

TURIN SHROUD

Testament to a Lost Technology

Nicholas Peter Legh Allen

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This book is dedicated to all those who seek the truth, regardless of the consequences or its threat to their comfort zone.

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FOREWORD

Stephen Toulmin, in an introductory text on the philosophy of science, once remarked that science entails a new way of looking at old or familiar phenomena. If this characterization is accurate and I think that it is, then Nicholas Allen's text on what is traditionally referred to as the *Shroud of Turin* is an admirable account of doing science by dispensing with worn out, unsatisfactory explanations and taking a new look at the phenomenon in question.

And if this new look involves the application of something else, in this case the familiar principles of photography, then the latter may equally be illuminated in new, unexpected ways which invite a surprising rethinking of orthodox accounts of the history of art, science and technology. At the same time, Prof Allen's hypothesis, the elegant simplicity of which is matched only by the persuasiveness of its explanatory power, is a salutary reminder that Western science and technology may not be all that we have traditionally been led to believe.

His work on the origin of the *Shroud* suggests, instead, that what most people have always regarded as the exclusive achievements of Western culture, may in fact have some of its important roots in some other knowledge tradition, from which it was appropriated by virtue of some set of historical circumstances.

In this respect, Allen's research is related to the work of those scholars such as Sandra Harding who have put forward arguments and adduced evidence that (“Western”) science may in fact be a multicultural phenomenon. Regardless of its contribution to the recovery of “lost” knowledge and technology, however, Allen's argument is a splendid instance of the structure of scientific research in the form of an interplay between what Popper called “conjecture and refutation” (and, of course, confirmation).

Every step of the way the reader witnesses the emergence of conjectural hypotheses that are continually subjected to scrutiny in the light of guiding theoretical assumptions as well as (corroborating or falsifying) evidence. Prof Allen's ability to formulate alternative, increasingly more accommodating explanations at every turn, bears witness to the breadth of his erudition and the depth of his insight.

I shall refrain from spoiling the fun of discovery on the part of prospective readers by letting the cat out of the bag, so to speak, concerning the specifics of Allen's hypothesis on the way the *Shroud of Turin* was made. Suffice it to say that it provides the most tenable account to date, as may be gathered from the fact that Prof Allen has even succeeded in making a Port Elizabethan counterpart to the Turin artefact by implementing the scientific technological principles and procedures which he believes to have been used to create the original *Shroud*. I am convinced that open-minded readers of his book will not be disappointed.

Prof Bert Olivier

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1997

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This book and associated research would not have been possible without the selfless contributions effected by innumerable people who have each in their particular way facilitated my attempt to resolve the curious riddle of the *Shroud of Turin's* manufacture. Indeed, most persons involved had no knowledge of the precise nature of this investigation, which due to its sensitive (and what would indisputably have been considered speculative) disposition, had to be kept confidential until the last conceivable moment.

In this regard, my earnest thanks go to the following persons and organizations, viz.: the late Fr Dr Leonard Boyle and his magnificent staff at the *Biblioteca Apostolica Vaticana*, the staff of the British Museum Library, the *Bibliothèque Nationale*, the *Hertziana* Library, Ms Marjorie Eales, Mrs Jean Thomas, Mrs Denise Barnard, Mrs Debbie Griffin, Mrs Geraldine Coleske, Mrs Annette van Zyl and all the other forbearing staff of the former Port Elizabeth Technikon Library.

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I am also indebted for the magnanimous support given to me by my two former colleagues: Mr Jonathan Hansford and Mr Glenn Meyer, not only for most of the photographic work that appears in this publication, but also for being prepared to share their knowledge of photographic science with me. I am also indebted to Mr Graham Thompson for his assistance.

I must also acknowledge the support that I have received from my many supervisors, viz.: the late Prof Thomas Matthews who never lived to see the fruits of this research project, Prof Alan Brimer and Prof John Butler-Adam (previously of the University of Durban-Westville).

I am also appreciative of the support that I have received from Prof Estelle Maré (University of South Africa) who was incidentally my co-promoter during the final phases of submission

for one of my doctoral theses. Without her moral and academic support this specific research would probably never have been completed.

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A very special thank you to Mr Barrie M. Schwartz, who was the official photographer of the 1977 STURP committee, for the employment of some of his original shroud images.

Finally, I would like to thank the Research Committees of both the former Port Elizabeth Technikon (chaired at the time by Prof Hennie Snyman) and the former University of Durban-Westville, for making funds available to me whilst I was completing my initial research. To all the above-mentioned individuals and the many others who are too numerous to mention, a very sincere thank you.

AUTHOR'S PREFACE

I can still recall, as if it were yesterday, a Sunday morning in the latter months of 1969 - a day when I was first introduced to that most alluring and mysterious of objects, the *Sudaria Christi* or as we now know it, the *Shroud of Turin*. On the lounge wall of the home of our two parish priests, hung a framed, green-hued positive image of the meditative face of Christ. I was soon to discover that this was a reproduction of the first colour negative photograph ever taken of the *Shroud of Turin*, an historically unique and time honoured relic which may be safely documented at least as far back as the middle of the fourteenth century.

As yet, there are no records of how its first recorded owner, Geoffroi de Charny, Seigneur of Lirey (a small village situated some 18 kilometres south of the city of Troyes), came to be in possession of this relic. Regardless, on September 19, 1356, Geoffroi I de Charny died a hero, using himself as a human shield to protect his king, John II on the field of Poitiers. The following year (1355) de Charny's widow, Jeanne de Vergy exhibited the *Shroud* at Lirey.

As a young boy, I was still a very naïve member of the Roman Catholic Church. My parish priest, Fr Philip Foster, disclosed to me, that on the surface of this long strip of woven linen could be seen the faint negative image of both the front and back views of the naked and crucified Christ, complete with the marks of the flagellation, the crown of thorns, the spear wound in the side and the bloody imprints of the *stigmata*. This winding cloth (which he firmly believed had enclosed the crucified Christ), supplied tangible testimony to the twentieth century of Christ's passion and ultimate sacrifice. For this reason, he explained, this sacred relic could be considered to be the Fifth Gospel of Jesus Christ, or if you like, very tangible evidence for the “doubting Thomases” of the modern world, that Christ had indeed suffered, died and ultimately risen from the sepulchre.

As a thirteen year old boy, I was completely overawed by what I then considered to be a holy relic as well as what I then innocently perceived to be have serious implications for mankind as a whole. As the years passed by, and I became a confirmed rationalist, for some reason I still never lost this sense of wonder for the *Shroud of Turin*, and eagerly kept abreast with the opinions of the scientific commissions which repeatedly attempted to unveil its secrets.

Finally, in 1988, after I had assimilated the outcome of the then recent, carbon-dating tests - tests which supported the argument that this piece of linen was produced sometime in the late thirteenth century - I finally knew for certain, that as far as the *Shroud of Lirey-Chambéry-*

Turin was concerned, there were, to put it quite plainly, no experts. Rather, there existed, inter alia, a proliferation of largely ignorant, unqualified and certainly opinionated individuals who often used whatever means were available to promote their particular hobby horse. I was also shocked by the speed with which this truly incredible product of medieval ingenuity was conveniently relegated to the intellectual scrap-heap - an event that took place the moment it was known for "certain", that the *Shroud did not* date back to the time of the historical Jesus. In this regard, I was especially disconcerted by those now oft-quoted words of Professor Edward Hall of Oxford University, who quipped,

There was a multi-million-pound business in making forgeries during the fourteenth century. Someone just got a bit of linen, faked it up and flogged it.¹

"Faked it up"! How inappropriate a term! Why, only a generation earlier, Dr Pierre Barbet had declared

If these be the work of a forger, he must have been a super-genius as an anatomist, a physiologist and an artist, a genius of such unexcelled quality that he must have been made to order.²

No surely, if this image was nothing more than the modest work of medieval men, then why couldn't twentieth century men duplicate their labours? It simply wasn't good enough to play down the significance of what surely must have been (by anyone's standards), an extraordinary image making technique - a technique which for over six hundred years had clearly duped those who would set themselves up as authorities on the subject.

Throughout my adolescent life, I had developed an interest in a vast range of subjects such as alchemy, the Dead-Sea Scrolls, Arthurian legend, the Knights Templar, Renaissance art and science and even parlour magic. I believe now, that it was quite possibly, this latter knowledge, acquired as an amateur magician that assisted me the most whilst tackling the problem in hand. I understood then, that like the best magical effects, it is very often the performance of the magician that mystifies us. The secret of the trick itself, once understood, is often common-place and disappointing.

Certainly, by 1988, I knew that the answer to the *Shroud's* secret had to be obvious - so palpable, that when we comprehended it at last, we should wonder for quite some time, how

¹ Michael Sheridan and Phil Reeves, *Independent*, Friday, 14 October, 1988.

our supposedly superior civilisation could have been so persistently dull and witless.

This book is an account of how I came to have these sentiments and of my research, which developed from a most fortuitous and propitious day in 1988 - a day when the solution to perhaps one of the most baffling riddles of our time came to me as if it were a gift from heaven itself. This obvious solution, which at the time, was considered to be far too speculative to be taken seriously, was to increasingly dominate my whole life-style, often forcing me to forfeit my then primary function as an artist and making major claims on my extremely limited time and resources.

With very little financial backing, I had to travel to Europe, where quite literally living on a shoe-string, I went to Rome, to read at the *Biblioteca Apostolica Vaticana* and the *Hertziana*. I also stayed very briefly in Paris to make use of the *Bibliothèque Nationale* and I travelled to London (incidentally my birthplace), where I made use of the British Museum Library.

Throughout my investigations, I received invaluable assistance from my many academic friends and colleagues and was granted very limited (albeit much needed), financial support from both the former Port Elizabeth Technikon and the former University of Durban-Westville. In all, this research (which still continues), entailed decades of experiments and exacting but exciting work which had to be sandwiched between a busy academic career, raising a family and two marriages.

Having finally established indisputable evidence to support my unique theory, I now had to consider the many possibilities which existed to explain why this obvious forgery was perpetrated in the first place. In this book I attempt to do this as well, and I am sure that you, the reader, will be as fascinated as I was by the often ingenious skulduggery which our medieval ancestors were capable of. If nothing else, I hope to disavow you of the notion that medieval society was technologically backward or that the so-called scientific revolution occurred solely as a result of the Italian Renaissance. To be sure, the truth is that we have underplayed the significance of the extant writings of such eminent scholars as al-Geber, Abn Is-haq, al-Haytham, Ibn Isa, al-Razi, Ibn Roshd, Witelo, Robert Grosseteste, Albertus Magnus and Roger Bacon - who are in many ways, merely the barometers of the kinds of knowledge, levels of expertise and problem solving abilities which we have never even suspected to have existed at this time - that is, until now.

² Pierre Barbet, *A Doctor at Calvary*, Doubleday, 1953, 183.

I

FABRICATING

A MYSTERY

The *Shroud* Phenomenon

As an artefact, the *Shroud's* physical composition is relatively well known. Outwardly, it is an ivory-coloured linen strip, woven in a herringbone twill, measuring 14 feet 3 inches by 3 feet 7 inches³. It should be mentioned for purposes of accuracy, that this linen strip has an additional narrow ribbon of linen material, of identical weave, sewn onto one of its edges (lengthwise). Regardless, what makes this piece of linen so unique is that it contains a faint enigmatic image (in pale sepia) of both the frontal and dorsal views of a naked man.

Moreover, only since 1898 has it been fully appreciated that this double image is modelled much like a modern day photographic negative, i.e. all highlights are depicted as shaded areas, and conversely, all dark and shaded areas are shown as highlights. If the polarity of this image is reversed (e.g. by making a photographic negative of the *Shroud*) one can clearly see a positive, seemingly three-dimensional image of a man. This positive version of the *Shroud's* image is highly naturalistic, containing as it does, details such as skin abrasion, a dislocated limb and swollen facial tissue.

The image itself (i.e. without photographic enhancement) is extremely subtle and cannot be readily discerned by the human eye at close range. In fact, most authorities who have had the privilege of seeing the *Shroud* at first-hand, confirm that the image is best viewed at a distance of some seven metres.⁴ Nonetheless, even without the benefit of modern photographic technology it is possible to recognise many features from the negative image

³ About 434 x 109 cm.

⁴ For example, the well-known sindonologist Ian Wilson, describes this phenomenon as follows: “The astonishing aspect of seeing the Shroud itself rather than a photograph is discovering how pale and subtle the image appears. The color of the imprint can best be described as a pure sepia monochrome, and the closer one tries to examine it, the more it melts away like mist”. Ian Wilson, *The Turin Shroud*, Victor Gollancz, 1978, 9.

alone - details that would have been obvious to persons living centuries before our own time.

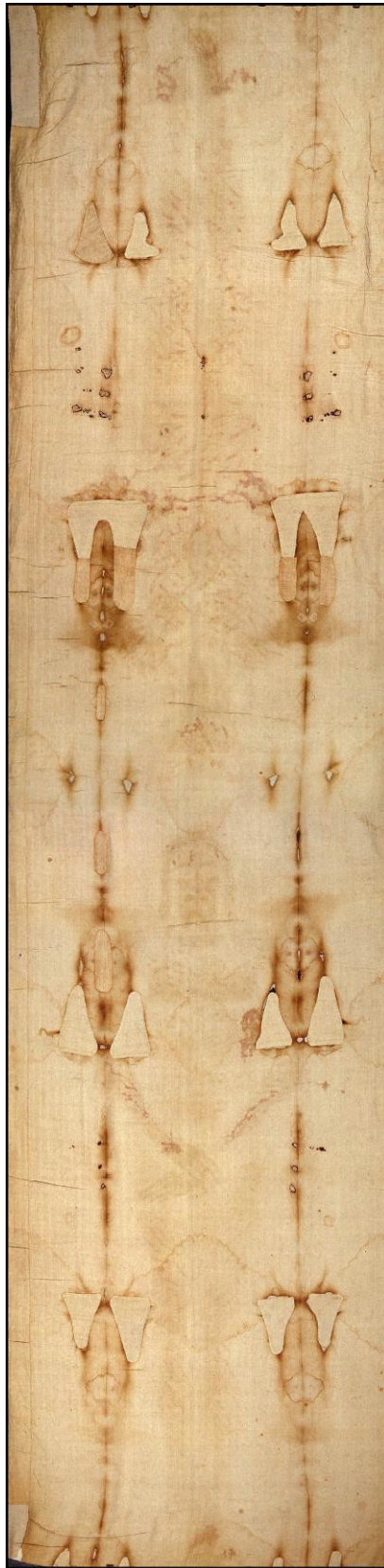
For example, the frontal image depicts a bearded man with long hair, his upper arms and legs lie straight. His forearms are bent at the elbow and cross over the pelvic area in such a manner that one wrist obscures the other. The feet point downward. The hands show only four fingers as both thumbs appear to be absent. Except for the face, all parts of the body, both in the frontal and the dorsal image, are covered with small regularly spaced brown marks which are usually interpreted as being skin abrasions caused by scourging. The wrist (which is discernible) contains what appears to be a nail wound, and “blood” flows are clearly visible running the entire length of both forearms. Similar “nail” wounds and “blood” flows are visible on the feet.

On the side of the man's chest (in the front view) is a larger wound and associated “blood” flow. This latter feature seems to be continued on the back view, as a large “blood” flow runs across the man's back in an open braided pattern.

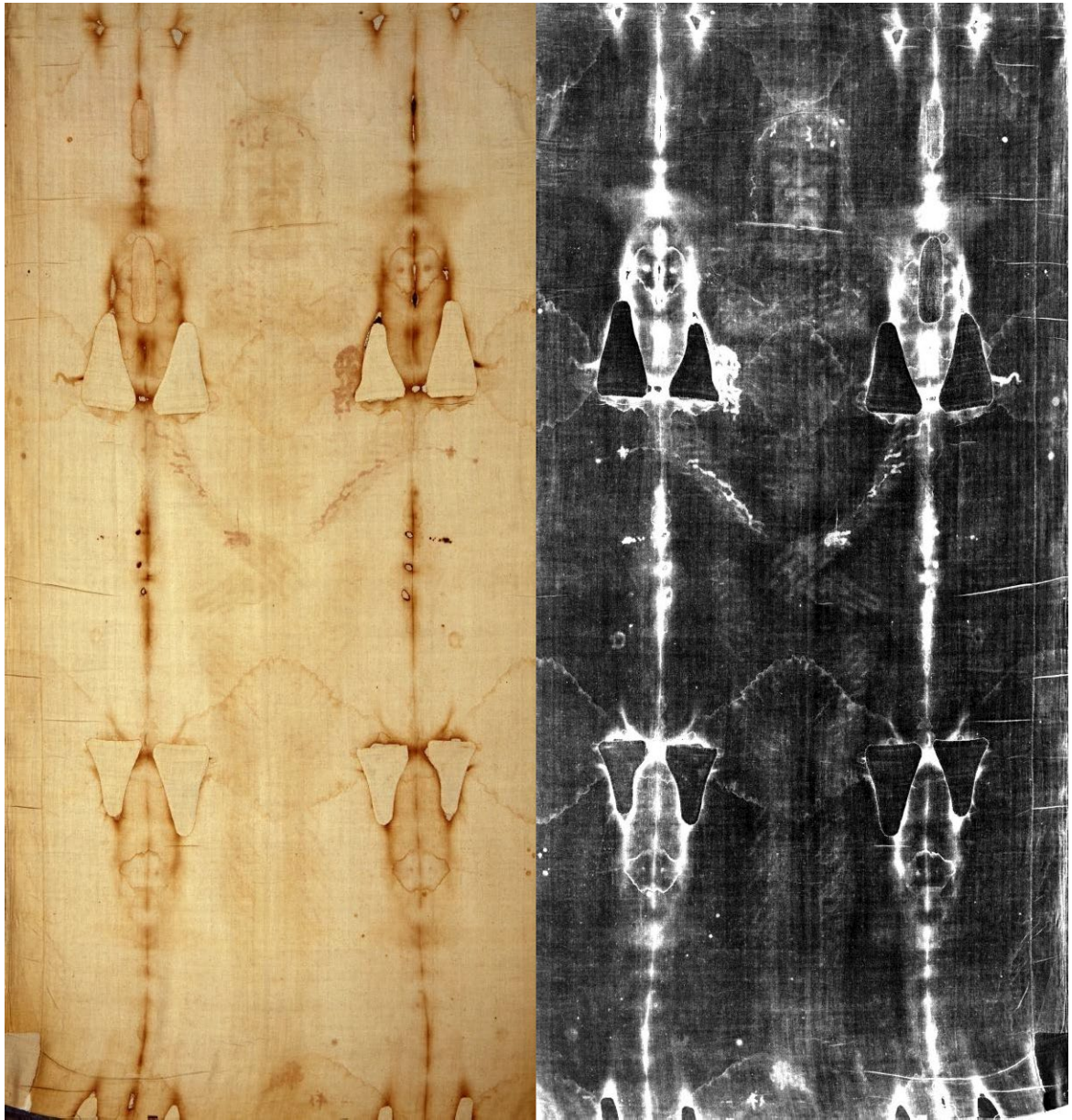
The head of the man seems to be perforated in both the front and back views and a number of smaller “blood” flows are visible - the most prominent being one in the shape of an inverted number “3” on the man's temple.

