I had not considered the use of uranium in this particular colour as there were no indications that there would be any. Up to that point I the research I had found no evidence of it being used in such a pale colour with iron. The evidence of the presence of uranium is discussed below.

2. The presence of uranium, sodium, potassium and tin.

At the appearance of uranium in the readings from the XRF a radiation monitor was produced and held against the glass box. Its counter reiterated that uranium was present within the body of the glass and was emitting radiation. The image below in Fig 42 shows where the telltale glow was seen.

Fig 42.
The box seen under UV light.

Fig 43.
The box in natural light.

In the above left-hand image (Fig 42) the pale, yellow base glass is clearly seen to be emitting a radiation glow. On the far lip of the box a UV-white colour showed up. On closer inspection this proved to be a smear of glue that had repaired previously unseen damage.

The use of a UV light does not always prove the presence or absence of uranium, as some compounds of uranium do not always show up under UV light. It is therefore not a trustworthy method of testing for radiation, but in this case the test proved successful (Strahan, 2001). Sodium and potassium are always present in glass in some quantities (Institute of Electrical and Electronics Engineers (IEEE),), but in her paper Strahan also mentions the use of the uranium compound sodium diuranate ($Na_2U_2O_7 \cdot 6H_2O$) to create a yellow colourant in glass. Skelcher in his similar article discusses the similar use of potassium dichromate (K_2U2O_7) amongst other uranium salts, and how it was used to produce a range of colours from yellow through to dark orange. It is telling that the results above contain those elements, as well as a significant level of tin. Tin is well known in glass making as an opacifier (Weyl, 1999).

At this point it is worth reporting the conversation I had with Dr Robert Brill, from the Rakow research Library in Corning, New York State. We discussed the presence of uranium and the lack of cadmium in Walter's glass. His opinion was significant in my understanding of the historic use of uranium as a colourant and, along with Donna Strahan's article, helped to further this avenue of research.

The conversation with Robert H. Brill.

Between the examination was made on the *Small Square Covered Box* and its report written, I visited the Rakow Research Library in Corning, where the opportunity to meet Robert Brill occurred. Mr Brill has written much on the analysis of early glasses and is an authority on the subject (Brill, 2005). I asked him if he knew what could have been the salt used as a pigment for the creation of the opaque ochre and amber colours in Walter's work, as seen in the chameleon dish above. I had explained my research had shown that cadmium sulphate is well known as a colourant in brown and amber glass, but at around 800° C it does not produce the familiar caramel-coloured band (Weyl, 1999). Even at 1270° C I had had an unexpected result, as the glass remained uncoloured by the salt. I explained also that the initial findings by Drs Hamilton and Trolean in their tests at the National Museum showed a presence of uranium.

Robert Brill proposed that the colour I was searching for may well have been made using uranium, and would have been created not at 800° C, but instead at founding temperature of around 1240° C. He showed me a wine glass produced at the Steuben Glass Works in Corning, NY by Frederick Carder. The colour of the glass was a transparent amber colour and matched exactly the amber colour in the *Chameleon dish* (Cat. No 24), as well as several of the other pieces in the Broadfield House Collection of Walter's work. Its colour had been made from an uranium salt. Mr Brill told me this wine glass was the only piece in this colour he had come across made from uranium. Despite that, he thought that uranium could well have been deliberately used by Walter to achieve some of his range of colours, as the element was used as a colourant in glass from about 1830 onwards, (Skelcher, 2007). I asked if that had been the case whether Mr Brill thought that an opacifier (such as antimony) could have been used with it to create the yellow ochre-coloured opacity in Walter's work (Weyl, 1999). He agreed, but the theory would need testing. He also recommended I try to examine further pieces of Walter's using X-ray fluorescence (XRF) and scanning electron microscopy (SEM).

The theory that the opaque yellow ochre-coloured glass was produced from an amber-coloured uranium glass mixed with an opacifier was correct. Instead, of antimony though, it would appear that tin was used. In combination with uranium, and perhaps an iron salt, an opaque yellow-ochre glass could be produced at founding temperature of 1270° C. Once it was finely ground into a powder and incorporated into the main body of glass paste the effect would be similar to what we see in the glass box. I am certain the effect we see in the '*Small Square Covered Box'*, and the opaque effects in the dark orange or amber colour of the Chameleon dish in Fig 34, is a result of a finely ground powder flowing through the body of pre-made uranium frit.

In the results form the XRF Uranium is also found. Its presence here may account for the pale translucent yellow as a base colour for the dish if it were present as sodium diuranate. Combined with the transparent pale yellow of the iron salt it would possibly achieve a colour similar to that featured throughout his work and seen in the three examples in Figs 44, 45 and 46, below.

Fig 44. Cat. No. 21

Fig 45. Cat. No.149

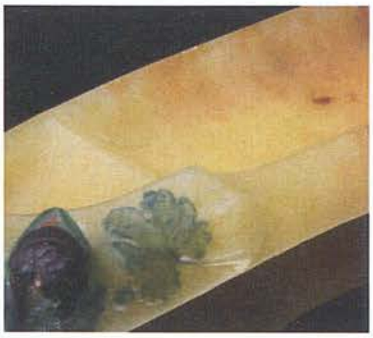


Fig 46. Cat. No. 18

Strahan describes ceramic glazes, which contain uranium for their colours, and reports that sodium uranate ($Na_2U_2O_7$), uranium oxide (UO_2) and sodium diuranate (Na_2UO_4) were all used in the their production. These salts of uranium produce a range of colours from yellow, green, ivory, through to orange and red colors in glasses and glazes and had been used since in the 1830s. Strahan also offers a short list of late French Art Nouveau glass manufacturers such as Daum, Baccarat, St Dennis and Gallé, all of them in the Nancy region, who worked with uranium salts (Strahan, 2001). This puts Walter's use of it into context. Rather than being an unusual event Walter was working with colouring products that were commonplace for the period.

3. The limited presence of antimony.

The fact that antimony was detected in such small amounts counteracts my suggestion to Robert Brill of its being used as an opacifier. Its presence in the '*Small Covered Box*' may be as a result from either the making of the original batch, or by contamination. Antimony is sometimes included to 'clean' the glass batch, which may account for its appearance in the data results (Weyl, 1999). In the four quartered images from the Italian calendar of close-ups of Walter's glass shown in Fig 23 there appears to be contamination of salts and/or oxides. It may be this is the case here. Further investigation is needed to secure an explanation for its presence in such small amounts. What is indisputable is that antimony plays no part in the creation of this particular opaque colour.

4. The presence of zinc.

In 4 of the 6 colours we were investigating zinc was present. This was an unexpected result. More significantly it was only present in the 4 colours that made up the 'paint' effects, which described the detailing of the design i.e. the leaves and berries, and the beetles. If zinc were a contaminant it would have shown up in a more random pattern throughout the data. As it was not seen in the pale yellow base glass, or the yellow ochre glass, the zinc was in those 4 colours for a specific reason.

In the formulae from Argy-Rousseau there was no mention of zinc as a colouring agent, nor is zinc used as a former for glass (Weyl, 1999). Its presence in these specific colour areas suggests Walter was including it deliberately. My first thought was that it had been used in some way to create the colour seen in each of the 4 colours above. The red colour of the berries in also contained iron, which from my earlier research I knew gave a reddish-brown.

According to Weyl, chromium in ceramic glazes containing zinc produces a brown colour, partly due to the formation of zinc chromite ($ZnO.Cr_2O_3$) and partly due to the stabilisation of the chromates. Other colours ranging from pink through to yellow and orange may be obtained with the addition of tin oxide, and are reliant on the oxidising conditions of the kiln (Weyl, 1999). This statement of Weyl's suggests that with the addition of another agent the predicted colour can be radically altered. If this is correct, the presence of zinc was there to either transform colours or to stabilise and opacify them. I tested this theory on the chrome oxide in a sample of lead crystal at 800° C and produced the two results below.

Fig 47. (G008)
Chrome oxide (Cr_2O_3) @ 0.1g
+ tin oxide (SnO_2) @ 5g

Fig 48. (G002)
Chrome oxide (Cr_2O_3) @0.1g

Fig 49. (G026)
Chrome oxide (Cr_2O_3) @ 0.1g
+ zinc oxide (ZnO) @ 1g

The three resulting colours are very different. It is clear that the introduction of tin or zinc into the glass sample at around 800° C changes the predicted chrome green (Fig 48) into yellow (Fig 47) and brown (Fig 49). The red colour in the berries on the powder box contained both zinc and iron. From my earlier research I knew iron oxide gave a reddish-brown. It was a colour I had experimented with, but with problems. That the zinc was present alongside iron suggested that it was there to help in the formation of colour or stabilise the iron salt.

In my initial research on this study I had made a test with cadmium salt combined with zinc, but it produced a poor result. At that time I was looking for the amber colour and the tests had instead produced the pale ochre colours in Figs 50 and 51, below.

Fig 50. (Y013)
Cadmium sulphide (CdS) @ 1g +
zinc oxide (ZnO) @ 1g

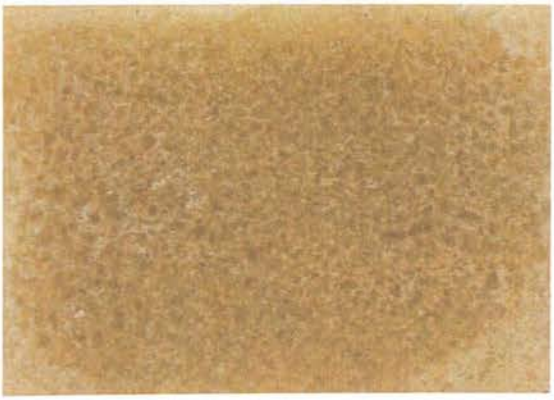


Fig 51. (Y014)
Cadmium sulphide (CdS) @ 3g +
zinc oxide (ZnO) @1g

The fact that some colour was produced with a cadmium salt and zinc oxide began to have wider significance than was previously suspected. What was clear was that zinc was being used by Walter to produce colour alongside that of other known formulae that used simple traditional salts. The question is why?

That question was answered by an examination of the way ceramicists treat their glazes. '*The Potters Dictionary of Materials and Techniques*' states that often other agents are needed to fix the salts used in colour production (Hamer, 1991). Iron oxide is has a tendency to travel and its particles to clog together. It is described as a 'coagulant', and is therefore less effective as a glaze (Hamer, 1991). This effect can be seen in a separate sample I made using 1g of (yellow) iron oxide (Fe_2O_3) in a sample of 100g lead crystal and fired to 800° C (Fig 53, below). The top temperature was held for two hours. The yellow stain to the glass is as a result of using the yellow iron oxide rather than the red.

Fig 52. Sample of yellow iron oxide in lead glass 6 cm x 4 cm.

While a dull yellow ochre colour is present throughout the sample uneven clumps of the iron oxide (the coagulated red matter) can be seen across the body of the glass. Further examples of the way the iron salts coagulate can be seen in Appendix 2 in the Red section. R003 and R005 are good examples. They contain 1g of the iron oxide and show similar clumping of the salt. In tests I found this problem could be resolved in two ways. Either the glass frit can be doped with enough iron oxide to saturate the sample, and so avoiding the coagulation, as in Fig 53, below. Or zinc oxide can be added (at perhaps 1%) to the iron oxide to produce a similar effect (seen in Fig 54, below) with a third less iron salt (Hamer, 1991).

Fig 53. (R006)
Iron oxide (Fe_2O_3) @ 3g.

Fig 54. (R007)
Iron oxide (Fe_2O_3) @ 1g + zinc oxide @ 1g.

5. The presence of iron.

That iron was present was not a surprise to me. I had thought that it would be found in the berries' colour as it presented the best chance of being what created that colour. I had asked Drs Hamilton and Trolean to look for selenium, an element that creates a good red colour in glass (Weyl, 1999), but this was not found.

6. The presence of zirconium.

Zirconium is not known to be included as a former for glass, nor is there any evidence of it being used as a colourant (Weyl, 1999). Klaproth at originally discovered it around the same time as he discovered uranium as it is present in the uranium ore (Hoppe, Damaschun & Wappler, 1987). In a conversation in May 2009 with Richard Beadman of Plowden and Thompson we discussed its presence in the report's data. Richard suggested that the zirconium's presence could also be a contamination from the ceramic crucibles in which the glass was made (foundry crucibles contain zirconium and have changed very little over 100 years).

8. The presence of chrome (and cobalt).

Chrome oxide is known to create a good green colour, and was established as one of the colourant in Walter's work earlier on (Stewart, Cummings, 2007). It makes a strong colour at both 800° C and at 1270° C. That there was cobalt only in these results suggests the green colour was made using both elements. At what temperature this colour was created is undetermined and would need further research. There are two possibilities:

1. The green colour was made at 1270° C using a chrome oxide and cobalt oxide from a set founding glass formulae. The glass was then ground up and zinc oxide added to create opacity once the colour is fired. This was turned into a paint (or glaze) by the addition of Fat oil. The paint is placed into the mould in the leaves' details.
2. Chrome and cobalt oxides were mixed together in a glass base in a given set of proportions. Zinc oxide was added to give stability and the whole was fired to around 800° C. The resulting fused, glassy mix was then ground down and made into a paint/ glaze, fat oil was added and the mix was placed into the mould before firing.

Which one of these two effects Walter used I am uncertain. Further research is needed, but either is a good possibility.

9. The lead content.

The amount of lead indicated in the glass was surprising. In my earlier research at the University of Wolverhampton it had been assumed that Walter had used 50% lead oxide as his base in the glass. The results of the SEM-EDS show that the average lead content of the glass was perhaps as little as 42%. However without calibration it is hard to determine its exact content. If it is true that Walter's glass was a harder type of lead crystal than the 50% supposed it would explain why few of his objects are casually scratched. 50% lead content glass is remarkably soft, and in previous tests I have been able to make a slight scratch in its surface with just my fingernail.

Table 6: SEM- EDS results: elements as oxides

Elements as oxides %	**Green**	**Red**	**Violet**
SiO_2	**44.85**	**43.89**	**46.17**
PbO	**32.26**	**39.97**	**40.39**

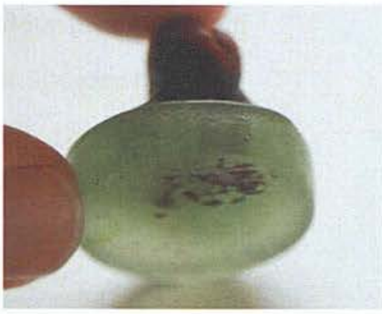
Even with the possible volatilisation losses of 5% maximum, as suggested by John Croucher of Gaffer Glass, the original batch would not have had more than 46% lead content. The analysis report clearly shows Walter was using a lower lead content for his glass than had been previously understood. This makes it a tougher glass than had been realised, and goes some way in understanding why few of the pieces in the Broadfield House collection (and seen elsewhere) are scratched.

Later in this study an examination of three other pieces from Broadfield House's collection of Walter using Raman spectroscopy confirmed the SEM-EDS result. In all three pieces the lead content of the glass was at 42%.

The initial idea that Walter was using a glass made from 50% lead oxide had arisen from several guiding factors. The main one was the hypothesis that for Walter to achieve the delicacy of detail in his colouration a relatively low kiln temperature - around 795° Celsius - would have been used to melt his glass frit, so allowing the 'paintwork' to be preserved. The thinking was thus: Walter generally produced work that only required shallow, open moulds (Cummings, 2006). This meant that the temperature of the kin could be slightly cooler, as the heat did not need to penetrate through the insulating layers of refractory mould to melt the glass. A high kiln temperature would have made the body of the glass become more fluid and the colours would have run more. Walter clearly uses the effects of a higher temperature in some of his work, as there are trails of colour moving through the glass. Some of it is as a result of glass being forced down into the cavity of the mould, as we see in the Small Covered Box in Fig 37, above. Some times the effect is created by the fat-oil being driven off in the firing process, which allows for colour to move through the body of the molten lead crystal. Fig 55 (below) shows this phenomenon.

a) Topside of the lid.

b) The flat bottom of the lid.



c) ¾ view of the same.

Fig 55 a, b and c.

Lid from *Inkwell with Snail Finial*, (Cat. No. 44).

All three images show colour has moved through the glass. In this case both the red and the black colours have flowed upwards into the lid's base. This can be clearly seen in the middle image. The red and black paintwork would have been introduced into the mould before backfilling with the translucent green-coloured lead crystal. The colour was produced from salts either at 800° C or at 1270° C, finely ground down and mixed with a binder of fat oil. The paste was placed directly where Walter intended it (Stewart, Cummings, 2007). The actions of the high temperature in the kiln forced any residue from the fat oil to be driven upwards through the glass. As it did so particles of the paint were taken up with it, so creating the effects seen in the images in Fig 55, above and Fig 56a and b, below.

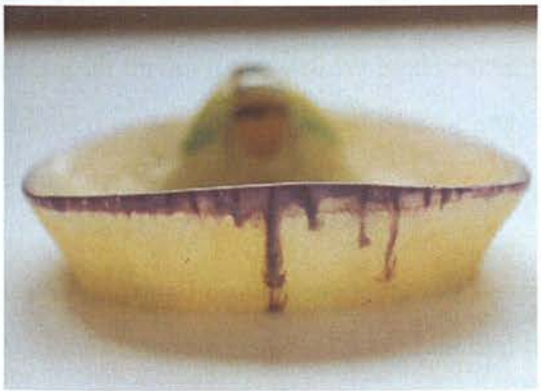


Fig 56a.

Fig 56b.

Fig 56a and b. *Dish with Bee*, (Cat. No. 62a).

Fig 56a, above, shows the lip of the dish with trails of purple colour running down from it. The dish is seen as Walter intended it. The purple colour appears to have dribbled down the edge of the dish. In this photograph one can clearly see where the paintbrush has moved along the mould leaving its mark. However, when the dish is turned upside down in the position it was originally made (as in Fig 56b) the colour is seen rising up to where the opening of the mould would have been.

Fig 56 c. A closer view of the colour trails.

Fig 56c shows a closer view of the colour trails. The dribbles of colour are in fact rising up through the yellow lead crystal to the surface. The purple colour is being dragged upwards by tiny bubbles of gas. This phenomenon is throughout Walter's work.

It was assumed that by reducing the temperature, by even a few degrees, allowed Walter's detailed paint effects to be maintained. However, in my piece *'Dolly-Mixture Sub-boi'* I have used a paint made from a cobalt-coloured foundry glass (See Appendix 9). Because the base glass contains a large quantity of vanadium, (which in my experience needs higher temperatures for the chemistry of heat and oxide to produce its varieties of pale lime green colour) I had to take the temperature of the kiln to around 840° C. Appendix 9 shows more examples of the use of vanadium in this work. Figs 57 and 58 shows some of those processes.

Fig 57.

Fig 57. Shows the cobalt-coloured paintwork in the interior of the mould before being back filled with glass paste and fired.

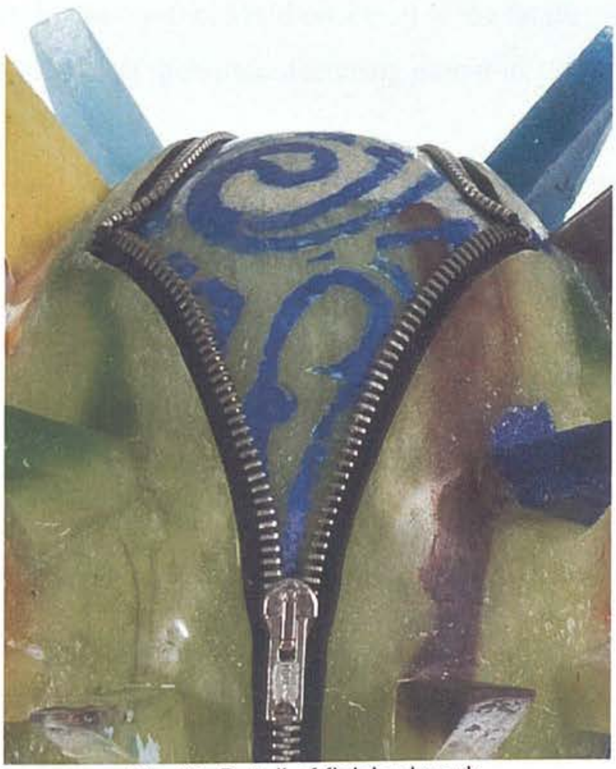


Fig 58. Detail of finished work.

In Fig 58 the cobalt paintwork (using the fat-oil as an adhesive) remains relatively crisp after firing. Unlike the other colours seen in emanating from the spikes this paintwork does not 'move' or 'travel' at that temperature. This indicates that Walter may well have used temperatures higher than 800° C to process some of his lower lead content glass.

When working with lead crystal, the higher the lead content the softer the glass (Newton, Davison, 1989). It is therefore relatively easier to cold work and polish. Because the paintwork detailing tends to lie on the surface layer of the glass and its depth is little so any abrasive cold working or polishing will remove it. Walter's pieces show relatively little sign of cold working, primarily because of the layer of shellac that was painted into the mould prior to firing. Earlier tests on objects made by me using Walter's processes showed that a brush wheel and Vaseline were sufficient to create a high surface polish and still retain the quality of pigment detailing (Cummings, 2009).

On my visit to the Daum factory in 2006 the same method of cleaning and polishing their pâtes-de-verre using brush wheels and a liquid petroleum jelly was being used. The method had been in use (so I was told on a visit to the factory in 2006) since Walter established it as part of their manufacturing output in 1906.

Another factor that was taken into consideration when deliberating on the content of the lead oxide was the actual weight of each piece. A good deal of Walter's work sits comfortably in the hand. When handling the objects they feel very heavy compared with similar objects made from other types of glass or from glasses with a lower concentration of lead oxide in the mix. While this is not an accurate assessment of the lead content it does give an indication of what one is dealing with when examining the glass. That is, a glass with a high lead content. As one becomes more experienced in handling and dealing with various types of glass one becomes better at judging their qualities.

The suggestion of a high lead content arose also from one of Walter's business cards that I saw in 2006 in the collection of an art dealer in Nancy. It describes the term 'pâtes-de-cristal'. The term 'crystal' or 'cristal' (trans. French) is a slightly confused one in context of pâtes-de-verre (See Book I: Chapter 12: Definitions). In the early 20th century it was largely used to describe glass products made in the pâtes-de-verre process that had clarity similar to that of clear lead crystal. Large pieces of clear or coloured cullet when melted reduce the amount of air trapped in the final product. It therefore increases clarity. Small bubbles may exist, but the overall effect is transparency. By using larger chunks of cullet the control of where the colour went in the mould is lessened and chance plays a part, and a very different result emerges.

Fig 59. *La Loie Fuller dansant.* Daum, 1912, ht 27cm.

Walter used this method early on in his work at the Daum factory. The three pieces above (Fig 59) are of the dancer Loie Fuller. Walter's version was made in 1905, and is one of Walter's earliest pieces for Daum. It was clearly an experimental work made to sit alongside a bronze original (on the left) from 1896 by Victor Prove, and a biscuit-ware copy by Mougin, circa 1902 (Debize, 1999). Walter's piece is unlike his other work at the same time. He and Daum seems to have abandoned this process early on and only reintroduced it when the Art Deco Style began to emerge in his work (see Book I: Chapter 7). In the late 1960's Daum reinvented itself and introduced this method of making glass objects in lead crystal, which they now call *Pâtes-de-Cristal*.

Fig 60. Modern Daum Vase with Orchids, circa 2000.

Fig 60 shows a work that is synonymous with the modern Daum name. The formation of its colour is remarkably similar to the figurine Walter produced for them nearly ninety-five years earlier.

Fig 61.

Daum's modern process of filing their moulds with chunks of coloured frit.

Fig 61 shows Daum's process of placing small fragments of glass into the mould's reservoir. It is a simplistic way to introduce colour into the mould and produces a result in the same vein as the *Loie Fuller* figurine. The process is quicker and easier than Walter's somewhat laborious process. It is as effective in a small piece of glass as in a large object, and it has proved a success for the company, having widened its appeal to a modern audience. The methodology is not new and is one many glass artists use to manipulate premade colour. Below is my version of the effect, which was made in 2005 before I started my work on Walter or had seen the *La Loie Fuller dansant* statuette by Walter.

Fig 62.

The Three Furies, Max Stewart, 2005, cast glass, ht 60 cm (approx).

The process I used was exactly the same as Daum's. Small pieces of frit were crushed and dropped into the mould. Larger chunks followed until they filled the mould's cavity. The rest of the colours in the form of glass billets were laid in a reservoir above the mould's opening (similar to that seen Fig 61) and the moulds fired up. Each Fury weighs about 25 kilos, so size does not matter when attempting to reproduce the effect of colour transition in *La Loie Fuller dansant* or Daum's *Vase with Orchids.*

Chapter 5: Conclusions.

The examination of this one *Small Square Covered Box* (Cat. No 86 b) has produced a set of results from which a larger body of research has emerged. The information gleaned from its examination has raised many questions, many of which have been answered. Some, need significantly more time and funding for their secrets to be given up. However, there have been some clear answers I have been able to give and fertile areas of research I have been able to undertake.

What can be readily stated is that Walter was making his glass objects in a way no one before expected. The idea that he was using uranium as a colourant was something that until the analysis on the box had been made (and my subsequent discussion with Robert Brill) had never been considered. There is very little specific literature on uranium in lead crystal. Most of what there is on uranium in glass discusses blown glass, not pâtes-de-verre. So its detection in a piece of Walter's glass is remarkable. I find myself here on relatively new and uncharted territory. That in itself makes answering the questions raised all the harder, as I can only speculate on some of the answers and make qualified suppositions.

Some of those questions will be answered in this thesis, and I address them in the following chapters. Other questions are for another study, but nevertheless, it is important to detail them here, as I believe they have not been asked before. The questions are:

1. Was uranium used in just the *Small Square Covered Box*, or is it throughout the collection, and, by implication, the rest of Walter's work?
2. If uranium is found in other pieces by Walter will it be just in the earlier pieces designed by Bergé? Or does uranium appear in his relatively later Art deco work as well?
3. If uranium is found elsewhere in Walter's work why exactly did he use it when (with the exception of two specific colours) other colouring formulae from the same period (e.g. Argy-Rousseau's) do not included it.
4. Did Walter include uranium in all his glass?

5. Did Walter use the uranium oxide and/or other uranium compounds to make the colour himself? Or was it bought-in as pre-made colour?

Wider questions also arise from this discovery, which I am not able to fully answer here. Some of them are considered below:

1. Is Walter the only pâtes-de-verre artists to use it in such a way? If so, what was his reasoning behinds its inclusion? Very similar colours can be made without it. Health and Safety issues were not the same as they are now, so perhaps uranium was regarded as just another metallic salt for colouring, which subtly added to the perception of the colour in which it was included. Skelcher suggest this an explanation and Eveson confirms it (Skelcher, 2007, Eveson, 1990).

2. How widespread was the use of uranium amongst the early exponents of pâtes-de-verre? Uranium was in glass production from the 1830's onwards: when, then, was it adopted as a colourant in pâtes-de-verre? Both Argy-Rousseau and Decourchement cite uranium as a colourant in formulae, but did they and the others at Sèvres use it more frequently than has been assumed?

3. Did Henri Cros use it a colourant too? That it is a possibility, as some of his orange and ochre colours match Walter's. Was it instead something Walter discovered, first at Sèvres, and then at Daum? Strahan states that the *cristalries* in and around Nancy were using uranium in their colour production at the turn of the 19th century (Strahan, 2001). Perhaps Walter singularly discovered its potential whilst at Daum. Did Walter continue the use of it after the Second World War when he returned to Nancy and tried to reinstate his studio?

4. A formal study of the historical records at the Ecole de Sèvres, Daum, Baccarat and the other glass manufacturers in Nancy, together with a proper biographical investigation into Walter, would answer much. The publication of Walter's notebooks, which remain hidden somewhere in either France or

Italy, would also render answers too, but that, as discussed earlier, is unlikely. A formal biography of Henri Cros may also help.

The detection of uranium in the main body colour of the *Small Square Covered Box* has changed the way the direction of my research has proceeded. Primarily, it changed my perception of Walter's pieces: What can now be said is that his colouring methods were less simple than had been previously supposed. The lack of uranium and cadmium within the opaque, yellow-ochre colour became of less significance to my research than it's discovery elsewhere. Robert Brill's assertion that Walter may have used uranium as a colourant was correct. It was just found somewhere else. As a result a rethink of what Walter was doing in his studio needed to happen. Immediately following the report on the *Small Square Covered Box* I arranged an examination of the whole collection of Walter pieces held at Broadfield House using a radiation monitor. This examination is discussed in full Appendix 1.

I also have been able to revisit the two historical formulae for colouring glass with uranium salts. By lucky chance I was able to acquire some uranium oxide. This gave me the opportunity to test the two formulae for making colour in glass with two different uranium salts. The tests and results are reported in detail in the next chapter. I also revisited one of Argy-Rousseau's formulae for making an amber coloured glass at founding temperature to see if that matched any of Walter's amber colours. The result for this test is also detailed below in the same chapter.

The presence of three metallic salts (chrome, iron and cobalt) in the four detailing colours on the powder box reaffirms my earlier research that these metallic salts were used by Walter to produce colour for his pieces. Conclusions in earlier research, based on observation and colour comparisons from experimentation, were confirmed.

The lack of any cadmium in significant levels suggests it was not used, and instead iron oxide, a salt known to produce a pale, yellow colour was used. It would appear the opaque, yellow-ochre colour was made from an iron salt and tin. Further work on how this colour was exactly produced needs to be done.

Questions and observations have arisen from the absence of cadmium in this colour. As this pale yellow glass is a translucent colour, and is made primarily from a iron salt with a small amount of uranium, it is almost certain that it was made at founding temperature. If so, was it a coloured glass was that pre-made outside his studio and bought in by Walter from Daum, or Baccarat or one of the other crystal suppliers? It may be that he used a pre-made uranium-coloured glass as base for all his yellow-orange-amber range and doped it with differing quantities of iron oxide or other salts as and when he required. Or were the colours we see in his objects, a glass that Walter made himself from scratch in his own studios following an established recipe? If that is the case, at what point did Walter introduce uranium into the mix? It may be that the glass may have been an iron and uranium-coloured one he bought in. I doubt this possibility, as Walter was known to be a '*chimiste*' (trans. chemist), and it seems unlikely he would have allowed anyone else to completely determine his colours (Vallieres, April 1925).

The discovery of zinc in all four of the detailing colours on the box also was an important breakthrough in understanding Walter's processes. It was the first hint of something other than a glass artist at work. As Walter was trained as a ceramicist it seemed conceivable that he was using his knowledge of glaze technology to modify his glass production. The relationship between glazing in ceramics and glass is a close one. Traditionally glass and ceramics go hand in hand. The paint effects seen in Walter's work have always been described as just that, paint. The base of the object is like a watercolour, whereas the detailing sometimes has the effect of oil paint or gouache. Walter's work has been thought (incorrectly) to have been enamelled on afterwards (in effect glazed). As shown in my earlier research the simple crushing of glass for pâtes-de-verre does not always produce the correct result for Walter's work (Stewart, Cummings, 2007). With the revelation that an amount of zinc being used to form colour in the red berries, the beetles' heads and bodies and the leaves, it became clear that Walter was glazing these details into his moulds before back filling them with glass prior to firing them.

This discovery has moved my research into new area and allowed me to develop formulae for both my personal work and for other pâtes-de-verre artists. The Dictionary of Potter's Terms gave references and explanations as to the way zinc, tin and other oxides and salts operated when included with simple metallic salts and how they worked in the creation of ceramic glazes (Hamer, 1991). As a result I have been able to create colours at around 800° C based on the Dictionary's information. Using its definitions and explanations I have enlarged the original set of 32 Argy-Rousseau formulae to around 140. These all use Gaffer Glass's lead crystal. The formulae and their associated colours are detailed in full in Appendix 2. From these colours I have made most of my personal glasswork. The applications of these colours are discussed and illustrated in Appendix 9, which discusses the making process of my work. A separate chapter on my tests combining zinc and iron oxide follows.

The discovery that Walter utilised uranium compounds to create part of his palette changes our view on his techniques and methodology. At the same time it throws up other questions about his contemporaries and predecessors. Little has been written about the use of uranium in lead crystal although it is known about. In living memory we have knowledge of its use and application. Certainly Professor Cummings and Richard Beadman know of it. Modern glass artists seem to have forgotten how widespread its use was before the 1940s. In my searches just one paper and two articles have emerged on its use. While much is discussed about Vaseline Glass (its colour is produced from uranium salts) how widespread the usage of uranium amongst crystallries throughout Europe and America remains sketchy. The Ford Rankin archive in Edinburgh, for instance, contains several 19th century formulae for the uranium-coloured glass by the Royal Hollyrood Glass Company. It also houses correspondence from the 1840s between them and glass manufacturers in America about the subject. Yet they hardly feature in any literature. Nor has a comprehensive list been compiled of the various formulae historically used to produce the myriad of colours that can be obtained from this mineral. From a modern standpoint the use of uranium is an unusual thing especially by the studio artist, although it is purchasable from at least one glass manufacturer in Europe and is now a colourant for blowing glass in New Zealand.