In addition, since 1532, the *Shroud's* image has been marred and visually dominated by unsightly scorch marks caused by an accidental fire when this relic was housed in the Church of the Holy Chapel in Chambéry.

It would not be possible to enumerate with any claims of accuracy, the total amount of literature, both speculative and supposedly scientific, that has been propagated on the topic of the *Shroud of Turin*, but the list would undoubtedly be quite staggering. Indeed, by 1902 alone, an estimated 3500 articles, treatises and books had already been generated in response to the heated debate concerning the *Shroud's* authenticity and the possible causes for its seemingly miraculous image. More remarkable still, most of this literary output was produced in the four years subsequent to Secondo Pia's discovery of the *Shroud's* photographic attributes (i.e. 1898).



1/ The *Shroud of Turin*, showing the frontal and dorsal negative images of a “tortured” man. CREDITS: 1978 Barrie M. Schwartz Collection, STERA, Inc. All Rights Reserved. COPYRIGHT: 1978 Barrie M. Schwartz Collection, STERA, Inc. All Rights Reserved.



2/ Detail from the *Shroud of Turin*: On the left, a positive photograph showing a negative image of a “tortured” man. On the right, a negative photograph of the *Shroud of Turin* showing a highly detailed, anatomically accurate, positive image of the same man (frontal image).
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Even at this early stage, there was a clear-cut division between those writers and authorities who wished to prove the authenticity of the *Shroud* (mainly within a religious context) and those persons, who while not necessarily doubting the existence of the historical Christ or even the validity of the Christian message, took a very sceptical stance as far as the *Shroud* itself was concerned.

It is safe to state, that by and large, both camps relied heavily on the Biblical account of Christ's passion (in particular, the Gospels of Luke and John) to both validate as well as refute the authenticity of the *Shroud*. Even Dr Paul Joseph Vignon, who at this time (c 1900)

was an agnostic, often turned to the New Testament to support his claims. This is because he (like most of the other pre-1988 researchers) was primarily concerned with proving or disproving the *Shroud* in terms of its claim to be the then 1900 year old burial cloth of the historical Jesus of Nazareth.

Not for one moment, did these researchers consider the possibility that the *Shroud of Lirey-Chambéry-Turin* might also be investigated in terms of its qualities as *sache selbst* and/or its importance as an outstanding product of some (possibly forgotten) medieval technology. This tendency (to justify the *Shroud*, solely or partly in terms of Scripture) has survived right down to the present day, and has (as will be shown) also been one of the many stumbling blocks to any alternate attempt at resolving the mystery of the *Shroud's* image.

Dubious Medical Opinions

Anyone who looks at the positive image of the *Shroud* is normally struck by the amount of naturalistic detail which is certainly not evident in other images produced by western and eastern cultures before 1355⁵. Indeed, the positive image contained in the *Shroud* is extremely life-like - a fact borne out by the number of medical practitioners and pathologists who, from the turn of the century until the present day, have claimed to be able to treat with this image as if it were a real corpse.

This medical examination of the man in the *Shroud* is extremely important because, although it offers no (immediately obvious) clue as to the actual process employed in the production of the image, it does most strongly support the notion that an actual corpse of a human subject was an absolute pre-requisite for the final “impression”.⁶ This information will also be shown (at a later stage) to be helpful in deducing how the image was actually produced.

In this connection it is enlightening to examine some of the opinions of those four completely misguided physicians who have, arguably, contributed the most to the medical debate on the *Shroud*, as well as creating a bizarre worldview that continues to muddy the

⁵ Earliest assumed date that the *Shroud* is recorded.

⁶ Fr Peter Rinaldi, in a similar vein, states that “Among the Shroud's details which not even a present-day artist with the most consummate knowledge of anatomy and physiology could produce, medical men include the following: the perfect characteristics of a corpse in the condition of *rigor mortis*, with the added characteristics of one who died while hanging by the arms, such as the abnormally expanded rib case, the distended lower abdomen, the sharply drawn in epigastric hollow, etc”, Peter Rinaldi, *The Man in the Shroud: This is the Face of Christ*, London: Sidgwick and Jackson, 1972, 53.

waters, viz.: Dr Pierre Barbet, Dr Robert Bucklin, Dr David Willis and Dr Robert Wilcox.

Collectively, these men have all contributed in their own distinctive way towards the creation of a very persuasive (albeit fallacious) mental picture of the man whose image now adorns the *Shroud of Turin*. Indeed, according to their “researches”, the *Shroud* depicts a man, who (if he had in fact existed) would have had the following specific physiological characteristics:

- a height of around 181 cm;
- a powerful and well-proportioned physique;
- a right shoulder lower than the left (possibly dislocated);
- facial features of the same physical type as modern Sephardic Jews and “noble Arabs”;⁷
- an age of between 30-45; and
- shoulder length hair and a forked beard.

The man in the *Shroud* seems to display a number of superficial wounds which have been identified by Dr David Willis⁸ as follows:

- a swelling of both eyebrows;
- a torn right eyelid;
- large swelling below the right eye;
- a swollen nose (possibly broken);
- a triangular-shaped wound on the right cheek with apex pointing towards the nose;
- a swelling to the left cheek;
- a swelling to the left side of the chin;
- at least eight independent streams of “blood” can be counted on the back of the head seemingly caused by independent puncture wounds to the scalp;
- at least four independent streams of “blood” can be counted on the front of the head.
- These are also normally assumed to be puncture wounds. Vignon, for example, ascribed these streams of blood to wounds inflicted by the “Crown of Thorns” and even stated that “No painter, in his most elaborate work, has ever risen to such exactitude”.⁹

⁷ Robert K. Wilcox, *Shroud*, Bantam, 1978, 129-36.

⁸ Wilson, 1978, 22.

⁹Paul Vignon, *The Shroud of Christ*, Archibald Constable, 1902, 30.

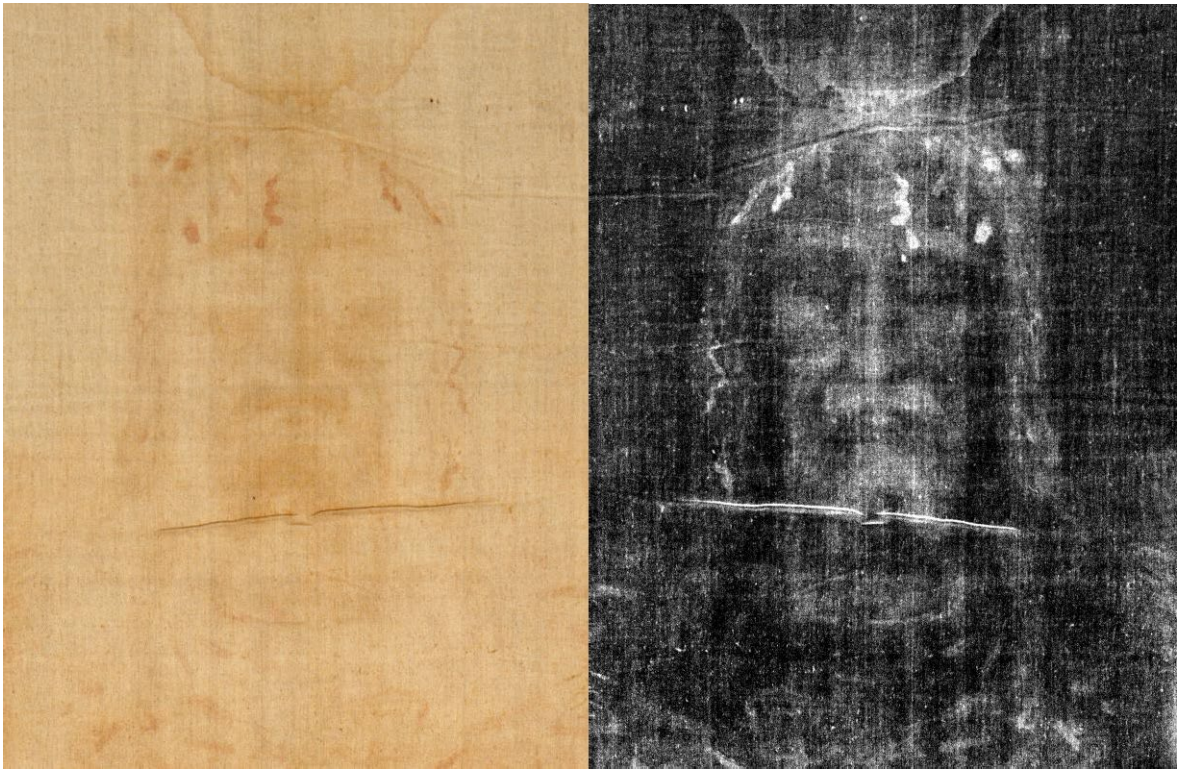
- 90 - 120 marks, each about 4 cm in length, covering the entire body except feet, forearms and head. It has been postulated that these marks were made by two whips (specifically Roman *flagri* or *flagelli*), each of which had a number of thongs studded with lead balls. From the “angle” of the “whip marks” it has been claimed that it is possible to deduce that the man in the *Shroud* was lashed by two men of different height;¹⁰
- two large excoriated wounds on the region associated with the *scapulae* which were supposedly inflicted after the scourging. Willis states, “These wounds could well have originated from the friction of some heavy object rubbing on an already damaged area of skin”;¹¹
- excoriations with jagged edges to the region of the left *patella* and a contusion wound to the area of the right *patella*;
- a supposed puncture mark in the left wrist (at a point in the metacarpals known as “the space of Destot”) with distinct blood flows. The thumbs of both hands are missing, suggesting that they are lying flat against the palms;
- an assumed puncture mark and visible blood flows from the right wrist. The left wrist obscures the right wrist;
- visual evidence that the feet were pierced by a single sharp object (nail?) at the position in the metatarsal bones known as the “Linfranc joint”. The left foot was placed on the right foot; and
- an elliptical wound corresponding to the space between the fifth and sixth ribs on the left side of the torso. From this wound flows “blood” interspersed in some areas with clear patches. These patches have been interpreted as “water”.

You are soon to discover, as I eventually did, that the truth (if such a thing exists at all) is far less complicated than these physicians perceived it to be. Indeed, much of the above listed information, far from being accurate, is in fact nothing more than the opinion of various individuals who were operating within a very narrow context.

One such example of the lengths that people will go to, (very often unconsciously) when attempting to give credence to their particular belief structure, may be illustrated by the great deal of attention that has been given to those areas on the *Shroud* associated with the *stigmata*. Of especial interest is the research undertaken on the wounds in the wrists and feet.

¹⁰ See also Kenneth. E. Stevenson and Gary. R. Habermas, *Verdict on the Shroud: Evidence for the Death and Resurrection of Jesus Christ*, Servant, 1981, 154 and Rinaldi, 28.

¹¹ See Wilson, 1978, 25.



3/ A positive and negative photograph (for comparison) of the face of the tortured man from the *Shroud of Turin*. CREDITS: 1978 Barrie M. Schwartz Collection, STERA, Inc. All Rights Reserved. COPYRIGHT: 1978 Barrie M. Schwartz Collection, STERA, Inc. All Rights Reserved.

For example, during the 1930s, Dr Pierre Barbet conducted a series of experiments on cadavers at the St. Joseph's Hospital, Paris. The purpose of these investigations was to “prove beyond doubt” that the man in the *Shroud* had suffered death by crucifixion. Most people immediately associate this terrible form of capital punishment with the ancient Romans and obviously, the sacred personage of Jesus Christ. Of course many other cultures employed this form of execution, including the ancient Chinese, Persians and Carthaginians.

It is worth mentioning that shortly after 400 CE, crucifixion, as a form of capital punishment, was officially outlawed by the Romans themselves. Bearing this point in mind it is important to note that certain aspects of Roman crucifixion had either been forgotten or were still not fully understood before Barbet's investigation.

Like Vignon before him, Barbet was especially interested in the position of the nail wounds in the man's wrist (as depicted in the *Shroud*). He realised that if a person were nailed to a cross (in the manner supposedly described in the Gospels but well-illustrated in the history of art!) the sheer weight of the body would tear the hands from the nails. In this context it would seem that the only way to attach a person to a cross (in keeping with the more traditional interpretation of the event) would be by taking the weight off the palms of the

hands by employing some additional support, such as a rope, binding the arms to the stipes.

However, if a person were to be attached to a cross by the wrists (as suggested by the image of the *Shroud*) the body could be adequately supported. Barbet experimented by placing nails in the wrists of cadavers (i.e. at the same point indicated on the *Shroud*), and made an important discovery, namely: the thumb contracted over towards the palm of the hand. Specifically, this action is caused when an object (like a nail) passes through a point in the metacarpals known as the “space of Destot”. This mechanical stimulus has been proven to be the result of the median nerve being touched by the nail as it separates the small metacarpal bones of the wrist. Amazingly, the *Shroud* appears to show this same feature on the figure's right hand (i.e. in the negative image) and by implication the left hand too.

This singular attribute, until now, despite it being a conflation, has been one of the most “convincing” pieces of evidence for supposing that the image in the *Shroud* is a naturalistic record of a crucified man in *rigor mortis*. However, what has been overlooked here, is that all of this research was conducted because it was assumed that the “nail wounds” were in the victim's wrists and by virtue of the fact that it is not possible to see the man's thumbs. In point of fact, there is only one “nail wound” visible and this in itself, is nothing more than a daub of blood applied on top of the image of the man's wrist. As for the thumbs, you will soon discover that there is another far more obvious reason for the supposed absence of these extremities.

Nonetheless, what is almost true, is that no artist in the history of art has depicted Christ quite like the *Shroud* does. Moreover, all the references in the New Testament clearly refer to the Messiah's hands being pierced (not his wrists). It is pointless (as many scholars have done *ad nauseam*) to point out that the Greek word for the hand can include the wrists and even, at a stretch, the arms themselves. Even if this latter point were accurate, the fact is, that (with few notable exceptions) no practising Christian since the Church's foundation, has ever been recorded to describe, sculpt, draw or paint a depiction of the Crucified Christ that places the wounds of the nails in the “space of Destot”.

In this connection, it should be noted that some versions of the crucifixion as painted by the Baroque artists, Peter Paul Rubens and Anthony Van Dyck, depict the nails in the wrists. However, neither artist shows the reflex action of the thumb as supposedly depicted on the *Shroud*. To date, I have certainly not come across any other record for this phenomenon which precedes the work of Barbet.

Barbet (who started his investigations as a confirmed sceptic) was so impressed with the anatomical accuracy of the *Shroud's* image that he wrote:

I am a surgeon and, as such, well-versed in anatomy which I taught for a long time; I lived for thirteen years in close contact with corpses, and have spent the whole of my career examining the anatomy of the living. The idea that an artist of the fourteenth century could have conceived, let alone painted or stained these negative images is sufficient to disgust any physiologist, any surgeon...Please, do not even talk of it! This image is enough proof that nobody has touched the *Shroud* except the Crucified Himself.¹²

The reader will, like myself, eventually come to view this as a rather imprudent conclusion.

¹² Barbet, 73.

II

THE FRUSTRATED SCEPTICS

The Scientific Commissions

Scientists were given their first opportunity to study the *Shroud* at first hand, on June 16 and 17, 1969. On this occasion, the church authorities permitted a group of predominantly Italian researchers to examine the *Shroud*. This two-day inquiry was intended primarily for the purposes of ascertaining the *Shroud's* state of preservation and to make recommendations as regards the feasibility of conducting scientific tests at some future date.

As a direct result of this preliminary investigation, a number of samples were taken from the *Shroud* four years later, on 24 November 1973, for analysis by a second commission, many of whose members had made up the original 1969 team. In addition, the legal owner of the *Shroud*, King Umberto II, gave permission for the *Shroud's* Holland cloth backing (that had been applied by the *Clarisses* in 1534) to be unstitched in a small area. This gave the researchers an opportunity to inspect the reverse side of the *Shroud* for the first time, and in this connection Silvio Curto (an Egyptologist) first noticed that the image was not visible on the underside of the *Shroud*.¹³

Four other members of the commission, that is: Gilbert Raes (an authority on textiles), Guido Filogamo (a blood-analysis specialist), Eugenia Rizzati and Emilio Mari (forensic experts), were each given linen samples (threads) from the *Shroud*.

Raes, in his investigation, discovered that one of his linen samples contained traces of cotton

¹³ Of course, more recently (2004), it was discovered that it is possible to discern (albeit unclearly) a hazy image of the man's face on the back of the cloth.

which could accurately be identified as belonging to the species *Gossypium herbaceum*. This species of cotton is grown exclusively in the Middle East. However, the portion of cloth originating from the thin strip of cloth that is attached to the side of the *Shroud*, contained no cotton traces. In addition, although the type of weave used in both samples was largely indistinguishable, the thickness of the linen threads was not. This implies very strongly that either these two pieces of material were of different manufacture or that they were woven by the same manufacturer on separate occasions.¹⁴

As could be expected, the results of the 1973 commission generated much interest from scientists internationally, and subsequently, a number of Italian sindonologists lobbied in support of a proposed in-depth programme of non-destructive research by a group of American scientists.

As fate would have it, 1978 marked the 400th anniversary of the *Shroud's* residence in Turin, and the then legal owner of the *Shroud*, King Umberto II, granted permission for the relic to be put on public display for six weeks commencing August 21 1978. On October 8 the *Shroud* was examined by the Americans, who as early as 1977 had organised themselves as the *Shroud of Turin* Research Project Inc. (STURP). This team, which comprised specialists in computer technology, haematology, physics, organic chemistry, spectroscopy and X-ray analysis, was headed by Dr John Jackson and Dr Eric Jumper, both of the US Air Force Academy.

The objective of this scientific arsenal, which included fluorescence, infrared radiometry, microchemical analysis, multispectral narrowband photography, optical microscopy, ultraviolet fluorescence photography, and visible, ultraviolet and infrared spectroscopy, was to investigate the *Shroud* as either a man-made (i.e. a painted/dyed) image or as a product of some (as yet unspecified) “natural” origin.

In addition, most tests were conducted in order to identify the elements present in both the image of Christ as well as those present in the “blood” stains. In the latter case, the scientists were especially keen to detect such trace elements as iron, potassium and phosphorous (the constituents of blood).

¹⁴ For a more complete account of the 1973 commission, see Wilson, 1978, 48-52.

By employing X-ray fluorescence, for example, it is possible to identify all elements which occur in relatively high concentration and are present in the material. This is accomplished by bombarding the *Shroud* with a beam of X-rays and then measuring the specific ways in which a secondary stream of X-rays are scattered.¹⁵

However, it should be carefully noted here, that the above mentioned investigation was undertaken within a very *specific* context, namely: to determine whether the *Shroud* and its image properties were a medieval forgery or the natural result of some older process. In addition to, and as a result of this context, the research undertaken by the STURP research team was unavoidably coloured by one very notable factor, namely: the STURP team had brought along equipment which could only adequately deal with the analysis of those atomic elements and/or organic substances which are normally associated with such materials as dried blood, artist's pigments, dyes and stains.