Similarly, the formation of colour from the use of metallic salts in glass at around 800° C is well known in the ceramic and glazing industry, but it is little discussed when applied to casting glass. Contemporary glass artists such as Sylvie

Vandenhourke, and Joan Crous use simple metallic salts to colour their work, but trying to find a 'how-to-do-it' manual remains impossible.

Chapter 6: Iron and zinc.

Following the examination of the '*Small Square Covered Box*' the question arose as to why there was a presence of zinc in the some of its findings. The element occurred again the subsequent examination of the other three pieces from Broadfield House's Collection of Walter. Although zinc crystal glass was a made in the second half of the 19^{th} century, and was once thought of as a competitor to lead crystal, zinc is not generally an associated element in glass made from lead oxide (Weyl, 1999). While colours in glass can be made using zinc oxide it is usually incorporated into nickel based colours (yellows) and selenium reds. It does produce colour when mixed with chrome (a brown colour) and has an effect on the colour of iron (Weyl, 1999). It has, though, been traditionally used in ceramics as an ingredient to glazes (Hamer, 1991).

In the four pieces examined using XRF zinc has significantly appeared in only the decorative motifs, not in the base glass itself. It can be assumed then its presence is there for another reason than the simple formation of colour at founding temperature (around 1270° C). As discussed in the previous chapter my tests and experiments to reproduce a piece of Walter was relatively unsuccessful. In particular the decorative elements using iron salts, such as the branches and the red berries dissipated when fired.

Walter's decorative detail appears as dense, opaque, sometimes matt glazes that foil the eye into thinking one is looking at ceramic rather than glass. Coupled with the knowledge that Walter was himself a ceramicist, I decided to investigate the possibility that he had applied ceramic technology to those areas.

Zinc oxide in Walter's glasswork.

It is known that zinc oxide is used in glazes as a flux. It is also a general stabiliser and glaze hardener, and is an opacifier (Hamer, 1991). At temperatures below 1085° C it has a strong influence on the fusion of its surrounding glaze. It is also insoluble in water, which would make its inclusion in Walter's paint mix (i.e. powdered glass, oxide and fat oil) ideal. Glazes are by definition a layer of glass that is fused into place the body of a ceramic object (Hamer, 1991). There is little difference other than bulk, perhaps, between the fusing of glass in a mould and fusing glass to a ceramic body.

As discussed in the previous chapter I had found difficulties getting the iron salts to mix into the glass. I decided the best test would be to introduce the zinc oxide into a mix of glass paste and iron oxide. From definitions supplied by the Dictionary of Potter's Terms I was able to create a series of tests using zinc oxide in various percentages. The Dictionary of Potter's Terms suggests that if zinc oxide is to be useful as a fluxing agent then it should be included at around 1% of the overall glaze base. However, for it to be an active opacifier at that proportion it needed another opacifier (tin oxide perhaps) to be included. The Dictionary of Potter's Terms gives a formula for the creation of an opaque white stoneware glaze that requires 10% zinc oxide and 5% tin oxide. I decide to use that as the starting point and work on from there. The first test I made uses those proportions but converted them to grams i.e. 10% measuring as 10g added into 100g of lead crystal. The result is seen in Fig 63 below.

Fig 63. (W001)
Test result for 10% (10g) zinc (Zn) and 5% (5g) Tin (Sn) in 100g of lead crystal.

As the Dictionary of Potter's Terms suggests, the outcome would be an opaque white glaze. Fig 63 shows the colour of what is produced when those proportions are incorporated into 100g of lead crystal frit and fired to around 800o C. The result is a creamy-white with a slight pink tinge to it. However, Drs Hamilton and Trolean's report on the *Small Square Covered Box* suggested that from the analysis of the XRF the red berries do not have any tin associated with them. Their assessment for the red colour of the berries is:

Red: zinc (Zn, strong peak), iron (Fe), chromium (Cr) and uranium (U, traces).

As zinc is found in a strong peak, which would suggest it was a major ingredient in a formula for creating the berries' colour. There is a presence of chrome, which I would suggest is a contamination from the adjoining leaves (all the decorative elements have a presence of chrome associated with them). There is also the possibility that the chrome may have been included as a chromate, but in the presence of zinc it would be produce a brown colour (Hamer, 1991). In light of this I think the appearance of chrome I this particular result is more likely to be from contamination. The traces of uranium are either from the pale yellow glass of the box itself, or perhaps from the same base glass, which Walter used to include the iron salt along with the zinc. That leaves iron, which combined with the zinc would make a red colour. As there was no tin found in the red of the berries I decided to try to make a red colour using zinc oxide mixed with iron oxide. At the same time I experimented using solely an addition of tin oxide to the iron oxide to see what the effect the tin would make. I also formulated one other test, which had a greater proportion of tin oxide to both the zinc and iron oxides. The formulae are quoted below and are per 100g x lead crystal. The finished samples codes are quoted and can also be viewed in Appendix 2.

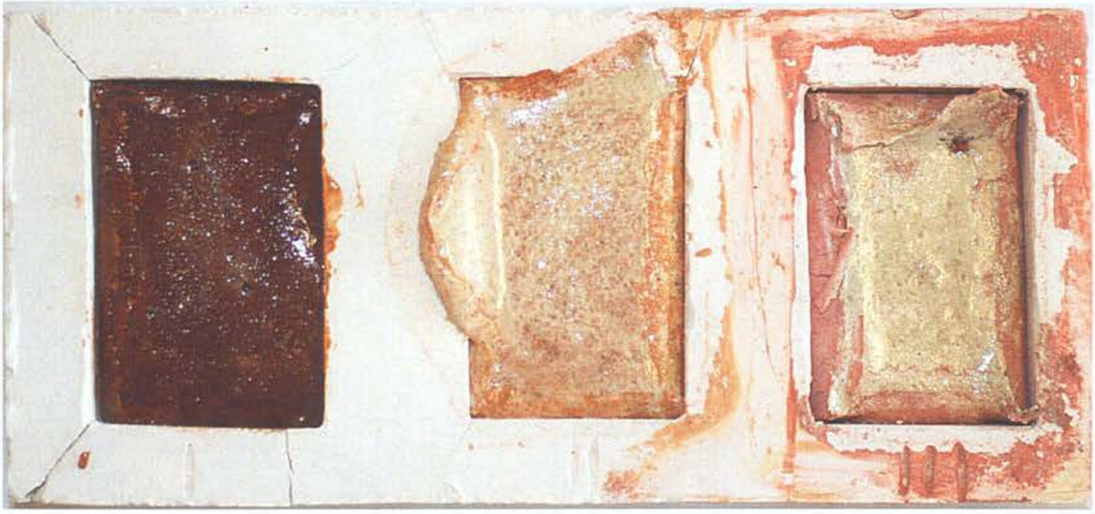
Tests:

I. 1g x yellow iron oxide + 1g x zinc oxide.
   Appendix 2: R007.

II. 1g x yellow iron oxide + 10g x tin oxide.
   Appendix 2: W009.

III. 1g x yellow iron oxide + 5 g x zinc oxide + 10g x tin oxide.
Appendix 2: W008.

In all the following tests using iron oxide I chose to use a yellow iron oxide. In previous experiments I have discovered a brighter red was produced from the yellow iron oxide (Fe_2O_3) when compared with the results made from the red version of the oxide. The red oxide produces a slightly duller brown hue. The result may be seen in Appendix 2: R004.



I II III

Fig 64.

The samples still in their plaster moulds after firing at 800° C.

The samples here in Fig 64. have been produced using 100g lead crystal. I have chosen to use 1g of iron oxide. This is to test what sort of effect the zinc and tin oxides may have on a small amount of iron salt. As with all the samples in this study they were fired at 800° C for 1 hour before annealing at 440° C.

The test samples were removed from their moulds and cleaned up. The bottom surface was polished to reveal the colour and the sample sliced in half to reveal the interior colour.

Test I.

R007 (exterior surface)

Iron Oxide (yellow)	(Fe_2O_3)	1g
Zinc Oxide	(ZnO)	5g

Fig 65.

Bottom exterior surface cleaned and polished.

R007 (interior surface)

Iron Oxide (yellow)	(Fe_2O_3)	1g
Zinc Oxide	(ZnO)	5g

Fig 66.

Interior surface.

Test I. gives a good berry-red colour on both external surfaces of the glass. Both the upper surface of the sample (i.e. the fire-polished surface) and the polished bottom surface (shown in Fig 65) indicate there is a good colour to be found using these two oxides in conjunction. When the sample is cut open, however, the colour is a pale brown-rose colour. If ground up and used as a paint, the colour would remain as that pale colour.

Test II.

W009 (exterior surface)

Iron Oxide (yellow)	($Fe2O_3$)	1g
Tin Oxide	(SnO_2)	10g

Fig 67.

The bottom exterior surface cleaned and polished.

W009 (interior surface)

Iron Oxide (yellow)	($Fe2O_3$)	1g
Tin Oxide	(SnO_2)	10g

Fig 68.

The interior surface of the sample.

Despite the hint of an iron red on the bottom surface little of the red colour remains in the centre of the body of the glass. It has dissipated to the surface for the mould. If ground up (for a paint) this sample would produce a pale white-pink colour.

Test III.

W008 (exterior surface)

Iron Oxide (yellow)	($Fe2O_3$)	1g
Zinc Oxide	(ZnO)	5g
Tin Oxide	(SnO_2)	10g

Fig 69.

Bottom exterior surface cleaned and polished.

W008 (interior surface)

Iron Oxide (yellow)	($Fe2O_3$)
Zinc Oxide	(ZnO)
Tin Oxide	(SnO_2)

Fig 70.

Interior surface.

There is a slight red-pink hue attached to both top and bottom exterior surfaces of this sample (Fig 69). When cut open however, the red-pink is to be found throughout the sample. However the increased the tin oxide. Has again whitened the sample. From this result it is clear the presence of zinc oxide has the effect of holding the iron oxide within the body of the glass sample. The zinc oxide is them the key to ensuring an even display of red pigment when using iron oxide at 800° C.

Following these results I then decided to use test I as a base for further tests. The proportions of the iron oxide and zinc oxide were changed. I decided to increase the amount of iron oxide each sample would have to ensure a good colour could be obtained. This had proved important when just using the iron oxide on its own (see Appendix 2. Red Samples: R006 compared with R005 for example). I also increased the amount of zinc oxide in two of the tests. They are described below with their formulae and are for 100g of lead crystal.

Tests:

IV. 5g x yellow iron oxide + 1g x zinc oxide.
Appendix 2: R020.

V. 10g x yellow iron oxide + 5g x zinc oxide.
Appendix 2: R021.

VI. 10g x yellow iron oxide + 10 g x zinc oxide.
Appendix 2: R022.

IV V VI

Fig 71.

The three samples after firing.

The three samples in Fig 71 are very similar in colour, with Test VI being a little more orange in character.

Fig 72.

A sample of Test VI (R022) broken up before grinding into a fine powder.

Fig 72, above, shows a sample of Test VI as it is broken up before grinding in to a fine powder. It is clear that the interior colour is the same as its exterior. The interior of each of the test showed a uniform identical colour running through each one.

The three samples were then ground down to a fine powder, mixed with fat-oil and painted into three separately prepared moulds in the shape of a shell on a small mound. The moulds were allowed to dry out for two days for the fat-oil to evaporate before the cavities were back filled with a large sized frit mixed with 0.4g of chrome oxide per 100g glass. This frit was approximately 3-4 mm diameter. The purpose of incorporating the chrome into the moulds was for several reasons:

1. I wanted to see what effect, if any the chrome would have on the iron oxide. In the Colour Bar Tests (see Appendix 4) the chrome oxide had a deleterious

effect on the iron oxide. I therefore wanted to test the theory the zinc would stabilise the iron salt its presence.

2. Secondly, I wanted to see what the reverse effect, if any, the iron and zinc mix might have on the chrome oxide.
3. Thirdly, I was preparing a design for my own personal work and wanted to revisit an effect I had produced during the firing process at the University of Wolverhampton using a similar sized frit (see Appendix 2, G005).
4. The green colour would be a good contrast to the red colour. As it is a constant throughout the three samples it would more readily show up any colour difference between the three. I also placed a ground paste of emerald green into the cavity on the surface of the mould. It can be seen clearly below on test samples IV and VI. The raw chrome oxide has not affected this colour however.

The filled moulds were fired to 800° C for one hour. For clarification the test samples in Fig 73, below are described as 'Snail Test A', 'Snail Test B' and 'Snail Test C'.

A B C

Fig 73.
Snail Tests I, II and III.

The results.

1. In general terms the combination of zinc and iron has worked very well. In all three tests the red paint colours have remained where they were placed and the colour has remained the same after this second firing of the pigment. There is no coagulating of the colour. Importantly, there is no contamination from the chrome oxide in the back filled glass. Nor is there any sign of colour dispersal of colour into the rest of the glass.

2. The three red colours have produced subtly differing hues.

Snail Test C produces an orange-red that matches its original colour in Test VI.

Snail Tests A and B have subtly differing colours which are more apparent than in their samples. Snail Test A is a slightly paler colour than B. It is what one would expect from a mix that contains much less iron oxide and zinc oxide.

3. 3. There was an extra result, which appeared when I removed the finished snails from their moulds.

Fig 74.

Fig 74, above, shows the three Snail tests just having been removed from the kiln. Snail Test I has been de-moulded.

All three of the refractory moulds have some traces of green left on them from the chrome oxide. None of them have, however, any traces of the zinc and iron mix. The surface is clean and detailed. This confirms that the zinc has 'locked in' the iron oxide into a true glaze. The two images (Fig 74, above and 75, below) show those results.

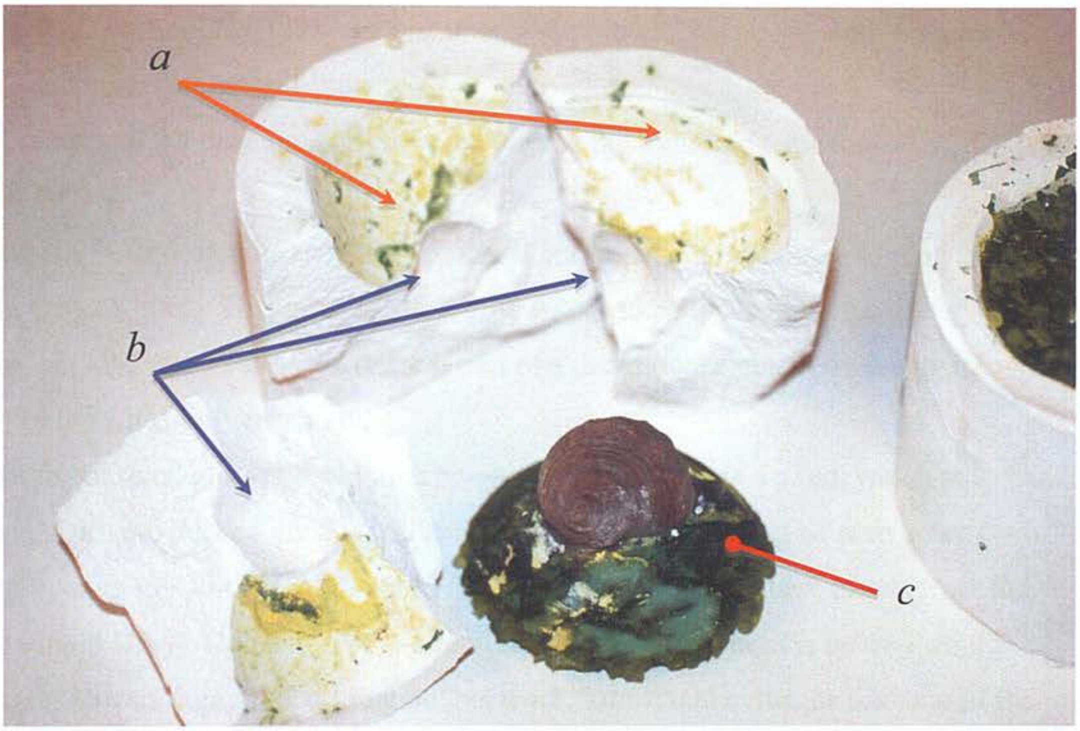


Fig 75.

The interior of the refractory mould of *Snail Test I* with its cast piece.

a. The residue from the chrome oxide on the refractory mould.
b. The interior surface of the refractory mould where the snail sat.
c. The glass mound containing the chrome oxide.

Conclusions.

The presence of zinc throughout the painted decorative elements would confirm that Walter was making a set of ceramic type glazes for the creation of those effects on his work. The results of my tests together with the evidence presented by the results from the XRF and the SEM-EDX suggest how Walter made this stage of his glasswork. This can be described as follows:

1. Colour was produced in a glass base either at the founding temperature of 1270° C or at 800° C.

2. At 800° C the specific metallic salt was combined with zinc oxide to produce what is in effect a glaze. This process allows the colour to be locked into the glassy base it is in, but also allows the salts to form part of a decorative element by fusing into the rest of the pâtes-de-verre body.

3. Both coloured glasses could then be ground up and use as a paint, which was introduced into the mould. Several examples of this method can be seen being employed in my work in Appendix 9.The examination of the three pieces from the Broadfield House Collection of Walter (see chapter immediately, below) would suggest he was doing this throughout his work. The visual evidence of many of the pieces that have similar painted detailed effects and which stretch across a 35-year period or more would also confirm that.

This particular painted effect is only seen in Walter's work. The other pâtes-de-verre artists use other effects to create their decorative elements. In his contract with Daum it states 'Walter is the sole inventor of certain processes' (Daum Freres, 1904). It can be assumed then it was this process of using ceramic glazing technology in pâtes-de-verre that Walter invented. This makes his work unique in the canon of the processes associated with pâtes-de-verre.

Chapter 7: XRF examination on three pieces from the Broadfield House Collection of Walter.

In January 2009 three further pieces from the Broadfield House Walter collection were analysed by Dr. Hamilton at the laboratories of the National Museum of Scotland using the X-ray fluorescence system (XRF). They were the *Dish with two Stag beetles* (Cat. No. 26), the *Chameleon dish* (Cat. no. 24), and the *Small dish with bee* (Cat. No. 110 a).

This same process of XRF had been used before in the *Small Square Covered Box.* As that enquiry had yielded positive results it was decided a further examination using XRF would be the best method. The subsequent data showed some important results. I have worked its findings into the following chapter. What are not shown in Dr Hamilton's report are percentages of the elements present (as they were with the SEM-EDX in the examination of the *Small Square Covered Box*), as XRF process does not yield percentages. Nevertheless conclusions can be easily drawn. A copy of Dr Hamilton's report can be viewed in Appendix 7.

The reasoning behind the choice of the three pieces.

The colour range within these pieces expressed a range of colours outside that of the *Small Square Covered Box*. The first two *Dish with two Stag beetles*, and the *Chameleon dish*, both contain colours, which were hard to reproduce in the studio. The third one, the *Small dish with bee*, had colours that were reproducible and along with the *Chameleon dish* is indicative of Walter's general colour palette. All three had painted decorative elements that correspond to the rest of his work.

1. *Dish with two Stag beetles,* (Cat. No. 26).

The dark red or *sange de boeuf* colour of the *Dish with two Stag beetles* is unusual in Walter's work and is not seen in the rest of his collection at Broadfield House (see Fig 75, below). In earlier research had been suggested the dark red was made from gold chloride. Gold chloride usually makes a rose-pink colour in lead crystal and formulae for its creation in lead crystal is to be found in the Argy-Rousseau notebooks and also Eveson's 'Reflections' (Argy-Rousseau, 1978 , Eveson, 1990). While the colour found in the dish cannot be readily described as a rose-pink, the base colour may well have been created from gold chloride and doped with another salt (manganese dioxide, for instance) to transform its hue. Skelcher and Weyl both suggest that a red colour can also be attained from salts of uranium alone (Weyl, 1999, Skelcher. B, 2002). However, Eveson gives two formulae for red/pink colours described as ' Tricolour' and 'Oriental' that uses both uranium and gold pennyweights dissolved in nitric acid (Eveson, 1990). It was these possibilities I wanted to explore. In a subsequent telephone conversation with Charles Bray (the glass artist and former course leader at Sunderland) in November 2009, it was confirmed that he had made a similar *sange de beouf* colour using a uranium salt in a high lead glass (70% lead, 20% silica, 10% alumina).

2. *Chameleon dish* (Cat. no. 24).

From the analysis of the *Small Square Covered Box* it seemed unlikely that the orange-amber colour seen in the *Chameleon dish* was made from a cadmium (Cd) salt, but instead may have been made from an uranium salt. Strahan mentions the possibility that Sodium diuranate ($Na_2U_2O_7$) and uranic oxide (UO_3) was used to create an orange colour in glass (Strahan, 2001). Charles Bray had also informed me that he had made a yellow-orange colour from sodium diuranate, bismuth and antimony. It was this possibility I wanted to explore.

3. *Small dish with bee,* (Cat. No. 110 a).

The reason, which guided the choice of the *Small dish with bee*, was that there were other colours in its composition not seen in the powder box, or the other two dishes. I felt it was a good contrast, and one, which may have yielded some additional data from this analysis. This dish has a green outer edge and a blue centre. The radiation monitor readings (see Appendix 1) showed no radiation presence from it, so it was unlikely any of the colours were made from uranium. My thought was that the green was made from a possible chromium salt and the blue from cobalt. The blue in the dish also has a slight turquoise hue to it, which may either be as a result of inclusion of a copper salt to the mix, or more likely, the combination of the cobalt blue bleeding into the green (and so creating that effect). I also wanted to test the yellow colour of the bee and the ochre on the florets. This we were able to do. As time was limited, the green leaves and the red colour remained unexamined.

The photographs and the positioning of the pieces.

The positioning of the all three pieces on the machine small platform was a challenge requiring each piece to be balanced or tilted on its side for the laser's beam to be correctly aligned. The shape of each piece did not allow for this to easily happen, as unlike their bases the sides of the dishes were curved in several plans. All three pieces has to be propped up and secured with dense foam and/or bubble wrap. In turn, the photography of the event became cramped and challenging too. Acute angles had to be adopted in order to record where the laser's beam was positioned on the glass, which have not produced the best images. Despite this the photographs below show a good account of the event.

The presence of lead and zirconium in the results.

In the following results lead and zirconium show a presence in the composition of the base glass in all three pieces examined. As the lead is part of the matrix of the glass batch the presence of zirconium could be accounted for as contamination from the crucibles in which the glass batch was made. It can be assumed, however, that they are also present in the decorative colours there as the examination results of the *Small Square Covered Box* show the glass base in the painted decoration is the same as the rest of the piece.

Dish with two stag-beetles, **Cat. No. 26**

Fig 76. *Dish with two stag beetles*, Cat. No. 26.

The areas on the dish to be examined were (*a*) the dark red of the main part of the dish, (*b*) the black head of the beetle, and (*c*) the russet colour of the beetle's carapace. The dish was placed on to the platform of the XRF machine and the laser's beam aligned.

Fig 77. Examination of the dark red area (*a*).

Fig 78.

Examination of the black beetle head (*b*).

Fig 79.

Examination of the russet carapace (*c*).

Test Results

1. The results of the analysis of the dark red base (*a*) showed the presence of lead (Pb), uranium (U), zirconium (Zr), manganese (Mn), iron (Fe), tin (Sn).
2. The black decoration of the beetle's head (b) showed a similar composition to the russet above, but with the addition of cobalt (Co).
3. The russet colour of the beetle's carapace in (c) showed a content of lead (Pb), zirconium (Zr), manganese (Mn), zinc (Zn), iron (Fe), chromium (Cr) and tin (Sn).

Conclusions

1. The major result arising from out of this set of data is that the dark red base of the dish contains uranium. It is that, therefore, which has be used to produce the colour we see. Gold chloride is not present and can therefore be dismissed as a colourant in this particular dish. That manganese (Mn) was found in small amounts within the dark red area suggests this colour was produced from a

formula that contained a uranium salt and manganese. The colour may have been made from magnesium diuranate (MgU_2O_7), which was used by Thomas Webb and Son to create colours from ivory through yellows to carmine reds (Skelcher, 2007), or possibly manganese (Mn) was included to add a subtle purple hue to what we see. As no zinc was present in the dark red base this colour would have been created at founding temperature. Eveson quotes a formula for the production of a 'russet' colour that contains uranium oxide as the major colouring ingredient with manganese dioxide at 50% of that of the uranium (Eveson, 1990). Tin is also quoted in that formula, which would explain its presence here.

2. The beetle's carapace appears to be made from several elements. A formula for a clear yellow brown colour using iron (Fe) and manganese (Mn) and chrome (Cr) is quoted by Argy-Rousseau (Argy-Rousseau, 1978). Something very similar with an addition of the tin oxide to act as an opacifier may well have used by Walter to create a base colour before being ground down to a paste for paint. The addition of zinc oxide may have acted as a flux for this when being fired in the mould.
3. It is hard to say what colour could have been created from out of these colours with the addition of cobalt, which is found in the beetle's head. However, two formulae for 'Blue-Black' and 'Brown-Black' at founding temperature are quoted by Argy-Rousseau in his notebooks (Argy-Rousseau, 1978). Both formulae have differing quantities of iron (Fe), manganese (Mn) and cobalt (Co), which would alter the hue form brown to blue. The inclusion of tin oxide may be as result of it being introduced as an opacifier at the founding stage of the colour, or it may be there as a contaminant from the russet colour along with the chrome. The zinc would once again act as a flux to bind the colour into the decoration of the piece once the coloured glass had been ground down and made into paint.

***Chameleon dish* (Cat. no. 24).**

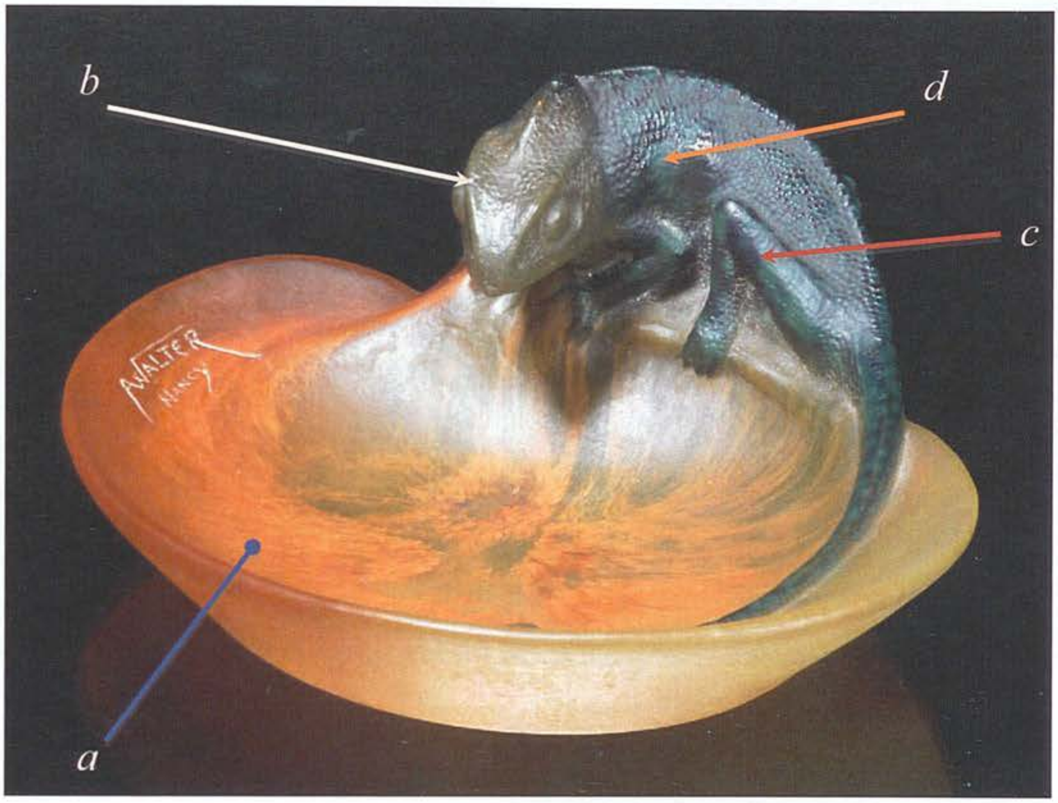


Fig 80. *Chameleon dish* (Cat. no. 24).

The main area to be examined on the dish above was (*a*) the orange-amber colour (seen on the left-hand side of the image in Fig 78.) as well as the ochre area held within it. The olive colouring on the head (*b*) was also examined, as well as the blue (*c*) and green (*d*) decorative colours on the body of the chameleon.

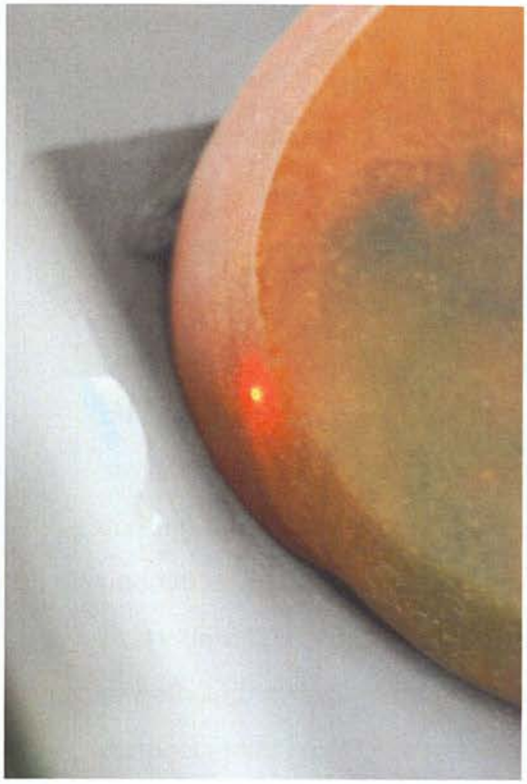


Fig 81.

Examination of the side rim containing the ochre and amber colour (*a*).

Fig 82.

Examination of the Chameleon's olive coloured head (*b*).

Test results.

1. The ochre/amber colour base (*a*) (described as 'toffee colour' in Dr Hamilton's report) contains lead (Pb) uranium (U), iron (Fe) and zirconium (Zr).

2. The olive green of the chameleon's head (*b*) contains chrome (Cr), cobalt (Co), iron (Fe), zinc (Zn) and tin (Sn).

3. The emerald green dots (*d*) on the chameleon's body contain chrome (Cr), cobalt (Co), iron (Fe) and zinc (Zn).

4. The blue dots (*c*) on the chameleon's body contain the same elements as the emerald green: chrome (Cr), cobalt (Co), iron (Fe), and zinc (Zn), but Dr Hamilton reports there is more cobalt (Co) in the blue than in the emerald green.

Conclusions.

1. The ochre and orange-amber colours in the main body of the dish are made from a combination of uranium and iron. This confirms Robert Brill's suggestion that the orange-amber colour in Walter's work was made from a salt of uranium. There is no report of potassium or sodium in the in the above results, but this does not mean either were not present in the glass. Dr Hamilton's caveat in her introduction ('Method') in Appendix 7 suggests that other elements may be present, but are not picked up in the data. One cannot say for certain whether the formula for this colour was either produced from sodium diuranate ($Na_2U_2O_7$) or potassium diuranate ($K_2U_2O_7$), but it was undoubtedly produced from some sort of uranium salt. The SEM-EDX in the first examination of the *Small Square Covered Box* showed up small amounts of both sodium and potassium. While there is the possibility that these two elements may have been in the base crystal, the fact that there is an amber coloured glass with the strong presence of uranium suggests either of these two elements would have been included somewhere in the formulae for making that colour.
2. The olive green of the Chameleon's head appears to have been made from a formula that incorporated iron, chrome, and cobalt. Argy-Rousseau gives several formula using chrome and cobalt oxides in varying proportions. They are quoted as giving a 'Grey-Blue', one of which I made. The result can be seen in the tests above in Chapter 6: The Colour Palette Broken Down, Fig 27, no.8. He also quotes a separate formula for a 'Green', which requires oxides of chrome and iron (Argy-Rousseau, 1978). It would not be hard to create a green colour from all three of these metallic salts (with the possible addition of tin as an opacifier or colour moderator).
3. The two decorative colours on the body of the chameleon seems to have the same chemicals attached to both of them. Once again variations of colour, tone and hue are dependant on proportions of the those elements listed, but it is not hard to see how cobalt and chrome oxides would produce an emerald green at founding temperature. The fact that chrome and iron appear in the analysis of the blue colour (*c*) may suggest contamination from its chromium-based neighbour (*d*).

***Small dish with bee* (Cat. No. 110 a).**

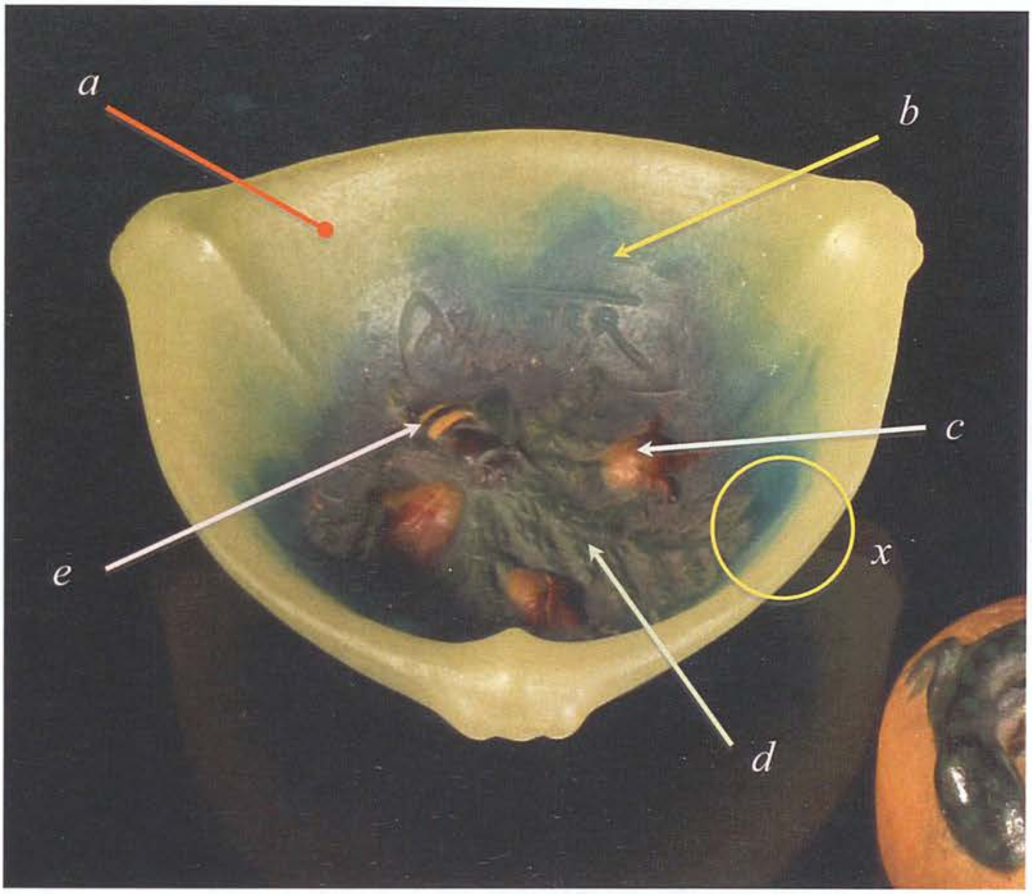


Fig 83. *Small dish with bee*, (Cat. No. 110 a).

The areas to be examined were (*a*) the green outer rim, (*b*) the blue interior, (*c*) the florettes, (*d*) the green foliage and (*e*) the bee. The turquoise hue can be seen in the ringed area (*x*).

Due to a time limitation neither the blue interior nor the dark green foliage could be tested. However, some elements pointing to their colours were recorded and are discussed below.

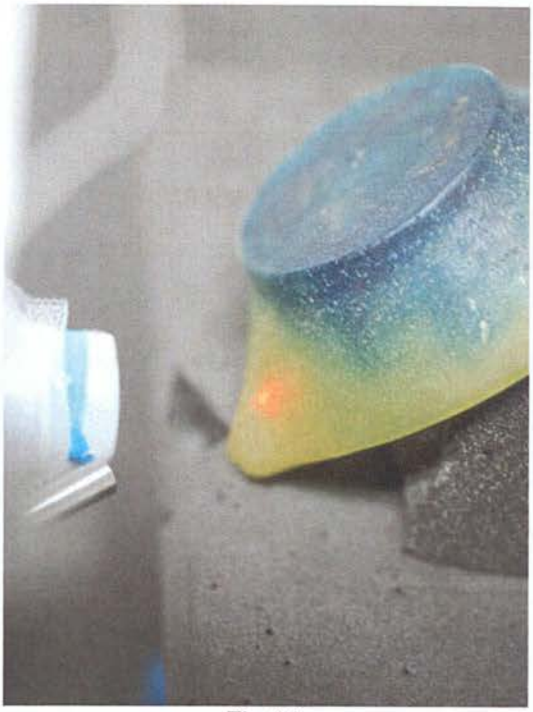


Fig 84.
Examination of the green outer rim (*a*).

Fig 85.
Examination of the bee (*e*).

Test results.

1. The clear green of the outer rim of the dish contains chrome, cobalt, iron and some zinc, but no uranium or copper.
2. The yellow of the bee has iron, chrome, cobalt, nickel and antimony.
3. The ochre colour of the florets on the dish iron, chrome, tin and antimony.

Conclusions.

1. The results for the clear green in the rim of the dish confirm the view that Walter's green (and blues) were not made form uranium salts. Certainly the leaf green here was made from a chrome-based formula, and we can presume the same can be applied to similar greens in his work. Cobalt was found in this green too, but this may be due to contamination from the inner blue colour. This presence of cobalt, but none of copper confirms my original thoughts that this particular blue was made from cobalt alone. The turquoise hue we see in this dish is as a result of the blue colour bleeding into the green glass. As iron was found in the main green base it may be that the original founding formula was based on a mix of chrome (leaf green) and iron (yellow). Argy-Rousseau

gives at least one formula using this combination of elements to produce a green (Argy-Rousseau, 1978).

2. The results on the bee appear at first glance to be somewhat confusing. This is possibly because, as Dr Hamilton suggests, it was hard to focus the laser onto the just the yellow or the black of the bee's stripes. However, what can be said is that the yellow of the stripes were in all likelihood made from an antimony based formulae, possibly either antimonate of lead (Pb_3SbO_4), or antimony oxide (Sb_2O_3), both of which produce a yellow colour in lead glass similar to that we see here when fired at around 800° C. I have used both in my colour samples to produce a similar yellow (see Appendix 2: Y003-8). One such example can be seen below. The black stripes of the bee were probably made from a combination of the iron, cobalt and tin. The presence of nickel suggests that it was included in the formula for the black, as nickel can produce a purple hue (Weyl, 1999). When fired at around 800° C nickel remains as a grey-black. An example may be viewed below. Others can be viewed in Appendix 2: GB001-4.
3. With the inclusion of antimony in the results the ochre colour of the florets appeared then to have made from a combination of either antimony oxide with iron and possibly lead oxide, or antimonate of lead with iron and possibly lead bisilicate ($PbO.2SiO_2$). Both the lead oxide and the lead bisilicate, which act as fluxes for the antimony, would not necessarily show up in the above readings. They would instead be part of the general lead content. I have made similar ochre colours from a combination of these salts in my colour samples (See Appendix 2: Y006 and Y009). An example may be viewed below. In all three cases the samples were fired at 800° C.

Y005

Antimony Oxide	(Sb_2O_3)	1g
Lead Oxide	(PbO)	5g

Fig 86.

Test sample for a yellow using antimony oxide and lead oxide.

GB002

Nickle Oxide	(NiO)	1g
Zinc Oxide	(ZnO)	10g

Fig 87.

Test sample for a dark grey using nickle oxide and zinc oxide.

Y006

Antimony Oxide	(Sb_2O_3)	1g
Lead Oxide	(PbO)	5g
Ferrous Oxide (red)	(Fe_2O_3)	1g

Fig 88.

Test sample for a yellow-ochre using antimony oxide, lead oxide and red iron oxide.

All three of these test samples above could well have been the ones Walter used in the *Small dish with bee*. The colours match very well and are very simple to make. Once ground down to a fine powder and mixed with fat-oil they are easily established in the mould, and when re-fired hold their colour.

General conclusions from the above results.

From the results and the conclusions above it can be said that from a modern perspective Walter was making colour in an unexpected way. In the three pieces from the Broadfield House Collection of Walter the orange-amber and the dark red (or *sange de beouf*) colours were all made from salts of uranium. This confirms that Walter used a variety of uranium salts in his colouring methods for the yellow-orange –amber-red range in his work. There is plenty of historical evidence that different uranates were employed to produce colours ranging from yellow to orange, through to amber and red (and green as well), all of which have showed up in his colour palette Strahan describes ceramic glazes that contain uranium for their colours, and reports that sodium uranate (Na_2UO_4), uranium oxide (UO_2) and sodium diuranate ($Na_2U_2O_7$) produce a range of colours from yellow, green, ivory, through to orange and red colors in glasses and glazes and had been used since in the 1830s (Strahan, 2001, Skelcher, 2007, Eveson, 1990). Strahan also offers a short list of late French Art Nouveau glass manufacturers such as Daum, Baccarat, St Dennis and Gallé (all of them in the Nancy region), which worked with uranium salts. This puts Walter's use of it into context. Rather than being an unusual event Walter was working with colouring products that were commonplace for the period and locality.

From the XRF results on these three pieces it is hard to say which ones he used. However, in the first set of SEM-EDX results provided by Lore Troalen both sodium and potassium have showed up alongside the uranium. This would strongly suggest Walter was using sodium diuranate ($Na_2U_2O_7 \cdot 6H_2O$,) and/or potassium diuranate ($K_2U_2O_7$) to produce his yellows and oranges.

Whether Walter bought in pre-made uranium-coloured glass or produced it himself from raw materials, is again hard to determine. His studio was based in Nancy and he maintained his connections with Daum, a company who used uranium in their glass products. Without Walter's own notebooks or a detailed search through the Daum archives it is impossible to state categorically what his exact process of acquirement was. My opinion is that Walter manufactured the uranium colours himself from the raw salts. As I have shown in the chapter below on the production of a yellow and green colour at founding temperature (1270° C) from the two uranium salts is easy.

Walter is described as 'great chemist' by Vallieres, which would confirm this view (Vallieres, April 1925). His contract with Daum states categorically he was the sole inventor of his processes (Daum Freres, 1904).

Why Walter wished to use uranium coloured glass is again unknown. The same colours can be, and were, made from other metallic salts. Skelcher proposes that once one was working in a tradition of using uranium it is just as easy to carry on using it, which may be the simple answer (Skelcher. B, 2002). Walter could have been introduced to the mineral as a colouring ingredient for glazes while he was at Sèvres during his training as a ceramist, or while he was working with Gabriel Levy on their pâtes-de-verre. An examination of the work of those early exponents of pâtes-de-verre for the presence of uranium would give vital clues as to whether Walter was the first to use it or not. I suspect somehow he was not.

As can be seen in both the examination of the *Small dish with bee* and the Geiger counter readings in Appendix 1 Walter did not use uranium in the leaf green (or blue) colours of his work. Those greens, by and large, were made from chrome salts. It is a colour, though, that is readily made by uranium and can be seen in a great deal of uranium coloured glass. When discussing the differences between the colours produced by uranium and colours made from other minerals we are talking about subtleties that perhaps only the artist or the maker sees. Why then did Walter choose to limit his use of uranium salts to the yellow, orange and amber range of colour?

I have no theory on this other than Walter, like all the other pâtes-de-verre artists of his generation, used glass to produce objects in an idiosyncratic way. He chooses a high lead-based crystal (42%), not for its high refractive index, which is the usual choice when using that type of glass, but for its other qualities of a low melting point and softer working surface. He makes glazes similar to that of ceramics to create dense, sometimes matt areas of detail, which further confuse the eye as to what is glass and what is not. He also chooses to use finely ground frits, sometimes coloured with metallic salts, which further obfuscate the passage of light through the body of the glass. He then creates with those same frits suffusions of colour like water-coloured inks. And he chooses a limited range of colours to use in his work. The choice of just three or four defined colours made from uranium salts falls into this pattern. As with most artists who are in charge of their own pigments' chemistry Walter seems to have chosen what he liked best, chosen what worked for him, and stuck with it. That gives me, and others who follow on from him a great liberality in what we do when we take his methodology and his techniques and apply it to our own work.

Chapter 8: Uranium into Glass.

The purpose of this chapter and its experiments is to test the theory that the creation of colours from uranium salts is as simple as historical documents suggest. Francois Decorchement (via his grandsons Antoine and Etienne Leperlier) gives a formula for the production of an emerald-green colour using uranium oxide (UO) (Lerperlier, 1982). Argy-Rousseau gives one for a golden yellow using uranate of ammonia ($U_2O_7Am_2$) (Argy-Rousseau, 1978). These two formulae are casually given, in the sense that they come with no historical caveats about handling or specialist manufacturing descriptions. Amongst Argy-Rousseau's notebooks the formula for a yellow using an uranate is listed in a general batch of other formulae for colours, and was clearly part of the general knowledge of the glassmaker's colour production methods. This would mean that if Walter were incorporating uranium in his work it would have been considered normal for its inclusion in any list and as casually used as the salts of chrome, copper and cobalt.

Fig 89. Water's *Chameleon dish*, Cat No. 48.

The description of the two colours to be made match exactly two colours seen in Walter's famous *Chameleon dish* (Cat. No. 48) now held in the Broadfield House collection. These two colours (the emerald green and the golden yellow) are clearly seen in the dish in Fig 89, above. They were originally thought of as being made from other metallic salts such as iron and chrome (for the green) and potassium dichromate (for the golden yellow).

The preparation for colouring glass with uranium oxide and uranate of Ammonia.

The use of uranium and its preparation for inclusion into glass comes with Health and Safety guidelines. At both the beginning and the end of the measuring processes a radiation monitor was used to measure the background reading of the area I worked in, and to check if there was any contamination from spillage.

Crucibles into which the glass batch and the metallic salts were to be placed were washed and cleaned out. The three that were to have the uranium oxide and the copper salts added to them (Formula A) had been pre-used to create a copper colour. The residue in them amounted to less than 100g of turquoise colour glass, which had been created with 0.2 g per 100 gm of glass. Given that the formula for the emerald green required the glass to be doped with 11g of copper oxide per 100 of glass and that 500g of glass was to be used per crucible I thought it acceptable to re-use these crucibles. New, unused crucibles were used for Formula B, the formula using the uranate of ammonia.

Fig 90.

Fig 90 shows the covered worktable with the filled crucibles. The top three crucibles contain the black coloured uranium oxide. The bottom two contain the yellow uranate of ammonia. The yellow and black box is the Geiger Counter monitor.

Fig 91.

In Fig 91, above, I can be seen checking the glass jar containing the uranium oxide for its CPS with the radiation monitor.

The two formulae for colouring glass with uranium and the synthesis of uranium oxide into an uranate.

The two formulae I used for making colour at founding temperature (1270o C) using salts of uranium are as follows:

Formula A Francois Decourchement's formula for an emerald green:

Per 100g of glass:

uranium oxide (UO_2) @ 0.8g

copper oxide (CuO) @ 11.05g

Formula B The Argy-Rousseau formula for a golden yellow:

Per 100g of glass:

Uranate of Ammonia ($U_2O_7Am_2$) @ 5g.

The equation for the conversion of the oxide to the uranate as supplied by Zoe Turner of the Chemistry Laboratories at the University of Edinburgh is as follows:

Part one – Synthesis of uranyl nitrate from UO_2.

HNO_3 acts as the source of NO_3^- but also as an oxidant to oxidise the unreactive U^{4+} (in this case) to UO_2^{2+}.

$2\,HNO_3 \rightarrow NO + NO_2 + \frac{1}{2}\,O_2 + H_2O$

$UO_2 + 2HNO_3 + \frac{1}{2}\,O_2 \rightarrow UO_2(NO_3)_2 + H_2O$

$UO_2(NO_3)_2$ is water-soluble.

Method

Concentrated HNO_3 (an excess of the stochiometric amount) was added slowly to UO_2 which was covered with distilled water. All solids were dissolved following the addition of the HNO_3. The pH of the solution was tested until ~pH 1.3 was reached.

Part two – Synthesis of ammonium uranate from uranyl nitrate.

In this preparation; acetone is used to remove excess NH_4^+ and NO_3^- ions.

$$2\ UO_2(NO_3)_2 + 6NH_4OH \rightarrow (NH_4)_2U_2O_7 + 3\ H_2O + 4\ NH_4NO_3$$

To the uranyl nitrate solution (~0.7 M) in a pH 3.7 acetate buffer was added 1.5 M NH_4OH to afford the precipitation of ammonium uranate. When no more precipitation occurred, the solution was filtered and the solid washed with acetone. The solid was dried in air and then over P_2O_5 in a desiccator.

The Measuring Process

1 kilogramme quantities of Gaffer Glass lead crystal were measured out and placed into 3 crucibles. These were for **Formula A** the uranium oxide.

As I only had 74 grams of the uranate of ammonia for **Formula B,** 1.5 kilos of glass was measured out and placed into 2 further crucibles. These crucibles held 1 kilo and 0.5 kilos of lead crystal respectively.

A 6^{th} crucible was used for a separate formula for a brown-yellow using iron oxide and manganese dioxide and is quoted in the Argy-Rousseau notebooks. This formula did not require any uranium oxide.

Part of the measuring out process can be seen in Figs 92 and 93 below.

Fig 92.
The uranate of ammonia being measured out.

Fig 93.
The uranate being placed into the crucible.

The three crucibles used for Formula A were ones I had used in previous experiments with copper oxide. A turquoise blue colour can be seen on the lip of those three crucibles in Fig 92 (above) on the left of the image. This is the remains of a previous pour. I chose to use these crucibles for the emerald-green colour as the formula calls for a copious amount of copper oxide to be added (11g per 100g of glass). Two new crucibles were used for Formula B, using the Uranate of ammonia, are shown in front of them. The 6th one (seen bottom right of Fig 93) was for a separate formula solely using iron oxide.

Once everything was measured out the crucibles were placed into the kiln.
A programme was written to allow the kiln to heat up to 1270o C over a 20-hour period and then let the uranium salt/glass mix to soak for 4 hours at top temperature.

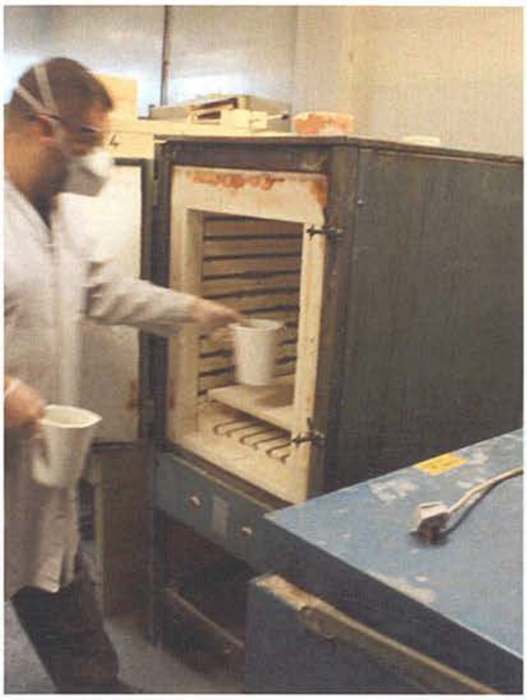


Fig 92.
The filled crucibles being placed into the kiln.

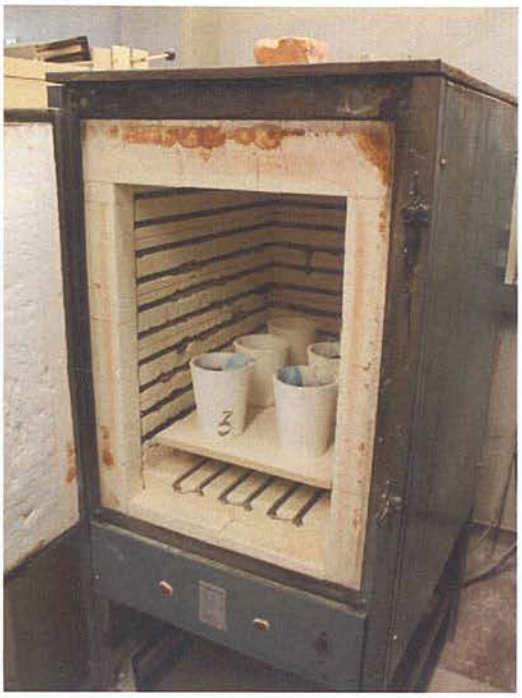


Fig 93.
The filled crucibles ready to be fired.

When I inspected the temperature of the kiln the next morning I found the kiln controller had failed. The result was the temperature inside the kiln had been sitting at around 650° C for at least ten hours. As time was limited I decided that to rectify the situation the kiln was switched off, reprogrammed and the temperature ramped up the remaining 600° C (to 1270 ° C) over a two-hour period.

The glass in crucibles was still hot which meant that an increase of 600 ° C in that time was quite possible. However, the point of bringing the kiln temperature up slowly is to let the salts to successfully enter the matrix of the glass as it opens at top temperature (Weyl, 1999). Ramping the kiln up 600° C in two hours does not always allow this to happen and can produce a poor result in the colour of the glass. This was seen in the colour from the 6th crucible that used iron oxide (Fig 94, below).

Fig 94.

Instead of a uniform pale yellow colour the glass has emerged with some purple/brown tinges to it. This would indicate the iron salts had not enough time at top temperature to dissolve into the glassy matrix (to produce the pale yellow predicted).

To some extent the colour produced in Formula B (using the uranate of ammonia) was affected too. In both crucibles the metallic salts had shifted to the bottom (of their crucibles) during their wait at 650° C. As a result, when it came for the molten glass to be stirred, too much of the salt was at the bottom of each crucible. The salts could not be completely reached for it to be properly incorporated into the mix. The results can be seen below in Fig 102.

Once the kiln was up at 1270° C it was opened and the crucibles were removed for their contents to be stirred.

Fig 96.
The removal of the first crucibles.

At 1270° C it is impossible to say what colour the glass (or anything else) is in the kiln. As can be seen in Fig 96 everything inside the kiln glows white-hot, so it is important to make sure one knows which crucible is which. I had recorded where each one was so I was able to identify it when the kiln was opened.

Two crucibles were taken out one at a time with tongs and placed on a secure surface. This comprised ceramic shelves, which had been painted with ceramic batt-wash for protection. They, in turn, had been placed on insulating material so as to avoid damage to the concrete floor from the radiant heat. In an ideal world a raised platform should have been built from ceramic tiles and bricks, so allowing the crucibles to be swiftly moved out of the kiln and placed on a surface closer to the opening of the kiln door. In this case the floor sufficed. Buckets of cold water (ready to take the pour of the glass) were on hand in case of spills.

The glass/salt mix was stirred using a potato on a steel rod. This is a traditional method that I have previously employed before.

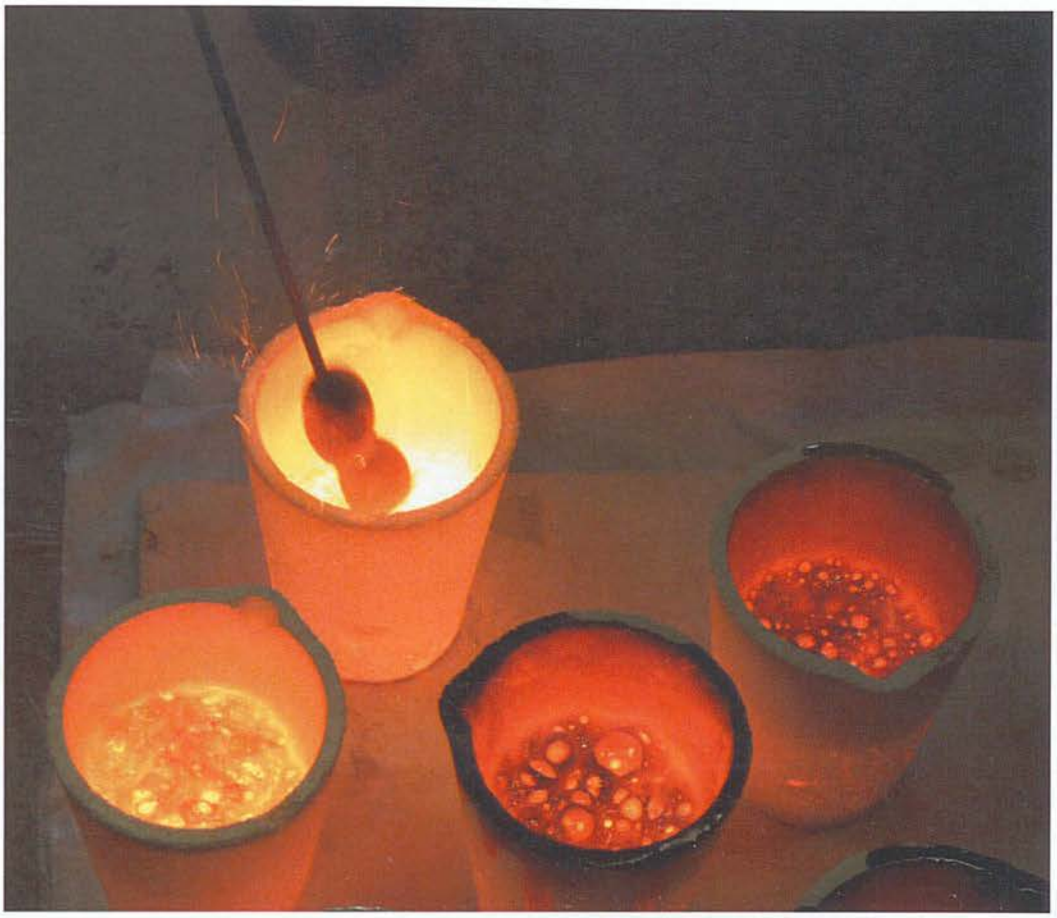


Fig 97.

The contents of crucibles being stirred with (two) potatoes on a steel rod.

Surprisingly, the potato is remarkably untouched by the intense heat. Importantly, as they are comprised of organic matter there is little chance of contamination to the glass. Steel rods alone could discolour the mix (Stewart, Cummings, 2007).

The crucibles were put back into the kiln and allowed to come back up to temperature again, which took another hour. They were then removed once more, and the contents poured into buckets of cold water (see Fig 98).

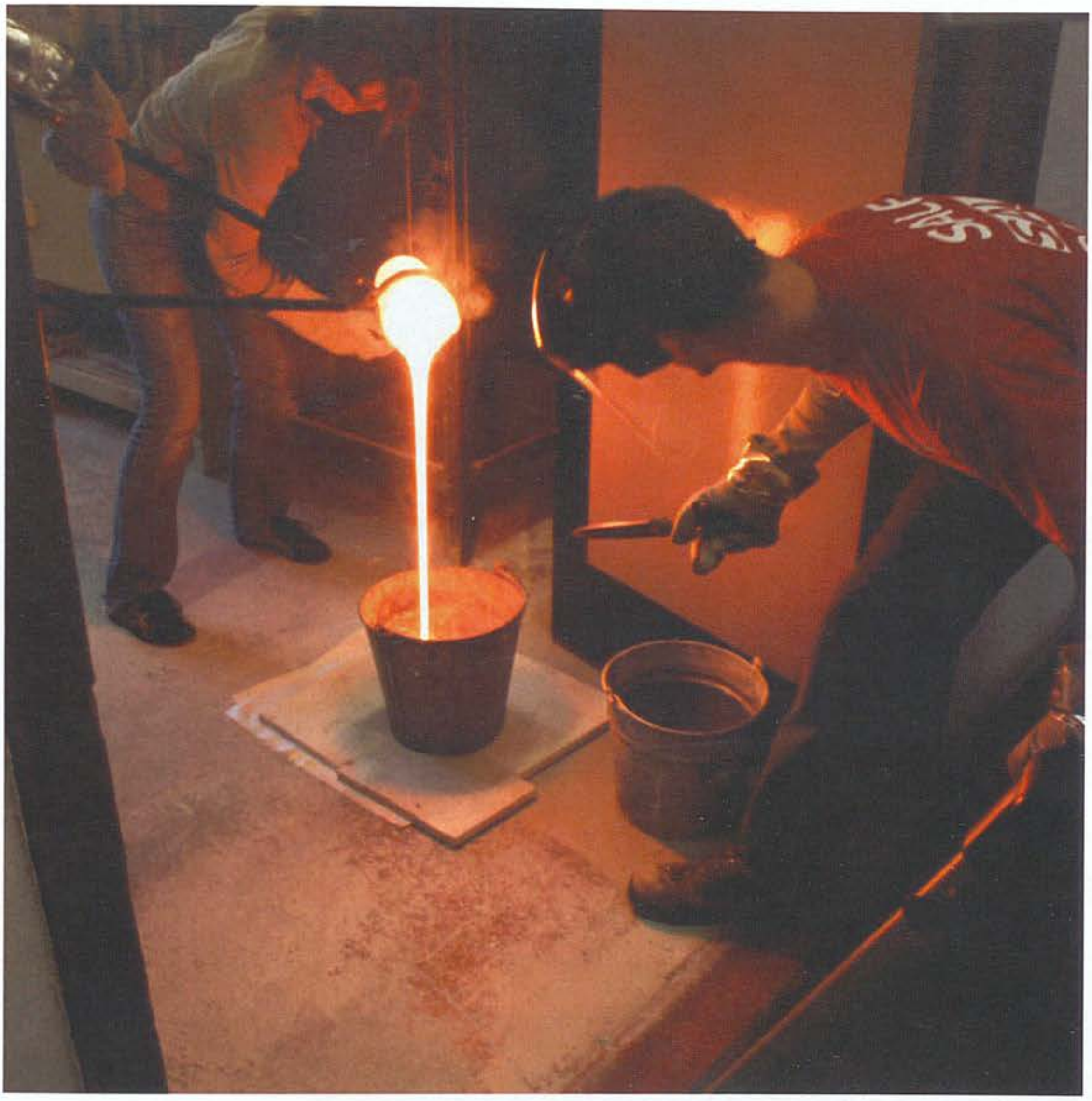


Fig 98.

The crucible is tipped and its molten contents flow into a bucket of cold water.

Assistant Alan Horsley gets ready to scrape the interior of the crucible.

When the glass is first cooled in the water it can be hard to determine what colour the glass is. From experience it can take up to 2 minutes for the colour to materialise as the glass cools down to around 200° C. It becomes more apparent when the glass is poured out from the bucket into a sieve, and then rinsed under water.

Formula A. Francois Decourchement's emerald green glass.

Fig 99 a. Formula A.
Uranium oxide emerald green frit.

Fig 99 b.
Prince Rupert curls.

As can be seen in Fig 99a the colour produced from the pour was not what was expected. I was prepared for a distinct emerald-green coloured glass, which is suggested by Francois Decourchement in the title to his formula. What emerged, instead, from all three crucibles containing the uranium oxide was a dense, forest green that reads almost black. Even when separated out into individual pieces of frit and Prince Rupert curls (Fig 99b) the colour is still dense. It is not a colour at this stage recognisable as one Walter uses in the *Chameleon dish* (Cat. No. 48), nor is it the emerald green that I was searching for.

The dark quality of the colour may well be a result of the heavy doping of the uranium with the copper oxide (the formula calls for 11g per 100g glass). As all three pours are identical, I would conclude this colour is meant to be like this, despite the initial failure of the firing programme. Derek Walls, the Glass department's technician offered to blow some of the glass to see what colour the glass would be if it were extrapolated. He took a lump of the dark green frit, heated it up in an annealing kiln to around 400° C, and secured it to the end of blowing rod. He then gathered a gob of K-Glass on top of the green, and blew it into a bubble. The result is below. It is a clear, rich, emerald-green.

Fig 100.
Emerald green, uranium glass, blown with K-glass.

Despite its quality it is not, though, the emerald-green seen in Walter's *Chameleon dish* of Cat. No. 48. Compared with the green seen here in Fig 100 that green has a much richer, yellow base to it making it an emerald colour (see Fig 89).

Derek worked a second gob of K-glass that he marvered onto fritted pieces of the green. He reported that he found the green lead crystal to be sluggish, less elastic, and harder to work, than the K-Glass. In his experience lead crystal should flow and be easier to work than a soda-based glass like K-Glass. The results are seen below in Fig 101.

Fig. 101.
The reduced uranium emerald green glass.

As I am not a glass blower I can only conclude it is the quantity of copper oxide, or that has produced this sluggish effect. Or it may be the blobs of lead crystal were too dense in quantity, compared with the amount of K-glass supporting them. When the piece came out of the annealing cabinet the exposed surface of the emerald green had reduced, producing a silvered effect (Fig101, above).

Formula B. Argy-Rousseau's golden yellow glass.

The colour that emerged is a good clear golden yellow, and it matches almost exactly the colour Walter uses in his *Chameleon dish* (Fig 87) and several of his other pieces, such as the *Green Lizard on Leaf* (Cat. No. 47), which can be seen in Fig 103, below. However, from the evidence in Lore Troalen's SEM-EDX report (in Appendix 6) it cannot be concluded Argy-Rousseau's formulae was the exact same one Walter used. Troalen gives analysis results which shows that traces of sodium and potassium was found in the glass matrix of the *Small Square Covered Box*. Sodium in conjunction with uranium would suggest Walter was using sodium uranate to create his yellows, not ammonium uranate.

Fig 102 (below) shows the golden yellow glass immediately after pouring from the crucible. Given that the *Green Lizard on Leaf* was producing high CPS readings of around 10, which indicates a high level of radioactive content, I would conclude that its yellow glass was made from a very similar uranate-containing formula to Argy-Rousseau's.

Fig 102.

The uranium golden yellow glass frit.

Fig 103.

The crucible containing the remains of the uranate of ammonia after firing.

Fig. 104.

Green Lizard on Leaf, Cat. No. 47.