As will become apparent, even though the STURP team did set out to establish elemental variations among all areas of the linen cloth, because of their unfortunate choice of equipment, they could only detect elements with an atomic number higher than 16. Furthermore, because for the X-ray fluorescence investigation the STURP team had only employed the use of Sn K α excitation radiation, it was not possible for the researchers involved, to detect such elements as silver, cadmium or tin. In fact, it would seem that the only element which was seriously investigated by the STURP research team was iron.

Jean Lorre and Donald Lynn from the Jet Propulsion Laboratory in Pasadena, utilising computer-assisted techniques, attempted to isolate any evidence of “directionality” in the *Shroud's* image. This latter feature is always present in such things as paintings, when the style and direction of application (by hand) of materials such as pigment, ink or dye can be determined. Their investigations indicated that the *Shroud's* image contained no “directionality”, strongly ruling out the possibility that a “forger” had painted it.

Samuel Pellicori, who was mainly responsible for the colour photomicroscopy work, took a series of coloured photomicrographs, (with a magnification of up to 20 times) of the “blood” stains, the water marks, the scorches and burns, the body image and even the clearer background areas. He noticed that the colouring of the scorches, the water marks and the

¹⁵ Readers may want to review Kenneth Weaver's personal account of the 1978 commission, viz: “The Mystery of the Shroud”, *National Geographic*, June, 1980, 730-753.

body image all appear similar against the background linen. Even at magnification he noticed that, except for the water stains, these areas tended to reflect light in similar ways. He commented that

the water stains had some distinct characteristics, notably that they penetrated the linen's threads to all depths, including around bends and into crevices in the fibre, which made for a darkish brown saturated appearance. The water stains also had an abrupt boundary where the unwetted areas begin.¹⁶

However, as far as the body image was concerned, his findings were similar to those of previous investigations, in that the image of the body consists of a straw-yellow discolouration which is restricted to the top three or four fibrils of each thread crown.

Under magnification, those areas which are normally considered to be “blood” stains appeared as red-orange amorphous encrustations trapped between the fibrils or the crevices. It appeared as if the *Shroud* had come into contact with a viscous fluid (like blood) and that this fluid had dried. The presumption was made that the solidified material (dried blood?) that had not been caught between the fibrils had simply fallen off or been eroded away over time. Samuel Pellicori informs us that

Close-ups of particular areas such as the apparent lance wound on the figure's right front side demonstrated a surprising contrast between the brownish background coloring of the blood stain and the exceptionally reddish particulate material caught in the fibrils.¹⁷

Blood oxidises and thus darkens in time, but the “blood” of the *Shroud* seemed paradoxical in that on the one hand its coloration was ostensibly in accord with its supposed age (i.e. a minimum of 621 years by 1978), and on the other hand this “blood” also contained particles that seemed too red in colour to be “old” blood.

However, by comparing the data of the reflectance spectra of several blood samples (four-day-old blood was used and in one case was artificially aged by baking) with *Shroud* “blood”, Pellicori discovered (as did both Alan Adler and John Heller), that there was a correlation in the spectrophotometry that indicated the *Shroud* blood to be genuine. Pellicori commented that

¹⁶ Samuel F. Pellicori and S. M. Evans, “The Shroud of Turin through the Microscope,” *Archeology*, 34 (1) 1981, 41.

¹⁷ *Ibid.*

the absorption spectrum of a blood particle removed from the *Shroud* independently suggests that blood is present. Furthermore, the resemblance to blood as seen in the photomicrography of these areas is strong. The spectrum suggests denatured met-haemoglobin.¹⁸

Yet another intriguing discovery made by Pellicori and other members of STURP which concerns the quality of the linen fibrils, should be noted. The researchers observed that the fibrils that contained portions of the body image were slightly different in appearance to the fibrils that made up the background. In this regard, the weave of the linen is tighter and smoother in the background areas where no stain appears.

By means of an X-ray fluorescence investigation, Roger Morris, Larry Schwalbe and J. Ronald London set out to provide estimates of elemental variations between those areas on the *Shroud* which were either pristine or which contained “blood” stains, image or scorch marks. They also examined the patches which had been sewn into the *Shroud* in 1534.¹⁹

This was done in order that they could compare those areas which were considered to be problematic (e.g. “blood” stain, image, scourge mark etc.) with those areas whose nature and cause was better understood (e.g. the scorches of 1532 and the patchwork of 1534).²⁰

If, for example, they were to find certain elements in the “unstained” background material or image areas that did not appear in the patches this might help to identify a specific staining compound, dye or pigment which may have been employed by the medieval forger. By employing the techniques of X-ray fluorescence, Morris, Schwalbe and London collected the individual spectra of an “anomalous dark spot on the foot”, a background area, a scorch, a sewn patch, an eye (image area) and the wound in the side (“blood” area).

Allowing for errors (such as small misalignments of their apparatus and the varying thicknesses of the *Shroud*) the researchers found that the spectra definitely varied between “blood” and “non-blood” areas. Furthermore, the “non-blood” areas were “qualitatively quite similar to one another”.²¹

¹⁸ Samuel F. Pellicori, “Spectral Properties of the Shroud of Turin”, *Applied Optics*, 19 (12) 1980, 1916.

¹⁹ R. A. Morris [*et al.*], “X-Ray Fluorescence Investigation of the Shroud of Turin”, *X-ray Spectrometry*, 9 (2), 1980, 40. NB: This group explains that: “[t]he available equipment allowed detection of elements with atomic numbers greater than 16. With this information the relative concentrations of observed elements can be correlated with visible features or historical events and be applied to test various image forming hypotheses”, Morris *et al.*, 40.

²⁰ Morris *et al.*, 44.

²¹ Morris *et al.*, 45.

The main elements identified with any certainty on the *Shroud* included calcium, strontium, and iron. The team felt that the levels of calcium and strontium contained in the *Shroud* may have been underestimated but Morris, Schwalbe and London caution us that

[b]oth calcium and strontium are relatively common elements. For instance we might expect considerable quantities of airborne CaCO_3 from the rich marble and limestone regions of northern Italy...Although other explanations are possible, the uniform calcium and strontium distributions might be explained simply as dust accumulations.²²

On the other hand, the levels of iron (unlike calcium) varied from one area to the next, but were generally higher in “blood” areas. If the “blood” areas are indeed caused by blood, then this observation makes consummate sense. However, interestingly enough, the background areas themselves very often contained higher levels of iron than the image areas that were investigated. This group believed that dried blood was a likely candidate for the “blood” areas and that there was little chance that the image areas on the *Shroud* had been made with pigment or paint.

Like many of the other researchers involved in the 1978 commission, the Morris group learnt too late that their proposed experiments were inadequate to test the *Shroud* fully. Thus, as a result of their X-ray fluorescence testing, they formulated a number of proposals for future research. For example, with the correct apparatus it would be possible to confirm or rule out the possible existence of aluminium, sulphur, potassium, silver, cadmium and even tin traces on the *Shroud*. This point is very important, since it again shows that even if the STURP team had wanted to test for the presence of such elements as silver or gold, they could not have actually done so with the equipment they had available to them at the time.

Alan Adler and John Heller conducted a series of tests on adhesive tape samples taken from those areas on the *Shroud* which correspond to the stigmata. In other words, pieces of adhesive tape (supplied by the 3M Corporation) were impressed directly onto alleged blood areas of the *Shroud* such as the supposed “nail” wounds in the wrists and feet, the scalp and temple wounds and the “spear” wound in the side. Their X-ray fluorescence investigation revealed that except for iron, no significant amounts of high atomic number elements appear on the cloth.²³

²² Alan D. Adler and J. H. Heller, “Blood on the Shroud of Turin”, *Applied Optics*, 19(16) 1980, 2742.

²³ Adler and Heller, 2744.

Under a 1000 x magnification, Adler and Heller observed (on the adhesive tape) hundreds of linen fibrils and a single brownish red translucent crystal. They then prepared a simulacrum from a sample of woven, undyed, Spanish linen (approximately 300 years old) which had been impregnated with their own blood twelve months earlier. The *Shroud* fibrils and the simulated fibrils were then examined by microspectrophotometry in the visible light range. Adler and Heller point out that because haemoglobin can exist in many different chemical states (e.g. it can be reduced, met-haemoglobin, denatured etc.) and its state of aggregation can also differ (e.g. film, crystal, solution) that for all intents and purposes, no specific spectrum exists for blood.

Their findings, however, showed that both the *Shroud* “blood” and the simulacrum blood contained porphyrinic material. In addition, as would be expected from very old blood, the *Shroud* “blood” sample's spectrum compared favourably with the spectrum of fully oxidised denatured met-haemoglobin (perturbed acid met-haemoglobin).

Adler and Heller backed up their suspicions by comparing their results with reflection spectroscopy tests that had also been conducted on the *Shroud's* “blood” areas. These tests also indicated the presence of porphyrin. Additional chemical tests were also conducted by Adler and Heller, whose main function was to ensure that it was aged blood and not some other (non-blood) substance (such as simple iron salt) that was responsible for the positive reactions they had achieved thus far.

Unfortunately, the nature of these highly sophisticated experiments involved (amongst other things) the use of formic acid which rendered their test sample unusable for a final microspectrum test. Adler concludes “Thus we were unable to provide this absolute final confirmation of the identity of the blood area material”.²⁴

Even so, it is highly unlikely from the tests conducted by Adler and Heller and indeed Pellicori, that anything other than blood was involved in those areas associated with the *stigmata*. Their summary of their investigation clearly indicates that aged blood is responsible for the image in the areas associated with the *stigmata*.

As should be clear from the evidence obtained in 1969, 1973 and 1978, it is positive that the

²⁴ K. E. Stevenson and G. R. Habermas, *Verdict on the Shroud: Evidence for the Death and Resurrection of Jesus Christ*, Michigan: Servant, 1981, 135-8.

Shroud of Turin contains no particles of pigment or paint. It is true that Walter McCrone of *McCrone Associates* analysed some of the fibrils pulled off the *Shroud's* surface by adhesive tape and claims that he detected the presence of red ochre. Red ochre is a pigment which contains iron oxide and a binder. This seems at first appraisal to support the possibility of some painting medium being employed in the production of the *Shroud's* image. However, if one considers that the microchemical tests as carried out by Alan Adler of the Western Connecticut State College detected no pigments or even binders for pigments of any kind to a level of less than millionths of a gram and that even McCrone was able to “see” coloured particles only at several hundred magnifications, then we are left with the realisation that even if red ochre is present in the *Shroud* it has nothing to do with the body image itself.²⁵

It is worth mentioning that in the course of well over 600 years the *Shroud* has been exposed to the elements on many occasions. The truth of this was borne out when such items as insect legs and even nylon fibres belonging to a woman's pantihose were found on adhesive tape samples taken from the *Shroud*.²⁶

John Jackson and Eric Jumper of the US Air Force Weapons Laboratory, working in collaboration with Robert (Bill) Mottern, discovered that photographs taken of the *Shroud* by Guiseppe Enrie in 1931 contained three-dimensional information. In other words, the brightness of the image contained in the *Shroud* is directly proportional to the distance of the body from the cloth. This means that areas such as the nose and eyebrows are proportionally darker than areas such as the sides of the face, the neck and the ankles.

This discovery suggested very strongly that the *Shroud* had never been in contact with a body at all. Rather, the two-dimensional surface of the cloth had encoded on it a record of a three- dimensional body. Stevenson explains that:

The mystery was that parts of the body not in contact with the cloth also appear on the image, and the brightness of these non-contact areas varies according to their distance from the cloth.²⁷

²⁵ Adler and Heller, 2742.

²⁶ Stevenson and Habermas, 63-4.

²⁷ Ibid.

The Image Characteristics

For the sake of clarity it would be well to recapitulate the more important and verifiable characteristics of the image which appears on the *Shroud of Turin* in the light of the 1973 and 1979 commissions. Stevenson and Habermas have already identified and summarised these characteristics quite adequately²⁸ and the following list of criteria is loosely based on their format.

- **Superficiality:** The image is essentially the discolouration of the uppermost fibres of the linen threads of the *Shroud's* fabric. The image has not “penetrated” the threads nor is it visible on the underside of the *Shroud*.
- **Detailed:** The *Shroud's* image is highly detailed.
- **Thermally stable:** The *Shroud's* image was not affected by the heat of the 1532 fire.
- **No pigment:** It is certain that no pigment was applied to the *Shroud* and the image is not caused by pigment either.
- **Three-dimensional:** The intensity of the image varies according to the distance of the body from the cloth. The mathematical ratio was so precise that Jackson and Jumper were able to create a three-dimensional replica from the image.
- **Negative:** The image is a negative which is as visually coherent as a positive photograph when its polarity is reversed.
- **Directionless:** The process that formed the image operated in a non-directional fashion. It was not generated according to any directional pattern as it would have been if applied by hand.
- **Chemically stable:** The yellow coloration composing the *Shroud* image cannot be dissolved, bleached, or changed by standard chemical agents. Here we must be careful. Testing was undertaken on single fibres. No one actually poured a litre of bleach over the *Shroud*! Had they done so the image would have been seriously damaged.
- **Water stable:** The *Shroud* was doused with water to extinguish the fire in 1532. Although this has caused a water stain, the image itself does not appear to be affected.
- **Slight top-lit quality:** The *Shroud's* image, when viewed in its positive aspect, reveals that the subject was more illuminated from above than below. In short, shadowed areas are to be found beneath the beard, fingers, stomach etc. Highlighted areas are more intense on the forehead, bridge of the nose, cheeks, top of the moustache, chest, fingers, knees and feet. It should also be noted as no practicing artist/art historian was invited to be part of the STURP committee that this important aspect of the image was never recorded before my own work.

If one accepts that water stability and chemical stability may both be covered by the same nomenclature then there exist nine main attributes of the image. Since 1902, any number of unsatisfactory explanations have been proffered in an attempt to account for the causes of these attributes. I will not attempt to outline each and every one of these suppositions since they may all be conveniently dealt with by discussing only three basic image forming theories.

Painting/Dyeing/Staining Theories

It is assumed by many persons, that a medieval artist “somehow” painted the negative image of a man onto the linen. This possibility is the least likely explanation, for even if an artist were able to apply some staining compound that contained a proportion of red ochre (as suggested by McCrone) the fibrils would be stained throughout, as is the case with the water stain caused by the Franciscan priests at Chambéry when they doused the smouldering *Shroud* in 1532. However, this problem aside, one must also ask how an “artist” could possibly view what he/she were painting/staining. As has been pointed out already, the image is so subtle as to be almost indiscernible from close range. This would imply that an artist would have to stand at least three metres from the *Shroud* whilst he/she executed the “forgery”.

Finally and probably the most incredible feature of all, the image has all the characteristics of a photographic negative, a fact that was only fully appreciated in 1898. How could anyone living in the thirteenth or fourteenth century have managed to paint, dye or stain a photographically perfect negative image of a crucified man, and more importantly why would they have bothered to have gone to such seemingly impossible lengths (assuming they had even understood these principles)? After all, an “inferior” version (in negative or positive) would have sufficed, a fact borne out by the *Shroud of Besançon* and the *Shroud of Xabergas* (the latter still in existence) which have been held in high esteem by their respective supporters for centuries. Indeed, both of these blatantly amateurish attempts at duplicating the *Shroud of Turin's* image have long been revered as if they were the genuine article.

Direct Contact Theories

Whether the image of the man on the *Shroud* is a natural chemical reaction between the

Shroud and a corpse, a man-made impression caused by covering a red-ochre stained corpse with the *Shroud* or even a man-made impression caused by covering a chemically treated corpse, statue or a heated metal statue with the *Shroud*, all of these conjectures can be safely excluded for one major reason, namely that if the *Shroud* came into contact with all areas of the hypothetical corpse/body/statue that appear in the actual image, then that image should be grossly distorted. Vignon (as early as 1902) undertook a series of experiments to prove this very point. He had a tautly held cloth placed over a face smeared with red chalk and carefully attempted to produce a *Shroud*-like image. His results were grotesque, noses were flattened and spread out, and faces were too wide.

Chemical Action Theories

Vignon as early as 1902 formulated his famous vaporographic theory, which supported the notion that a person having died as a result of a highly stressful death (such as crucifixion) would give off ammoniacal vapours. The *Shroud*, had it been prepared with an aloes-and-myrrh unguent, would have turned brown in those areas where it was suspended over the corpse. This theory may be quickly eliminated due to the fact that the laws of gravity would not have allowed the *Shroud* to have suspended itself horizontally over the cadaver in order to ensure a two-dimensional surface. The latter feature would have had to have been an absolute prerequisite to obtaining a vapour induced and still visually coherent three-dimensional image. Any deformation of the cloth's surface would have resulted in a distortion of the final image. Of course Vignon did not bother to explain how the dorsal image was produced according to this scenario. Indeed, one wonders why the pressure of the body reposing on the *Shroud* has not been recorded on the dorsal image. In other words, such features as the buttocks, calves and heels are not at all distorted on the *Shroud of Turin*. It should also be noted that vaporographic images are caused by chemical changes that would be evident throughout the fibrils of the *Shroud*. The image on the *Shroud* is in fact visible only on the outer surface of the fibrils²⁹.

The Stigmata

Readers should also realise that there are two different images on the Shroud: The one is the

²⁹ As already noted, more recently (2004), it was discovered that it is possible to make out (albeit unclearly) the image of the man's face on the back of the cloth. Thus, apart from the head, the image is only visible from the front of the cloth.

primary object of my research. Here, I am referring to the seemingly photographic negative image of the body of a tortured man. However there is a second positive image which is clearly painted, most likely in dilute blood mixed with a binder and red ochre. Here, I am referring to the *stigmata* - those marks of the Passion of Christ which so duped those medical practitioners who employed them as evidence that the man in the Shroud had been a crucifixion victim!

What is very interesting to note at this juncture is that where blood has been applied onto the cloth containing the negative body image, the underlying cloth is slightly bleached. In my own tests I have concluded that haemoglobin has a bleaching effect. When blood is placed on an image area caused solely by oxidation of the linen, it in fact starts to disappear.

If one is more circumspect, the depictions of the *stigmata*, as seen on the *Shroud of Turin* tell an interesting story. Readers should make themselves familiar with the details of the various images of the *stigmata* from the frontal and dorsal images. These are supposedly flows of blood from different areas of the body, head, hand, torso, feet etc and are each ostensibly caused as a result of different types of wounds caused respectively by nails, javelin points and thorns. You will observe that each “blood flow” (regardless of the wound it issues from), has five distinct features:

- the blood flows are nearly always distinctive as separate flows;
- there is always clear directionality;
- there is absolutely no smudging as one would have expected had a real bleeding/leaking corpse been wrapped up in a cloth;
- they all have an acute angle at least once in any one flow direction; and
- there is often a gap in the flow line.

These obvious facts show how someone of the calibre of Robert Bucklin, who, because he was so immersed in the seeming flawlessness of his irrational belief system, could so willingly and unconsciously prostitute his supposed medical knowledge.

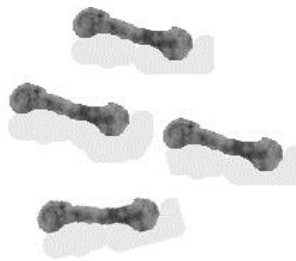
Indeed, incredibly, Bucklin made the following bizarre observation “[e]ach of the different wounds acted in characteristic fashion. Each bled in a manner which corresponded to the nature of the injury. The blood followed the flow of gravity in every instance.”³⁰

If these are supposed to be natural blood flows issuing from a freshly deceased corpse, then

³⁰ Robert Bucklin, “The Medical Aspects of the Crucifixion of Christ”, *Sindon*, December 1961, 7.

clearly, something very strange was going on at the time. Indeed, contrary to Bucklin's wishful thinking, the blood often *defies* gravity as well as the *contour* of the body it is supposed to be running upon. Of course, there is a simple explanation for this phenomenon, viz.: the blood flows were applied with an instrument such as a brush (which had a uniform thickness) upon the linen when it was laid out flat upon a two-dimensional support (like a table) by means of conscious human agency. In short, the blood flows were clearly applied by hand, showing distinct and common stylistic traits. NB: All *Shroud stigmata* conforms to post-1250 depictions of this phenomenon.

The marks of the scourging were most likely made with a stamp of some kind. A potato print comes to mind here. All the forgers had to do was make a small stamp and repeatedly print out the marks of a *flagellum* as they saw fit. This of course makes nonsense of the notion that the man in the Shroud was whipped by two men of different heights!³¹



4/ A diagram illustrating the general shape of some of the whip marks as appear on the frontal and dorsal image of the *Shroud of Turin*. These marks seem to have all been made by one or two similar shaped stamps resembling an elongated dumbbell.

Miracle or Forgery?

Since none of the above mentioned theories even comes close to adequately explaining the causes of body image formation on the *Shroud*, most supporters of this relic's claim to being the burial cloth of Jesus Christ have (quite understandably), felt perfectly confident in believing the image to be of divine authorship. However, in 1988 this bubble was burst when three highly reputable institutions, namely: the University of Arizona in Tucson, the Oxford Research Laboratory and the Swiss Federal Institute of Technology in Zürich, with the aid of the latest carbon dating techniques, supported the interpretation that the linen material was produced in late medieval times, i.e. c. 1260-1350.³² It is surely this finding, more than any

³¹ Wilson, 1978, 24.

³² N. Ostler, "Debunking the Shroud of Turin", *Time*, 24 October, 1988, 56 and I. Anderson, "Teams agree on

other, that has convinced people that the *Shroud* is nothing more than a clever forgery, one which was produced for the sole purpose of deceiving the Catholic world of the late thirteenth century.³³

However, this conclusion is far from satisfactory, since it fails to address a number of very important issues. Firstly, if it is to be accepted (as popular opinion seems to indicate) that the *Shroud* is, in fact, a product of a medieval band of forgers, intent only on profit and gain and who, conceivably, could have quite easily satisfied the needs of the credulous with a production far less sophisticated than the *Shroud* actually is, then why is our culture (with its highly sophisticated level of technology and expertise) still unable to explain its means of production, far less duplicate it?

Secondly, why does this relic not contain the vestiges or stylistic minutiae characteristic of the culture that produced it? For example the *Shroud* depicts a highly naturalistic, three-dimensional (albeit negative) image of a naked man who has apparently been tortured and crucified. This image was produced at a time when Christian art (although tending towards naturalism and humanism in certain centres such as Florence and Rome), was more normally characterised by the fairly rigid stylistic conventions as found in much Italo-Byzantine (c. 1235-1285 CE) and Byzantine (c. 550-1285 CE) images of Christ). Similarly, the authority of orthodox ecclesiastical teaching in the late thirteenth century would have ensured that Christ be depicted with the marks of the nails in his hands and with the marks of a *crow*n of thorns. However, the *Shroud* not only shows Christ uncharacteristically naked, but with the marks of the nails in his wrists and with the marks of a “helmet” of thorns.

In addition to these uncharacteristic, possibly heretical depictions of Christ, the image of the man in the *Shroud* displays a degree of anatomical/medical knowledge that simply was not available to a medieval natural philosopher let alone a medieval forger of relics. Indeed, the depiction by the *Shroud* of such anatomical details as the reflex action of the thumb when an object is forced into the wrist at the Place of Destot, is a phenomenon that was not documented until the early 1930s.

It is because of these and other seeming paradoxes, that most sindonologists, since 1898, when Secondo Pia accidentally discovered the *Shroud*'s photographic qualities, have each

medieval origins of the shroud...”, *New Scientist*, 22 October, 1988, 25.

³³ I. Smullen, “Female Jesus”, *Omni*, 1988, 112.

alluded in different ways to the suggestion that the *Shroud* could *almost* be a photograph taken of an actual victim of a crucifixion but for the fact that photography was not invented until 1827. In this regard, the following statements by Rinaldi are typical of the sort of views expressed before the carbon-dating of 1988:

The concept of a negative became known only through the invention of photography in the nineteenth century. No artist of any earlier period could have conceived the idea of producing a picture in negative...That this body [image] can only be the Body of Christ is the inference of learned scientists, particularly of noted physicians and anatomists who have examined and studied the figures of the Shroud as photography reveals them. [i.e. as positive images] They have marvelled at the natural and anatomically perfect proportions of the Body, with its true perspective and with a wealth of details whose fidelity to nature is unsurpassed...We might say that photography has unlocked the secret of the Shroud.³⁴

Fr Peter Rinaldi could never have known how prophetic these words were to become.

³⁴ Rinaldi, 64-5.

III

THE PARADIGM SHIFT

A Serendipitous Solution

In the latter months of 1988, with the *Shroud* carbon-dating results still very fresh in my mind, I was having a discussion with some of my colleagues, Mr Jonathan (Jonty) Hansford and Mr Graham Thompson, both of whom, quite co-incidentally, were photography lecturers. During our exchange, which touched on a number of topics, including the paradoxical *Shroud*, I casually commented on what would happen, if we were to become irrational for but a moment. In short, suspend disbelief and pretend, purely for the sake of argument, that the *Shroud really was* the burial cloth of an incarnate deity. Further, what if the image contained thereon was in fact a scorch caused as a result of some form of radiant energy, somehow emanating from the body of this fictional super being (still, incidentally, a very popular notion for many Christian believers). If we pretend for a moment that that is what really happened then why did the resultant image, which appears on a two-dimensional support (linen) contain three-dimensional information concerning the original subject - a feature that had been recognised by Jackson and Jumper as early as 1978?

We have already witnessed Vignon's experiments in 1902 which predicted this problem. Indeed, in terms of the afore-mentioned context, if a piece of cloth was to be wrapped around a radiant corpse, then the image thus obtained would be grossly distorted and very unlike what in actuality appears on the *Shroud*. This fact may be easily observed by trying to duplicate Vignon's experiment where he tried to make a direct-contact print of a head which had been painted with a fugitive pigment. The negative imprint obtained by this method is always much wider in appearance than the dimensions of the original form. For example, because the cloth must pick up the image from the sides of the nose and face, a human face is portrayed as being almost twice as wide - a grimace for a mouth, a wide flat nose resembling a gorilla etc. The *Shroud* clearly displays a face as if viewed from a distance and not as a result of direct contact. Further, why is there no top to the head? Surely, if the supernatural body was radiating out beams of energy it would have made an "impression" on the cloth at every point of contact? Apparently Jesus managed to avoid

depicting the top of his head!

With this problem firmly in mind, it seemed to me that the only way a radiant corpse could form an image on cloth (such as now appears on the *Shroud*), would be by placing the corpse some distance from the cloth. The latter being flattened out and suspended exactly parallel to the corpse itself. The corpse would then have to give off a very controlled burst of radiation - one which would be recorded on the now two-dimensional cloth. This scorched record, of a regulated amount of radiant energy would then be, as it were, three-dimensionally “etched” into the linen, since those parts of the corpse which were closest to the cloth (e.g. nose, cheeks, beard *etc*) would oxidise more acutely than areas which were further away (e.g. sides of the head, edge of limbs *etc*).

In the terms of this seemingly bizarre scenario, it would not be possible for a radiant corpse to make both a frontal and dorsal image at the same time! Indeed, once the frontal image had been formed, the whole operation would have had to have been repeated again for the dorsal image.

I suddenly realised that what I was struggling to come to terms with was not outlandish at all! In fact, what I was trying to imagine was nothing more banal than the basic tenets of photography itself.

Could it really be possible that the *Shroud of Turin* was nothing more than a giant, life-size negative photograph! More incredible still, could what we now call the art of photography have been practised some five hundred years before the tentative nineteenth century experiments of such photographic pioneers as Thomas Wedgwood and Sir Humphry Davy? If so, how could the historians have been so inaccurate concerning the development of this technology and further, if they were so wrong about the history of photography, what other achievements of our medieval and classical forefathers may have gone unrecorded?

The Parameters of Investigation

Once I had fully grasped the enormity of this concept I could not sleep for several days. I decided there and then that I would set out to investigate the more probable methods and techniques employed in the production of the image on the *Shroud*. To do this properly,

however, required me to fulfil a number of tasks. Firstly, I had to evaluate critically all the existing data which I could lay my hands on concerning the phenomenon of the image on the *Shroud*.

Secondly, I had to evaluate critically the various technical image formation theories as proposed by previous researchers of the *Shroud* in order to better understand where they fell down.

Thirdly, I still had to determine whether there was any evidence for a medieval society having been able to produce the image on the *Shroud* by means of some photographically related technique and in addition, determine whether it was actually possible to produce an image which duplicates the image on the *Shroud* employing only those materials, apparatus and kinds of knowledge known to have been available to persons living between c. 1200-1355.

I could, of course have simply given my idea out to the press and been done with it, but that would have been both premature and somewhat irresponsible. I had to be absolutely sure of my facts. I had to look for alternatives to my idea, even if need be, to disprove my own hypothesis. Of course, I also naively believed that the reward for successfully proving my theory would be the acknowledgement from the scientific community, that I was the first person in nearly seven centuries to have correctly solved the mystery of the *Shroud of Turin*.

I had to relearn everything I had ever believed concerning this relic and start, as it were, from the very beginning. I had to reconsider the phenomenon of the *Shroud* in isolation, without recourse to either popular misconception, biblical texts, religious orthodoxy, the iconographic tradition of the church or even the established dogmas of scientific opinion. In short, I had to reconsider the facts as they are presented by the *Shroud* itself - an action which immediately determined that the only possible and logical way that the image on the *Shroud* could have been produced was by means of photography. This provisional conclusion seemed outlandish only once it was placed back within the context of our present-day understanding of medieval cultures and their respective levels of technology.

It should not be forgotten that the *Shroud* (regardless of how it was in fact produced):

- actually exists and therefore bears testament to some form of technology (albeit unknown or even forgotten);

- has the attributes of a modern photographic negative; and
- was definitely manufactured sometime between the foundation of very specific Christian iconography overtly present in the *Shroud* image and its first recorded exhibition in *c.* 1355.

What is important here is that in view of the iconography employed in the image on the *Shroud* it is not possible for the *Shroud* to have been produced before the occurrence of a Christ-image that had, inter alia, such key features as closed eyes, a beard, long hair, exaggerated marks of the *stigmata* etc. That date would have to be sometime close to *c.* 1250 CE. Thus the *Shroud* was manufactured sometime between *c.* 1250 and 1355 CE. Certainly not before 1200 CE. I discuss this important issue in more detail, later in this book.

At the outset it is important to realise that if the image on the *Shroud* was indeed produced “photographically”, its mode of production would have differed (in quite a few respects) from the way modern photographic images are normally produced. This was true even of the first products of the pioneers of modern photography. For example, Thomas Wedgwood (1771- 1805) and Sir Humphry Davy (1778-1829) (who are well known for their publication entitled: *Account of a method of copying paintings upon glass and of making profiles by the agency of light upon nitrate of silver* [1802]), first produced images, in the form of silhouettes and negative images of botanical specimens (i.e. contact copies of leaves) on both white paper and leather moistened with a silver nitrate solution. However, they could not fix their images, which had to be kept in a dark room and could only be viewed by candlelight.

William Henry Fox Talbot (1800-1877) like the other early pioneers of photography, first employed silver nitrate as a suitable light-sensitive chemical for his investigations. At first his products were simple negative images, but he went on to perfect a negative-positive process and is consequently accredited with being the discoverer of modern photography.

Similarly, the *Shroud* displays a number of features that would necessarily classify it as a very primitive form of photography. It is certain that the photographic hypothesis seems almost tailor-made to resolving the *Shroud* mystery in the sense that it neatly explains each and every one of the image's peculiar characteristics. Indeed, the only real hurdle in the way to accepting such an obvious conclusion is that photography was apparently only developed in the early 1820s - nearly five hundred years *after* the *Shroud* first came to light. The

obvious fact that the *Shroud's* image is photographic is not in itself considered proof enough (by other researchers) that our perceptions concerning the history and development of photography are seriously flawed. Sindonologists simply ignore this option and doggedly continue to search for a solution which does not compromise their comfortable paradigm. Surely, after more than one hundred years of wasted time, money and effort it is time to do a little lateral thinking?

It will have to be accepted that *if* the photographic hypothesis has any merit it will surely require us to rethink our present interpretations concerning the abilities and technological capabilities of the thirteenth and fourteenth centuries. Thus, the problem in effect shifts from the *Shroud* itself to the issue of verifying the following possibilities:

- Is there any historical evidence of persons knowing about such devices as the *camera obscura* and/or understanding the nature and cause of pinhole images before *c.* 1355? After all, it is hardly feasible for someone to attempt to produce a permanent record of such an image if the means to produce such an image are not available in the first place!
- Is there any historical evidence of persons knowing about light-sensitive chemicals before *c.* 1355 and/or having the technology to arrest the sensitivity of these chemicals to light? In short, is it plausible that they could have “fixed” their resultant image?
- Is there any historical evidence of persons having practically experimented with either magnifying glasses, plano-convex lenses or concave mirrors before *c.* 1355 and/or understanding the relationship of these lenses to an aperture and its effect on the resultant image?
- Finally, through practical experimentation it would be necessary to produce a negative image on linen cloth which duplicates (in every way) the characteristics of the image on the *Shroud of Turin*. This image would have to be produced employing *only* those substances and equipment that were known to have existed in a medieval society before *c.* 1355 and whose natural characteristics were known to have been reasonably well understood before *c.* 1355.

Surprising as it may seem, most of the information that I sought had been available to previous researchers all the time, quite literally staring them in the face. In short, the problem wasn't so much the lack of documented evidence as it had been our inability to think the “other” - to remove the blinkers and to see the obvious.

IV

THE HISTORICAL EVIDENCE

The historical evidence I sought was not difficult to obtain. However, I did come across a number of strange contradictions as regards the chronological development of those scientific and artistic discoveries which were pertinent to my investigation.

The *Camera Obscura*

My first task was to find my medieval *camera obscura*, this being a pre-requisite to producing any photographic image (permanent or otherwise).

To this end it is well known that in 1550 a description was given by one Girolamo Cardano of Milan, of a *camera obscura* with a bi-convex lens (made of crown glass) fitted in its aperture. By 1568 Daniel Barbaro not only recommended a lens but also that the aperture be made in a diaphragm, thus enabling him to cut a very sharp-edged hole for producing sharper images.

Although Leonardo da Vinci (1452-1519) described the functioning of the *camera obscura* quite fully and is credited by most authorities as being the first person to compare the *camera obscura* to the workings of the human eye, it is Giovanni Battista Della Porta who is more generally considered to be its real inventor.

Della Porta's account (in which he gives the first detailed description of the pinhole camera and its employment) appears in the first edition of the *Magia Naturalis sive de Miraculis Rerum Naturalium*, in four books (1558: lib. iv, cap.2). He used no lens with his version of the device but mentions the utilisation of a concave mirror (*speculum*) in front of the aperture. With the aid of this mirror he was able to both enlarge and reverse the image, thus enabling the spectator to see the image the correct way round.³⁵ All of these above cited

³⁵ I. B. Cohen, *Camera Obscura*, *Encyclopedia Britannica*, Vol. 4, 1953, 659.

accounts are undisputed references to the device known today as a *camera obscura* (this latter term being coined by Johannes Kepler in his *Ad Vitellionem paralipomena* in 1604). However, all of these references are far too recent. What I needed was indisputable proof that this apparatus existed prior to 1355 (the earliest assumed date for the *Shroud* when it was housed at Lirey).

This was a little more tricky, because in fact no documented evidence exists (or possibly more correctly, survives), which indisputably refers to this item. However, on the positive side, there do exist tantalising references which strongly suggest that the camera and its principles have been understood for quite some time. For example, it is generally accepted that the ancient Greeks for one, would have known about this device.³⁶

In addition, many accounts have come down to us that were written (in some cases, literally millennia) before the more well-known sixteenth century descriptions. All of these texts, point to the existence of an unnamed device which seems to fit the description of the *camera obscura*. However, bearing this possibility in mind, we would do well to heed the words of Andor Krasna-Krausz, who states that,

Knowledge of the camera or, at least, of its principle has been ascribed to Mo Tzu in China of twenty-five centuries ago, the Greek philosopher Aristotle (384-322 B.C.), the learned Arab Ibn al-Haitham (965-1038), the English friar Roger Bacon (1214-94), the Hebrew scholar Levi ben Gershon (1288-1344) and others. But some of these assumptions are based on imaginative readings of barely more than sketchy remarks³⁷

It would be advisable, therefore, to exam more closely some of these “sketchy remarks” and ascertain their probity and merit. Thanks to the work of Joseph Needham, we now have a very good idea as to the levels of science and technology that existed in Ancient China. Indeed, it transpires that in the *Mo Ching*, a document which dates from Mohist China (c. 400 BCE), that it was well known how one might obtain the image of a man by use of a pinhole and *camera obscura*. I quote below some tantalising excerpts from the *Mo Ching*:

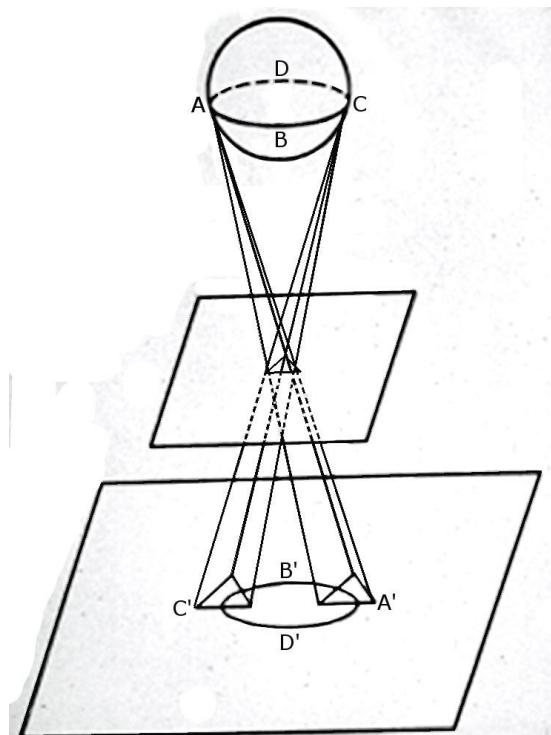
The “collecting-place” (khu) (or; the “wall” [chang]) is the place where the “change” (i) (i.e. the inversion of the image) starts...It is an empty (round) hole (hsü hsüe), like the sun and the moon depicted on the imperial flags...The image is inverted (tao) because of the intersection (wu). The intersecting place is a point

³⁶ Cohen, 658.