One note of caution though, the colour of the glass is slightly less intense than it is the *Green Lizard on Dish* seen above (Fig 104). Some particles of glass do have the deep, golden yellow colour (seen in the centre of Fig 102), but traces of a caramel colour are also amongst the golden yellow glass. That can be seen in the lower part of the same image. This looks like contamination, but at the bottom of both of the crucibles there was a dark brown area of stained glass. This can be clearly seen in Fig 103, above, and in Fig 105, below. Traces of the caramel colour (surrounded by the golden yellow) can be also seen running from the bottom towards the open lip of the crucible where the glass was poured. These stains are the remains of an amount of the uranate of ammonia. It shows the salt was not fully mixed into the body of the glass when it was stirred after it was taken out of the kiln. If these crucibles were to be partially refilled with about 300g of lead crystal, and re-fired on a similar, but successful, firing programme it would be possible to pull out some more of the golden yellow colour.

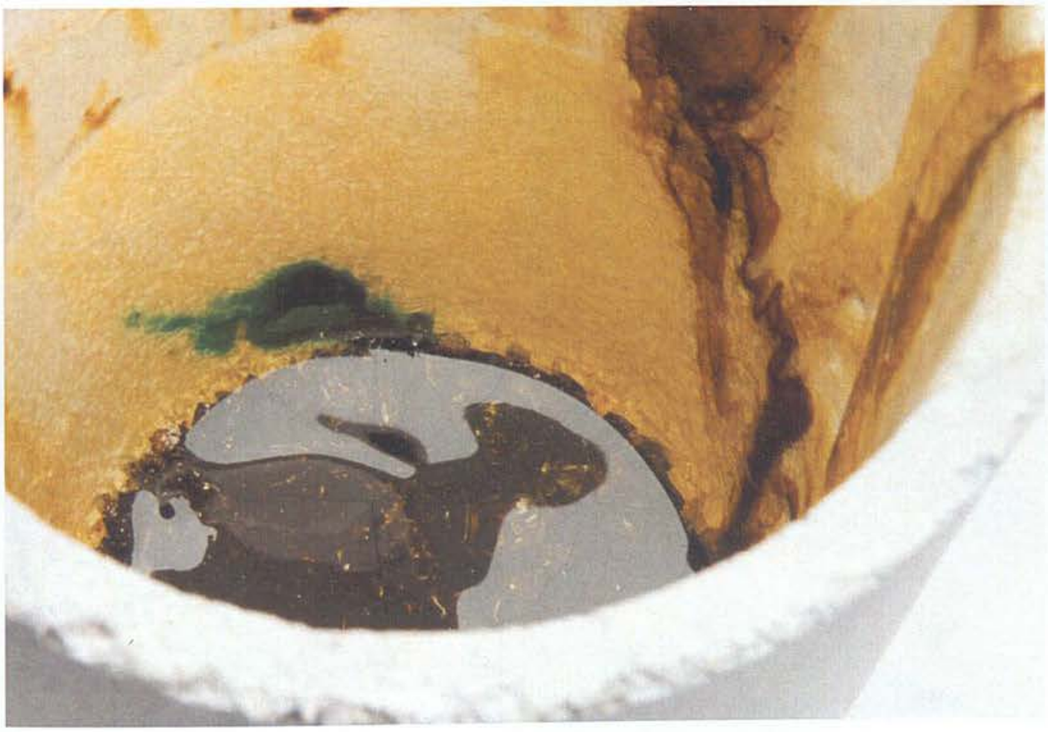


Fig 105.

The interior of the crucible with the emerald green and caramel-coloured stains.

In Fig 104, above, it can be seen there is an emerald green colour inside one of the two crucibles. This is a small amount of contamination that came from off the scraper that had been previously used on one of the emerald green crucibles. The green here is a richer hue than the emerald seen above in Figs 99 and 100, and is more comparable to the green in the yellow leaf in Fig 105, above. I would therefore conclude the golden yellow uranate glass could be possibly doped with a small quantity of the intense emerald green uranium oxide glass to produce the rich, emerald green hue we see in Walter's work. The lizard on the dish in Fig 105 has a very dark green, almost black, colouration to its body. Its colour bleeds into the yellow to produce an effect similar to that of the effect we see in the crucible immediately above.

Immediately after these set of experiments above I gave 10g of the emerald green colour to Graeme Thyer, one of the MFA students who had helped me. He included it in one of his cast pieces. The result is seen below in Fig 106.

Fig 106. *Bowl: B16*
Graeme Thyler, 2009, ht 5cm.

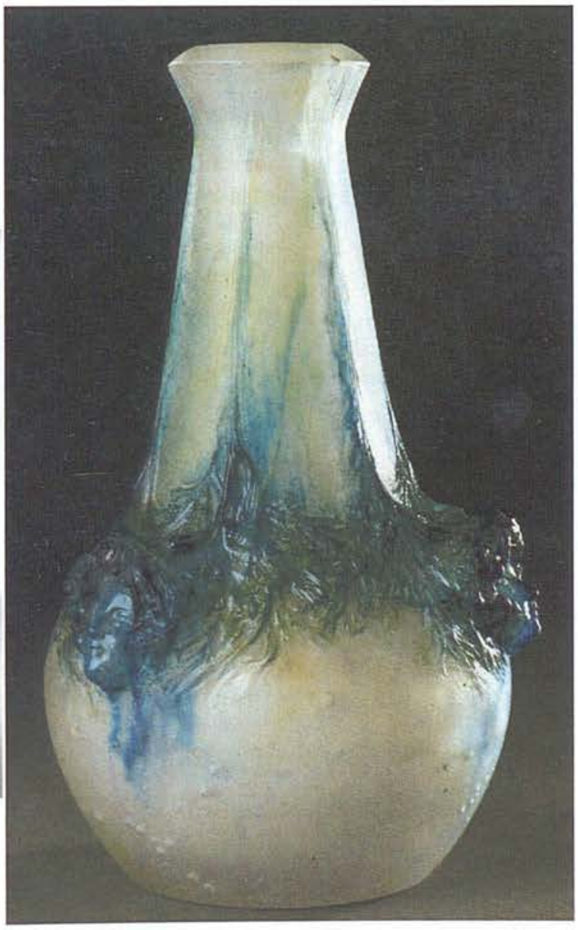


Fig 107. *Vase au long col. Masques*,
Decourchement, circa 1908-10, ht 19.5cm.

Within Graeme Thyer's *Bowl: B16* trails of dark green and turquoise can be seen. This effect is significant as no turquoise glass was introduced separately into the casting. These lines of blue colour are in all likelihood the copper oxide leaching out from the green uranium glass into the clear crystal base. The effect is remarkably similar to Decourchement's *Vase au long col. Masques* from 1908-10 (seen above in Fig 107), and it may be that this vase is using the same emerald-green as his quoted formula. The inclusion of over 4% of copper oxide into a batch of glass will not increase the intensity of the copper blue. Decourchement's formula therefore must have been deliberately devised to ensure not all the copper oxide (11%) was incorporated into the lead crystal in order to produce the effects we see here.

Chapter 8: conclusions

The process of making colour using an uranium salt is as simple as both the formulae above suggest. Other than modern Health and Safety issues surrounding the use and the legal possession of uranium salts there is no difference their use to create colours than there is to make a turquoise colour from copper oxide or a purple from manganese oxide. As long as one knows which uranate one needs any colour from their spectrum can be readily produced.

Two good distinct colours were made from these two formulae, which both match their general description. The golden yellow colour is very similar to Walter's golden yellow colour, and the formula may well be the one he used in his work.

The emerald green, however, is not, as its hue is somewhat bluer in colour. But the result in the green contaminated crucible above (Fig 104) does give a good idea as to what can be tried to make an emerald green that is rich in a yellow hue. It would be very easy to combine the two formulae to create a slightly different emerald green colour, and a new formula could be written. It would also be easy to simply reduce the amount of copper oxide incorporated into the original recipe in Formula A. In my earlier research at the University of Wolverhampton I had found that the addition copper oxide over 4g per 100g of lead crystal does not intensify the turquoise blue colour. It remains as a mid-turquoise colour. It can be deduced then that Decourchement's original formula was deliberately designed to give an emerald green that leached out its turquoise blue colour that we see in Graeme Thyer's *Bowl: B16* and possibly Decourchement's vase. This phenomenon is not seen in any of Walter's emerald-greens. If Walter had used a similar formula for an emerald green I would suggest it read as:

Per 100g @ lead crystal:
Uranium oxide (UO) @ 0.8g +
Copper oxide (CuO) @ 4g

Given that the uranate of ammonia makes a good golden yellow it would also be easy to produce a variety of other hues of yellow and green from it. The addition of iron salts at 1240° C may produce an orange hue, as would a small amount of manganese (Eveson, 1990). The addition of chromium oxide or potassium dichromate into the original formula would create other (leaf) greens rich in yellow. The addition of cobalt would produce another emerald-green.

As discussed earlier in Chapter 3 in this Book, (An Examination of the Broadfield House Collection of Walter) there are some pieces of Walter's glasswork that have a chrome-green colour to them, yet show up CPS readings of around 3-4. That is about twice the normal background level as recorded. This would indicate that Walter used uranium salts with perhaps the addition of chrome to create some of his greens. It is possible that the dark green hue of the leaves in the *Small Square Covered Box* in Fig 37 were made in this way.

From everything discovered above, it would seem then, that for Walter and his colleagues at Sèvres and Daum, making colour was a personal choice. They did not have to rely on 'off the shelf' colour to create their pieces, as modern glass artists do. They could decide on any colour they wanted and, provided they understood the processes and employed its chemistry, they would set about creating colour from dull raw metallic salts. That in the end is what makes that period of glass creation exciting. It is the knowledge that the colours we see in their work were made specifically for them by them. The methodology of producing colour was an integral part of their studio techniques. That knowledge alone adds an extra dimension to what we see.

What emerges for me out of the trials of making colour with metallic salts is that the possibilities for the creation of colour for the glass artist are endless especially with the use of uranium based salts. As an artist I get very excited by the production of colour this way, whether it is with uranium salts, which by their 'forbidden' nature automatically have a mystery about them, or with the use of less controversial metallic salts such as copper oxide and chrome oxide. The yellow produced with the uranate of ammonia, however, is a revelation to my artist's eye. It is the 'good sunshine yellow' made from cadmium, which I was taught at school and on my Foundation Course at Cambridge that is the basis of all good greens when mixing paints. To see it newly made in glass (and not from cadmium), and recommended by an artist who operated nearly a century ago, is astonishing. It transports us back not just a century, but much further in time. In gazing down at the golden mass made from the uranate of ammonia we suddenly inhabit the mind of the Medieval Alchemist in his efforts to turn base metal into gold. We experience what he was aiming for, and realise that (in this case) it can be done.

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Book III: My Personal Work

Introduction.

In this Book I explore my own personal work and how it has developed during my research. In this section of the research I draw together the first two books and bring them together into my own glasswork. My continuing investigations into Walter's methodology and techniques, and, in particular, his colour palette, have inevitably had an impact on my own work and thinking. Sometimes it is just the clear understanding of where I sit as an artist within his tradition. And sometimes, particularly with the formation of my new colours, the realisation I am on new ground and am extending existing boundaries. My work, which is illustrated below, has been challenging on many levels, not least in its subject matter and in the scale on which I have chosen to explore it.

In the following chapters I discuss my credo, which governs everything in my design work. I examine the antecedents of my present work including the influences, which have coloured it. I relate my early childhood experiences and the crystallisation in my mind of a duality in human nature that has had an effect on almost everything I do as an artist. I lay out the various influences on my current subject matter and define exactly what the subject matter is and from where its imagery is derived. I also discuss my relationship with colour, and its involuntary nature. It is colour (Walter's palette, how it was formed, how to reproduce it and how use it) that is the central thread, which runs through this study. However, in the exploration of Walter's techniques and methodology I am not copying him slavishly. I use what I have unravelled about his processes to inform my own work and to produce a type of pâtes-de-verre that Water did not.

I also discuss why I have chosen to work in glass. I discuss the use of glass as a medium of expression and how my work relates to other glass artists who portray similar imagery in their work, and I place my work in a contemporary context.

Chapter 1: My credo, the antecedents of my work and the influences on it.

There are many influences, which have imposed themselves upon me and ultimately inveigled their way into the realisation of my work. Like many artists I am not indifferent to the effect of external influences. In my research on Walter's work (his methodology, his techniques, his historical aspect and his scientific one) I have chosen to explore those external influences on me in the same defined, conscious way as I have chosen to explore his. Alongside this investigation there has been a long distillation of what makes up and defines my work. This, for me, has proved to be an interesting and fruitful one. Three major external influences have emerged, which I see as having informed most of my adult work, and which have helped to make up the thick soup of its imagery. A fourth one, one which possibly explains part of my fascination with Walter's own work, is my relationship with colour. This bond has always been there. As my relationship with colour literally has a chemical basis, it is in effect part and parcel of me.

At the very heart of how I view the world around me lie formative experiences I encountered growing up in post-colonial Malaya during the 1960s. They revolve around extraordinary religious and cultural events outside the usual everyday events we encounter in Britain. They have coloured nearly everything I do, and, I imagine, will continue to do so. At that time the exposure to cultures such as Chinese Taoism or emerging fundamentalist Islam, or the Dayak head-hunters of Sarawak were rare things. The Tamil festival of Thaipusum is one important exposure, which I discuss in depth later. We take for granted, now, that modern Britain is a multi-cultural place. Forty years ago it was not. But forty years ago Malaya was, and it was far more integrated in its acceptance of diversity. My early youth was spent learning about other peoples lives, however bizarre they might seem compared to the lives of white Britons.

Existing hand-in-hand with those experiences went the mixed emotions of continually moving backwards and forwards across the world to my homeland of Britain, and then back again to my parents' home in Malaya. These travels were at a time when international tourists were not so common. They sent me to places of legend and fantasy such as the ruins of Greece and Rome, and the temples of Siam and Ceylon, as well as the capitals of the Cold War and the slums of Cairo. But the effect it had was to displace me, resulting in a cultural confusion of identity. When the time came to resettle in England I remained unsettled, and it is a feeling from which I have yet to emerge. Friends, who experienced something similar in post-colonial Africa, as well as the Far East, have expressed that same feeling of displacement. Like me they feel they remain outsiders, never participants. It is a curious emotional experience, for a sense of belonging is at the centre of everyone's notion of security. For me, as an artist, it does allow me to consciously, and easily, step out of what I am doing and analyse it from another point of view. In the moment of participation one becomes an observer.

A third major influence came on me in my early twenties. It was the exposure to the painter and stage designer Nicholas Georgiadis (1923-2001). He was first my tutor in Stage Design at the Slade School of Art, in London, and then he became my mentor when I worked as his assistant on several Opera and Ballet projects. I quickly learned his methodology of working and observational techniques, and they have both stayed with me as working practise and have become my credo.

The fourth influence, which I have only recently come to understand, has always been there in my design work. Although its method of working is a strange, internal and chemical process, it does play a part in what I illustrate. I have only recently begun to comprehend its processes and the results often have been disquieting. It is the way emotions, provoked most noticeably by music, produce colour in my mind. This phenomenon is what I choose to discuss first, as much of my research into the work and aesthetic of Walter has dealt with the interaction of colour in glass.

From the analysis of what makes me tick as a human, a body of work for this PhD study has emerged that sometimes has little apparent connection with these original sources. But like a tapestry, although warp and weft are not always apparent, they still hold the silks that produce the image.

1. My Relationship with Colour.

While it has not been formally diagnosed I am aware I may have a form of synesthesia. The succinct definition by Cytowic (Cytowic, 2002) is this: Synethesia is 'a neurologically-based condition in which stimulation of one sensory or cognitive pathway leads to automatic, involuntary experiences in a second sensory or cognitive pathway'. In other words a sound, or perhaps a smell, triggers a memory or an experience of something totally unrelated. We know it most generally as the ability to see colour when words are spoken, although it is not confined solely to that. I do not have that form of it, but I do experience something similar when I hear music or experience intense physical emotion.

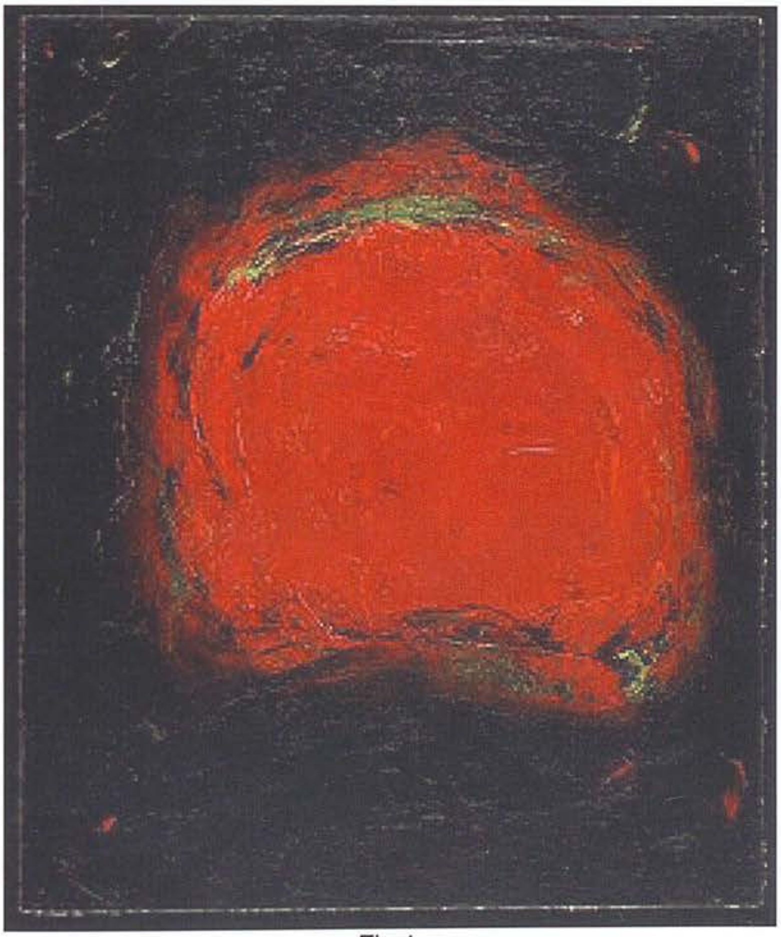


Fig 1.
Vision, Carol Steen; Oil on Paper; 15x12-3/4" 1996.

The painting above in Fig 1. by Carol Steen, is for me an important image. It is a representation of a synesthetic photism experienced during an acupuncture session. It is exactly the form, shape and vibrational colour of something I too have experienced during acupuncture. In remembering that event my mind's eye holds nothing else, and the longer I look at Steen's piece of work the more I re-experience the experience. I can even feel the rotational prickling of the needles in my knee, and the way the colour held a vibrational note. I have partially used Steen image in one of my pieces.

I first began to be truly aware of this facility when I was assisting on the model designs of 'Swan Lake' for the stage designer Yolanda Sonnabend. Like Georgiadis, she too was a tutor at the Slade School of Art, and had a long working relationship with the Royal Ballet. The sets for Act 1 had been created in autumnal tones of yellows, browns and oranges. This colour palette had emerged from a continuous listening to and absorption of the music. Associated chords in C-major flow through the composition of that Act, the key of 'C' being traditionally the 'sunshine' key (Cytowic, 2002, Firth, 2010). Act 2, which follows, is a much 'darker' scene emotionally involving as it does half-humans trapped between worlds. It is written in minor chords. The sets for Act 2 were proving to be a problem for Sonnabend. 'What colour is the key of B-minor?' she kept asking. To my mind, having being exposed continuously day after day to recordings of the music, it was an intense Prussian blue, and could only be that. Once I voiced that opinion no other colour would fit the identity of the music. Sonnabend embraced the idea, and the colour, for the basis of her design.

Fig 2.
Model for Act 2 Swan Lake, Royal Ballet, 1987.

I continued to use much of this ability when I worked as a production designer on animated films for the BBC and Channel 4 (UK). There I designed stop-frame animation, which used classical music as the text.

This innate ability to judge colours from provoked emotions has continued throughout my career in television and film, and continues to do so now in my work in glass. In one piece made during this research, "The Sense of My Screaming Skin: Manifesting My Bi-polarity' (see Fig 3, below), I have deliberately chosen colours that convey the suffocation of the experience, or rather colours have emerged that fit the experience. What one observes in the piece are my internal experiences during an intense episode of ultra-rapid cycling Bi-polarity, a condition that has plagued me since my teens. Intensity of experience does not always produce what we traditionally assume should be intense primary colours, as seen in Steen's image above in Fig 1. Sometimes, intensity of emotions can be claimed by a subdued palette of tertiary material. That is the curious nature of the condition. In this study I have not used music to colour my work as I have done for my animated film work, but rather to allay the effects of the work itself as I make it.

Fig 3.

The Sense of My Screaming Skin; Manifesting My Bi-polarity, Max Stewart, 2010

I discuss this later in more detail in this Book when I describe the processes of my work. But the general choice of colour and what I experienced because of it partially is how I judge my own work and how I judge others, whether glass or not. For me it is an essential component of what the piece works and how successful I find it. Colour has to go hand-in-hand with Shape and Form rather than be overlaid. Nor should the work just be about the colour. That I find lazy and dull. Even its absence i.e. colourless, transparent glass, has to be a deliberate choice. I have described in Book II: Chapter 1 how Walter's palette was deliberately chosen and limited. I have also shown that in the works of other pâtes-de-verre artists, such as Argy-Rousseau, coloured glass began to be used simply for its own sake. In my study it is colour that has become the central thread.

2. The Batu Caves.

The continuous and underlying influence on my work that lurks in the depths of my memory is my exposure to the Thaipusam Festival of the Tamil Hindus. It is an extraordinary religious event takes place over three days every January in the Batu Caves that lie to the south of Kuala Lumpur, and which are the southernmost tip of the Himalayas.

Fig 4. The Batu Caves, 1964.

During the three days a vast public procession of devotees, their families and onlookers, wends it way to the enormous lime stone caves. Male devotees, who have fasted, cleansed and chanted themselves into a frenzy of ecstasy, make penance by mutilating their bodies. They pierce their chests, backs, thighs, cheeks, lips, tongues with silver needles or skewers, sometimes hanging pots of buffalo milk or fruit from them. The devotees, with the use of additional skewers carry contraptions called 'kavadi' that act as shrines. These too are hung with brass or clay pots full of milk as a thanksgiving gift for children, the symbol of prosperity. The images seen in Figs 4, 5, 6 and 7 were taken by my father in 1964 at the first festival I remember attending.

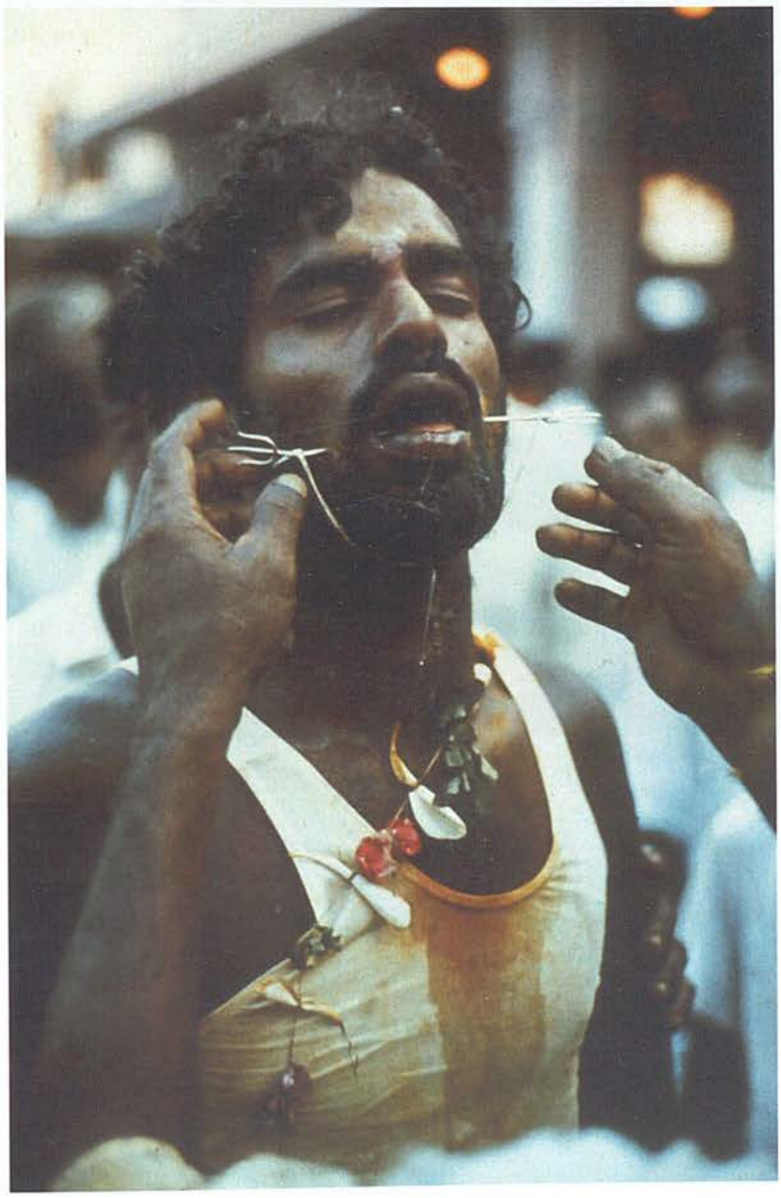


Fig 5.

A Thaipusam Devotee being pierced with a silver skewer.

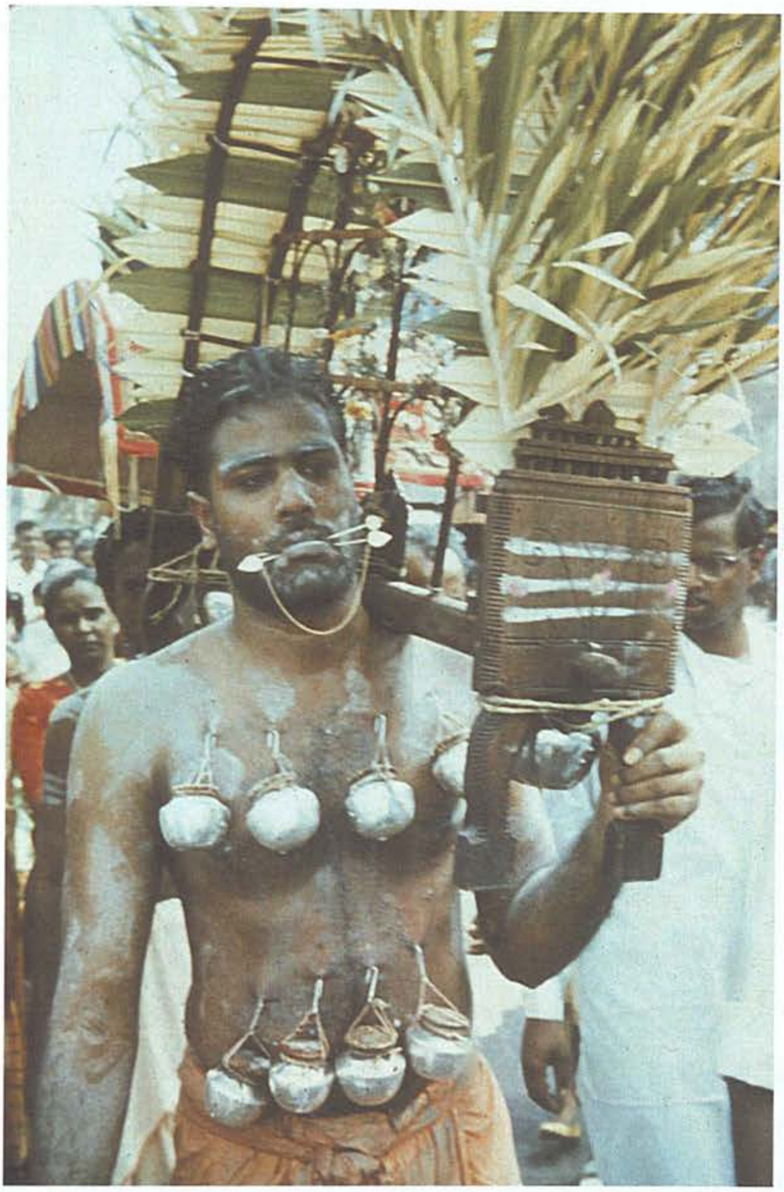


Fig 6. A devotee in procession.

Fig 7. The Thaipusam procession in Kuala Lumpa, Malaysia.

Sometimes hooks are inserted into the back of the participant with family members pulling on ropes attached to them like monstrous umbilical cords. When he reaches the temple cave the religious devotee must then endure an arduous climb up a 272-step staircase. Observers and devotees alike, claim no blood is shed during the piercing or removal of the silver hooks and skewers and, miraculously, the wounded flesh heals with no apparent scarring, the only ones being deep in the mind of the casual observer. A Duality of Being is achieved. Cut, pierced, but seemingly impervious, a mortal man is temporarily made immortal. In these images you have duality of pain and balm: the pain of mortified flesh and the balm of (mother's) milk. For me as a child a normalisation of what is acceptable *in extremis* began to take place.

Bizarre and culturally alien as these ceremonies seem to us in the West they are readily paralleled in the Christian world, and this was continually pointed out to me. The singular theme that strikes me in all three of the photographs immediately above is one of the Stations of the Cross and Christ's Procession to Calvary. The self-imposed fasting during Lent, the mortification of flesh in some religious aesthetic communities, and the willing 'crucifixions' of devotees during the Good Friday parades in the Philippines and South America are purely Western inspired, yet they are identical in form and ceremony to Thaipusam. Ritual mortification of flesh to achieve another state of mind and body modification as part of a rite of passage is a worldwide phenomenon. It seems it is a deep-seated part of the human psyche. Roland Loomis, better known as Fakir Musafar has debated this in his interview given for the book Modern Primitives (Vale, 1989). In the interview he discusses the range of societies, which use piercing as a form of ritual. They include the Sadus of India, the Ndebeli people of South Africa, the Mandan Indians of the Missouri region of America and the Minangkabau people of Padang in Western Sumatra.

Fig. 8.

Fakir Musafar in a state of trance as his pierced flesh supports his kevadi.

Because of my young age and my parents' emphasis on the acceptance and investigation of other's cultures, public self-mutilation as an act of devotion, seemed perfectly normal. Our intrusion seemed to be welcome, too, as the participatory nature

of the event does involve by-standers. And if public display of intimate moments (and the voyeurism that accompanied them) were normal, then what couldn't be?
The exhibitionist nature or 'performance' of these devotees (whether Hindu or Christian) fed directly into my interest in Western Theatre techniques. Having been introduced by my ayah to the shrines of the Taoists, and seen at first hand the similarity of their devotional prayers to the practises of the Roman Catholic Church and the theatrical aspects of the High Altar in Rome, I learnt early on that theatre, both in the West and in the Far East, came out of religious ceremonies, and that religious practice was predominantly about the spectacle of costume and drama.

In many ways St Peter's Basilica in Rome parallels the vast space within the Batu Caves, albeit a man-made space. There is something about an enormous area constructed for ritual that creates anticipation. The empty pressure of the space, for me, taps directly into man's ritual psyche. It is easily witnessed in stadia worldwide at rock concerts and football matches or in the arenas of the bullfights and other coliseums. Afterwards there is the intense empty presence of a drama that has passed. That, too, is identical where ever one goes. I discovered a similarity of this presence in the Victorian proscenium theatres of London's West End and the grand opera houses of Europe. During the gathering of the audience there existed an anticipation that some extraordinary event was to take place. Gods and monsters were about to declare themselves, and through seemingly magical transformations divided bodies would be restored without the actual shedding of blood or of pain. In these performances/ceremonies a transubstantiation of the physical took place. Man dons a mask and becomes 'Other'. With a simple piece of shaped leather or decorated fabric reality is transformed into imagination and a duality exists (Masks: The Art of Expression. 1994). This has filtered its way into my present work and the continuing fascination I hold for the head, and its decoration. This duality is important to me and I explore why in my work below.

3. A displacement in the sense of belonging.

The next major influence on my work involves a displacement in terms of the sense of belonging. In the 1960s Britain was then, and to a certain extent remains, a foreign country to me. As a peripatetic émigré, crossing borders and cultures as we travelled to and from Malaya, my family, my individuality, my 'I' remained the same. What changed were people's perceptions of us, and therefore how we were treated. The final move back to the UK was unsettling and disorientating for me. In order to fit in, not stand out, a Mask was created. At an early age I learned that this Mask took on a different shape or meaning depending not just on how one played oneself, but also on the prejudices the viewer brought to it. For instance Accent and Position represented Class, and friends and enemies were established immediately and purely on the sound of one's voice and where one lived. A *duality* began to exist in my mind that became normalised throughout my teens. On a childish level there is always the real and the pretend, but as an adult it is about perceptions, about boundaries and the blurring of edges. It joins forces with the duality I observed in the Thaipusam festival and reinforces that experience. Depending on one's perception everything is fake and everything is real.