³⁷ Andor Krasna-Krausz, *Focal Encyclopedia of Photography*, 1982, 453.

(tuan). This affects the size of the image (ying). The reason is given under “point” (tuan)...An illuminated person shines forth as if he was shooting forth (rays). The bottom part of the man becomes the top part (of the image) and the top part of the man becomes the bottom part (of the image).³⁸

The text goes on to describe how the rays cross over at the pinhole, like the oars of a rowboat. However, what is the most unbelievable aspect of this knowledge is that here is proof of a culture that clearly understood how light operated, literally millennia before the time of Newton. By stark contrast, the Ancient Greeks at this time (c. 400 BCE), believed that light rays were emitted from the eyes, whereas the Mohists clearly indicate that the subject is only giving off reflected light.



5/ Diagram, based on the work of al-Haytham, showing the effects of a pinhole camera employing a geometric aperture (before 1039 CE). The illustration shows the image of the sun being focussed through a triangular aperture. The resultant image is in fact composed of a multitude of triangular light patches (only two described in the diagram) and would thus produce a blurred image. NB: the smaller the aperture - the more focussed the resultant image.

This kind of optical knowledge was only the tip of the proverbial iceberg. During the next thousand years the Ancient Chinese made both mirrors and lenses of every conceivable

³⁸ Joseph Needham, *Science and Civilisation in China: Volume 4, Physics and Physical Technology, Part 1, Physics*, 1962, 82.

shape and material (including burning-mirrors) and even produced, by at least the second century CE, the first moving images by means of “umbrella lamps”. These devices, which are clearly the ancestors of modern cinematography consisted of a light canopy which hung over a lamp. These contraptions (zoetropes) possessed vanes which spun as a direct result of the rising convection currents. On the sides of these zoetropes would be positioned thin panes of mica or paper, which sported images of animals or humans. If the canopy spun fast enough, these images would appear to move!³⁹

There was also a particularly great interest in the subject of optics in Europe and the Middle East between 1250-1355, the very period I claim that the *Shroud of Turin* dates from. This undisputed preoccupation with optical matters, is borne out by the number of important natural scientists and philosophers of both the Latin Christian West and the Moslem East who concerned themselves with optical issues. For example we have the Latin works of Robert Grosseteste (1175-1253), Albertus Magnus (Albert the Great) (c. 1193/1207-1280), Roger Bacon (c. 1210/20-c. 1294), John Peckham (or Peckham) of Canterbury (1220-1292), Raymund Lull (c. 1235-1315), Witelo of Poland (active in 1271 [Viterbo, Italy]), John of Paris (1225-1306), Dietrich of Freiberg; the Arabic works of Ahmed ibn Idris al-Qarafi, Qutb al-din al-Shirazi, Kamal al-din al-Farasi; and the Hebrew writings of Levi ben Gerson (Gershon) (1288-1344).⁴⁰

Most authorities agree that this interest was due to the singular influence of the *Kitab al-manazir* of Ibn al-Haytham. This publication was known in the West as early as the thirteenth century as the *Perspectiva* or *De aspectibus*. This was later published by Friedrich Risner along with Witelo's *Perspectiva* as the *Opticae thesaurus Alhazeni Arabis libri septem* in 1572. Sarton asks

How shall we account for such ubiquitous and simultaneous efflorescence? The explanation is that all these scholars were drinking from the same source, which became available to them (or which they were ready to use) at about the same time. That source was the *Kitab al-manazir*.⁴¹

Abu “Ali al-Hasan ibn al-Hasan ibn al-Haytham (known as Alhazen or Alhacen in the Latin

³⁹ Needham, 122-4.

⁴⁰ See G. Sarton, *Introduction to the history of science, Volume III: science and learning in the fourteenth century*, Baltimore: The Williams and Wilkins Company, 1947, 141-2 and David, C. Lindberg, “The Theory of Pinhole Images from Antiquity to the Thirteenth Century”, *Archive for History of Exact Sciences*, Vol. 5, 1968, 154-176.

⁴¹ Sarton, 141.

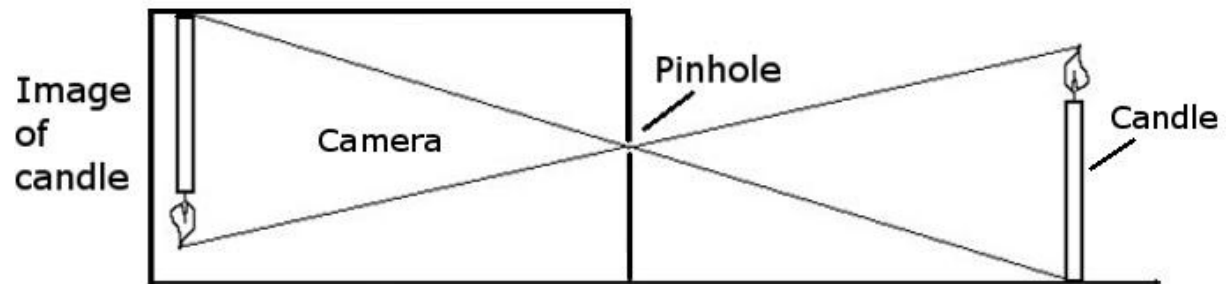
west) lived in Arabia c. 965-c. 1039 CE and not only produced the *Kitab al-manazir* but numerous other texts which covered such subjects as optical illusions, the height of the atmosphere, the apparent increase of the size of the moon near the horizon and atmospheric refraction, perspective, binocular vision, shadows and colours. In addition he produced a treatise on burning mirrors (later translated into Latin as the *De speculis comburentibus*).

More importantly, he also wrote on a number of topics more directly related to this investigation, namely, the structure of the human eye and a piece of apparatus which can only be a form of *camera obscura*. In particular, he formulated a detailed and fairly accurate analysis of pinhole images. Of particular importance is his description of an experiment wherein a number of candles are placed opposite the aperture of a darkened chamber. In this regard at least, there is no doubt that al-Haytham was referring to what was to become known as a *camera obscura*. al-Haytham makes the following comments:

The evidence that lights and colours are not intermingled in air or in transparent bodies is that when a number of candles are in one place, [although] in various and distinct positions, and all are opposite an aperture that passes through to a dark place and in the dark place opposite the aperture is a wall or an opaque body, the lights of those candles appear on the [opaque] body or the wall distinctly according to the number of candles; and each of them appears opposite one candle along a [straight] line passing through the aperture. If one candle is covered, only the light opposite [that] one candle is extinguished; and if the cover is removed, the light returns...Therefore, lights are not intermingled in air, but each of them is extended along straight lines.⁴²

al-Haytham does not specify the dimensions of the aperture, but considering that he wanted to prove that light was made up of rays which ostensibly travelled in straight lines and did not mingle, it would most assuredly have been as small as possible (if not actually being a pinhole). This assertion is also supported by practically duplicating this experiment. However, it is important to realise that as far as al-Haytham was concerned, the main emphasis of this specific experiment was not to produce images (although from other texts it is obvious he was more than aware of this possible application), but to prove to his readers that separate light rays emanating from specific sources do not mingle and produce a common ray. In this sense at least, the documented experiment with the aperture was considered useful only in so far as it proved this latter point.

⁴²Lindberg, 1968, 154.



6/ Diagram recreating al-Haytham's employment of the *camera obscura* (before 1039 CE). Whatever is situated outside the camera (opposite the aperture) is automatically transformed into an inverted image within the camera.

Historically, al-Haytham is a most significant figure in the history of the science of optics. Like the Mohist Chinese, before him, he refuted the very popular extramission theory of vision (as propounded by such writers as Euclid, Galen and Plato) and proposed his own original intromission theory of vision. Briefly stated, the extramission theory (which was still popular in Bacon's time), supported the idea that rays emanated from a spectator's eyes, which in turn grasped the object under observation and returned with the visual information to the eyes. In opposition to this, al-Haytham proposed that light reflects from objects and enters our eyes. Specifically he showed that every point on a body (in space) radiates in infinite directions. al-Haytham states that:

from each point of every coloured body, illuminated by any light, issue light and colour along every straight line that can be drawn from that point.⁴³

al-Haytham is here applying the principle of punctiform analysis to nonluminous bodies. In other words, he is aware that light is reflected from all parts (or points) of a body and is received by the eye. This discovery is especially pertinent to this investigation and shows a radical departure from the previous intromission theories of the atomists and Aristotle, who believed that "atomic" particles stream off of objects and then enter the eye.

In addition, al-Haytham was probably one of the first recorded natural scientists to realise that images, produced by the aid of an aperture (finite or geometric) were in fact composite. In other words, he fully realised that the image is formed by the superimposition of an incalculable number of image patches, each in the shape of the aperture and each radiated from every point of the object.

⁴³ David, C. Lindberg, *Theories of Vision from al-Kindi to Kepler*, Chicago: University of Chicago Press, 1976, 73.

These overlapped images give the soft-focus appearance of the original object and not the shape of the aperture. This of course explains why a pinhole image is more focussed in appearance than an image produced with the aid of a larger geometric aperture. Hence, an image in a *camera obscura* can only be fully discerned at some distance and often is unrecognisable at close range. Readers will realise here that this description conforms with the quality of the image as found on the *Shroud of Turin*.

It should be especially noted that in many ways al-Haytham seems to have had a greater understanding of pinhole images than many of the philosophers who succeeded him in the west. In this regard at least, here is proof that certain scientific ideas and discoveries are not necessarily improved upon with subsequent development. Moreover, the Latin translations of the *Kitab al-manazir* only directly influenced the west from about 1250 onwards.

Of course there always exists the possibility that during the period of the Crusades, (c. 1060 - 1291) certain Christian ecclesiastics and scholars living in Christian occupied territories such as the County of Antioch, or the Kingdom of Jerusalem could have come into direct contact with al-Haytham's Arabic writings concerning the *camera obscura*. In addition, there is no reason to doubt that Moslem scholars at least, through the work of Ibn al-Haytham, knew of the workings of both the *camera obscura* and the nature of pinhole images well before the middle of the eleventh century.

Finally, it should be pointed out that Ibn al-Haytham himself mentions that he did not discover the device we call a *camera obscura*, “*Et nos non invenimus ita...*”⁴⁴ and thus implies that it was quite common knowledge even in his own time (i.e. late tenth and early eleventh centuries).

Another fertile source for information concerning the *camera obscura* is Roger Bacon (c. 1210/20-1294) who died about sixty years before the *Shroud* first came to light. In part five of his *Opus majus*, Bacon, drawing heavily from the work of Aristotle, Galen, Avicenna, Constantinus and especially Alhazen (al-Haytham) lays down what must have been the most comprehensive outline concerning optical science for its time (i.e. c. 1250-1270 CE).

However, in this and his other works, he never once makes a direct comment or observation

⁴⁴ Cohen, 658.

concerning the phenomenon of light as observed in a darkened chamber. There are however a number of tantalising remarks made by Bacon which can only make sense if one acknowledges his awareness of this device.

For example, Bacon correctly identified (before 1270) the structures that make up the human eye, and perhaps more importantly, clearly understood how light enters through the aperture of the eye (pupil) and is refracted by the convexity and density of the lens and finally “focussed” onto the optic nerve. Although his ray diagrams do not agree exactly with more modern ray diagrams, and his depiction of the eye is distorted to allow each part of the eye to be described by a perfect circle, his general understanding of the form and function of the parts that make up the eye, such as the pupil, lens and optic nerve are fairly accurate.

It is well known that the workings of the human eye and the *camera obscura* are (for all intents and purposes) identical but it wasn't until the fifteenth century that scientists such as da Vinci actually wrote down this analogy. However, Bacon does make mention of some of the properties of the eye that support the suspicions one may have of his knowledge concerning not only the workings of the human eye but also darkened chambers. For example he makes the following statement:

The coats and humors, according to Alhazen, have their admirable qualities, from which follow the benefits of vision, as he himself shows. The first function of the cornea is the closing of the opening in the uvea, preventing the escape of the humour albugineus (Bacon's term for aqueous humour. N.P.L.A.); it is, moreover, transparent, so that the impressions [species] of light and colour may pass through it, as was verified before...The uvea is usually black, in order that the humour albugineus and the glacialis (Bacon's term for the lens. N.P.L.A.) may be obscured, so that feeble impressions of light and colour may appear in it, since feeble light is very apparent in dark places, and is concealed in places full of light.⁴⁵

This is very good evidence for assuming that Bacon not only had some experience in observing images in darkened chambers but was applying its phenomenon to the workings of the eye. Anyone who has tried to observe the faint pinhole images that are produced inside a *camera obscura* will know that it takes the human eye quite some time to become accustomed to the reduced light levels. In this regard it also becomes impossible to detect

⁴⁵ Roger Bacon, *Opus majus: Vol.II*, Tr. R.B. Burke, Philadelphia: University of Pennsylvania Press, 1928b, 444.

these faint images if even the slightest amount of light enters the chamber (through a secondary aperture for example). Only someone with this experience could have stated “feeble light is very apparent in dark places, and is concealed in places full of light”.

This assumption is further strengthened by Bacon's referral to Alhazen's experiment with candles and an aperture. In this regard, Bacon simultaneously attempts to show that light travels in straight lines as well as supporting his own theory that different rays of light can mix together as one. This latter point (which disagrees with al-Haytham's account), need not concern us too greatly, for what is relevant to this investigation is his comment that

when three candles are placed opposite an opening; for then the lights appear distinct beyond the opening, and therefore also in the opening...since light travels along a straight path, while it is being multiplied in the same medium (e.g. air. N.P.L.A.), therefore the light of each candle, just as it passed along different straight lines before the opening, so must it continue to do beyond the opening as regards the principal multiplication, and therefore the primary and principal paths are divided beyond the opening just as they were before it.⁴⁶

To undertake this experiment, it is necessary that the candles are the only source of light in the room. In other words, only a darkened room or *camera obscura* will serve as an adequate venue in which this experiment may be carried out. Indeed, the candle flames are very dim and have to be quite close to the pinhole to be discerned. In addition, the flames (as they appear in the image patch) are clearly upside down indicating to the observer that the rays from the candle to the image patch are straight.

This is not the only evidence that Bacon fully understood the principle behind the phenomenon of pinhole images and the cause of their inversion. For example, Bacon knew from experience, that the world as viewed through the human eye appeared to be the correct way round. This fact must have contradicted what he understood about the principles of the pinhole camera. We know this because in one of his texts he had the difficult task of trying to explain to his reader (Pope Clement IV) how the more typical phenomenon of the inverted image patch had been modified in the case of the human eye by what he thought were the effects of the different refracting properties of the various translucent mediums within the eye, i.e. the lens and the vitreous humour. To this end he describes how light would “normally” enter the eye if no such refraction were to take place. He explains that:

For if the rays of the visual pyramid meet at the centre of the anterior glacialis (i.e. when the rays emanating from the object converge on the lens. N.P.L.A.), they must be mutually divided, and what was right would become left and the reverse, and what is above would be below, and thus the whole arrangement of the visible object will be changed...⁴⁷

As can be ascertained from the literary evidence alone, both practical and theoretical knowledge pertaining to pinhole images was available in the Moslem east before 1039 CE - a full three centuries before the *Shroud of Lirey* came to light. In addition, it would be fair to state that at the very least, some practical understanding of pinhole images was evident in the Latin west before 1270 CE.

Light Sensitive Chemicals

So far so good, but can we really accept that persons living before 1355 knew about light sensitive chemicals? After all, the earliest recorded experimentation which involved a light sensitive chemical (silver chloride) and its ability to change colour was undertaken by Robert Boyle in the seventeenth century. Furthermore, he erroneously believed that this chemical darkened when exposed to air and not light. In fact, it was not until 1725 that Johann Heinrich Schulze accidentally discovered that a suspension of chalk in silver nitrate was transformed by the action of light. This is some three and a half centuries after the *Shroud's* time.

Notwithstanding, there do exist a number of very simple chemical compounds that are more or less sensitive to light. The most obvious being the silver salts and the silver halides. This includes such substances as silver chloride, silver nitrate and silver sulphate.

Silver Chloride

Silver chloride (which is a precipitate and not soluble in water), whether in liquid suspension or dry powder form is extremely sensitive to the action of sunlight. If used as a light sensitive emulsion/solution on a suitable two dimensional support it will form a latent image fairly rapidly. After some time a visible dark blue-grey discolouration will appear. Mellor, the renowned inorganic chemist, informs us that in nature, silver chloride occurs in veins of clay slate together with other silver ores, and is known as horn silver, chlorargyrite,

⁴⁶ Bacon, 1928b, 466.

or keragyrite. He states that there

can be little doubt that silver chloride was known in the time of Pliny for in his *Historiae naturalis*...he refers to operations in which this compound must have been formed. Geber also, in his *Summa perfectionis magesterii*, describes its *color mirabilis*.⁴⁸

There is an apocryphal account which tells how a stained glass worker lost his silver button in a crucible of molten glass and accidentally created a yellow stain on glass.⁴⁹ From this “discovery” a silver stain was apparently developed and introduced to the art of stained glass by the French at the beginning of the fourteenth century. This stain produced a full range of tones from lemon yellow right through to orange.

Previously, workers in the glass medium had relied on a mixture of iron oxide and powdered glass to achieve a monochrome brown.⁵⁰ In addition, before the discovery of silver stains, pieces of glass destined to be stained yellow (and indeed any other colour) had to be produced separately. Thus, the new techniques of silver staining allowed the artisan to mix certain colours on the same piece of glass. For example, it was now possible to take a piece of red glass and highlight it orange by simply painting on a layer of silver stain to the appropriate area. Brisac and Grodecki explain that

This remarkable technical accomplishment freed the glazier from the constraints of leading: silver oxide allowed a piece of white glass to be coloured with yellow without any cutting, and it modified the tonality of glass so that two shades could be set together without the addition of a lead. The oxide, usually placed on the outside of the glass, fused into the glass during firing; when used on the inside of the glass, it was handled like paint. Stained glass was consequently renewed, enriched and even made simpler by this process.⁵¹

It should be pointed out that modern glass-stainers can employ a variety of silver based stains to achieve their yellow hues, and in this respect silver chloride, silver nitrate, and even silver oxide will colour glass yellow. However, most popular writers cite any one of the above mentioned silver based solutions as being the constituent of the original silver stain discovered c. 1310. For example, Brisac and Grodecki (quoted above) mention silver oxide as being the stain employed. In fact, the actual chemical employed in France in the early

⁴⁷ Ibid.

⁴⁸ J. W. Mellor, *Inorganic and Theoretical Chemistry: Volume 3*, London: Longmans, 1922, 30.