On a personal level it is easy to indulge in the fantasy that another country or another time is a splendid place as memories become blurred or reinforced. To allow one's present situation to be compared and contrasted to a past existence is all too easy to do. For me the guiding hand in the correction of memory and the justification of choices is Georgiadis's quote about the past in the next section below. I apply this to my work as well, and I constantly seek to change, develop and advance on the present. That contradictory composition of life, its slight schizophrenic quality, has had a lasting effect on my perception of things.

What all this means is that I am constantly intrigued by the way people observe and react to the same stimulus, whether it is written, visually observed, emotionally felt or physically experienced. The truism that one man's meat is another man's poison is constantly upheld. Without having to make work to sell for a living I am, in this research project, allowed the freedom to explore some of those ideas generated above.

4. The influence of Nicolas Georgiadis on my personal work.

The influence of Georgiadis has had an immense influence on my design work and the thinking behind it. His quote to me below is the prime example of what I have always attempted to explore in my own work.

'What interests me is the space between what the viewer sees and what he thinks he sees.'

For me, that space is filled with responses that spring from awakened emotions.

In his obituary in *The Independent* by Nadine Meisner she writes that as a tutor in Stage Design at the Slade School of Art, 'wanted his students "to learn from the past in relation to what they might be trying to do", but discouraged them "from becoming *enamoured* of the past".' (Meisner, 2001;) It is a simple statement, and once expressed to a student becomes firstly a great truth, and then afterwards becomes the underlying touchstone. Crudely put it allows the past to have an influence, as it is there to be delighted in, drawn from and plundered, but it must not restrict your progress, as it remains the past.

As his assistant he would constantly reiterate the phrase to me: 'At 40 feet (in the theatre auditorium) you have to be subtle in an obvious sort of way'.

I took it to mean that the observer must begin to understand the motivation of the artist without programme notes, and that something must be awakened in the viewer even if he does not consciously recognize it. I believe this phrase holds great truth for any artwork whether it be theatre, sculpture or painting, and it has been the motivating force throughout my work as a designer in theatre and film, and now latterly as a glass artist. These three quotations of Georgiadis have melded to become my guiding Credo.

Chapter 2: Why I have chosen to work in glass.

I came to working with glass relatively late in my design career, even though I was introduced to glass on my foundation course. Making objects from it for a living never really promoted itself as a career or a study choice as I was determined to seek a career in stage design. It was only having a successful career in animation at the BBC and then later at Channel 4 that afforded me the indulgence of collecting modern glass, notably the work of Peter Layton and his studio. Finished work from him, together with experimental pieces from his assistants, formed the base of my collection with two notable examples from his *Rainforest Collection*.

My interest also lay with modern ceramics, and I bought a great deal of work from the gallery of the Craftsman Potter Association, in Marshall Street in London. Amongst purchases and commissions were the work of the Irish ceramist Michene Bradley, whose degree work echoed platters and forms derived from Bernard Palissy and his revivalists. At the same time I bought vases and *vides-poches* from the Paris shop of Daum, and began to take an interest in the way glass could be something other than blown. It is the combination of the last two that curiously drew me to Walter's work.

Glass was also a relatively foreign substance to me. It is not an historical artefact in the Far East where pewter, wood and porcelain are supplements for glass. It was never a substance the region made, or had a history in evolving. Glass milk bottles were of enormous fascination to me when I returned to Britain, and the pressed glass of my grandmother's vanity table seemed to have come from the world of fairyland.

It is not necessarily the transparency of glass that appeals to me rather it is its chameleon quality that grasps my attention. Consequently, I like it all and I have little time for practitioners who claim that glass 'should be this' or 'that'. The fact that ancient Egyptian and Mesopotamian glass is opaque matters not. The solidity of their surfaces and their attempts at precious stone fakery is as entrancing to me as the delicate *cristallo* products emerging from 15th century Venice. I am constantly startled by the phenomenon of light passing through stained glass in the cathedrals of Europe, and relish the thought that imbibing quality wines from gilded and etched crystal allows one to live like a renaissance prince. Equally, I enjoy the subtlety of surface from the glass mosaics of the Persian and Mughal world with their mirrored ceilings formed from thousands of convex ovals.

I recognised early on in my involvement with glass that the substance was full of contradictions, its body being difficult to manipulate and manhandle when hot or cold. As I began to collect some Roman glass which was 14 hundred years old (or so I was assured) it seemed extraordinary that something so fragile could remain intact in the burning deserts of the Eastern Empire for so long only to shatter in a moment on my kitchen floor in a myriad of shards. In some way one is dealing with a chimera, a substance made up from several disparate but concrete ingredients, and yet can become nothing in an instant.

In the end, and at the deepest level of my enjoyment of it, it is the implied magical alchemy involved with glass, which has held my fascination. Glass is truly base matter transformed into pure. Unlovely raw ingredients such as litharge and silica are heated to vast temperatures until they merge one into another, and the subtle matrix of glass is achieved. That seems to have a whiff to it of Titans performing tasks for the ancient Greek gods in the creation of their world. Similarly, the fact that glass remains a liquid even when cool is one of the 'magical' properties that fascinate me. How is it that one can hold a liquid without it slipping through one's fingers? With glass, one can hold a wave upon the sand. The knowledge that lead crystal glass was a centuries-old attempt to emulate rock crystal lies for me at my relationship with glass. Like that mineral, glass seemingly has metamorphosed from something other (Pliny, Healy, 2004). When I see colourless, transparent glass I do not see 'glass', I see rock crystal, and I am reminded of both Pliny and Georgiadis. In the modern world we seem to have forgotten what exactly we are we looking at, poetic substance, or divine happening? Or both. Pliny's assertion about the antecedents of the mineral has poetry to it. It reminds me, too, of the Maori creation myth of the physical world being brought into being the moment when Light congealed into Matter. That is a good metaphor for glass and I have its image tattooed on my arm.

Chapter 3: Placing my work in a contemporary context.

At the beginning of this study I was asked by my lead supervisor, Ray Flavell, to place my work within a contemporary context. I decided I had an opportunity to make a new body of work that came solely from my own imaginings and experience. This was a way of continuing to develop the work I had begun in New Zealand prior to my research here, which had partly been about heads and masks. It also afforded a way of establishing myself in a new (British) market. As a result I felt I had to find an area of subject matter that had not been tackled very much before and which would possibly establish me in the public's eye. It would be all too easy to argue the case for making reproductions of Walter for this study and become a mere faker. While I like Walter's work and admire his output I am not interested in making reproductions of his work. I want to know what his techniques are so I may illustrate and develop them. That is the purpose of this study. Sometimes the shapes and subject matter in the work I have made for the discussion in this Book have been chosen partially to illustrate techniques. Calculated choices have governed what I have produced, but fundamentally, I think that Walter and I are two very different artistic beasts.

As I have discussed in Book I, Walter's subject matter was simple, relatively unchallenging and sat neatly within the decorative sensibilities of the world of the late French Art Nouveau. His work was decorative craft. Mine is not. In all his glasswork it would appear Walter has never produced something that could be described as a personal body of work made simply for his own benefit, or one that presents him as an expressive studio artist. His work was made to sell to a buying audience. Unlike Walter, my work involves my personal thoughts and experiences and is designed to challenge the viewer. It sits within the sensibilities of the early 21st century, not the 20th's.

Before beginning this study, my work in New Zealand started to deal with masks and facial presentation, with subject matter that sometimes sat between two worlds as in the image of 'The Ghost' in Fig 9, below, shows.

Fig 9. *The Ghost*, Max Stewart, 2004.

I also explored historical events that affected gay man such as the experiences of homosexual men in the concentration camps of Nazi Gemany during the period 1934 – 1945. The image of 'The Hanging Man' (Fig 10, below) represents one such piece.

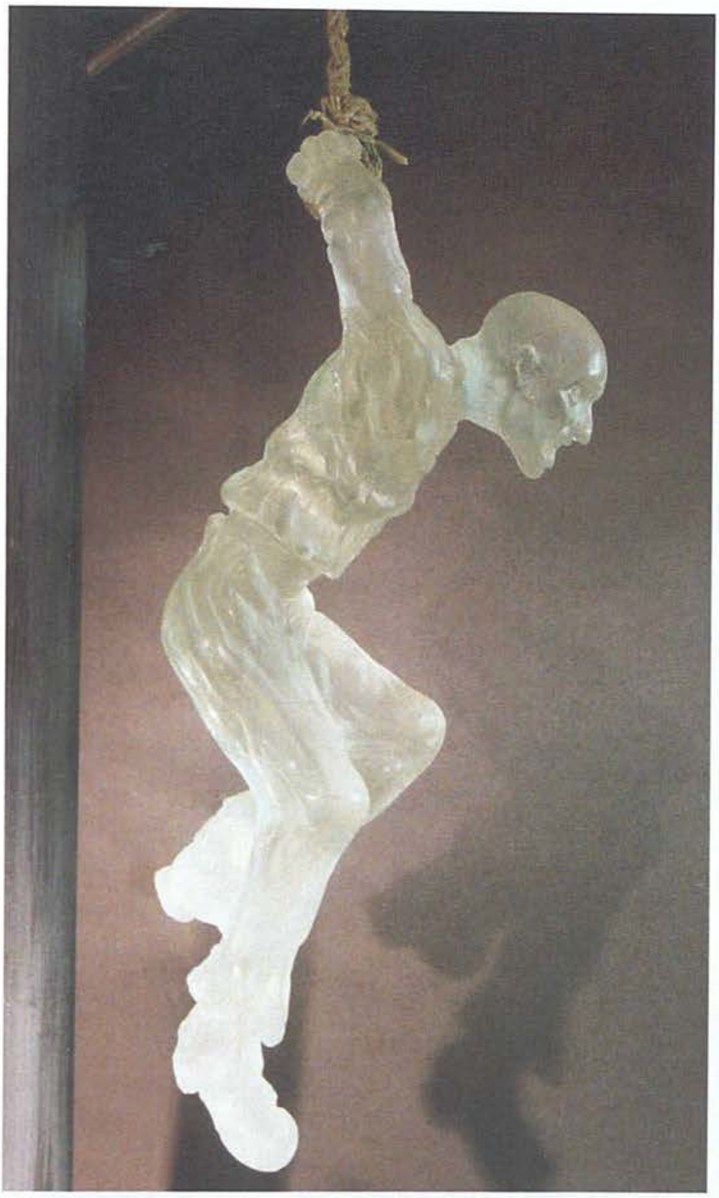


Fig 10. *The Hanging Man*, Max Stewart, 2005.

Both these pieces portray disturbing images. *The Ghost* (Fig 9.) deals with a moment in time when an unhappy spirit breaks through the worldly membrane to deliver a message of portent. *The Hanging Man* (Fig 10.) portrays man's own inhumanity to another in a torture scene. Neither is meant to be a comfortable image. They are designed to disturb and unsettle.

Coupled with this, my pieces are designed solely by me rather than in collaboration with other artists and designers as Walter had done. They are also on a scale much larger than his, and involve enclosed moulds, which are technically more challenging for pâtes-de-verre than the relatively small-scale open cast moulds Walter employed.

In trying to place one's work within a contemporary context inevitable comparisons and alignments are made as to whose work is similar in subject matter and feel. While I am very aware of other glass artists, such as David Reekie and Bertil Valien who deal with figurative material in a powerful way, I have rarely allied myself artistically with them. I have always felt my work has more of a connection with artists such as Ana Maria Pachego and the late Michael Ayrton (both sculptors and printmakers). Certainly these two artists have made lasting impressions on me, and, like other images that I draw upon, their work has remained in the background of my thought processes for over thirty years. The most telling example is of a photographic image of Pacheco's 'The Acrobats'. I have been carrying it around with me for a quarter of a century.

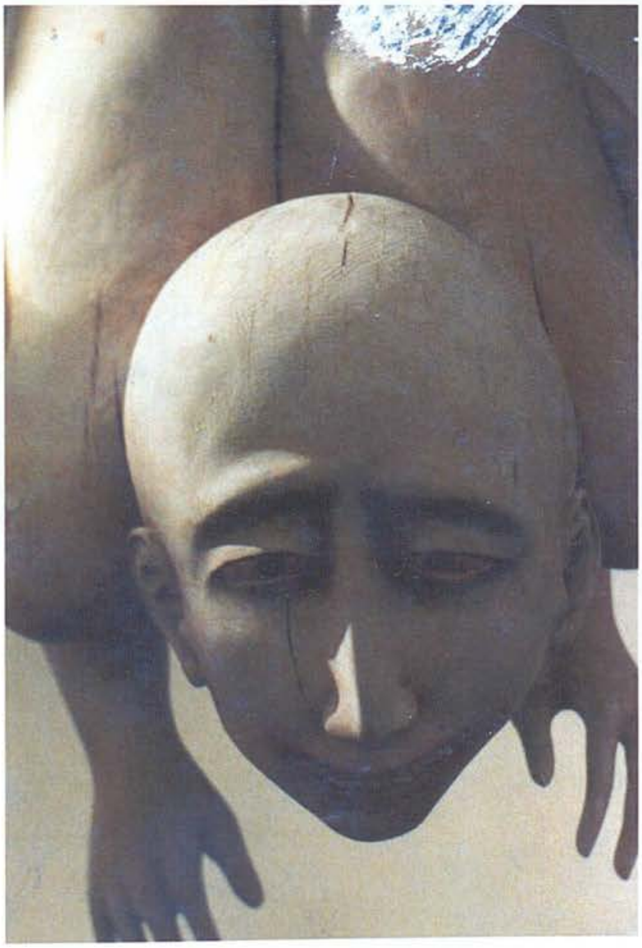


Fig 11.

The Acrobats (detail), Ana Maria Pacheco, 1983.

It is now a fading print having been a constant on my studio wall above my desk, but its power to disturb remains a constant trigger for me.

Pacheco is an artist who ploughs her own furrow despite fashion and trends in worldwide art movements. Her work has the ability to disturb and push away the viewer. Another image of a piece of hers, which I also keep in my studio, is *The Banquet* (Fig 12, below).

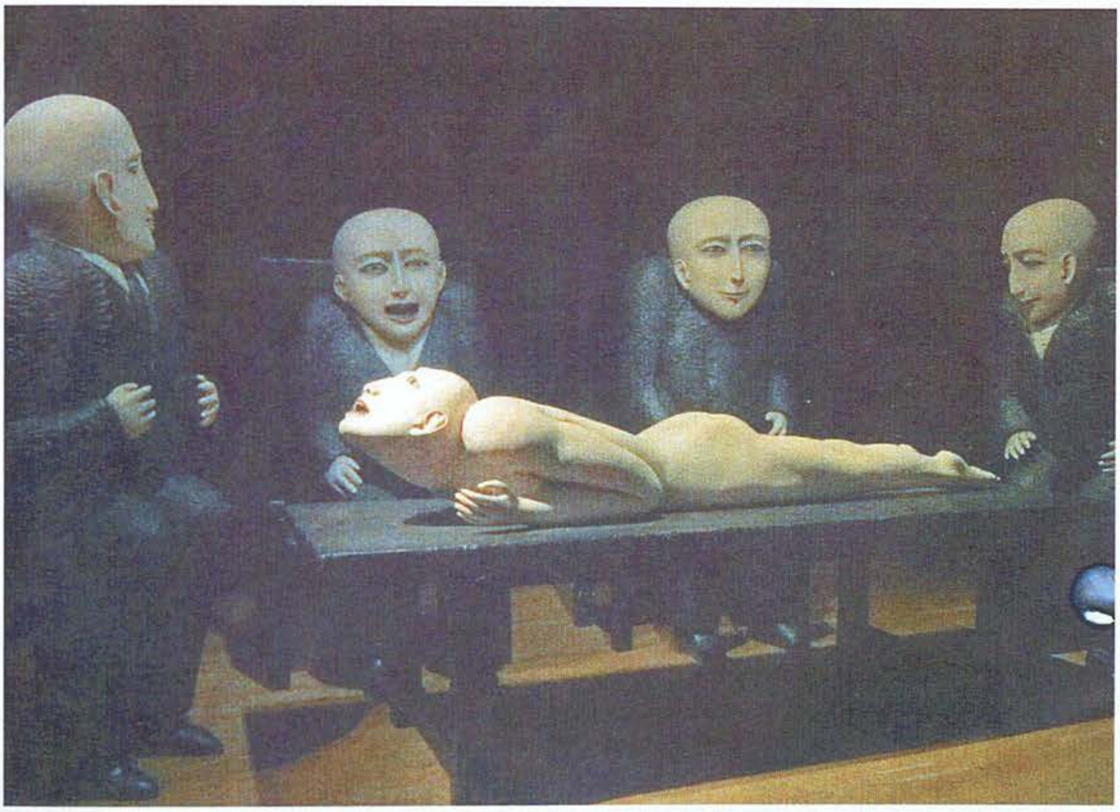


Fig 12. *The Banquet*, Ana Maria Pacheco, 1985.

It is a piece that holds immense power. Four over-large dark suited men with doll-like heads are seated in judgement around a naked woman who is laid out like a piece of fantasised rubber or moulded veal. Its subject matter, which touches on abuse of power and gender, resonates and disturbs.

Her 2006 exhibition entitled 'Some Exercise of Power' in the West Dean Gallery, West Dean, West Susex, in which the *The Banquet* was displayed, created much consternation from the viewing public. On that occasion I watched people flee the gallery when confronted with her work. For me that is an achievement. For a piece of work to have such force that it is able to make a person tremble with such terrible emotions so that they have to remove themselves from its presence is what I want to accomplish.

Pacheco's subject matter is figurative and symbolic, whether it is portrayed in her printmaking or in sculpted wood, her chosen medium. Coming from Brazil her imagery contains elements of religious iconography (bible stories play a role in her work), and there is a deep influence of the gessoed saints of the Portuguese and Spanish South American baroque. Her work is partly inspired by the troubled period of Brazil's history, culminating in the takeover by the military junta in 1964, to which she was an eyewitness in her youth (Collected Essays: texts on the Work of Ana Maria Pachecco. 2004). The works consistently deals with relationships between oppressors and their victims. It is a constant food, which feeds her images. Clearly her work has the ability to shine light in the void between what Georgiadis said interested him: the space between what one sees and what one thinks one sees.

When I met her in 2006 Pachco told me to just do what I needed to, and to not rely on fashion or the market when inventing images for my work. This, for an emerging artist, gives the reassurance to pursue one's subject matter, even when one is confronted with other' doubts about the work. It has encouraged me to continue in what I have produced in this part of my study.

Michael Ayrton (1921-75), on the other hand, has subject matter that lies within the realms of myth. He is closely associated with the English neo–romantics such as Graham Sutherland, John Minton and John Piper (Cannon-Brookes, 1978). His figure of the 'Talos', the robot of Ancient Greek myth, was constantly in the fore of my consciousness as a teenager in Cambridge where it stands close to the market square.

Fig 13. *Talos*, Michael Ayton, Bronze, 1975.

Ayrton worked at a time in British art (1950-1970's) when abstract expressionism had the upper hand, the figurative being relatively discarded and viewed with suspicion (Cannon-Brookes, 1978). Ayrton found a way around the problem of how to display the human form and describe its humanity while being confronted by an aggressive reaction against figurative art. He fragmented the figure into its essential parts and portrayed the rawness of what motivates and drives the subject. The drawings and the maquettes of his larger projects hold a vast weight, sometimes suggesting a subject matter of the calm before onslaught, sometimes describing a visceral power. This can be all to readily seen in his portrayals of the Minotaur, a theme he turned to constantly in later years, and which consistently deal with the notion of a beast defined by a duality (Cannon-Brookes, 1978).

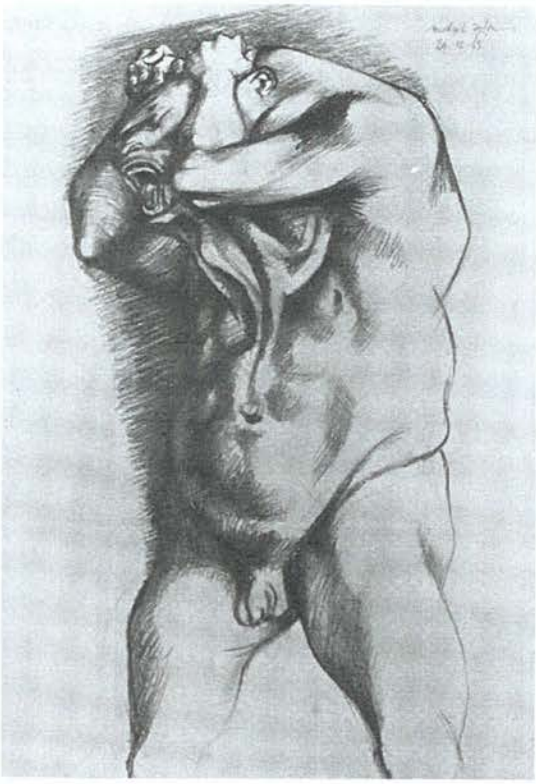


Fig 14. Michael Ayrton, *The Minotaur*.
Engraving, 1963.

Fig 15. Michael Ayrton, *The Minotaur*.
Bronze, 1968-69.

In the two images above the intensity of the inner beast breaks through to the viewer. We are confronted with a screaming anger in one (Fig 14.) and a reflective power in the other (Fig 15). Both send the immediate message to the viewer that he/she is in the presence of a primeval force of nature, something that exists in a space between clearly defined worlds.

Ayrton, too, was a stage designer and his work has a sense of intense drama about it. This is what partially appeals to me about his fabrications. It is not hard to imagine any of his figures about to emerge onto a stage and declaim bold truths, which define and manipulate the drama.

A third artist has recently come into the gravitational pull of my consciousness, one whose honesty as an artist I admire. She is Tracy Emin. While much of her work, to my mind, remains a series of repetitions which possibly verge on the edge of art therapy, I have nonetheless have been pulled in to her mode of working. Taking her own chasm-deep experiences of sex, alcohol and emotional betrayal she serves up on a metaphorical platter raw, honest emotion, displaying it, quite literally, as dirty washing, as in the work of her infamous *My Bed*, or in the vein of crass neon advertisements for lagers in a Witherspoon bar (Elliot, 2008). The two images below show how brutal she can be: unnerving statements, which shock.

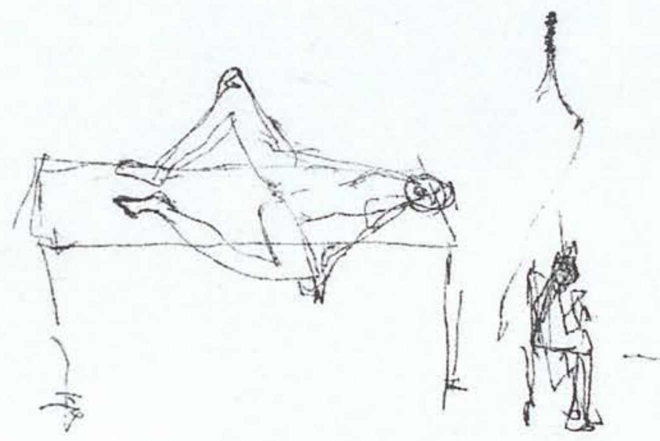


Fig 16.
Abortion: How It Feels. Abortion 1, Tracy Emin, 1995.

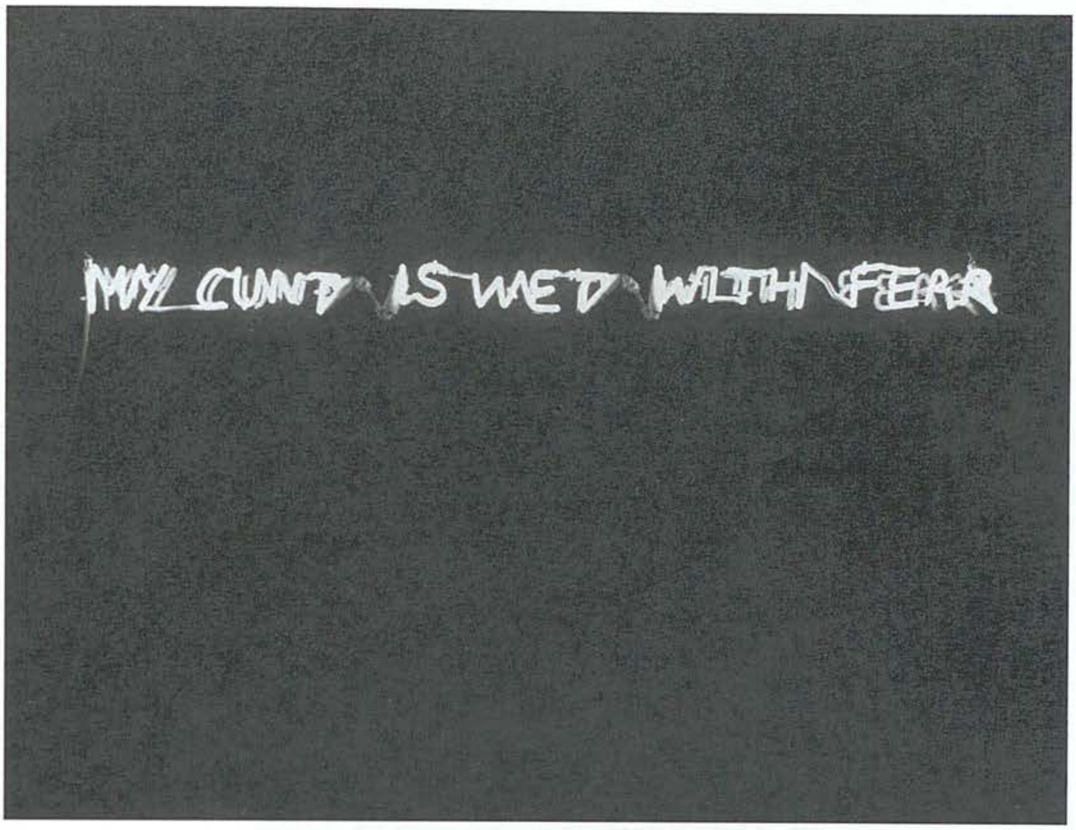


Fig 17.
My Cunt is Wet with Fear, Tracy Emin, 1998.

Emin has the tenacity to know that what she gives us her audience is something we all experience at one time: fear, desertion and utter loneliness. Emin is not ashamed to present her emotional entrails for our inspection. In fact she embraces it, and it is this boldness of confrontation, which appeals. It links her with Pacheco and Ayrton. And in a curious way links her to Palissy, showing us, as she does, the human condition in this age (Elliot, 2008). Palissy served up for his audience direct metaphors displayed by the hedgerow of French flora and fauna. Emin serves up similarly bleak messages about the human condition derived from her personal metaphorical hedgerow. She goes where few have dared in holding the mirror up to nature.

The themes portrayed in the work of Emin, Ayrton and Pacheco I have rarely seen portrayed in glass, if ever. The works of David Reekie, Bertil Vallien, and Michael Clayton, while technically astounding and full of their own enchanted meaning, do not pull my heartstrings or manipulate my emotions as Pachego, Ayrton or Emin do. In these glass artists' work I find there is no sense of danger and drama, no sense that a rip tide will pull one unwillingly from out of a comfortable viewing point into wild depths of emotions. Inevitably comparisons can be drawn with their work and mine, especially as we all work in the same general area of form as the three images below show.

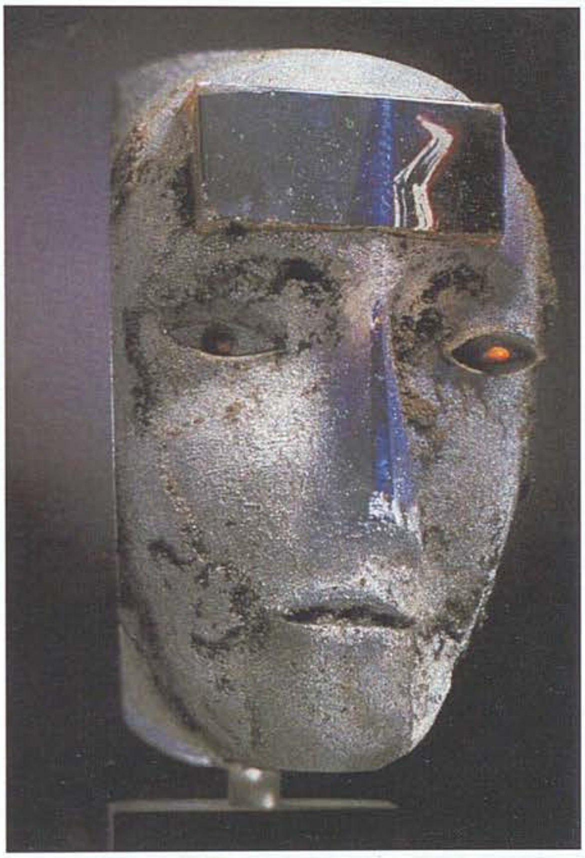


Fig 18. *Heads*, Bertil Vallien.

Fig 19.
Disturbing News, David Reekie, 1990.

Because Vallien and Reekie make works in glass of heads and figures does not necessarily mean I ally myself with them. I do own a piece of Reekie's work, but it is a drawing, not a piece of glass. It is the message the drawn work sends out and how it moves me, the viewer, which produces the alliance. While I admire their technique and mastery of their craft, their work does not inveigle its way into my sub-consciousness, as others have done.

That being said with the presentation of Vallien's work there are resonances of what I am trying to achieve. The way he displays his work and the way he considers the presentation of the work as part of the overall design, have become important to me during this research. Often his work has stands and supports, which are integral to the overall look. The three heads in Fig 20 below are a good example of this.

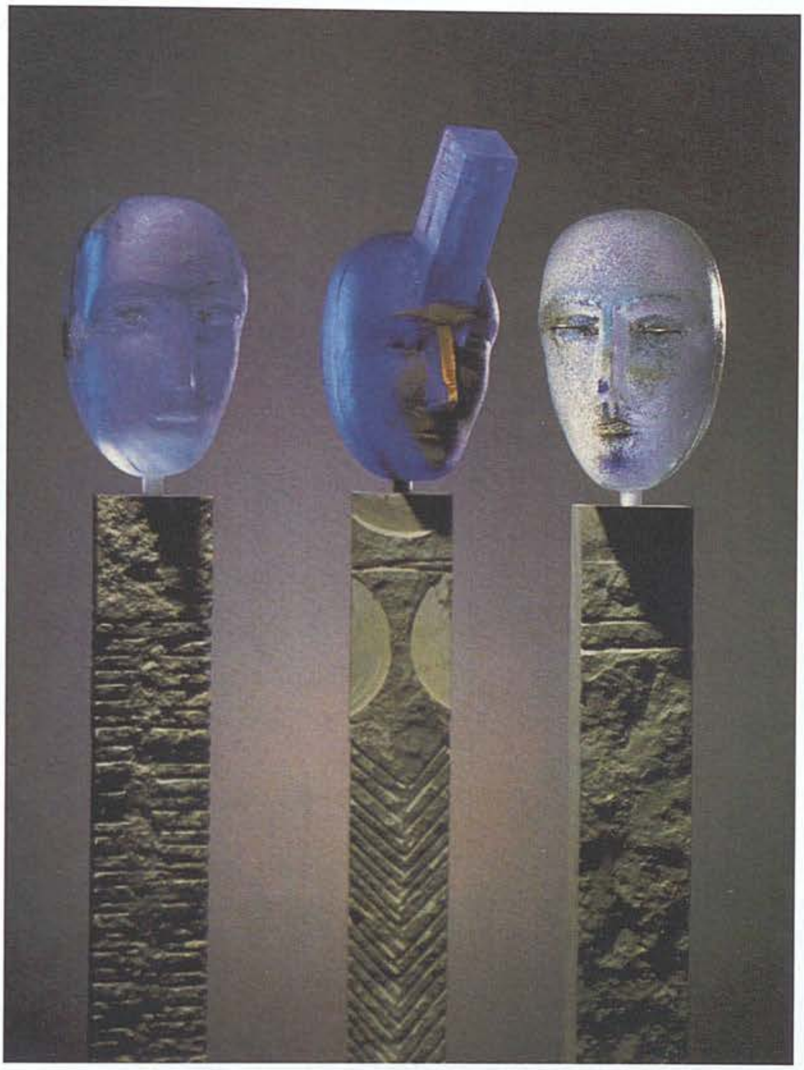


Fig 20.

Heads, Bertil Vallien, sandcast on plinths of hewn and polished limestone.

The image echoes the quality of destroyed heads of French kings I have seen in the Musée de Cluny in Paris. The archaic quality of Vallien's sand casting techniques for resonates with the ancient corroded sandstone of royal ghosts. But it is the way both sets of very different work and materials are considered for presentation to an audience.

Fig 21.

Exhibition of blue heads, Borgholm Castle, 1996,

Fig 22.

Heads of French Kings, Musée de Cluny, Paris

Fig 23.
Display of broken statuary, Musée de Cluny, Paris.

By placing the works on stone plinths, either carved or simply styled as in the three image above (Fig 20, 21, 22, 23) , the past nobility of these heads are honoured. It is this quality of presenting the work as an artefact or a museum piece that I like. It promotes the work from being just another piece of glass to something that the audience has to consider. The question that floats in the sub-consciousness of the viewer is " why is the work promoted like this?' It forces the viewer to take the work seriously, like a figure of authority wearing a hat; the implication being that as the work has been presented as a museum object then it must be worth considering, and therefore subject matter that may be all too easily dismissed is given a second chance.

Elements of Valien's work do have another link to mine, but only in the way that he is prepared to use within the work another material very foreign to glass and one that contrasts. The work *Aran Safir* (trans. 'Aran Sapphire') in Fig 24, below, is one such piece. The long, Canterbury blue shard is girdled by a rusting leather corset, which becomes the focus.

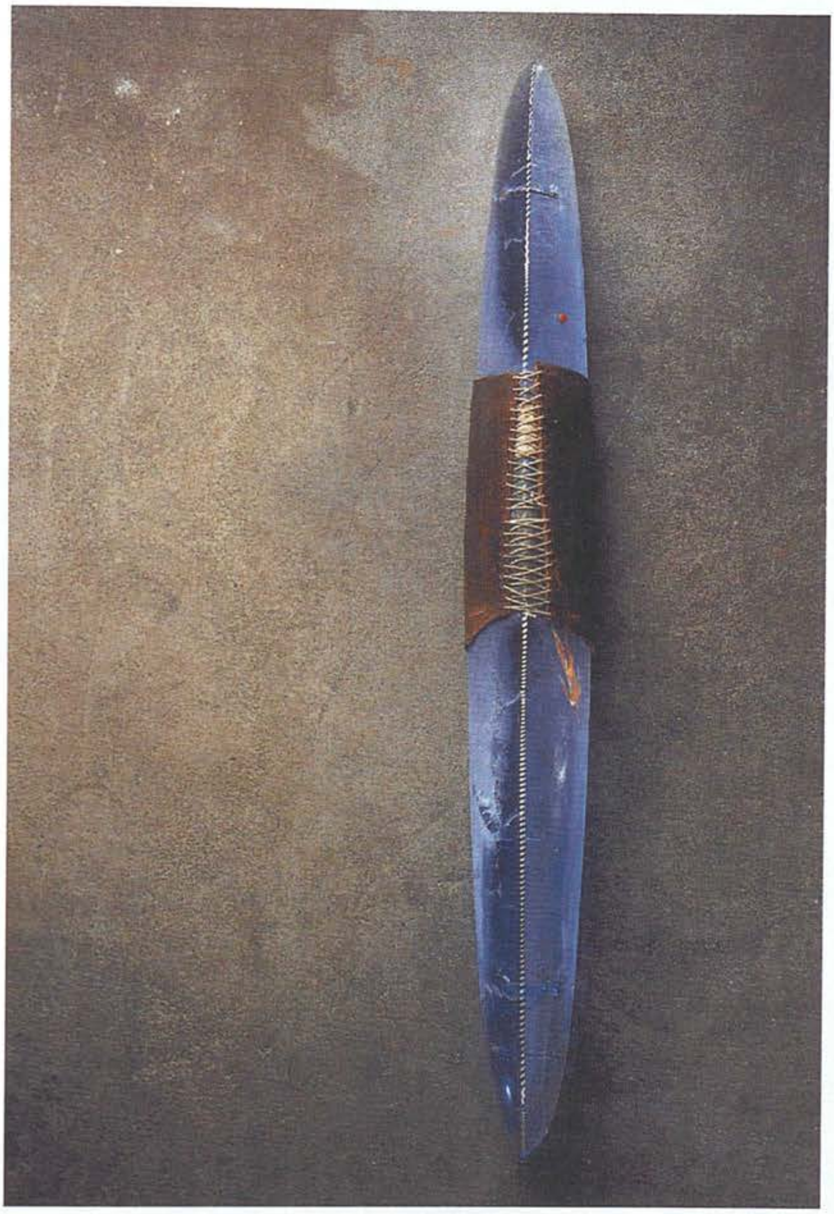


Fig 24. *Aran Safir*, Bertil Vallien, 1988.

By using another material in such an extraordinary and integral way the glass becomes less important. Its quality takes a secondary place to the final overall image. That I find very exciting. As a result, during this study, I have begun to explore this use of other materials in my works.

Irene Frolic and Isabel de Obaldia perhaps come close to what Pachego *et al* achieve for me, but I have only experienced these artist's work through photographs, and that is no substitute for being in the presence of the real thing.

Obaldia draws on the spiritual to define her work and the animal for inspiration. It has been suggested by Klein that her work has a shaman like quality to it and lives in the world of myth (Klein, 2001). He states 'She sees them as guardian angles or protectors. But there is a darker side to them and they may be demonic and threatening.' This appeals to me as I like people who recognise the stories and subtleties of their ancestors. Certainly her work is raw and sensitive and the images she produces have a duality to them, living in both this world and the other place from which they have emerged.

Fig 25.
Nazareno, Isabel de Obaldia 1999.

Because of Obaldia's French and Panamanian heritage her work has an immediate link with Pacheco's. Both draw upon their South American inheritance to inform their work. The piece above (Fig 25) suggests gessoed saints and angels, and I am reminded of Ayrton too. With its use of glass powders defining shape and form it also links directly into Walter's work. For me her pieces have a power to move greater than their size. Even in a photographic image they reach out and speak.

Frolic's work appeals to me in a similar way. She draws on the memories of her mother as a holocaust survivor to portray the human condition. She is tortured by these stories and they have informed most of what she creates. As such, they are links to a world she never knew and has only experienced as stories through the memories of another. The piece below is one such example. I find it of enormous strength and presence. The surface colouring removes it from the world of shiny glass, which would have reduced its intensity. It hovers between bronze and something else, something dignified and undeterminable, perhaps marble, perhaps Egyptian faïence. The Madonna blue quality of the colour gives the viewer a feeling of peace and comfort. The bronze suggests a figure from antiquity and inherited authority.

Fig 26.
Dialogue Irene Frolic, 1988.

Frolic takes the past and (again as Georgiadis suggested) uses it in relation to what she is doing now. She does not display the past, but retells it using her own emotional and intellectual response (Klein, 2001). I like her images enormously. I want to touch them, interact and examine them, and allow them to speak to me of their story and knowledge in person. That, I think, is the test of whether a work is successful or not.

All of these artists have some resonance in the pieces that I am beginning to produce. Their sculptures are touchstones for the testing of mine. While I aim to make my creations as different from theirs as they are from one another, nevertheless there is a connection between us all, which can best be described by Georgiadis's quotation 'What interests me is the space between what the viewer sees and what he thinks he sees.' In the imaginings of these artists I have experienced that space and it is what I am beginning to explore.

The formation of my personal work for this PhD study is described in detail below. While it has strange connections that are sometimes hard to define all of it is coloured by the influence of these artists.

Chapter 4: The formation of my current work and the arrival of its subject mater.

From out of all these influences and imagery has come the following body of work. The head, the mask, the duality of the experience of the performer, and the sense of the space between viewer and the viewed have all combined, with a final influence, to produce the images which I illustrate in glass.

The final influence, which shines through my present work and links everything else above, is, quite simply, my experience as a gay man. While I do not think of myself as a 'gay artist' (whatever that is supposed to be) I am a gay man, and everything I view is informed by my experiences of prejudice, the reactions of others once they discovered what was behind the mask of heterosexuality, either their perceptions or my performance, and my experiences of male sexuality. Early on in life I realised that everyone holds up a mask of presentation and deals with duality in his/her own way. We are all actors to a certain extent, but I am drawn to the male form both as a thing I know best as an artist, and as a sexual object. Its intimacies are woven into all the things I explore in the male body, and colour the present subject matter. Like Emin I have chosen to use my own experience to inform this present work.

By pulling all of this together I have arrived at the use of the head, combined with fetish imagery to produce some works that also illustrate Walter's glass making techniques. The mask, the representation of a duality of experience both seen and performed is realised in this work. In the work the potential of the act of pain and violence (in the mind or otherwise), is illustrated to arouse a disturbance in the viewer. The image below illustrates the starting point of the imagery in my body of work.

Fig 27.
Rubber Sex-play Mask.

The photograph here, taken from an online catalogue of rubber fetish wear, has produced an image of suggested threat (in a potential sexualised situation). It disturbs the casual viewer. The stare of the semi-naked, masked model, his eyes being the only trace remaining of this humanity, arrests and engages the viewer's own gaze. The heart leaps and there is a seemingly unspoken contract between the viewer and the viewed. One is not sure who is the viewed and who is the viewer. The image here has an immediate and fortuitous connection to the image discussed below in Fig 28.
I doubt the two were ever intentionally connected by design, but there is curious alliance.

Traditionally, from the ancient Greeks onwards in Western Art, the head is the place of intellect and imagination. As such it is regarded as having the sense of the Male. Pallas Athena's birth from the fractured skull of her father Zeus confirmed this in the imagination of the Ancients and has fed it way down into western artistic and intellectual thinking until relatively recently (Graves, 1992). As such the head became an allegory of the Alchemist's Philosophy and the perfection of the Alchemist's art: that of the transformation of base matter into pure, thought into product. The late 16th century alchemist Gerhardt Dorn saw the human body as a distilling flask, the vapours arising and condensing in the alembic (or the head of the human being) (McLean, 2007).

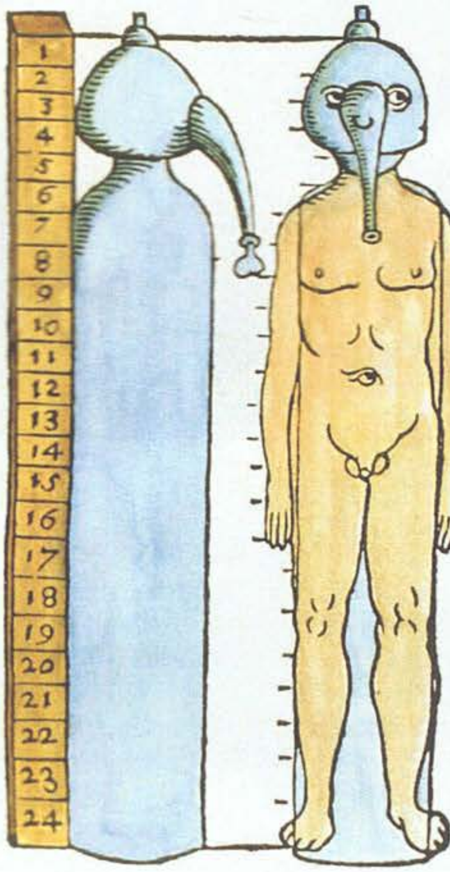


Fig 28.
Gerhart Dorn's vision of the Alembic, 1577.

While there is a strong design connection between the fetish mask and the alembic, the difference is that the rubber mask suggests that the thought is the deed, while the alembic does not.

My use of the head as an object of artistic expression for Walter's techniques creates a direct link to the first *Ecole de Nancy*, which was one of psychoanalysis not art

(Debize, 1999). Sigmund Freud was brought to Nancy in 1886 by the émigré Bernhard Hippolyte, whose own work on the subconscious is one of the pillars of the modern psychoanalyst movement. The influence of that movement inevitably found its way into the ethos of the Nancien Art Nouveau, as the painting by Victor Prové, one of the founders of the movement, shows in Fig 29, below (Debize, 1999).

Fig 29.
Visions d'automne, Victor Prove, 1899.

The depictions of three figures, above, are reduced mainly to representations of their heads, the seat of the subconscious. They seem to float in a world of swirling uncertainty. They are surrounded by the attitudes of autumn: the decaying sensations of nature dominate them, not the other way around. The souvenirs of regret, the inevitability of fate and sadness, permeate this painting making it typical of the way the new science of Psychoanalism influenced the artists of Nancy.

In the early stages of this research study I realised I wanted to make a body of work that came solely from my imaginings and experiences. Embarking on this study was an appropriate juncture in which to explore ideas that had been floating around my consciousness and apply them to a new technique. As a production designer for animated films I am more used to working to given texts, briefs or music and tend to flounder without a defined subject matter. A phrase came to mind, which had a good ring to it: 'The Sense of my Screaming Skin'. It is a line from a Blondie song on their album 'No Exit'. The phrase seemed to coagulate into a possible theme in which to portray a new body of work. The accompanying video to a song by the Icelandic singer Bjork also floated back into my consciousness. It was 'Pagan Poetry' from the 2001 album 'Vespertine'. Both sets of music fired images in my mind, which have slowly come to fruition through my practise. Like the synaesthesia of colour I experience these two pieces of music have drawn out and challenged my design process. The image below is from a frame from the video and shows Bjork's back, the flesh of which has been pierced and laced with cords to resemble a corset.

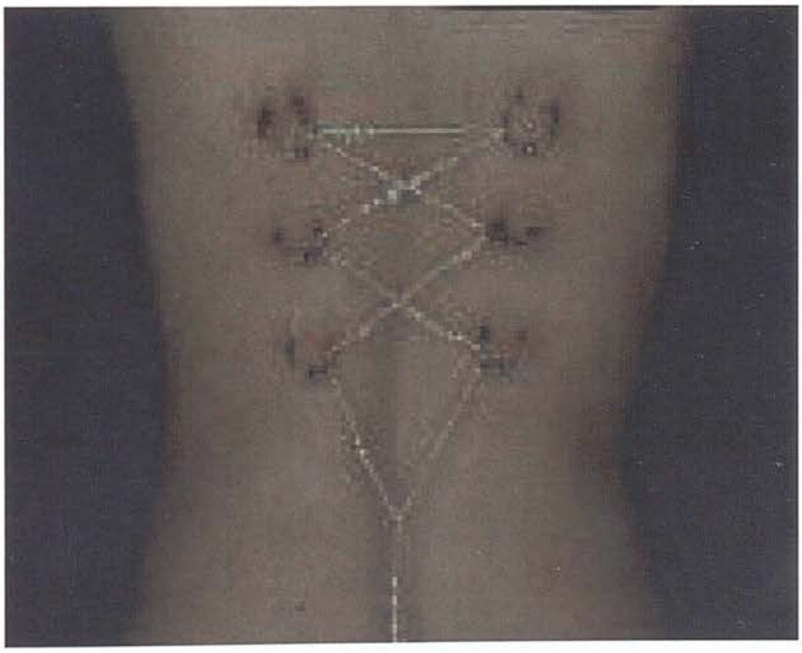


Fig 30.

Frame grab from video of '*Pagan Poetry*', Bjork, 2001.

It is unsettling, and immediately we are placed in the position of wondering what it must feel like to have one's flesh pierced. In one's mind the skins screams at the thought of it. The phrase fitted as a concept for a body of work. We are all familiar with the notion that skin crawls and flesh creeps. They are turns of phrase that writers have utilised since Mary Shelley's story about Dr Frankenstein's monster, or are associated with encounters of snakes, or 'the Other'. That skin screams is also satisfying notion. The phrase suggests pain and horror as something of intensity is experienced. The images at the Batu Caves also drifted to the surface and begun to flavour the mix. A close friend of mine also related to me his visit to the annual Inferno gathering of Chicago's Hell Fire Club in the United States, a group for gay men who wished to experience the rituals of sado-masochism. His experience is related in the next chapter. As a result of our conversation a distillation had begun. I was drawn to the idea that gay fetish gear, particularly that used in BDSM (Bondage, Domination, Sado-Masochism) might be an interesting area to explore in pâtes-de-verre, which is a type of glass most often associated with pleasant, uncontroversial and decorative objects. The effects could shock an audience, unsettle them and make them question what they were seeing.

The very nature of the words 'gay sex' immediately awakens all sorts of fears for a heterosexual audience, HIV/AIDS being one of them. With the advent of the disease in the early 1980s the gay community has transformed itself once again, and has re-masked and remade itself. For an observer, as well as a participant in the contemporary gay scene, I have watched with curiosity as body-shapes and attitudes have morphed and changed. For a period of ten years in the 1990s intensively working out at a gym and smoking was the thing to do. A strange duality existed in its statement: 'I am so fit, i.e. I don't have HIV, that I can even smoke without the fear of getting cancer'. At the same time in an effort to extend the sexual experience under the new social rules of 'safer sex', and to penetrate through the dulling membrane of the condom, some gay men's sexual appetites have conversely become more extreme. Or rather, it has been started to be openly acknowledged that there is extremity of experience. Rubber, leather, uniform, hoods, masks, boots and membranes are amongst the devices used to inform the situation and to extend the participant's experience. Sometimes recreational chemicals are used to create altered realities, sometimes not, or by the physical act of nulling and confining some of the senses, participants are removed into a personalised inner world. Sometimes flagellation and piercing is involved, sometimes on an individual basis and sometimes as a group experience. An erection or ejaculation is not always demanded.

Chapter 5: Simon's experience at Inferno.

Simon's own deeply emotional experience at Inferno is worth relating as it clarifies some of what I am trying to explore in my work, that there is uniformity of extreme of experience across cultural divides, particularly on a sexual and religious basis. Simon regularly attends Inferno meetings, which are on an 'Invitation Only' basis. Like most sub-cultural organisations and events involving sexual experience Inferno's participants are shy of relating what they participate in and what they do. Simon has described to me what he went through and drew for this study the sketch of himself (Fig 31, below). It is an interesting piece of work that has every bit of the intensity involved in Emin's work. The event itself had involved ritual, and there can be no other word for it. The group of men who were to participate were made to be naked. They stood in a circle and were ritually cleansed and purified in a Native American fashion using burning white sage and chanting. Gently and with the utmost care and compassion the group of 12 or 13 men had their chests pierced above their nipples with surgical steel hooks. The hooks in turn were attached to cords that co-joined the others in a ring at the centre of the circle.

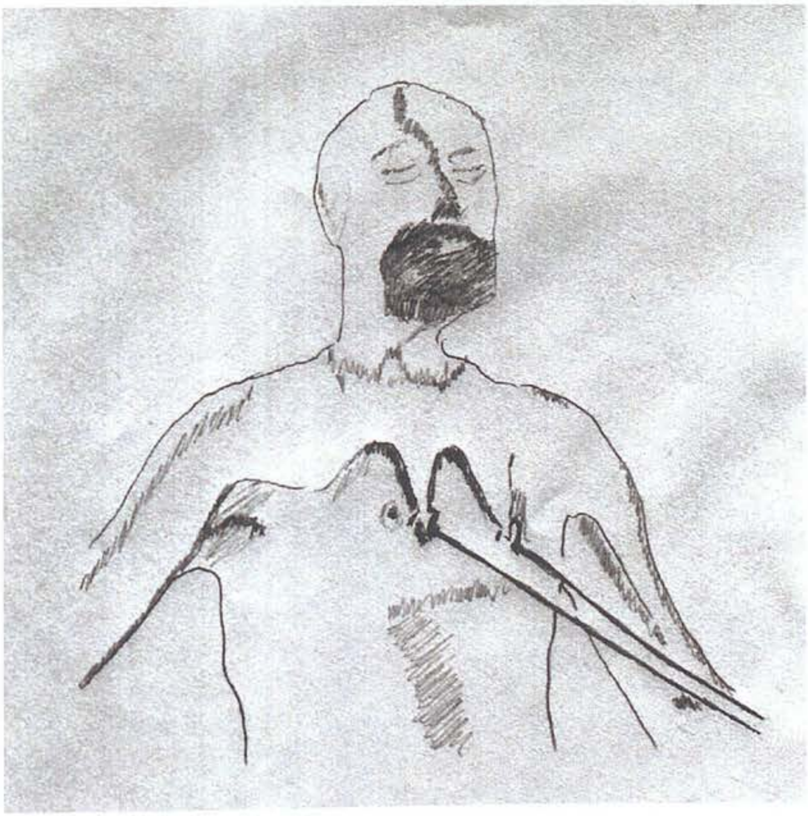


Fig 31. Simon's image of himself at Inferno.

All thirteen men were thus connected one to the other. By leaning backwards or forwards the intensity of pain could be manipulated. Vibrations from either the throat or by lightly touching each cord resonated through the group. After a while endorphins kicked in and a state of ecstasy was achieved in all the participants. Simon reports that, for him, it was an experience like no other, at once personal and private and at the same time there was an intimate emotional and intellectual connection with the other 11 or 12 men. There was duality of being, which he could not fully explain. Each individual was part of a whole yet each was experiencing something personal and remote. He was connected emotionally and physically to 10 or 11 other men he knew nothing of. For one man it became a life-changing episode. Raw intense emotions were driven to the surface so severe that he had to be held for hours as he sobbed. The photographs I have seen of the event do not show that it was prurient in any way. The participants do not have erections, and the observers seem to be watching in a serious and attentive manner.

To my mind what the participants of Inferno experience is paralleled by that of the devotees at the Batu Caves. It seems to me that the only difference is what the package of experience is wrapped in: Change her nun's habit into a rubberised body suit and what you see in Bernini's *Ecstasy of St. Teresa* is what is experienced at the Batu Caves and Inferno. The many depictions of the martyrdom of St. Sebastian suggest the same thing. Both are easily interchanged with the imagery depicted in Instigator Magazine, a hard-core manifesto and depicter of gay fetish sex, an image from which is below.

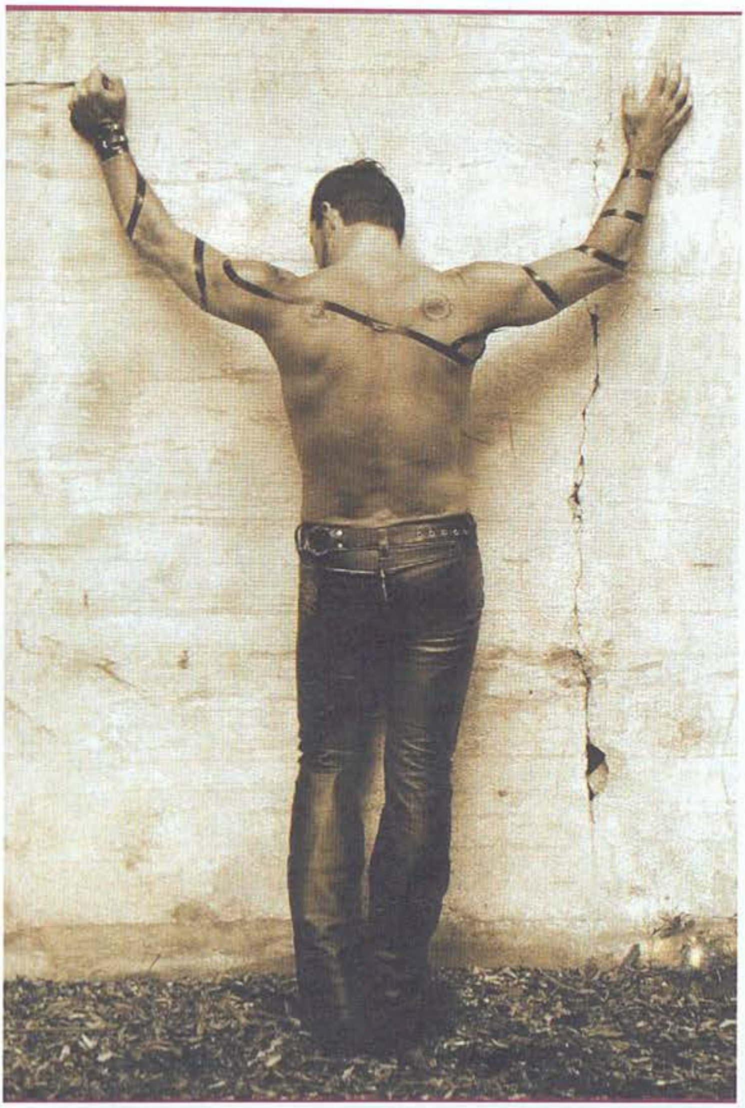


Fig 32. Image from *Instigator Magazine.*

The Inferno participants have derived a great deal of their sexual experiences from the idealised butch male imagery of Tom of Finland (Lucie-Smith, 1998). Their presentation of the Gay Male as being harder and more masculine than that of their heterosexual counterparts became a huge success in the mindset of gay communities around the western world. Gay American males in the 1970's took to the gym deliberately pumping their bodies into an idealised shape and dressed themselves in the garb of their oppressors: Hells Angels, Skinheads, Nazi SS Guards. They thus subverted the oppression by creating an imagery that became a fetish. In sexual terms and as heroic ideals they became, and have become, gods to worship.

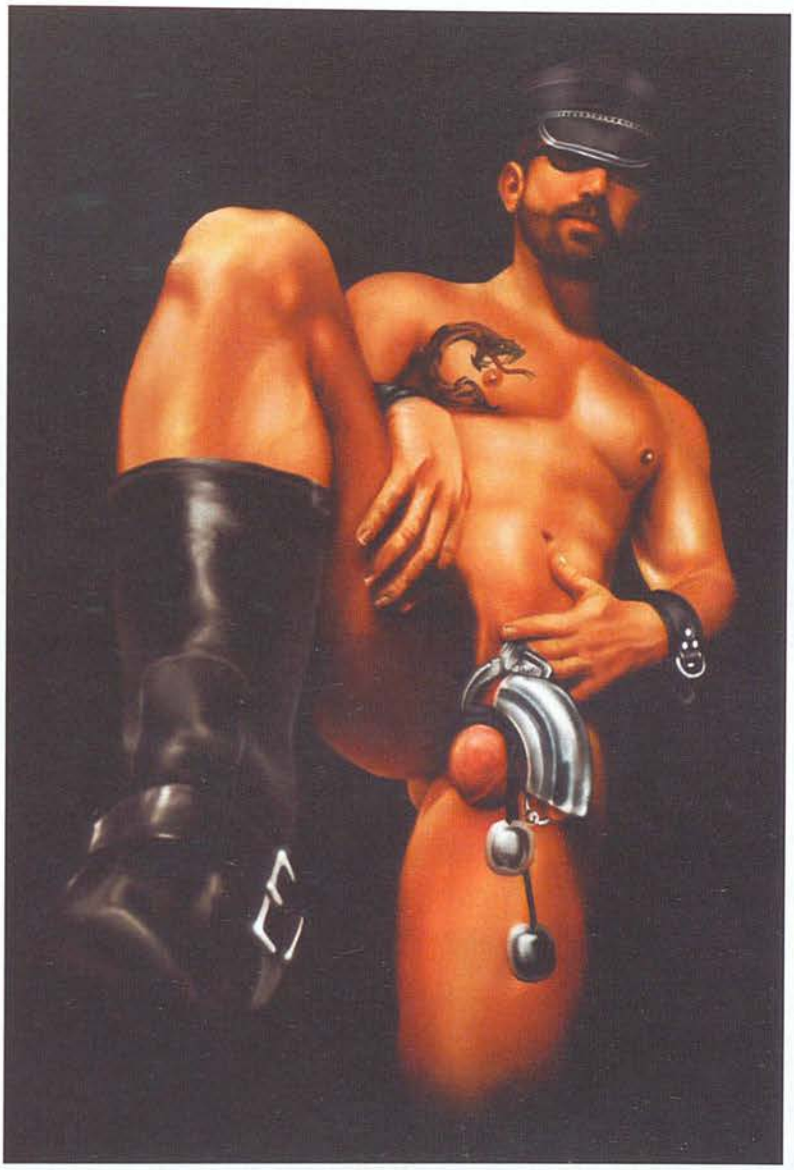
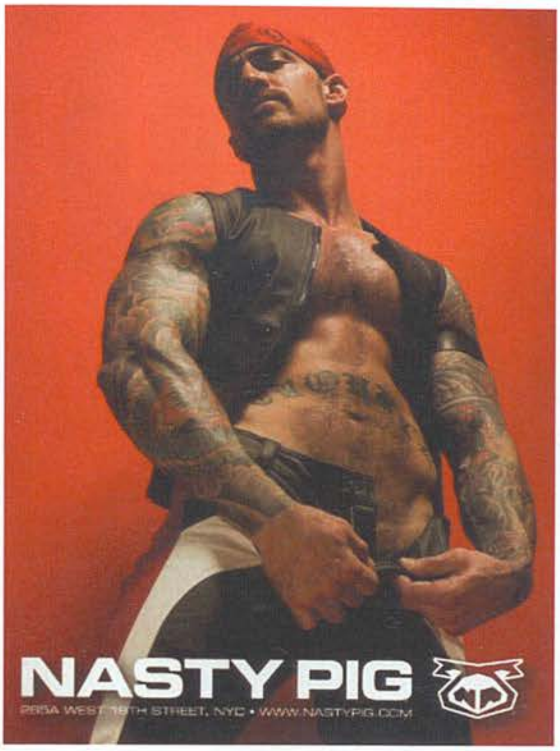


Fig 33.

In this image, above (Fig 33) the army jackboot, the machined tool, the emotiveless distant gaze from a figure of authority takes on a powerful sexualised image and plays with the viewer's mind. More recently a new look has appeared in gay graphic literature, derived from that of the prison inmate. It is enforced by the extension of the polychrome tattoo down the whole arm suggesting an internalised violence that might bubble below the surface. The more tattoos the wearer has, the 'harder' he supposedly is, suggesting too an innate ability to exist with groups that live as an underclass. The image also implies a sexual encounter harder and more extreme than experienced before. A frisson of danger is created.



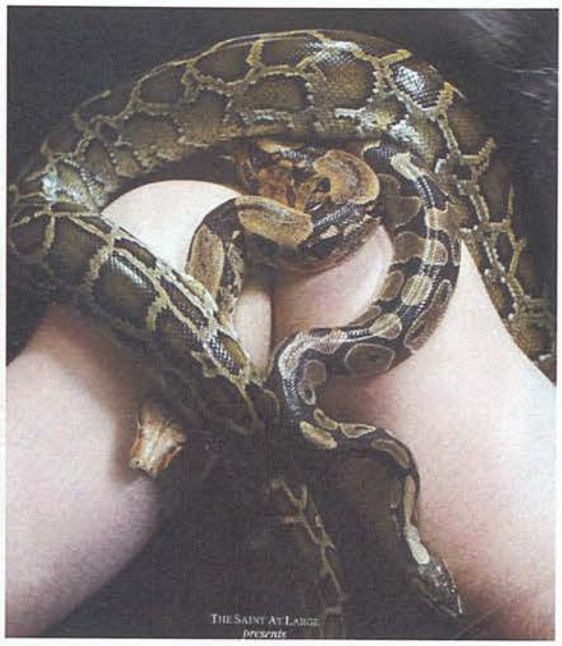


Fig 34.

Fig 35.

The application and display of the tattoo has the advantage of allowing the male gaze to linger without the fear of sexual intrusion (Lucie-Smith, 1998). What it also does is to clothe and animalise the wearer. A new skin is created. From a distance, the tattoo takes on the patination of a serpent (see Figs 34 and 35, above, and Fig 36 below). Metaphors and similes become deliberately mixed and confused. The space between what you see and what you think you see widens. As in this image below the serpent in the Garden of Eden becomes the desire, and for the gay community, who are deliberately excluded from Eden by the Religious Right, fallen angels are the ideal.

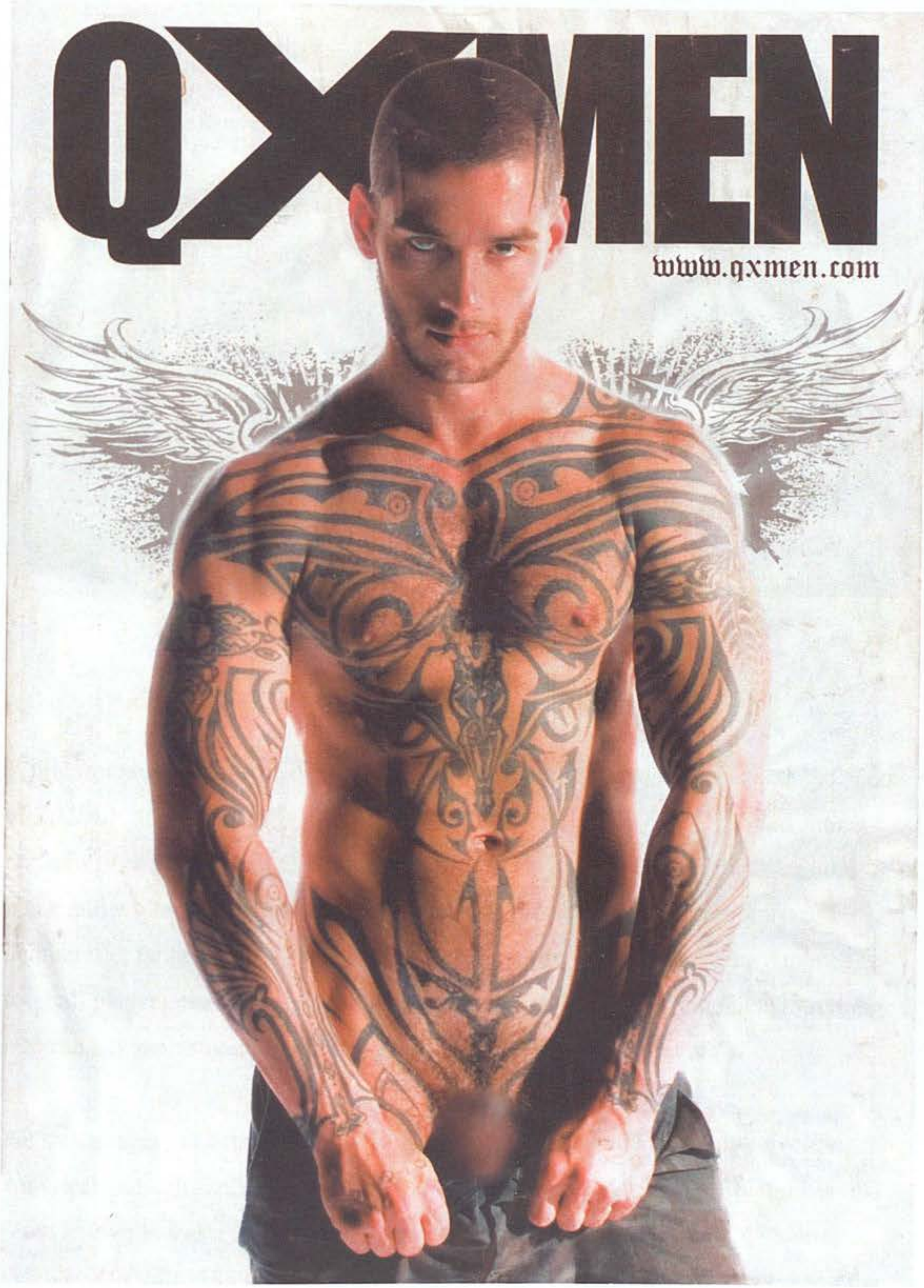


Fig 36.