⁴⁹ This account is variously given in the following sources, viz: L. Lea, G. Seddon and F. Stephens, *Stained Glass*, London: Spring Books, 1989, 84 and B. Coe, *Stained Glass in England: 1150 - 1550*, London: W.H. Allen, 1980, 9.

⁵⁰ C. Singer [et al.] (eds), *A History of Technology. Volume III: from the Renaissance to the Industrial Revolution. c. 1500 to c. 1750*, Oxford: The Clarendon Press, 1957, 240-3.

fourteenth century was chloride of silver or silver chloride.⁵²

To prepare this stain it was necessary to dissolve about an ounce (32 grams) of pure silver in an equal amount of pure nitric acid (the silver being finely ground before-hand to speed up the process). Boiling water was then added to this silver nitrate solution. Once the silver had completely dissolved, it was saturated with sodium chloride (common salt). The resulting precipitate was allowed to settle and any excess water was poured off. This sludge was then mixed with fresh water and allowed to stand until the sediment settled and the excess water could be carefully poured off. After about six of these “washings” with fresh water, a residue of relatively pure chloride of silver remained.⁵³

This development constituted a major advancement during the “decorated” period of the history of stained glass (c. 1280 - c. 1380). During which period many other colours were also added to the palette of the stained-glass artist.

Silver Nitrate

By comparison to silver chloride, silver nitrate is highly soluble in water and is very sensitive to the action of sunlight. Specifically, after exposure to sunlight, a visible dark purplish-brown discolouration will appear. Because of man's need to refine both gold and silver deposits, nitric acid (because of its ability to dissolve silver) became an invaluable chemical for separating silver from gold and silver alloys (electrum).

If we can accept the accuracy of the twelfth century Latin translation of Geber's work (*De inventione ventatis*) we have to accept that as early as the ninth century, silver nitrate was prepared by the admixture of ground silver to nitric acid.⁵⁴ To produce this chemical it was necessary for nitre to be collected and transformed into nitric acid. The silver was then ground and dissolved in the acid. One medieval alchemist who not only knew about nitric

⁵¹ C. Brisac and L. Grodecki, *Gothic stained glass*, Tr. B.D. Boehm, London: Thames and Hudson, 1985, 176.

⁵² Singer [*et al.*], 240-3 and H. Osborne, *The Oxford companion to art*, Oxford: Clarendon Press, 1970, 46.

⁵³ See A. L. Duthie, *Decorative Glass Processes: Cutting, Etching, Staining and Other Traditional Techniques*, New York: Dover Publications, 1982, 79-81 and E. R. Suffling, *A Treatise on the Art of Glass Painting: Prefaced with a Review of Ancient Glass*, London: Scott, Greenwood and Co, 1902, 84-6. The reaction can be expressed as follows: $\text{Ag}^+ (\text{soln}) + \text{NO}_3^- (\text{soln}) + \text{Na}^+ (\text{soln}) + \text{Cl}^- (\text{soln}) \rightarrow \text{AgCl}(\text{solid}) + \text{Na}^+ (\text{soln}) + \text{NO}_3^- (\text{soln})$ where (soln) indicates that the ion is in solution and (solid) indicates that AgCl is a solid. The deleted formulae indicate those ions that do not change during the course of the reaction. The result of which is: $\text{Ag}^+ (\text{soln}) + \text{Cl}^- (\text{soln}) \rightarrow \text{AgCl} (\text{solid})$. In modern parlance, this is simply a description of a typical “no-electron-transfer” reaction which occurs when a solution of sodium chloride is mixed with a solution of silver nitrate. See also R. A. Plane and M. J. Sienko, *Chemistry: Principles and Properties*, New York: McGraw-Hill, 1966, 85.

acid (*eau prime*) but actually used it to separate gold from silver was Albertus Magnus. His account is enlightening:

Take two parts of sulphuric acid, two parts of nitre and one part of calcined alum; pulverise and blend these materials properly and distil them in a sealed glass beaker. It is essential that this vessel is sealed firmly in order that no gases may escape. Begin the process by heating, slowly at first and then more and more vigorously. - The liquid thus obtained, dissolves silver, separates gold from silver and oxidises both mercury and iron.⁵⁵

Of course, this implies that Albertus Magnus must have also produced silver nitrate. Although he doesn't actually give his version of this reagent a name, he does mention that the dissolved silver and *eau prime* stains the skin of a man black and is difficult to remove.⁵⁶

The fact that Albertus Magnus mentions this phenomenon is not at all surprising. Indeed, even if there existed no documented evidence of his discovery of silver nitrate's ability to change colour, it is certain that if he had physical exposure to it he would have known about it.

In this regard, it is common knowledge amongst photographers and other persons who have had occasion to handle this seemingly innocent, colourless liquid that silver nitrate causes extremely severe skin stains. These normally occur on the fingers and take weeks to be eroded away. It is interesting to note that photographers in the nineteenth century (because they prepared their own light sensitive emulsions) were identified by the public-at-large by the state of their brown and yellow stained hands. Once the lesson has been learned, persons who handle this chemical are very careful to don protective clothing and gloves.

Considering the chances of someone not experienced in handling silver nitrate (e.g. Albertus Magnus) not getting his hands stained, taken together with Albertus Magnus's written description of the staining powers of the chemical he produced (c. 1250), it is quite certain

⁵⁴ G.D. Parkes, *Mellor's Modern Inorganic Chemistry*, London: Longmans, Green and Co, 1951, 459

⁵⁵ Hoefler translates this text from the Latin into French thus: "Prenez deux parties de vitriol romain, deux parties de nitre, et une partie d'alun calcine; soumettez ces matieres, bien pulverisees et melangees, a la distillation dans une cornue de verre. Il faut avoir soin de fermer exactement toutes les jointures, afin que les esprits ne s'echappent pas (*ne spiritus possint evaporari*). On commence par chauffer d'abord lentement, puis de plus en plus fort. - Le liquide ainsi obtenu dissout l'argent (*est dissolutiva lunae*), separe l'or de l'argent, et transforme le mercure et le fer en chaux (oxydes) (*Aurum ab argento separat, mercurium et martem calcinat, convertit in calces*)", F. Hoefler, *Histoire de la Chimie*, Paris: Libraire de Fermin Didot freres, fils et Cie, 1866, 388.

⁵⁶ Albertus Magnus is quoted in the original Latin as follows: "*tingit cutem hominis nigro colore et difficulter mobili*" Hoefler, 389.

that Albertus Magnus both produced silver nitrate and understood its ability to change colour well before 1280 CE. Indeed, it can be safely stated that anyone who discovered silver nitrate would have discovered its staining power at the very same time.

However, no evidence exists that Albertus Magnus or indeed any other alchemist or metallurgist (before the seventeenth century) knew exactly *why* silver nitrate changed colour. Even so, given the early occurrence of this reagent in western history, it would be safe to assume that silver nitrate in whatever form was known well before 1355.

Silver Sulphate

This silver salt is derived from sulphuric acid, a chemical which is not only found in nature but is also far simpler to produce than nitric acid. Sulphuric acid is mentioned in the Latin version of al-Geber's ninth century writings, although some authorities believe this to be a thirteenth century elaboration on al-Geber's original text. Even so, there is no doubt that this acid was being manufactured in the thirteenth century, by the distillation of ferrous sulphate crystals and was known in medieval times as *oil of vitriol*.⁵⁷ To produce this acid it was necessary for a mixture of sulphur and nitre to be burned over water and it is for this reason that sulphuric acid may be found in mineral springs whose waters have been contaminated with such sulphide minerals as iron pyrites. Mellor explains that the Rio Tinto river in Spain contains large quantities of sulphuric acid because of this natural process.

If ground silver is dissolved in this acid, silver sulphate results. This colourless silver salt is very light sensitive, turning to a rich maroon-red in the presence of sunlight.

Magnifying Glasses

Having satisfied myself that - in theory at least - three light sensitive reagents were available to any knowledgeable alchemist living in the thirteenth century, my final challenge was to find evidence for lenses before 1355.

Now as strange as it may seem, until quite recently, most authorities believed that the die-sinking and gem-cutting tasks of ancient times were undertaken by persons who were very

⁵⁷ Parkes, 463-4.

short sighted.⁵⁸ Such persons, (according to this scenario) would have been much sought after since they would have possessed (in effect) a pair of magnifying glasses permanently attached to their eyes. Beck states that

This idea is so prevalent that when ancient magnifying glasses are found, scholars go to the trouble of trying to find some other use to which they could be put, the favourite suggestion being that they must have been ornaments.⁵⁹

In fact the invention of glass and the subsequent manufacture of lenses may be traced back to Predynastic Egypt, the Ancient Near East and the Aegean. For example, a large piece of blue glass was found at Abu Shahrein in Mesopotamia (c. 3000 BCE).

It is accepted that two separate traditions of glass manufacture coexisted in ancient times: the one centred in Egypt; and the other in the Aegean. In general, the Egyptian glass may be coloured whereas the Aegean examples are either transparent or more normally colourless.

However, magnifying glasses were not always made from glass and many have been found which are made from crystal (optical quality quartz). This latter point is important, since it implies that the discovery of the lens does not necessarily depend on the manufacture of glass *per se*.

In the Department of Egyptian Antiquities at the British Museum are housed two plano-convex, magnifying glasses found at Tanis in 1885 and dated to c. 150 CE. One is badly damaged, and both are tarnished through age. Beck maintains that originally they would both have been quite able to focus the Sun's rays. Both lenses would have been of about the same dimensions, i.e. between 55-65 mm in diameter and both having an estimated 80 mm focus, which would mean that originally they could magnify about three diameters. Both of these examples, which I have had the privilege of seeing at first hand, are ground glass lenses and do not appear to be cast.

Similar lenses have been found at Carthage (c. 300-500 BCE) and from Crete (c. 1600-1200 BCE). The latter site revealed one lens which is eight-tenths of an inch diameter (20 mm) and has a focus of about one inch (22.5 mm). This would give this lens an effective

⁵⁸ Readers will get a fuller inventory concerning the technological prowess of our medieval and classical forefathers by reading H. C. Beck, "Early Magnifying Glasses", *Antiquaries Journal*, 1928, Vol. 8, 327-330.

⁵⁹ Beck, 327.

magnification of ten diameters.

Ibn al-Haytham (965-1039) employed the segments of glass spheres for magnification and Grosseteste (1175-1253) mentions that lenses made “small things appear large” and “distant objects near”.⁶⁰ In fact, most of the natural philosophers (both western and eastern) knew of the burning lens (made normally by filling a round blown glass container with water). In this regard Roger Bacon not only fully describes the working of the burning lens and its manufacture but also undertook a series of experiments employing plano-convex lenses (c. 1270 CE).

The Visby Lenses

No discussion on ancient lenses may be had without at least a brief mention of the Visby lenses.⁶¹ When I first revealed my photographic hypothesis (1993) and suggested that mediaeval craftsmen could have made lenses I was literally laughed at. An article that was going to be published in *Nature* was withdrawn because a so called expert academic referee was not prepared to accept that mediaeval craftsmen could make lenses! This says a lot about the quality of scientific discovery in contemporary times, the dangers of mindlessly accepting particular worldviews and the problem of so-called experts who live in restrictive paradigms, literally unable to see the wood for the trees. A few years ago (1998 to 2005) I believe I was clearly vindicated with the discovery of the so-called Visby lenses. These artefacts, which conservatively date to the eleventh or twelfth century are all lens-shaped and made out of optical quality quartz. Most are piano-convex in form and seem to have been employed in later years as jewellery as some are framed in silver mounts. They were discovered in the graves of Vikings on the island of Gotland. Some are quite capable of producing images and can be employed as magnifying glasses. Some are less useful and may have been trial products. Regardless, the largest of these is some 50 mm in diameter and most surprising of all, most are aspherical in nature and probably made on a lathe! This is extremely advanced technology for the time and supports the notion that someone in Eastern Europe, Byzantium or Italy also had access to this kind of technology by 1275 onwards.

⁶⁰ Singer [*et al.*], 230.

⁶¹ Schmidt, Olaf, Karl-Heinz Wilms and Bernd Lingelbach, “The Visby Lenses”, *Optometry & Vision Science*, Vol. 76, No. 9, September 1999, 624-630.

Those who still want to claim that mediaeval craftsmen were only capable of carving crude gemstones need to hang their heads in shame and certainly should not serve as academic referees on leading scientific journals!

Spectacle Lenses

Possibly the most interesting aspect concerning the history and development of lenses concerns the invention of the spectacle lens. I believe that the scant facts surrounding the spectacle lens's discovery sheds much light on the fact that no information (apart from the *Shroud* itself) has come down to us today which can absolutely verify my suspicion that some person or persons were privy to a form of photographic technology almost five centuries before Sir Humphry Davy and Thomas Wedgwood. According to E. Rosen, lenses were discovered sometime between 1280 and 1285 and were first employed in the correction of presbyopia.⁶²

However, Venice (which is renowned for its glass production), has had a glass-making industry since at least Roman times. According to the Petrus Flabianus Phiolarius,⁶³ vessel-glass was already being made by 1090 CE. Certainly, by the thirteenth century, a glass industry was flourishing at Venice. From at least 1294 onwards, spectacles were in use in Northern Italy. It is recorded that a certain Fra Giordano of Pisa preached a sermon at Florence in 1306 in which he made the following statement:

It is not yet twenty years since there was found the art of making eye-glasses which make for good vision, one of the best arts and most necessary that the world has. So short a time is it since there was invented a new art that never existed [before]. I have seen the man who first invented and created it, and I have talked to him.⁶⁴

We can surmise from this, that Fra Giordano had personally met the man who invented the spectacle lens in the west, which would place their introduction into our society in or around 1286 in Pisa. A more exact record is also given by Rosen who supplies us with the name of the man who invented eyeglasses - one Salvino degli Armati. He quotes Ferdinando Leopoldo del Migliore who published an historical description of Florence in 1684. Whilst discussing the

⁶² Edward Rosen, "The Invention of Eyeglasses I", *Journal of History of Medicine and Allied Sciences*, XI, (1) 1956a, 13-46.

⁶³ Singer [*et al.*], 209.

⁶⁴ Singer [*et al.*], 230.

church of Santa Maria Maggiore, Del Migliore wrote:

There was another memorial which went to ruin in the restoration of that church. It was faithfully recorded, however, in our ancient register of burials. It is very precious because by means of it we came to know about the first inventor of eyeglasses. He was a gentleman of this country [Florence], which is so highly renowned for genius in every subject requiring keenness of mind. He was Messer Salvino degl' Armati, son of Armato, of a noble family which continues to give its name today to the Chiasso degl' Armati, that short alley (for that is what "chiasso" means) situated behind the Centaur. The statue of this man in ordinary dress was to be seen reclining on a large slab with letters around it, which said the following: "Here lies Salvino degli Armati, son of Armato, of Florence, inventor of eyeglasses. May God forgive his sins. A. D. 1317."⁶⁵

However, technically speaking, eye-glasses were not invented by the Italians as magnifying glasses made of rock-crystal employed for the purposes of "deciphering illegible documents in criminal cases" are mentioned by Liu Chhi before his death in 1117 CE.⁶⁶ Of course we have no way of knowing whether these were affixed to a person's face or whether they were simply independent lenses.



7/ Diagram illustrating the typical, standard design for medieval European hinged spectacles (early fourteenth century). Similar constructions were available in Italy by at least the close of the thirteenth century – a minimum of some 25 years before the production of the *Shroud* (c. 1290 – 1355 CE).

In 1300, certain Venetian guild by-laws, which applied specifically to glass-workers (*cristalerii*) mention *roidi* (for *rodoli*) *da ogli* (little discs for the eyes) and by 1301, eye-glasses for reading are mentioned (*vitreos ab oculis ad legendum*).⁶⁷ Indeed, in 1316, an intriguing text speaks of *oculis de vitro cum capsula* (eye-glasses with a case!) which sold

⁶⁵ Edward Rosen, "The Invention of Eyeglasses II", *Journal of History of Medicine and Allied Sciences*, XI, (2) 1956b, 183-184.

⁶⁶ Needham, 121

for six Bolognese *soldi*.⁶⁸

It is accepted that the first shapes employed for eye-glasses were convex lenses and, as has been already mentioned, were employed for the correction of presbyopia. These lenses were ground to the proportions dictated by the radius of a circle⁶⁹ from glass which conformed very closely to the standards of modern bottle and window glass.⁷⁰

Vasco Ronchi informs us that the history of

these little transparent discs of glass is one of the most fascinating although it has been allowed to sink into oblivion because it was thought perhaps erroneously, that it did not bring any credit to science.⁷¹

He concludes that the invention of the spectacle lens must have occurred purely “by chance” by persons who “knew nothing about optics.”⁷² According to this scenario, ageing stained glass artisans, working in the late thirteenth century, noticed that curved pieces of clear glass corrected their poor vision. I do not totally agree with this explanation, since natural philosophers such as al-Haytham and Roger Bacon, who both dissected the human eye and observed the crystalline lens or *glacialis* within, must have been aware of a bi-convex lens's ability to magnify an object or to focus an image. However, I do agree that the reason such knowledge concerning the practical benefits of the magnifying lens (i.e. correcting failing eyesight) has not survived has much to do with the fact that lenses were generally not considered worthy of attention by the educated classes at this particular time. In this regard, Ronchi tells us that,

Lenses were thought unworthy of any attention and were ignored for over three centuries. No other conspiracy of silence was ever so unanimous and so lasting. In the whole period of time from the fourteenth to the sixteenth century we find very little mention of lenses, and the few who mentioned them were people well known for their lack of prejudice. No mention whatsoever is found in books and this indicates that lenses were not discussed in schools.⁷³

One such person who displayed such a lack of prejudice was Leonardo da Vinci, who, with

⁶⁷ Singer [*et al.*], 230.

⁶⁸ Ibid.

⁶⁹ Singer [*et al.*], 231.

⁷⁰ Singer [*et al.*], 234.

⁷¹ Vasco Ronchi, *The Nature of Light: an Historical Survey*, Tr. V. Baracos, London: Heinemann, 1970, 69.

⁷² Ronchi, 70.

⁷³ Ronchi, 71.

reference to a ray diagram, wrote,

A proof of the manner in which glasses aid the sight: Let *ab* be the glasses and *cd* the eyes, and suppose these two have grown old. Whereas they used to see an object at *e* with great ease by turning their position very considerably from the line of the optic nerves, that now by reason of age the power of bending has become weakened, and consequently it cannot be twisted without causing great pain to the eyes, so that they are constrained of necessity to place the object farther away, that is from *e* to *f*, and to see it better but not in detail. But through the interposition of the spectacles the object is clearly discerned at the distance that it was when they were young, that is at *e*, this comes about because the object *e* passes to the eye through various mediums, namely thin and thick, the thin being the air that is between the spectacles and the object, and the thick being the thickness of the glass of the spectacles, the line of direction consequently bends in the thickness of the glass, and the line is twisted, so that seeing the object at *e* it sees it as though it was at *f*, with the advantage that the position of the eye with regard to its optic nerves is not strained and it sees it near at hand and discerns it better at *e* than at *f* and especially the minute portions.⁷⁴

It is clear to me, that the *Shroud* was produced by someone like a Leonardo - one who was not too prejudiced to consider the connections between the optical theory as expounded by such people as Witelo and Roger Bacon and the practical function of the spectacle lens as employed by the lowly medieval spectacle-maker. However, it *was not* Leonardo because the creator(s) of the *Shroud* lived at least a full century before he was even born!