The development of the Bear Male, echoing the working class American male with his facial hair and un-toned bodies predominate. The fantasy imagery of fire-fighters, truck drivers and other blue collar workers has also made a huge impression within the gay community of what is acceptable to idealise, display, and then sexualise. New tribal subcultures are formed and changed.

Fig 37. The New Tribes.

While in many images the depicted male body remains toned and muscled, the 'Tom of Finland' image (based in part on Marlon Brando in 'The Wild One' and James Dean in 'Rebel without a Cause' (Lucie-Smith, 1998) seen here in Fig 37, as the black and white sketch) has been superseded by other, more contemporary and democratic, fantasy ideals such as the sports man (the racing driver, the American football player), the street gang thug and the cyborg. Role-play and alienation merged into the gay mainstream or what is acceptable for play (Miller et al.,).

All this imagery is being mixed with another established and constantly evolving American subculture first termed as 'Modern Primitive' in 1967 by Roland Loomis (now known as Fakir Musafar) in a transcribed interview in the book 'Modern Primitives' (Vale, 1989). It exhibits itself in a mixture of New Age thought and the Anarchic music of the post punk culture, exemplified by the Burning Man Gathering in the Nevada Dessert, an alternative cultural happening that leaves no mark on the soil it touches, just in the minds of its participants. The Modern (urban) Primitives take their imagery from other tribal cultures utilising their types of tattoos, body modification and piercing (Figs 38 and 39, below).

Fig 38.

Modern Primitivism, The Burning Man Gathering, Nevada Desert.

Fig 39. A display of Modern Primitivism.

It seems that when the tribal imagery and the modern fetish combine a hybrid is formed. Gods and monsters are created that speak a new language. It is this, which is the springboard for my current work. The finished pieces illustrated below are not necessarily about fetish sex, but my work uses fetish gear as a place from which to start making disturbing and challenging images that hopefully speak in all sorts of ways to the viewer. Each has its own story and each has metamorphosed over time as the work has been made. The myriad subject matter above has been put into a vast mental pot and been left to stew gently. Over the course of this research project my fascination with heads, mask, perceptions, the 'Other', the space between viewer and object, what goes on in the mind of the participant (sexual or otherwise), and what we experience as we stand as observers, have all congealed into a body of personal practical work.

As I have researched the historical aspects of Walter's methodology and techniques and uncovered the scientific findings within his output my own personal work has evolved. Inevitably the findings of the research have channelled themselves into my personal work. Although it may not be immediately apparent there are deep connections between all three aspects of my research. What appears to have tenuous links, perhaps, are nevertheless derived from strong connections. The major one being that all pâtes-de-verre artists are in some form pioneers of their craft. Nothing that we do technically can be said to be 'wrong' as, in the end, there is no 'right', just 'is'. A better understanding of where Walter's work sits historically and artistically has emerged form Book I. I understand now that Walter does not sit on the peripheries of the pâtes-de-verre makers of his generation as has been supposed, but rather is in the very centre of them. My personal work, which is created at the start of the 21st century contains a colour palette the formation of which would be understood by Walter and his contemporaries 100 years ago. 150 years before them the gemmological paste makers of the 18th century would have understood them too, as would the chemists of their period. The glass paste makers in 15th century Milan and their predecessors trailing all the way back to the ancient world would also understand exactly what I have made in glass, how the formation of colour works and what effects could be achieved with them. In essence I am working in a long tradition of colour making in glass, and as such, am a follower-on of those techniques and methods of enquiry, which have constantly revolutionised glass making throughout at least two millennia. Subject matter may change, but the techniques do not. That inevitably gives one a feeling of confidence. It places one's work not just in a contemporary context, but in a historic one too. My subject matter may disturb and challenge, but that is the privilege of doing what I do in the 21st century. We live in an age of liberality of ideas and choice of subject matter, which Walter and his predecessors did not.

My investigation into the science aspect of Walter's glass in Book II has yielded amongst many other things a colour palette, which is now the centre of my work. That in itself is a major shift for any artist. There is little now in my personal palette of colours that is premade colour. With the exception of the use of four colours - an opaque ivory, a opaque red, a gold ruby and a transparent amber - all the colours I have used in my work I have produced from metallic salts. And those four premade colours were chosen for very good technical and chemical reasons. That in itself is a liberating thing, and it is almost impossible now for me to go back to the way I worked before I started this research. The investigation has also changed the way I perceive the choice of colour. Like the knowledge that the clarity of lead crystal is an attempt to reproduce the quality of rock crystal, so my knowledge of colour formation has changed my view of how to colour glass. I look at a green colour and find myself asking 'Is that made from a chrome base, or an iron? What blue exists there? Is it copper or cobalt? How is the yellow produced? And what else might exist in the chemical base'. The choice of premade colour is no longer a casual one, but is now a rare and deliberate selection to either enhance and/or contrast my own palette of colours. I use the chemistry employed in those premade colours to activate a range of textures and effects in my own work. The pieces I have made would be very different and probably not so effective if I had chosen to use premade colour solely on its own, or without he knowledge of the chemistry and its history.

The technique and methodology of each piece is discussed, together with an explanation of what meaning the piece has for me. It is then up to the observer to draw conclusions and experiences, and to measure the gap of what they see and what they think they see. In Books I and II I have looked into the past and into the minutia of scientific detail. The view constantly has been 'back' and 'in'. In the works below the horizon expands and I look forward. In this body of work I do not try to emulate the past, or rely solely on my grasp of the science to achieve my work, but instead I use both to express ideas in a modern context. Always I am wondering what is the next thing to do?

The following group of sculptures represent the body of my work made during this research project. Their creative motivation has been described in the chapters above in this book, and as such they speak for themselves and need no explanation. However, should the reader wish to know more about each piece then he/she may turn to Appendix 8, which gives a definition and contextualisation of each work. Appendix 9 shows the making process of each work, and explains the methodology and technique I have employed in their creation.

Chapter 6: The Body of my Personal Work

The following images are the accumulation of this study. They emerge from out of the examination of my personal credo and artistic drives and the analysis and research into the historic and scientific aspects of Walter's methodology and techniques.

For definitions and contextualisation of their content please refer to Appendix 8. For the processes involved in their making please refer to Appendix 9.

The list of works is as follows:

1. The Sense of My Screaming Skin: Manifesting My Bi-polarity.
2. Piss Mask.
3. And So I press My Lover's Palm to Mine.
4. Dolly-Mixture Sub-boi: Sperm und Glitter.
5. The Spite of No-Hope.
6. Mayan Christ.
7. The Phallus.
8. A Duality of Sorts, No 1.
9. A Duality of Sorts, No 2.
10. Sex with Cyanide: In the Mind of The Auto-erotic Asphyxionist.
11. Standing Men 1, 2, 3.

1. The Sense of my Screaming Skin (Manifesting my Bi-polarity).

Fig 40.

Fig 41.

Fig 42.

Fig 43.

Fig 44.

Fig 45.

Fig 46.

2. Piss Mask.

Fig 47.

Fig 48.

Fig 49.

Fig 50.

Fig 51.

3. And So I Press My Lover's Palm To Mine.

Fig 52.

Fig 53.

Fig 54.

Fig 55.

Fig 56.

Fig 57.

4. Dolly Mixture Sub-boi: Sperm und Glitter.

Fig 58.

Fig 59.

Fig 60.

Fig 61.

5. A Duality of Sorts. No.1.

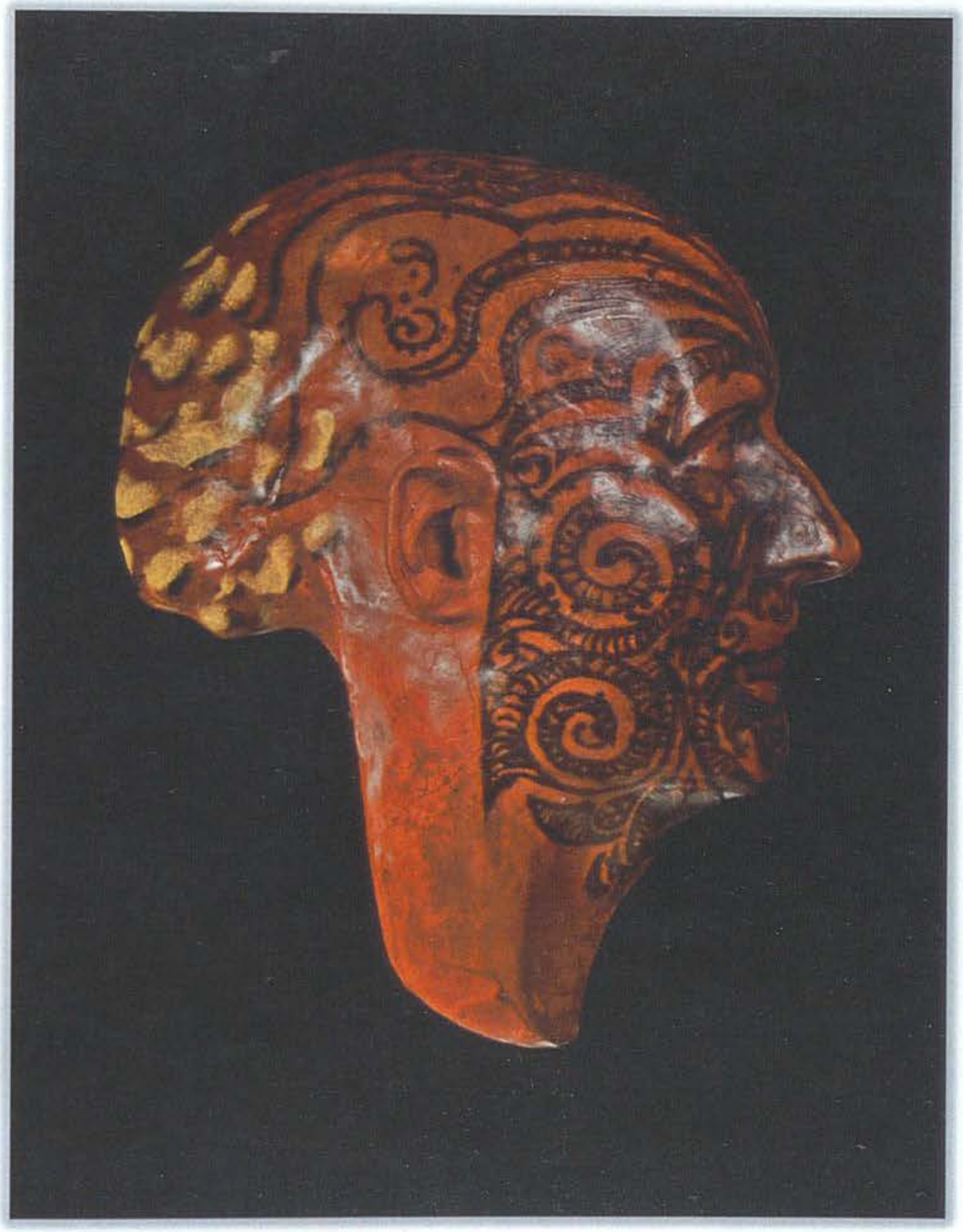


Fig 62.

Fig 64.

A Duality of Sorts. No 2.

Fig 65.

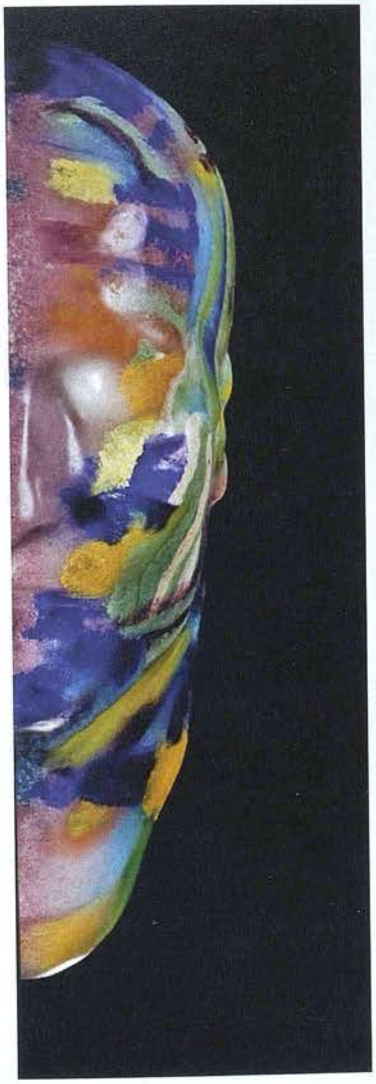


Fig 66.

Fig 67.

Fig 68.

6. The Spite of No-Hope.

Fig 69.

Fig 70.

Fig 71.

Fig 72.

7. The Mayan Christ.

Fig 73.

8. Phallus.

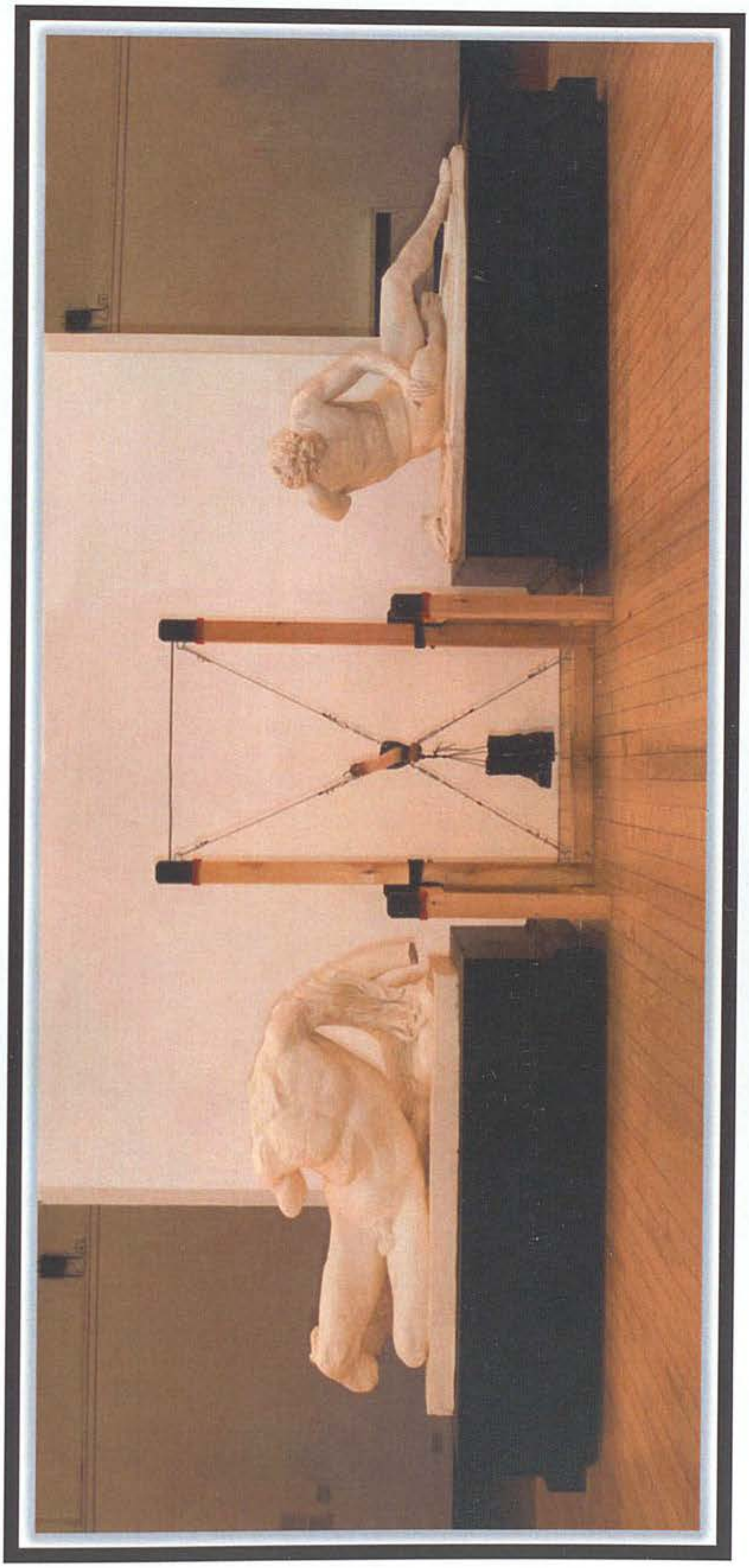


Fig 74.

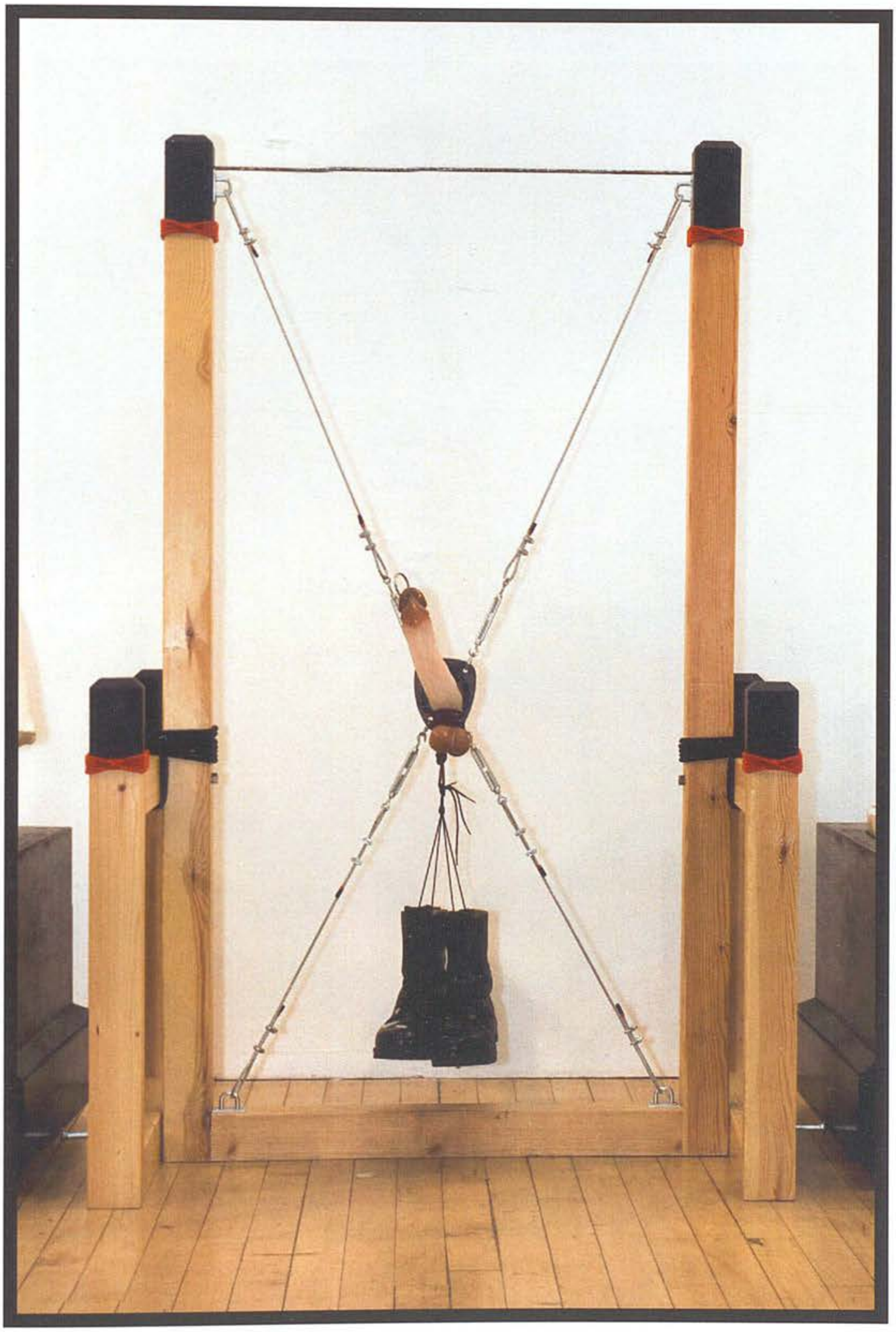


Fig 75.

Fig 76.

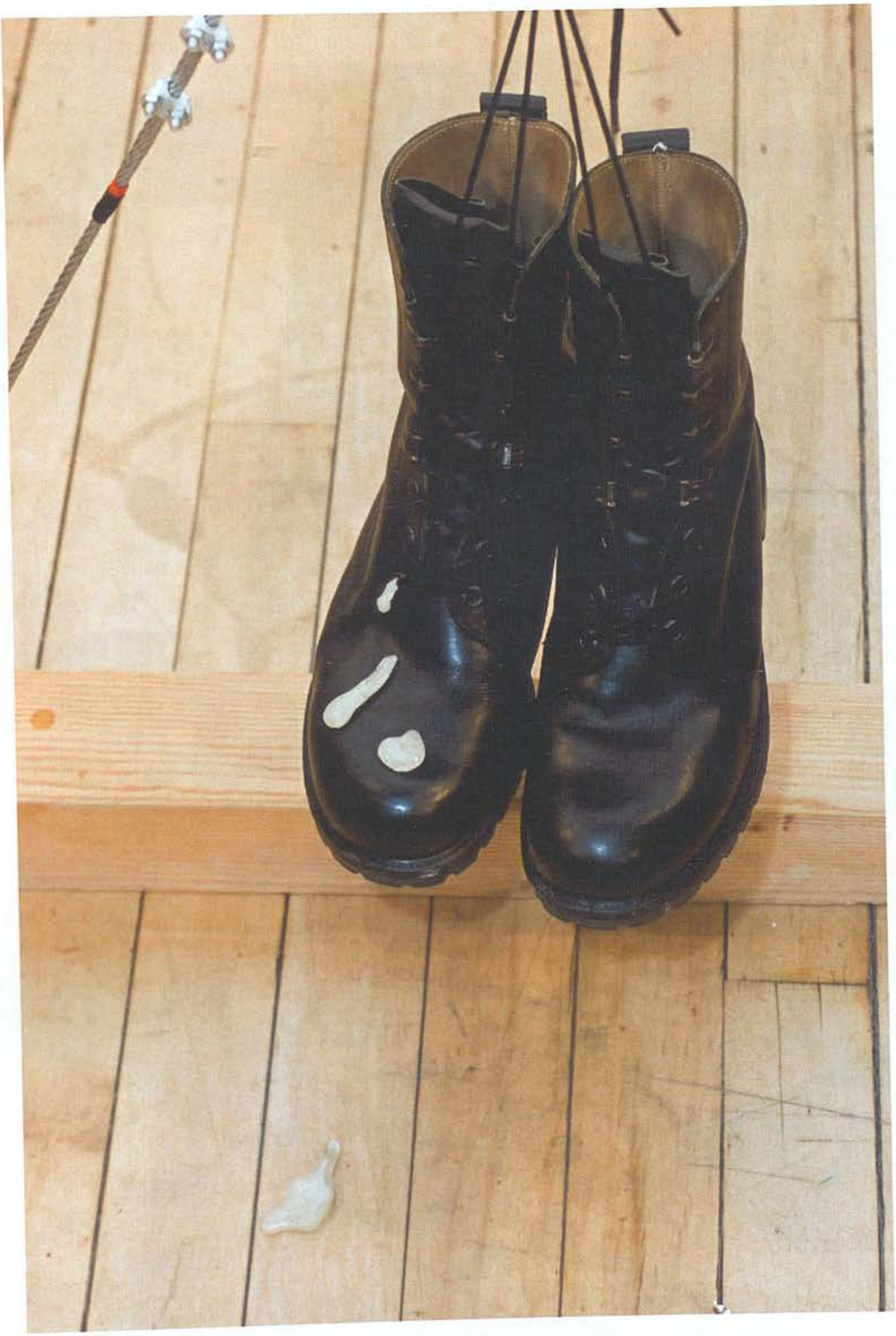


Fig 77.

9. The Objects of My Desire.

Fig 78.

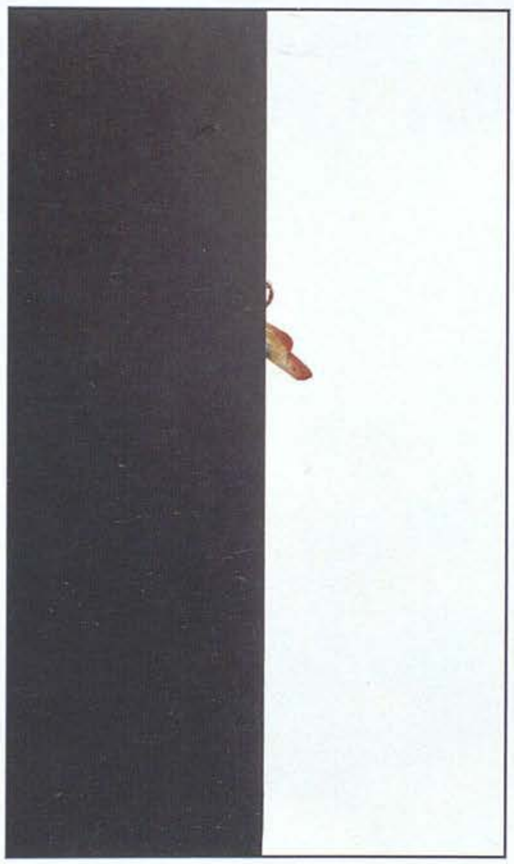


Fig 79.

Fig 80.

10. Sex with Cyanide: In the Mind of the Auto-erotic Asphxysionist.

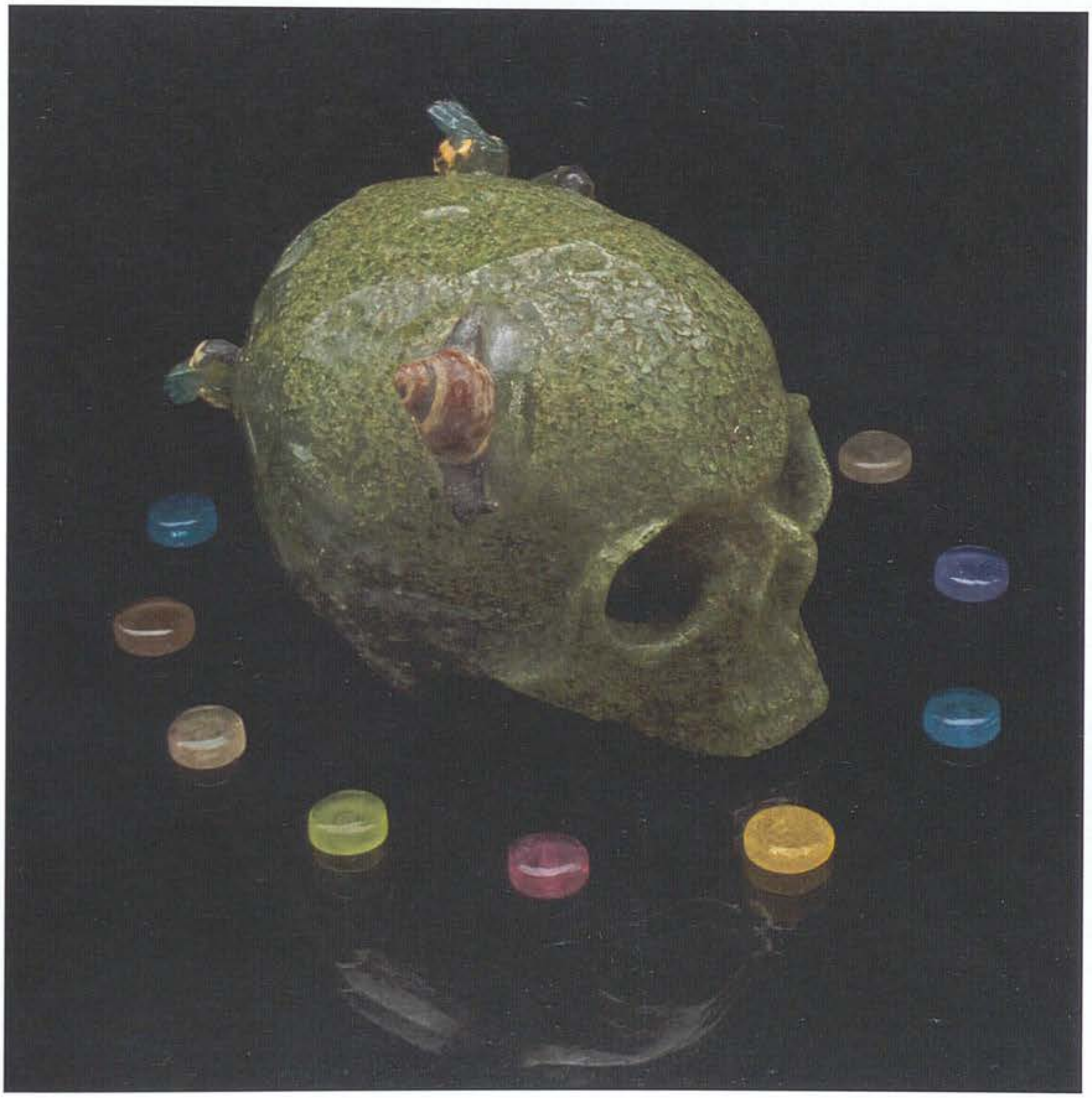


Fig 81.

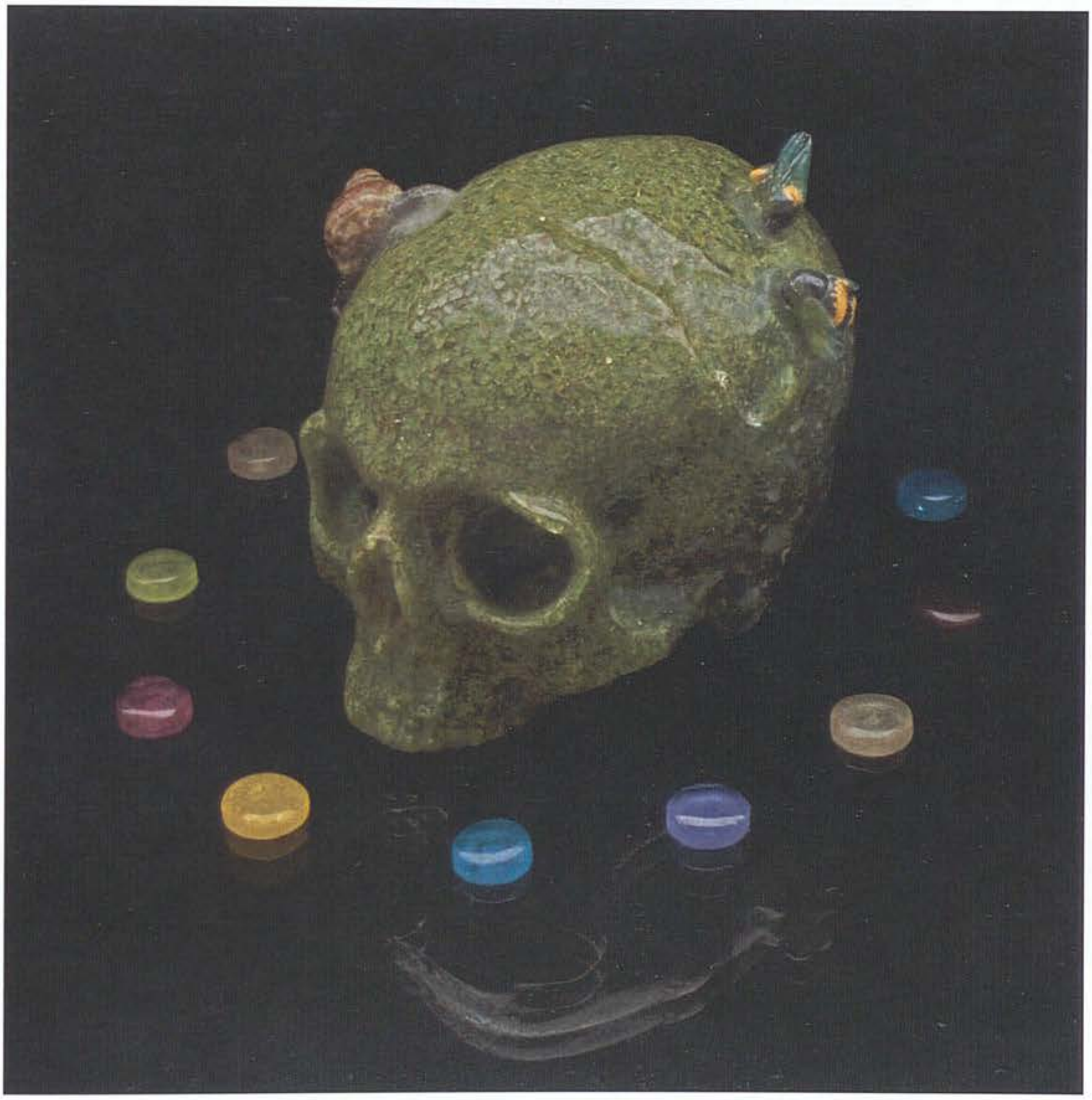


Fig 82.