Unfortunately, despite the recent spate of interest in a highly dubious connection between da Vinci and the *Shroud of Lirey*,⁷⁵ our sought after genius must be found in the years preceding 1355.

Considering, that the format of the image as found in the *Shroud of Turin* is frontal, symmetrical and to the unaided eye, rather two-dimensional in appearance, it is conceivable to treat with the *Shroud* as one would with a Byzantine icon. Is it not intriguing that the first spectacle lenses were most probably made in the Venetian republic, where a flourishing glass industry had developed (incidentally at about the same time that Marco Polo had first introduced Chin porcelain to the west i.e. 1271-95). Venice and the Byzantine world have very obvious connections in this regard and both must surely rank as two of the more likely sites for such a technologically superior production to have occurred.

⁷⁴ See Edward MacCurdy, *The Notebooks of Leonardo da Vinci*, London: Jonathan Cape, 1948, 249.

⁷⁵ See my article entitled "How Leonardo *did not* fake the Shroud of Turin", *De Arte*, Volume 52, UNISA, 1995b, 32-39 and also Lynn Picknett and Clive Prince, *Turin Shroud: in whose image?* London: Bloomsbury, 1994 and

Another tantalising clue to the origins of spectacle lenses comes from the origins of the word “lens” itself. Indeed, the Italian word *lente* referred to lentils, but the very specific and descriptive term *lente di vetro* (literally glass lentils) referred exclusively to the spectacle lens. This further strengthens the argument that the invention of the European spectacle lens as a practical device, owes much to Italian or Venetian expertise.

Ronchi also informs us, that perhaps another reason why lenses *per se*, were not treated as serious objects of research during the thirteenth century (despite their obvious existence and prescription for the correction of presbyopia), was because, as far as the medieval mind was concerned, nature in her perfection could only be observed by the unaided eye (itself a result of divine and perfect insight). Any attempt to “alter” the path of the visual rays might have been viewed by the medieval philosopher and theologian alike, as a form of illusion and thus as a path which would lead the serious scholar away from the truth.

The best way to learn the truth is not to alter either the rectilinear form of the rays or the regular travel of the *species* [medieval term for those rays sent to the eyes from illuminated bodies, N.P.L.A.]. The introduction of mirrors, prisms, and lenses in their path brings inescapable an alteration of truth and these instruments make us see figures where the material objects are not and often make us see them enlarged or reduced, inverted, distorted, doubled and coloured. It is all a trick and an illusion. All optical means must be eliminated if we really want to reach the truth.⁷⁶

To be sure, the world had to wait until the Renaissance before any scholar gave serious intellectual attention to such things as lenses and mirrors (especially curved mirrors). The veracity of this notion is borne out by the fourteen editions which were produced between 1486 and 1583 of an early form of encyclopaedia which had the rather voluminous title: *Epitome omnis philosophiae, alias margarita philosophica, tractans de omni genere scibili*. This compilation which is better known by its abbreviated title: *Margarita philosophica* was collated by Reisch who was the prior of a Carthusian monastery situated quite close to the town of Freiburg. It deals at length with the nature of light and colour and tends to rely heavily on the older ideas first postulated by the classical schools rather than the teachings of scholars like al-Haytham, Roger Bacon and Witelo of Poland. As unbelievable as it may seem, this text was produced at least three centuries after the invention of spectacle lenses, and at least four and a half centuries after the discoveries of al-Haytham, yet, no mention is

Anthony Harris, *The Sacred Virgin and the Holy Whore*, London: Sphere Books, 1988.

⁷⁶Ronchi, 73.

made by it, of lenses, despite the fact that they were used by scholars at this time for the very purpose of reading texts!⁷⁷

Quite understandably, many of my critics ask me “if your right about the *Shroud* being a ‘photograph’, how come there aren't other examples of this technology around?” Considering the degrees of secrecy surrounding any one particular guild's techniques at this time (c. 1280-1320) and the previously discussed factors which contributed for the total lack of information for something as relatively common as an eye-glass, I am not surprised that such “esoteric” knowledge as was required to make the *Shroud* never became general knowledge and thus was never passed down to our own time in any accessible form.

⁷⁷Ronchi, 74.

V

THE SCIENTIFIC EVIDENCE

The Practical Investigation

Having satisfied myself that it was at least possible for persons living in the late thirteenth and early fourteenth century to have had access to the kinds of knowledge and/or apparatus necessary to produce a photographic image (permanent or otherwise), I set about conducting a series of experiments designed to test the efficacy of selected medieval chemicals and equipment.

In this regard, it is important to emphasise that for the purposes of impartiality and historical accuracy, only those relevant examples of technical expertise, chemicals and equipment that were known to have existed *c.* 1200-1355 were included in my practical investigation.

However, this strategy (as it stood) had two serious drawbacks:

- Firstly, it was assumed that many important medieval technological discoveries have not come down to us and therefore, even if these technologies are suspected to have existed, they could not (for the sake of objectivity) be employed; and
- Secondly, it was assumed that it would be impossible for a twentieth century researcher to completely divorce himself from his own socio-technological paradigm and successfully embrace a medieval world-view.

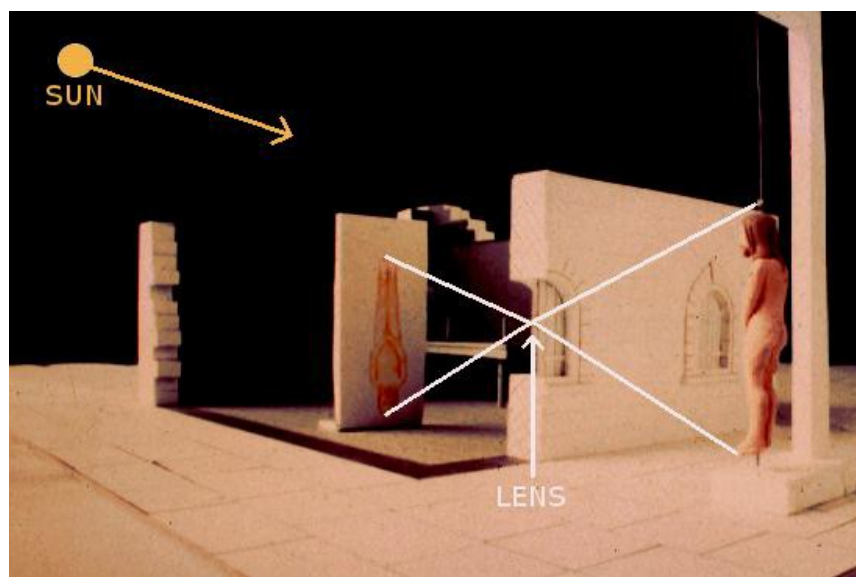
Therefore, in an attempt to overcome this impasse, I had to accept that the photographic hypothesis (as outlined previously) had to be supported or refuted by the employment of known medieval technology and/or a technology that was at least conceivable in a medieval context, so long as it could be irrefutably supported by the physical evidence of the *Shroud of Turin* itself.

It was in this spirit that I set out to ascertain the suitability of certain light sensitive reagents

(available before *c.* 1355) as regards their respective abilities to produce an image as found on the *Shroud of Turin*.

It seemed logical to me that whoever made the original *Shroud* had to have used a large *camera obscura*, within which they suspended vertically, a piece of light-sensitised linen material. Onto this cloth, they presumably focussed (by means of either a lens or pinhole), the inverted image of a sun-illuminated subject (a cadaver or body-cast of a person). This subject had to have been suspended such that it received an equal proportion of morning and afternoon light. I knew that the four and a half metre piece of cloth, which had constituted the original *Shroud*, had to have been folded such that half its length was exposed at any one time. In this way, the medieval forgers would first have exposed the frontal view for an unspecified period of time and then once finished, they would have turned the body around, reversed the cloth, and exposed the dorsal view. In this way the *Shroud* would have required at least two exposures of more or less equal duration: One for the front view and one for the dorsal view.

I also knew that the head of the man on the *Shroud of Turin* was about 10% too small for its body. Thus it was also more than likely that a separate exposure had been made for the head as well.



8/ A model which was built to the specifications of the author by Mr Derrick Erasmus in 1991. The model illustrates the general working hypothesis, that a corpse was suspended in sunlight in front of a lens-filled aperture of a full-scale *camera obscura*. Within the darkened room, the image of the suspended corpse appears focussed and inverted on the stretched shroud fabric. (Copyright: Mr Glenn Meyer)

Thus began a period of investigation (which still continues to this day), which went through many phases and was anything but a trouble-free process for me. Certainly I made many false turns during the earlier phases.

In this chapter, I will only deal with the more important features of this fairly lengthy process, concluding with my successful manufacture of a full-length facsimile of the *Shroud of Turin* in 1994. Interested readers may want to refer to the appendix at the end of this book for more detailed information apropos my employed methodology.

Pinhole apertures

I soon discovered that a very small aperture (*sans* lens), gave the best results as far as producing an acceptable, focussed, life-sized image was concerned. Despite this fact, however, the smaller aperture did not allow sufficient levels of light into the camera to affect the various light sensitive chemicals that I was experimenting with. Indeed, even after many days of exposure, no results were forthcoming. For this reason I have firmly ruled out any possibility of the original manufacturers of the *Shroud* having made use of a pinhole.

Glass lenses

I also discovered, very early on in my investigation, that despite the rapidity that silver nitrate reacted to direct sunlight, that if these samples were placed under thick glass they took far longer to reduce. Glass screened out the specific ultraviolet wavelengths in sunlight that had a direct effect on the silver salts. Now, the only substance which allows better transmission of light, including many of the UV wavelengths, is optical quality rock-crystal (quartz). Indeed, and as it turns out, it was the *only* suitable material for a medieval forger who sought better optical quality.

Medieval glass would have been totally unsuitable as a medium for this kind of lens, as it was invariably tinted and its formula certainly not much different to modern window and bottle glass. I now know that, given more time, silver sulphate can be exposed successfully with a modern glass lens as well. However, it is far more likely that the forgers used quartz since it was an easily obtainable, clear material, whereas optically clear glass would have been very difficult to produce at that time.

Portable *camera obscura*

For the envisaged smaller tests (c. 1989 – 1992), a heavy duty cardboard box measuring 340 x 450 mm was fitted out with an aperture which could accommodate either a pinhole or a lens. This small test camera obscura was in effect a smaller version of a full-scale *camera obscura*.

Subject

For a suitable subject to “photograph”, I produced a plaster-of-Paris head, which was in actuality a life-cast of my friend Glenn Meyer. This head was originally painted in flesh tones but ultimately was painted matt white to increase its reflectivity.

Linen

For my tests I needed to acquire some pure, hand-woven linen. This was not at all easy to obtain (certainly not in the early 1990s) but eventually I managed to obtain a good substitute in the form of machine-woven Irish linen. I purchased a four meter length of this material from which a number of small pieces were cut measuring approximately 10 x 20 cm each. These were used for testing most of the light sensitive reagents during the investigation.

The linen was first machine-washed with soap and very hot water (90 C) and repeatedly rinsed with clean water. This was done to ensure that the cloth contained as little trace of starch or sizing agents as possible.

Light sensitive solutions

I conducted many tests during this period, during which time I managed to develop (after much trial and error) a very simple recipe for a light sensitive solution, viz: .5% solution of silver nitrate in distilled water (by volume). I referred to this recipe at the time as reagent E. This was because of the failure of reagents A, B, C and D - all of which had been too heavily laced with silver nitrate. Less was ultimately better and reagent E was just perfect at the time.

The exposure

At first I mistakenly made use of two, identical piano-convex glass lenses (50 mm diameter) arranged in a binary relationship. This arrangement was identical to a modern condenser, employed in photographic darkrooms until the advent of the digital age. Little did I know at the time that the very arrangement and fabric of these two lenses was in fact defeating my very attempts at reducing the silver nitrate! Regardless, I found that if a piece of linen was painted with this solution (reagent E) at night-time and then left to dry, that by the morning it would be dry enough for me to place it inside the small test *camera obscura*. Thus prepared, I would set up the plaster head, so that it received a fair share of both the morning as well as the afternoon sunlight. The head would face the double-lens arrangement of the test *camera obscura* and at the appointed hour in the early morning, I would open the aperture and wait impatiently until late afternoon to close the aperture, open the *camera obscura* and evaluate the results.

After some twelve months of disappointment and extremely bad luck, I finally cracked the nut. I realised that the glass fabric of the lenses was in fact hindering my progress. With good advice from Mr Jonty Hansford, I made contact with Mr Derek Griffith of the CSIR and asked him for assistance. With my tried and tested recipe and a borrowed, small quartz bi-convex lens (40 mm in diameter) with a focal length of about 500 mm, I found that I could in fact, produce an excellent facsimile of the head image (albeit in negative) in dark sepia brown, similar to what appears on the *Shroud* in just a few days.

My next problem was to find a method of “fixing” the image. If removed from the safety of the closed *camera obscura* and exposed to the rays of the sun, the unaffected, imageless areas of cloth would also, in their own turn, gradually turn sepia brown and the image of the head would eventually be indistinguishable from the rest of the cloth.

I soon discovered that by submerging the cloth in ammonium hydroxide (NH_3 [aq]) that all the silver, both reduced and unaffected (i.e. both silver atoms and ions) was removed. This action strips away all traces of the original silver salt image but leaves behind a secondary image which is, in fact, caused by the structural alteration to the linen fibre itself. In short, the final “fixed” image was not composed of dye, stain, powder or paint, but was a chemically induced scorch. Although much of the detail is lost during this “fixing” process, the remaining image is very often better than that observed on the original *Shroud*.



9/ The plaster of Paris head of Mr Glenn Meyer which was cast by the author and used as the model for the 1992 experiments. (Copyright: Mr Glenn Meyer)



10/ On the left: a positive photograph of the test piece of linen (previously prepared with dilute silver nitrate) showing the negative image produced after three days. This image is a composite of oxidised lined and silver atoms. On the right, the same negative image after all silver nitrate has been removed with ammonium hydroxide. (c. 1992). The image on the right is only formed by oxidised fibrils on the surface layers of the linen. Any silver atoms still present will be parts per million at best. (Copyright: Mr Glenn Meyer)



11/ A negative photograph of the test piece of linen (previously prepared with dilute silver nitrate) showing the resultant, highly detailed positive image. (c. 1992). Compare to Plate 9. (Copyright: Mr Glenn Meyer)

I was delighted to observe, that the better results had (visually) all of the characteristics of image formation as observed by the STURP committee in 1979. To test this hunch more substantially, I had my samples subjected to a series of standard scientific tests, such as tests for viscosity, oxidation (methylene blue tests) and also had samples subjected to Inductively Coupled Plasma Mass Spectrometry to confirm the exact causes for image formation (please see the appendix for details).

The following findings are important, viz:

- The negative state of these images appear exactly like the *Shroud of Turin* in that the image is strictly frontal, the eyes appear owlish, the image contains no pigment, dye or stain and is caused by the oxidation of the uppermost fibrils of the material. In this regard the image is permanent and may not be removed by standard chemicals except household bleach.
- These images have no directionality since they are caused by radiant energy. These images are three-dimensional in that the intensity of the images are proportional to the distance of the original corpse from the screen during exposure. In short, the *Shroud* itself, is nothing more than a very elaborate suntan - one that uses the silver-salt as an agent in the transfer of energy from the sun to the hemicellulose and cellulose polymers which make up organic materials (esters) such as linen, cotton, paper and even leather. The polymer chains which make up the structures of the linen material are in fact broken down and shortened during this process - exactly as they would be if they were scorched by an iron or left in the sunlight for several years.
- No image appears on the back of the cloth. However, thin cotton or linen works the best and in these cases it is possible to make out a very blurry secondary image on the

reverse. This is not evident on thicker materials.

The Shroud of Port Elizabeth

It was only by the end of 1992, that I knew for absolutely certain that my original hunch concerning the manufacture of the *Shroud* might be correct. Indeed, by that stage of my research, I knew that if the original creators of this much maligned artefact had indeed made use of a photographically related technique, they would have had to have used a silver salt (like silver nitrate in solution) as their light sensitive reagent. This colourless liquid, painted onto a piece of linen and allowed to dry in a shaded place was capable (by employing a *camera obscura*) of capturing the most delicate tonal ranges (albeit in the negative), of any subject which was illuminated by direct sunlight. It was so obvious, so simple and also so unbelievable that no-one (up until then) had seriously considered this possibility as a valid explanation for the causes of the two-fold, negative photographic image of a naked and crucified man which appears on the *Shroud of Turin*. I also knew that if my enigmatic medieval “photographers” had indeed made the *Shroud* in this way they would have had to have either made use of a simple, bi-convex, rock-crystal lens or an extremely large concave mirror. I believe that the most simple and obvious solution is the most likely and although I would not go so far as to say that the *Shroud* was *never* made by the employment of a concave mirror, the use of a simple bi-convex lens is certainly the more direct and simple route to follow.

Within a short space of time I soon became quite adept at producing negative *Shroud*-like images of Christ on linen samples. If you like, I was producing veils of Veronica. However, producing negative images of plaster heads on linen only proved how the actual *Shroud* was made in theory. What had not been achieved was a full-scale reproduction of the *Shroud* - an event that would be a prerequisite to reconstructing the original lens that would most likely have been used by the *Shroud*'s creators (c. 1250-1355). I knew that I required a lens which was able to focus a life size figure onto an area which was at least 1800 mm in diameter.

I also knew the length of time it took to produce an image with a lens which measured 40 mm (placed 1000 mm from the aperture), by the results obtained thus far. Furthermore, I knew that the silver nitrate saturated cloth was mainly sensitive to a small range of the light

spectrum, namely: 200-240 nm. By employing the principle of the inverse square law I calculated that if I had a lens with a larger diameter I would speed up the time of exposure. This was an important consideration, because depending on the outcome of my deliberations I would know for certain whether an actual corpse, a preserved corpse or a cast taken from a corpse/living subject had been employed for the *Shroud of Lirey's* production (i.e. sometime before 1355 CE).

The decomposition factor

To explain this point more clearly, readers should be aware that this latter consideration of the exposure time was the most problematic for me. This was because if the hypothetical medieval “photographers” had made use of a human corpse, they would have had to have completed their task before the process of decomposition disfigured their subject. Here, I can also speak from first-hand experience as I am also a trained undertaker and still continue to assist in this capacity from time to time. The actual rate of decomposition, of course, is subject to any number of factors, but by and large this process may be retarded in environments where there is a deficiency of bacteria, low moisture content in the air or low temperatures. According to Scudamore⁷⁸ the average corpse would begin to show visible signs of distention from about the third to fifth day after death. Certainly by the eighth day, the disfigurement would have been too noticeable for the corpse to have remained a viable subject. I realised that it was not unthinkable for our hypothetical medieval “photographers” to have made a body-cast from their subject, but considering the wealth of anatomical detail contained on the *Shroud of Turin* and, considering that to make a cast from life would have been far more trouble for them than the actual manufacture of the *Shroud* itself, I tend to favour the notion that the subject was more likely to have been a freshly deceased individual.