11. Standing Man: No.1.

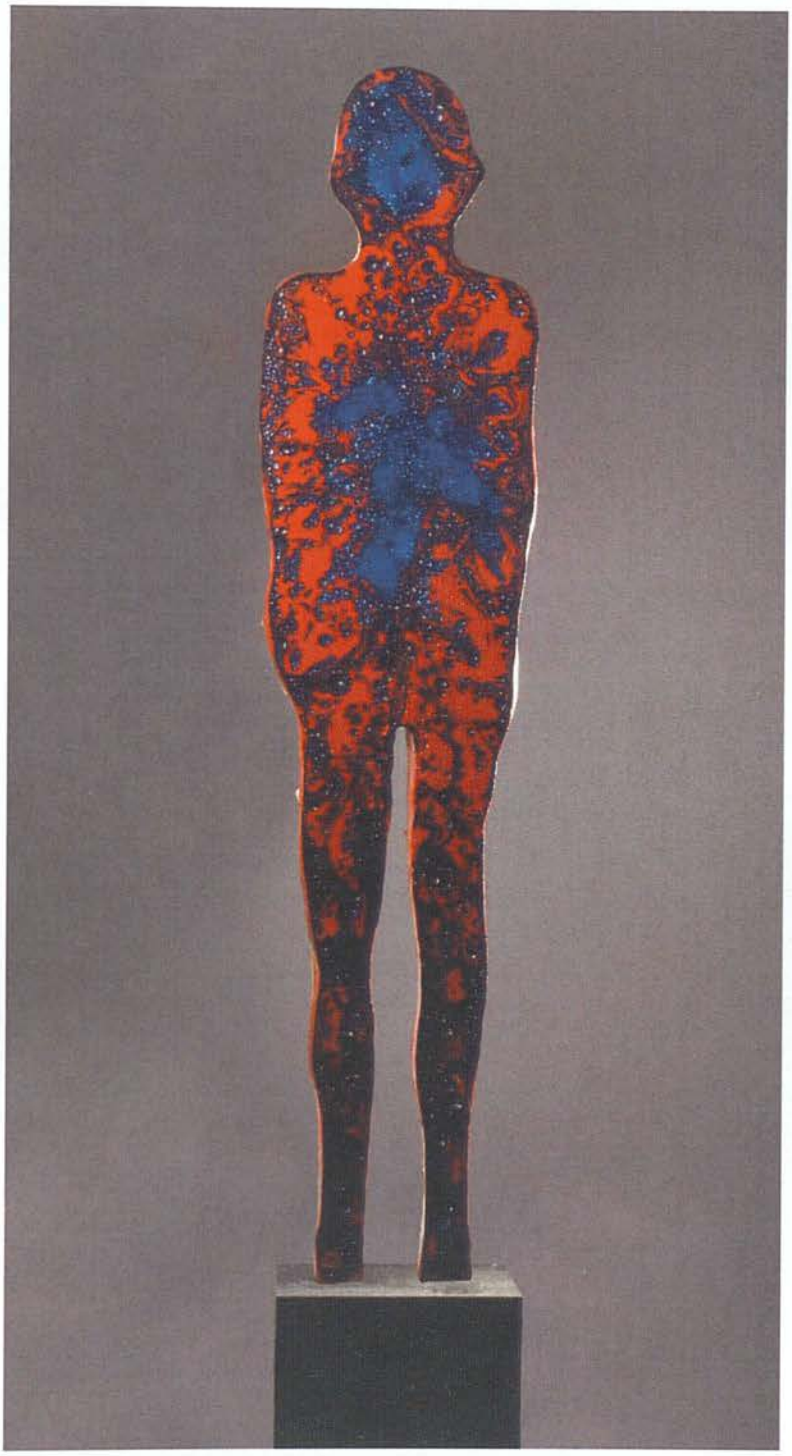


Fig 83.

Standing Man: No.2.

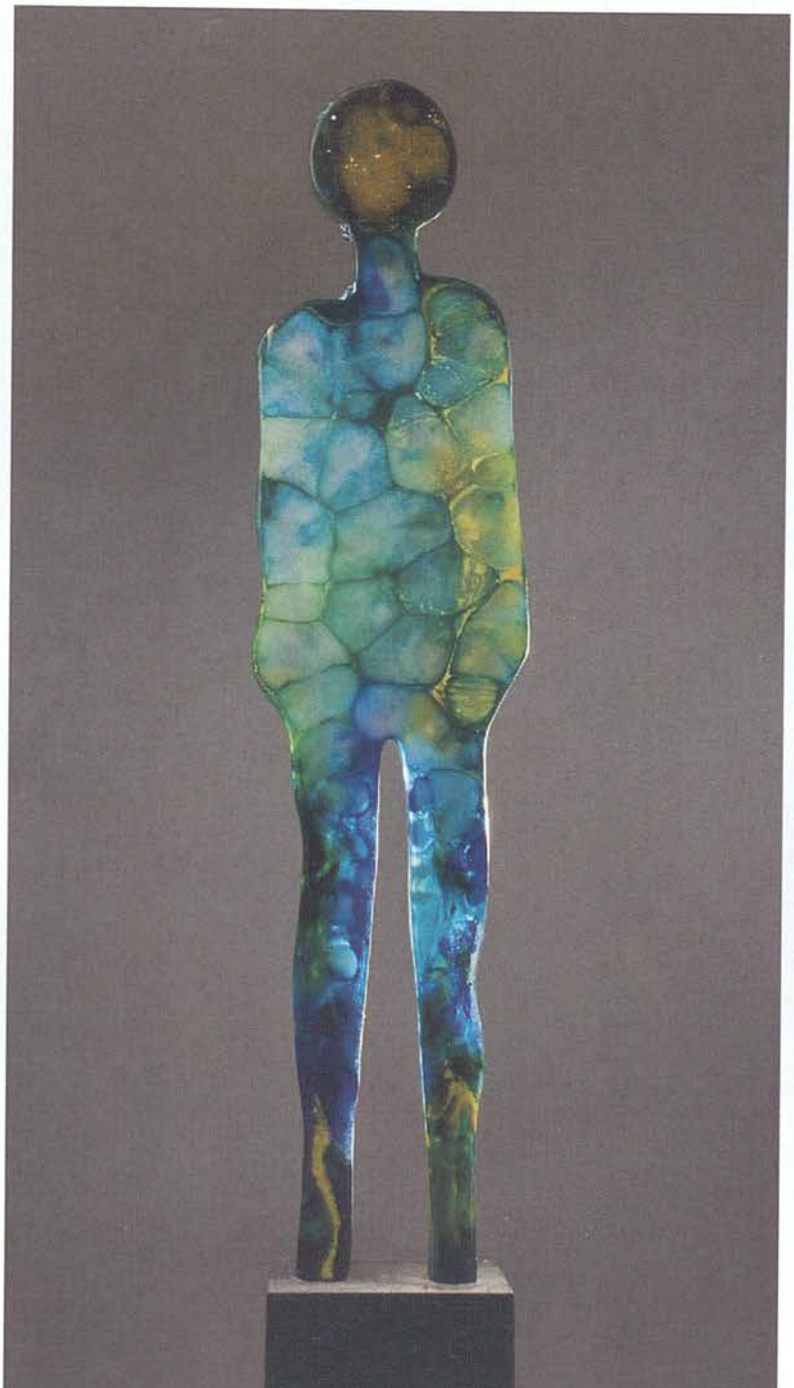


Fig 84.

Standing Man: No.3 / front.

Fig 85.

Standing Man: No.3 / reverse.

Fig 86.

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Thesis Conclusion

Thesis Conclusion.

Introduction.

My research in this study has been directed by the desire to understand how Walter made his colours, what they can offer the modern artist working with glass, and where the findings of my research can be placed in the historical assessment of pâtes-de-verre in particular and glass making in general. Throughout my exploration I have kept in mind Georgiadis' tenet of understanding the space between what is seen and what is thought to be seen. The application of that principle embraces my own personal philosophy, which is one of scepticism in the presence of absolute truths. I certainly believe truths are there to be claimed, but if those claims are factual then they need to be based on tested hypotheses and critical thinking: empirical scepticism requires blood on the fingers to prove whether the miracle is fact or just commonplace smoke and mirrors. And, as I have shown in my research, the commonplace is sometimes more interesting than the miracle which we are told is true.

By taking this particular approach my research throughout Books I and II has revealed a large amount of hitherto unknown information about Walter, his processes, and his methodology, and it is this new knowledge that has led me to a far greater understanding of Walter's work, his heritage and his legacy. My investigation has used both practical methods of analysis and modern scientific methods of enquiry to unravel important aspects of his work, such as the composition of his glass and his use of uranium as an integral colourant.

This exploration has helped to expand the little that was known about Walter's work into a comprehensive discussion as to how and why Walter made the glass he did.

The original research questions as laid out in the Introduction to this thesis are answered below. They are discussed under the three separate headings of Historic, Scientific and Personal.

1. Historic.

1.1. By examining an overview of the history of pâtes-de-verre in which Walter worked what conclusions may be drawn?

From the investigations surrounding Walter, and the environment in which he worked, many questions have arisen about what is known about the historical documentation of pâtes-de-verre, when it started and by whom. In my attempt to understand Walter's glassmaking techniques and the artistic background in which he worked, I have explored the wider subject of pâtes-de-verre in its historical context. Glass historians tell us that at the time Walter began his career he was working in a new medium the like of which had not been seen for 2000 years. My research shows this to be false. It is clear that pâtes-de-verre has a continuous history spanning those 2000 years. The research in this paper therefore challenges the status quo and offers up a radical way of looking at the subject. What we are told about pâtes-de-verre's late 19th century origins, compared with what I have discovered about its continuing existence from the Roman period through to the 18th century (and into the 19th), is very far from the truth. The gulf between received wisdom and historical accuracy is quite literally two millennia wide.

A proper assessment and reorganisation of our formal knowledge is therefore needed. This involves a new linear approach to understanding how glass paste has continued to be made, and how its processes were preserved and developed. The mythological fog and esoteric mystery created by the French contributors to the subject needs to be removed. The contribution of the French makers themselves needs to be reassessed and clarified. Their input is enormous, but so was the participation by James Tassie and the other gemmological makers of the 18th century. So, too, were the efforts of the makers of fake precious and semi-precious stone artefacts in the intervening years when there was little call for the real work of glass pastes, but whose production unwittingly kept the medium alive. The reorganising of this knowledge is significant not just for academics and historians, but also for the new makers and experimenters of pâtes-de-verre of the 21st century. Its contribution will allow modern artists to identify themselves as part of a long, continuous tradition. They will then be able to associate themselves with differing historical artefacts, their makers and their processes, which hitherto have been regarded as outside a modern pâtes-de-verre artist's territory. This will change perception, and, by effect, will change what can be made and what is made.

Thus, a new history can be written. Rather than a top down version of the past that positions Henri Cros as the 'father' of pâtes-de-verre, a more homogeneous way of looking at what has been created by (glass) artists using pastes of glass over the past 2000 years can be established. The necklace that joins my work to the pâtes-de-verre produced in 650 B.C via Walter, Tassie, the Milanese gem makers, and the church reliquary of Rheims and Charlemagne needs to be laced and knotted. In doing so I suspect more artefacts, more knowledge, will surface. They will only enrich what we already know.

1.2. What were Walter's own artistic influences and how did they fed directly into own his artistic portfolio?

The research shows Walter's work was heavily influenced by his association with a variety of sculptors, designers and modellers, who offered him his subject matter. Walter also allied himself with the ceramic work of the Palissy revivalists of the 19th century. Both sources helped to generate for him a portfolio of work unique to him in the field of pates-de-verre of the first half of the 20th century. The disparate studies and evolution of styles driven by the late French Art Nouveau, and then the Art Deco tastes of his buying public were homogenised firstly by his colour palette, and secondly by his hand (as the artist) when applying the paint work to the design in the moulds. Whether the modelling was done by Berges or Blandot the unifying force was Walter.

1.3. Is Walter the true inheritor of Henri Cros in his creation of a self-colouring polychromatic sculptural technique?

A much wider sense of what constituted his methodology and technical practice has now been explored and presented in this thesis, and it is clear that Walter straddled the two worlds of ceramics and glass. No other pâtes-de-verre maker during Walter's time achieved quite what he did in the creation of his pieces. My analysis of how he understood ceramic technology and employed it in his glasswork shows that he was pushing the boundaries of pâtes-de-verre making, or rather, that he was rewriting the rules of what could be done. This has an important significance for modern day glass artists, as it sounds a note of liberation. In effect, if 'anything went' then, then the same should apply now. This knowledge re-establishes Walter as the forerunner in his field, and positions him as unique in the history of glass making. I believe that my assertion, made in the introduction, that he was not a mere technician, but an important artist who invented a way to make polychrome sculptures, has been demonstrated, substantiated and furthermore establishes him as the inheritor of Cros.

2. Scientific.

2.1. What was Walter's methodology and what exactly determined his techniques?
The research in this study can claim to have refined and placed one of the final missing pieces of knowledge into the confusing jigsaw of the development of pâtes-de-verre at the turn of the 19th and 20th centuries. From what we generally know about the methods and studio practises of those pioneering artists, all else flows. Before the investigation began in Wolverhampton little was known about Walter. Much of what was thought about his techniques was subjective or misinterpreted. At the end of this PhD study a great deal more substantial facts have been revealed, and we can say now for certain we understand his working practises, we know his methodology, we can see his techniques and how he thought as an artist, and how he developed his personal style. A great deal of the chemistry in his work has been revealed, opening up new and exciting avenues for others to research. His practices are now visible and usable for modern glass artists to plunder, develop and shape in his/her own way. In my researches I have further unravelled the complex nature of Walter's techniques that shed greater light on his methodology and studio practises. My research has established that Walter was working in a long tradition of scientific and artistic exploration.

2.2. Did Walter colour his glass with an historically known band of metallic salts?
The testing of three further pieces of Walter's work using a combination of Raman spectroscopy and XRF has revealed much of what compromises a piece of Walter. As well as a band of traditional glass colouring salt a such as chrome, copper, iron, manganese and cobalt a unique discovery has also been made. Many pieces of Walter's work in the Broadfield House collection, particularly in the yellow-orange-amber range of colours, appear to contain uranium. Although in the decades before the Second World War it was generally understood that its use in lead crystal was widespread a comprehensive search of the literature surrounding it suggests it is not a subject upon which much had been written. Uranium has a hundred year history in its general usage in glass from the 1840's through to 1942 and it was used in the *crystallries* of Daum, Baccarat and Gallé in the Lorraine region, as well as throughout Europe and the Americas. It is best known as a greenish-yellow colourant in Vaseline Ware, but it incorporation into lead crystal has been little discussed That suggests Walter was using it in an unusual, and hitherto, unrecorded way. This discovery has been one of the two major scientific breakthroughs in the current research.

2.3. Did Walter use a 50% lead content crystal within his glass work?

The second breakthrough discovery is the level of lead oxide incorporated into the glass Walter used to create his pieces. At the University of Wolverhampton it was suggested that Walter's glass contained 50% lead oxide (PbO). Results from this study using SEM-EDS and Raman showed that the level of lead oxide in the glass was, in all likihood to be around 42%.The discovery removes a level of concern as to whether the colour tests I made are accurate in their relation to Walter's chemical methodology. While my style of design and artwork is very different from his I am confident that I am working in the same tradition as Walter. 10% difference in the content of the lead in the base glass may produce no perceivable difference in the end results of the tests and samples, but the knowledge that Walter's glass is remarkably similar to that produced by modern Gaffer Glass is important, as it removes any doubts about comparisons and methodology. It also makes Walter's work less remote.

2.4. Is it possible to establish principles for colouring glass at around 800° C, which utilises the technology of ceramic glazing to fix the salts, thus making reliable the use of those pigments? And, if so, is there a new colour palette from which glass artists may draw upon?

A primary area of interest has been produced from both is the historical and scientific analysis undertaken, which has led to my being able to extend the relatively small area of Walter's colouring methods into a large palette of 160 formulae. These produce colour and texture in clear glass at around 800° C in the kiln. In addition to their formation there has been an establishment of the general principles of making colour from metallic salts, which if the basic guidelines are followed will allow for the development of more. These new formulae (Appendix 2) are illustrated in my personal work, which has undergone a major development in both subject matter and practice, and effectively form the basis of a handbook to colouring glass during the kiln firing process. In another research project one could have quite easily have presented the formulae as the final work, as they have importance for our knowledge about colour production in glass. The intriguing part of their production however is their use and application for all artists who are interested in making work with colour and texture in a pâtes-de-verre context. During my study at Edinburgh College of Art jewellers, enamellers and sculptors, who also want to understand how a certain end result was achieved, have made enquiries about my work and its processes. They can see the potential for their use if they knew how to use them.

The colouring formulae are not mere recipes for the making of colour, but should be viewed as an expressive vocabulary. Certainly they may be used quite literally as paint with which to control line, define shape or make marks as a painter would. But they can be used for their chemical processes, the results of which express emotion or tell stories, or again used as building blocks in the modelling technique in which mass and volume are expressed with colour and texture. The results of all the formulae can be worked on after the casting process has taken place, thus manipulating them further still. Some of these formulae have been employed to illustrate my own personal work, which, as a result, has undergone a major development in both subject matter and practice. Much of the colour seen in my work has been created solely from them. By no means have all of them have been illustrated in my work in the thesis, as there are too many to try within the relatively small body of work I have produced. But with each glasswork made, I have used one or more of the samples from these formulae as an integral part of the design.

My own formula for realising my designs has always been: Shape, Line, Colour, Pattern and Texture, along with: Mass, Volume, Colour, Rhythm and Repose. Colour then is always central to the work and, as discussed and illustrated in Book III, central to me and the creation and expression of my personal practice. The results that come out of the kiln are not always predictable, as I have shown (Appendix 4). Changes take place without understanding why, and without a thorough scientific investigation the answers can only be guessed at. The formulae for the 160 colours are a stable set of codes. Individually, the colours are repeatable. It is when they are placed next to another that sometimes the volatile nature of their chemistry leads to unexpected outcomes, or the atmosphere in the kiln or in the mould alters the nature of the chemical exchange.

These formulae are then an important contribution. They liberate the glass artist from the relative small world of premade, off the shelf colour available supplied by glass manufacturers. New choices of colour and texture can now be made using these relatively easy formulae. As I have shown premade colour can be adulterated and turned into something no one has seen before. The type of glass they are fired in, the size of frit, firing temperature and the length in which they are held all make subtle changes to the end product. So, too, does the size and shape of the mould and the bulk amount of glass used. The variables are enormous. With each artist's hand the colour effect changes, as it must do being dependent on the choice of glass type, application into the mould, and the firing context. Thus a much wider range of colour and effect will be created than is shown here. All of this has the possibility to produce glass objects with colour and texture not seen before. Premade colours can be transformed into colours that no one predicted. My calculation is that by the using the 160 formulae with the 42 colours that Gaffer Glass produces in their lead crystal range some 6,780 new colours and textures can be achieved. Adding in to that equation the 50 transparent blowing colours, and the 66 opal colours they also make, a total range of 17,960 different effects may be seen. These formulae can be readily adapted for other types of glass, and changed subtly or radically with the addition of new salts. In doing so a new colour vocabulary is produced, which belongs solely to the artist employing it. These formulae become intimate with the artist in ways premade colours use on their own do not. The possibilities are infinitesimal.

3. Personal.

3.1. How does my personal work change as a result of questions 6 and 7?
My own work has changed enormously with the use and application of the metallic salts and the creation of the formulae. I have achieved works, which have produced an intense emotional response from their viewers. The use of a new vocabulary of colour effects has allowed me to explore issues that otherwise would not have been discussed in such a way. These formulae have extended the possibilities of dialogue with an audience.

Large objects are rarely made in pâtes-de-verre. This is something perhaps to do with kiln size, the experience of makers or even just subject matter. Walter made small pieces that were easily producible. Henri Cros, however, made the largest pieces ever seen in the medium. If it were possible for him to make monumental works, then it was possible for me to attempt large-scale works, too. Scale is only a matter of technique.

The choice of subject matter, on the other hand, was not only an attempt to push my own artistic boundaries, but also to extend and expand the possibilities of Walter's small-scale working methods. The development of the colouring formulae has undoubtedly increased my understanding of Walter. But they have also helped me to understand my own work and to develop its own particular vocabulary. My work would not have the same impact were it not for my use of metallic salts, and I want other glassmakers to experience the same thing.

3.2. What new studio practices can be established, which will influence the way other pâtes-de-verre artists and other glassmakers can address their work?
The contribution of my personal practice illustrates what can be realised in subject matter, as well as by technique. Technique I have touched upon, but the subject matter I have chosen to discuss is relatively rare in the glass world in any medium. Sexual objectification and sado-masochistic experience, and fetish gear, are not generally illustrated outside of pornography or erotic graphic art. The visceral emotions felt by the bi-polar sufferer I have yet to see outside the clinic of the art therapist, and none of it in glass. In that sense I have deliberately chosen to be provocative and to confront. Unlike Walter and his contemporaries I do not want my work to be decorative and polite. By rejecting what is usually perceived as acceptable I am trying to destroy the comfortable, cosy image that pâtes-de-verre sometimes has. Flowers, leaves, bowls, abstract shapes with little meaning or context tend to predominate. It is only the few, who are able to transcend the medium and produce work that grabs one right inside the gut.

My body of work consciously runs against the norm and shows that pâtes-de-verre can be used to examine and illustrate difficult subject matter, which confronts the viewer. The dirty, the dangerous, the sexually affronting, the 'other', can all be explored without fear that the medium will dominate the message. Like any other artist's material pâtes-de-verre can be made to look unpleasant and disgusting if needed, and be used deliberately to create images that provoke strong emotional responses. In my work I disguise glass to look like something else, plastic perhaps, perhaps oil and gouache paint, or volcanic rock. I have created the effects of body fluids and produced a tongue made from what looks like rose quartz. With the set of 220 formulae I have, in effect, given back to the medium its original purpose, which was to be a chameleon substance. In other words to deceive the eye into believing the glass is something else.

Through my research it is possible to conclude that pâtes-de-verre is not a small arcane area of glass making in the much larger word of glass casting. Rather, is it is the reverse. Glass casting is just a small part of the much larger world of pâtes-de-verre. And it is a much larger world than has been recognised either in the available published works on the subject and/or by curators of glass, or by glass artists themselves. True, objects cast from glass have been made for millennia, but those products are a far smaller part of the story than has been supposed. It is a pâtes-de-verre world in which casters operate. This view is a reversal of the importance of their respective positions or heritage within the world of glass making.

The process of making an object from glass by heating it in a mould is an old one, but that process has changed little in three millennia or more. By placing coloured glass in a reservoir above a mould little control can be exercised over where the colour forms. If one wants a single coloured piece of glass as the end product, or as an amorphous mass, then that is fine. But it is a narrow method of making. As soon as a decision is made to manipulate colour within the body of the glass object then the much wider vocabulary of pâtes-de-verre takes over. The process of manipulation of colour within the mould and during the firing process is a far more complex technique than casting glass. It requires skill, experience and knowledge. In fact, there is no 'one' technique that defines pâtes-de-verre, as I have shown in my research in Book I. The possibilities provided by the use of metallic salts to create endless colour and textural effects also require the understanding, or at least the appreciation, of the chemist. The effects are wider, the conversation with its audience, stranger, and no two objects are ever alike. In the process of pâtes-de-verre making the hand and mind of the artist is revealed.

Instead of being mere technique, pâtes-de-verre is a philosophy of approach with underlying rules and principles. In producing colours in glass, by making objects from fractured shards and reforming their particles in a mould and in the kiln, something much bigger takes place. It requires the mind of each individual artist to transcend the immediate object and to imagine a wider possibility of engagement than technique alone can produce. I would state, too, that most glass artists who call themselves 'casters' are in fact 'pâtes-de-verre-*ers*'. They just do not realise it.

Therefore, a new way of approaching the subject has to be established. In doing so it has to embrace a new way of regarding the science, the history, the art and the craft of making objects in the realm of pâtes-de-verre. Since the formation of the post-war, modern studio movement there has been a real desire to understand what pâtes-de-verre is and what it can be. But there remains a confusion of what it meant to Henri Cros, his followers, and importantly for this research, Walter. To each of them it meant something subtly different, if indeed it meant anything at all. Each had their own personal view of what they could achieve with the medium and they illustrated their techniques as they wished, pushed boundaries, explored ideas and new methods, and changed what had gone before. There were no strictures of 'it should be this and cannot be that'. None of them tried to make glass look like peeling frescoes as Cros did. None of them really achieved the polychrome mastery of Walter. But they made remarkable works. In the 21st century we are left with the question 'what is pâtes-de-verre exactly?' and it is one that I am constantly being asked by artists and practitioners. The answer, of course, is that it is what you want it to be, provided you follow some rules and invent some of your own. But that answer never seems to satisfy. In the attempt to understand where pâtes-de-verre has arrived from partial facts are clung to, and have morphed into whole truths. Anything made with glass pastes before Cros is considered to be another field of study. The result is that the fluid and multi-coloured, historical world of pâtes-de-verre is misrepresented as an assembly in monochrome. I have shown that Cros and his promoters were part of that loss and confusion, and his dominant figure still casts a long shadow over our perception of what pâtes-de-verre is, and what it can be. The true nature of pâtes-de-verre is only now beginning to be challenged. It is only a few practitioners who feel hampered by the traditional view of defined technique who challenge it in their making and academic discussion. This thesis therefore is a contribution to that thrust of change, and a lever to help move the tectonic plates of established theory.

Areas of Further Research.

a. In many ways the research in this PhD study has raised more questions than it has answered. These have arisen throughout the research and are therefore still to be explored and investigated. I have already discussed the desire to form a new history of pâtes-de-verre for a new generation of artists. There is evidence enough to rewrite the story of what we have been told. Detailed examinations of the works and lives of the pioneers of the so-called 'new medium' of pâtes-de-verre should be included in that research. And the contribution of Henri Cros, about whom we know so little, about whom so little has been written, needs to be rethought and placed in its true historical (and artistic) setting.

b. In terms of Walter, a general cataloguing of his work should be produced. This can now be done with greater ease, as I have laid the foundations of that study. The Broadfield House

Collection of Walter is the largest in the world. But 161 pieces do not necessarily display his whole oeuvre. With each exploration I have made outside the collection, new forms with new subject matter have been discovered. We know he made pseudo-religious works, particularly of the Passion of Christ, yet none is held within the Broadfield House collection. In that sense the collection is limited and has limited parts of my research. What form the rest of his work took, how much he made, and what still exists would be an important research undertaking. So, too, would be a cataloguing of the work Walter made during his time at Daum. Some of it is obvious to the eye and can be indentified, despite the lack of acknowledgement, but much of it goes unnoticed and unauthored in published research. On my visit to the Daum factory in 2006 I was given the chance to inspect some pieces of pâtes-de-verre. They were clearly made by Walter, but no one knew they were part of what he had produced while he was there. Instead, I was told it was just part of the factory's output before 1914.

c. As well as this, a comprehensive and detailed investigation into what pâtes-de-verre was made at Sèvres under the direction of Levy and Dammouse, how it was produced and under what conditions it was made needs to be undertaken. This should be investigated alongside a display of what remains of their experiments, both the successes and failures, and the attempts of artists such as Walter to produce work never before seen. The present situation is that we do not fully know what exactly was done there, what remains or what there is to be found. As a result one speaks in generalities about important figures and their works. The results of that investigation would show Walter to be as much a pioneer as Cros, Levy and Dammouse. It would then elevate Walter into the pantheon of the great and good of the pâtes-de-verre makers of his generation. The muddy waters that confuse technique and artistic quality in this period and area of glass making need to be sieved and clarified. Cros has benefited from this conflation and Walter has lost. My work in this study allows for the disentanglement and therefore the re-assessment of Walter's position as both artist and prime developer of the process of pâtes-de-verre.

d. A detailed investigation into Walter's personal life would be of major interest and importance. Our natural curiosity about the emotional functions of the artist and his/her day-to-day life always adds interest to their work, and gives us important understanding of how he/she operated and thought. I have already discovered a little about him, his divorce and his house-keeper-mistress. This is intriguing, and gives us a rare glimpse of the man himself. The knowledge that he went blind from acid fumes provides the answer to how he cleaned his glass, but there appears to be little else I do not really know what drove him to be the artist he was. Any real understanding of him has purely come via the dissection of his methods and techniques and what is in effect archaeological osmosis. That is an obtuse way to discover the human side of someone. I am aware of an antique dealer in Nancy who has many artefacts relating to Walter's life, including a copy (he believes) of his fabled lost notebooks. He is assembling this knowledge with a view to publishing a biography. That, combined with my research, would give a comprehensive study of this elusive man, Walter.

e. The detection of uranium in Walter's work is an important discovery, but to give greater insight into his processes more research is needed on other pieces, especially those outside of the Broadfield House Collection. The presence of uranium raises questions about who else in the artistic environment in which Walter worked used this element and why. In the 21st century we look on uranium as a strange and dangerous element, and so treat it with extreme caution. I am certain Walter just regarded it as another colourant useful to his palette, but it would be interesting to know how it came to be included in his work. The research may also reveal which other makers of pâtes-de-verre at this time worked with it. I suspect the key to unlocking the answer lies in the archives of the Sèvres Museum. Their assurances to me that nothing exists are frankly unlikely. Where and who else would hold the documentary evidence of the place and period?

From my investigations following the discovery of the use uranium I have become aware that there is little published about that element's use within lead crystal. There is plenty of evidence that it was used, and it is mentioned several times in articles. Unlike Vaseline glass, which is a soda-based glass, no real investigation into the historic or artistic use of the element in lead crystal per se hasbeen attempted. A study on this area would shed an important light upon a dark corner.

f. By a combination of all the areas examined, a test may be able to be devised into what is a Walter forgery and what isn't. The fact that he used uranium in his work is unusual, but the use of it today is very unlikely. Compounds of uranium are relatively hard to come by in the modern world, and it may prove too difficult for a forger to bother with. If so, it may be that this is the solution to giving the glass world a device for the detection of forgeries.

g. I have already touched upon the historical aspects of pâtes-de-verre itself, what we have been told and what we now know. I have also discussed how a radical new approach to the way we think about the subject should be addressed. This will only come about with further research and the publication of that research. Articles and papers around the subject would undoubtedly help, but a solid tome that unveils the true linear history of pâtes-de-verre, who its makers were and what they accomplished would greatly add to and expand our knowledge.

h. Not all my results in the search for colours have been successful. In practical making terms the production of a scarlet or ruby red at around 800° C has been challenging. Its eventual creation should be achievable with more research and more experimenting.

In tying together the strands of this PhD enquiry it is clear that the three methods of investigation undertaken (the historical, the scientific, and the artistic) have not been treated as solitary tools for their own end. By consciously interrogating the original research questions with art that is informed by science, and science by history, and history by art, the landscape which Walter inhabits, has been transformed. So too has the topography of pâtes-de-verre. Exciting new geographies have been established, which can be charted by artists or by academic researchers, or by the creature that is both.

From out of my conviction to question perceived areas of wisdom, and to test the results, raw intelligence has been produced which has further driven the investigation. Its outcomes have forced changes in my own artwork and forced changes in me.

My own personal work has been radically altered, and I think differently as an artist.

I would suggest it would be the same for anyone who undertakes such a journey with an open mind.

It is only time and practice that will test the new ideas that have arisen out of this thesis. The research undertaken has made me more aware that we do not live in a completed age. We are just at one point in a continuous line of making and development that evolves and changes, advances and retreats, but is always reinventing itself. My challenges to the perceptions about pâtes-de-verre, what it is and how it can be made, will undoubtedly be challenged too. However, with the use of the 220 formulae a new era in pâtes-de-verre making awaits. I have no idea what those works will be that utilise these formulae, or how this new period will be categorised. The hand of each artist who chooses to embrace the possibilities, and the extent of his/her imagination can only determine that. But those works, however good or bad, however strange or beautiful, will communicate their language, and they will become its history. Lying at the heart of what these artists do will be the purpose of their existence: the creation of new methods of expression to entrance the world and craft fresh ornament. That is the point of unravelling the past and using it to push forward new ideas.