It is not inconceivable that the exposure was made in a mountainous region, where the UV levels were naturally higher and the air was dryer and of course, significantly colder. Coupled to this was the fact that the subject (whether a life cast or a cadaver) may have been painted white. This latter action, apart from making the subject more reflective, would also have helped to lower the body temperature of the body, thereby retarding the decomposition

⁷⁸ For a detailed account apropos the process of decomposition of a human cadaver see E.F. Scudamore, *Embalming: Theoretical and Practical*, Bristol: British Institute of Embalmers, 121-126.

process yet further. It would appear, therefore, that unless the body was preserved in some way, the exposure for both the frontal and dorsal images would have to have been achieved within a maximum of six to eight days.

It is also not too outlandish to consider that the forgers employed an embalmed body or even more than one corpse. The fact that the two images on the *Shroud of Turin* (dorsal and frontal) are different lengths may be explained by this possibility as well as by the fact that different exposures would have been needed for the front and back images.

The synthetic quartz lens that I had on loan from the CSIR at this time was 40 mm in diameter and, from repeated experiments I knew that the minimum time period needed to make an acceptable negative image employing this original set-up was about four days. By applying the principle of the inverse square law it is possible to determine the length of exposure for other lenses with different diameters and different focal lengths. For example if the combined image conjugate and subject conjugate distance remained constant and the lens diameter was increased from 40 mm to say 80 mm, then the exposure time should be reduced by 80%. Within this scenario an exposure which had taken 32 hours (i.e. four days) could be reduced to six hours (i.e. less than one day), merely by doubling the diameter of the aperture or lens.

The second issue of major concern, was the lens distortion which also, incidentally, appears in the original *Shroud*. Indeed, it would appear that there is a discrepancy of some 10% between the dimensions of the head and feet as compared to the hands and the pelvic region. This factor gives the image in the *Shroud* a strange feminine appearance - as though the entire length of the body is lozenge shaped. This is further exaggerated by the fact that there are two parallel strips which run the entire length of the *Shroud* but which are most noticeable on either side of the head. Indeed, these strips, where the image appears to be less visible, have given rise to the very popular and persistent misconception that the man in the *Shroud* wore a chin binding!



12/ The author's friend and colleague, Mr Glenn Meyer standing next to the plaster-of-Paris "corpse" employed for the manufacture of the *Shroud of Port Elizabeth* (c. 1992). (Copyright: Author)



13/ A general view inside my giant *camera obscura* (c. 1992 – 1995). Visible are the 180 mm crystal lens in the aperture, the safe lights (candles) and the screen for supporting the shroud during exposure. (Copyright: Author)



14/ An image taken inside the closed, giant *camera obscura* showing the frontal image of the plaster-of-Paris “corpse” (c. 1992 – 1995). The image is upside down due to the effects of the rays of light being inverted by the 180 mm lens. (Copyright: Author)

In fact, these strips are synonymous with the position of the warp threads of the material. Originally, these were sized as a pre-requisite to the weaving process. From tests that I have conducted with my own *Shroud*-images, starched linen tends to repel dilute silver salt solutions, which causes loss of image (especially during the “fixing” process where all silver is removed from the fabric). In addition, the region to either side of the head, because it is mostly in shadow, ensures that very little light is reflected in the region of the warp threads. These two factors taken together ensure a section of nearly pristine linen clearly demarcated from the other image areas.

The fourth factor which had to be taken into consideration and which is of course related to the previous problem, concerns the issue of curvature of field. It is not possible to focus a life-sized image of a man onto a two-dimensional plane without a certain amount of blurring at the perimeters of the image patch. Nevertheless, this phenomenon may be neutralised by focusing the image onto a concave plane. However, this is no easy task when dealing with 5.4 square metres of linen material.

These above stated concerns were communicated to Mr Derek Griffith at the CSIR (Eloptro) who took on the daunting task of trying to approximate the dimensions of the original lens which was employed for the original *Shroud* image over seven centuries ago.

After many weeks of deliberation, Derek came up with an initial design, namely: a synthetic quartz lens of 80 mm diameter and with a focal length of 2200 mm. This meant that the combined image and subject conjugate distance would have to be exactly 8800 mm or nearly nine metres!

This is a very long distance when compared to the original 2000 mm required for the CSIR quartz lens of only 40 mm diameter. At first, I feared that the increased distance would have a serious impact on the efficacy of the levels of radiant energy necessary to affect the silver nitrate-impregnated linen. For example, by employing the principle of the inverse square law I calculated that whereas the original exposure for the plaster head had taken about 32 hours of sunlight (four days), this new lens, placed so far from the subject (despite the fact that it was five times larger in terms of area), would necessitate an exposure of just under 200 hours of sunlight or 25 days!

This of course is a ridiculously long period to wait for an exposure. I should also point out that the original CSIR lens had been made from very high grade synthetic quartz which allowed for good transmission of UV whereas the new lens was made from rather more average material which would cut down on the available spectrum quite noticeably.⁷⁹

The full-scale *camera obscura*

I moved operations to a small outbuilding on my property in Port Elizabeth. This room measured approximately 2200 x 6000 mm and made an ideal venue for a giant *camera obscura*. I bricked up all the windows, inserted lightproof air vents and light proofed the only door to this room. I then painted every square inch of the inside wall surface black. In order that I could support the light sensitive linen material at the correct angle and distance (image conjugate distance) from the aperture, a large mobile, screen was constructed. This piece of

⁷⁹ Various grades of synthetic quartz are available, some of which have better transmission levels than others, For example one commercial product, viz: Suprasil allows a very high percentage of UV radiation to pass through. Another product, viz: Herasil is also an excellent substitute for natural optical quality rock crystal, but is slightly inferior to Suprasil.

apparatus, which was welded up by my good friend, the late Mr James Toseland, measured 280 x 122 cm and was made of mild steel and tempered hardboard. This screen was fitted with wheels and could be moved in and out of focus as and when the need arose.

Thus prepared, the screen was placed, exactly 4400 mm from the lens. Outside the *camera obscura* I suspended a life-size plaster-of-Paris life-cast, taken from one of my braver students, Mr Duncan Burn. This “corpse” painted matt white, was placed in its turn, exactly 4400 mm from the lens. This latter cast from life, I embellished with imitation hair and beard. During the next few years this “corpse” was to undergo many minor transformations as I perfected the technique of making *Shroud* images. Thus prepared, I at last, had my human subject suspended in the sunlight such that it received exactly the same amount of morning as well as afternoon light.

My first task was to focus the image of the “corpse” onto the linen cloth suspended on the screen. This was no easy matter as despite Mr Derek Griffith’s careful measurements and Mr Dan van Staaden's perfect grinding and polishing, a noticeable amount of lens fall off was evident. In effect, this meant that only the centre of the “corpse” was in sharp focus (i.e. the crossed hands over the pelvic region) whereas the head and feet were out-of-focus. Nonetheless, I had a recognisable image which compared well with the *Shroud of Turin*.

After some very disappointing time spent testing the efficacy of reagent E and also a mixture of silver chloride diluted in pure ammonium hydroxide I took a chance and suspended a silver nitrate impregnated piece of linen measuring 2250 x 1200 mm inside the *camera obscura*. After weeks of waiting, with perfect weather, I achieved no image - only a very uniform brown piece of linen cloth which became increasingly darker as the weeks went by.

The Eloptro⁸⁰ Quartz Lens (180 mm)

I now had a number of choices open to me, namely:

- somehow make the silver nitrate more sensitive;
- obtain a piece of very high grade synthetic quartz for another lens; or

⁸⁰ This company was founded in 1974 and specialised in optical related products for national defence. In this context, its normal products included such things as submarine periscopes, laser rangefinders and laser target

- obtain another lens which had a much larger diameter.

In addition, I needed to cut down the combined image conjugate and subject conjugate distances as much as possible. Indeed, I needed the best compromise which would allow me to focus a six foot “corpse” onto a screen and still allow as much radiant energy into the camera as was plausible. Remember that I also had to consider the fact that the only lenses that have survived from the Middle Ages (and also much earlier) are never much larger than about 60 mm in diameter.

I discussed the problem with Mr Derek Griffith who advised that I should go for the bigger lens (after all I could then make this lens as large or as small as I wanted, merely by stopping it up or down with varying aperture diameters). I also wanted only the best grade quartz for the job, which, incidentally is an extremely expensive commodity. The blank that I needed was not small either, measuring 180 mm in diameter and with a width of just over 7 mm.

Through the kindness of my Dean and fellow Heads of Department I was made a loan with which I purchased a blank piece of high-grade quartz. After many months of waiting, a blank sent from Switzerland, finally arrived in South Africa, where through the sterling efforts of both Mr Derek Griffith and Mr Dan van Staaden, it was ground and polished into a bi-convex lens.

The new lens had a focal length of just over 2000 mm which meant that the distance between the screen and the “corpse” could now be reduced from 8800 mm to just over 8000 mm. This was quite a saving, cutting off an estimated 50 hours of exposure time alone, if one did not consider the fact that the new lens could be any diameter I liked, over and above the original 80 mm of the previous lens employed in phase eight of the investigation. To be sure, had I increased the diameter of the lens to the full 180 mm which was now available to me, I calculated that the exposure should take about 30 hours (i.e. just short of four days).

In addition, because the quartz was of a higher grade I knew that higher levels of UV radiation would enter the *camera obscura* thus speeding up the process here as well.

I set up a small piece of linen impregnated with reagent E inside the *camera obscura* and focussed the head of the “corpse” onto it. I started the exposure at eight o'clock in the morning and went into the *camera obscura* three hours later to see how things were

progressing. I was amazed to find that on the cloth, had formed a perfectly recognisable *Shroud*-like head in the negative! I was absolutely elated by this result, as now, I knew for certain, that I had plenty of room to play with concerning the parameters of such factors as the diameter of the lens, the length of exposure, the image conjugate distance and the subject conjugate distance. Indeed, I now knew that even if I was to reduce the aperture to 80 mm I could achieve good results in just over two days. These newer, more accurate calculations, also gave credence to the notion that the original *Shroud* could have made use of an untreated cadaver or cadavers.

Silver Sulphate versus Silver Nitrate

I set up a piece of linen which equated exactly to the proportions of the original *Shroud of Turin*. This piece of cloth was painted at night with reagent E (0.5% silver nitrate in distilled water) and was suspended on a very long washing line and blown dry by electric fan until the early hours of the morning. This piece of cloth, was then carefully rolled up and placed in a number of black plastic rubbish bags and transported to the *camera obscura*.

By eight o'clock in the morning the cloth was ready for exposure, such that 2250 mm of its length was suspended on the screen and 2250 mm was rolled up and placed under protective black plastic. I commenced with the frontal image of the corpse, with the intention of turning the cloth over after this exposure and repeating the performance for the dorsal image. I left this arrangement for three days with the lens set with a diameter of 140 mm. After this period I obtained an excellent negative image of the figure on the exposed linen.

However, although the results were very encouraging, this image was marred by a number of factors which I had not completely anticipated, due no doubt, to the fact that I had never had to work on such a large scale before. The first problem that occurred, concerned the method by which I applied the silver nitrate solution to the linen. Those areas of the linen which were not completely free from size repelled the silver nitrate, which meant that I had blank sections on my image. This problem of course must have beset the original manufacturers of the *Shroud* as well, as the missing image sections which are synonymous with some of the sized warp threads testifies to. In addition, the exposed silver nitrate had tended to concentrate in those areas where the paint brush had pressed hardest and the areas between brush strokes were often unexposed. Briefly stated, after a short period of exposure I could make out every brush mark originally made when the solution was transparent and

invisible!

If this was not bad enough I had yet one other problem to contend with, namely unwanted oxidation of the silver nitrate in those areas where there was no image. In short, background UV (present everywhere, even at night), and scattered UV rays which were reflecting off of the walls inside the large *camera obscura* (despite the fact that the walls were all painted black), were also affecting the light sensitive linen. In effect I had to balance the time spent exposing the linen to the sun illuminated corpse with the gradual all-over darkening of the linen that was occurring at a constant rate. Every day the cloth would become more and more oxidised, changing colour within about four days from pristine white to a rich, butterscotch brown. The image was, of course always visible, but became less contrasted as time went by. With a smaller camera and a smaller piece of cloth this effect had not been so noticeable but now it was very difficult to cope with. I also realised that the high humidity of the atmosphere inside the camera was affecting the sensitised linen adversely. Indeed, the drier and cooler it was, the longer it took for the oxidation process to commence. The wetter and/or hotter it became, the quicker the cloth became oxidised. The situation was truly paradoxical in the sense that I needed nice long hot days for the best UV levels and the cooler days normally came with associated rain storms or early morning dew. At every turn I was being thwarted by nature herself, realising that the worst possible place to be in the world for undertaking this form of testing was in a coastal town like Port Elizabeth. I needed a dry desert region or even better, to be at high altitude in a place that was blessed by cloudless skies, cool weather and no rain. I could not help thinking rather idealistically about a place like the Italian Alps as the perfect venue for such a production.

I repeated this experiment many times and managed to perfect the application process for the light sensitive reagent. In fact the simplest way to get the best results was to dunk the linen cloth unceremoniously in a bucket of reagent E, pull it out, hang it up to air dry and then

suspend it in the *camera obscura* on the screen. By this method I eliminated the unsightly brush marks. Of course, this did not solve my problem of background radiation or “background noise” as I christened this phenomenon.

Readers will recall that at the commencement of this long period of experimentation that I had rather hastily eliminated silver chloride and silver sulphate as being suitable candidates for testing as light sensitive reagents. I now sat with a problem. How could I control the oxidation process so that it worked for me?

Fortunately for me, the Port Elizabeth Technikon was, at the time, blessed by being a very multi-disciplinary tertiary institution wherein it is possible to find academic personalities who dabble in more than one field of expertise. One such scholar is Prof Dr Peter Loyson who was the Head of Chemistry at the time. He is also a keen Classicist and has studied such things as Egyptian Hieroglyphs and Classical Latin. Peter was always very supportive of my work and he and other members of his staff have made innumerable contributions to the project, especially as regards certain questions I had concerning chemistry. On one such occasion I was discussing the problems that I was experiencing when attempting to produce a full scale *Shroud* when he and Prof Dr Ben Zeelie appraised me of the fact that silver nitrate is a natural oxidising agent and that chemists employ it as an oxidiser for that very reason. Peter suggested that I try another silver salt, one which does not oxidise unless in the presence of sunlight. “Have you tried silver sulphate?” he asked. “What's the point?” I retorted, “silver sulphate, like silver chloride is a precipitate and insoluble in water!”. Peter then said something I will never forget, “Well, yes, but it is *slightly* soluble!”. “Would I be able to make a solution of 0.5%?” I asked him. Peter paged through a very weathered and well-worn chemistry text book and said, “Silver sulphate will automatically make a solution of 0.47% at room temperature.” I was amazed.

This chemical, without needing the benefit of any measuring apparatus, would naturally make a solution which was only 0.03% less than the formula I had been using for reagent E! It was almost too good to be true. I immediately borrowed about 25 grams of this silver salt from him and went straight away back to my office. I needed to know there and then if it would be as sensitive to light as silver nitrate, because if it was I knew that not only were my problems over, but that I had most likely come across the very “recipe” used by the manufacturers of the *Shroud* seven centuries ago.

I mixed up a small amount with some distilled water and painted a piece of paper with the

colourless liquid. Next I took a bunch of car keys and placed them on top. I placed this in the sun for two minutes and then went back to my office with the result. On removing the keys I had a perfect negative image of the car keys. The silver sulphate itself turned an iron oxide brown colour. At first I was worried that this was too dark and bore no resemblance to the *Shroud of Turin* at all. However the moment I submerged the sheet of paper in ammonium hydroxide the brown vanished as the silver was stripped away and I was left with a beautiful lemon yellow stain exactly like the silver nitrate had done. I sent this sample immediately to Mrs Ronnelle Claassens and asked her to check my sample for silver under her electron microscope. The next day I received a message on my answering machine. It was Ronnelle, "Good news, Nick, there's no silver!" With what I had learnt from that piece of oxidised paper with a negative image of the car keys I could now proceed confidently and produce a full length *Shroud*.

The Moment of Truth

I prepared a test piece of linen saturated in a solution of silver sulphate mixed at room temperature and within three hours produced a negative image of my corpse's head. It was my impression that the silver sulphate was fractionally less sensitive than the silver nitrate but then the "background noise" problem was solved.

I set up a 2.25 m length of silver sulphate impregnated material in the *camera obscura* and after three days of exposure I had a most remarkable image (see Plate 15). I also tried experimenting with the quartz lens. I found that by tilting the lens in its frame I could improve the focus on either the face or the feet without affecting the position of the image of the corpse as a whole. This meant that I could tilt the lens for a day one way and burn in the head with great attention to focussed detail and sacrifice the feet (which would now be out of focus). The next day I could tilt the lens in the other direction and increase the focus on the feet and play down the head.

All the time of course, the hands (crossed over the pelvic region), remained in sharp focus. In this way I managed to focus the whole length of the body. This particular piece of cloth I kept in the camera for nine days in all while I played with various settings. Although I have achieved far better results since, this test piece remains my first real success in the art of making *Shrouds* and proved beyond any doubt that an alchemist or natural philosopher working before 1355 could have easily produced the *Shroud of Turin* in this way. I dubbed this image the *Shroud of Port Elizabeth*. If a photograph is taken of this *Shroud*, a

mysterious, positive image of the plaster corpse results (see Plate 15). This image should be compared to the photographs taken of the *Shroud of Turin* by Secondo Pia, Giuseppe Enrie and Barrie M. Schwartz. There is absolutely no doubt in my mind whatsoever, that whoever produced the *Shroud of Turin* must have employed a technique that approximated my own efforts very closely indeed. After all, there simply is no other way that you can produce a *Shroud*. On the positive image of the *Shroud of Port Elizabeth*, it is possible to make out the finest detail of the original subject, details which are not visible in its negative state. This phenomenon is exactly in accord with that of the *Shroud of Turin*. To be sure, on my own positive image I can see the wound in the side, the ribs, the navel, the fingers etc. Having achieved a similar result, our medieval “photographers” only had to paint on the *stigmata* with real blood (with or without a binding agent). Indeed, the blood that appears on the present day *Shroud* was freely trickled and painted on those areas associated with blood flows and the site of the nail and thorn wounds. This application of blood was done in accordance with the conventions of the time - that time being the late thirteenth or early fourteenth century.

I also realised that the head of the *Shroud of Tuirn* is far more detailed than the body, far more so than would be possible to achieve with a combined 8000 mm image and object conjugate distance. Also, the head is too small for the body. If one measures the distance across the eyes and compares it with the width of the hand, the head is some 10% too small for its body. Finally, due to curvature of field, when focussing a two metre image of a man, the top of the head and tip of the toes becomes blurred, whereas the pelvic region is in sharp focus. It would not have been possible to make the *Shroud of Turin*'s frontal image with only one exposure.

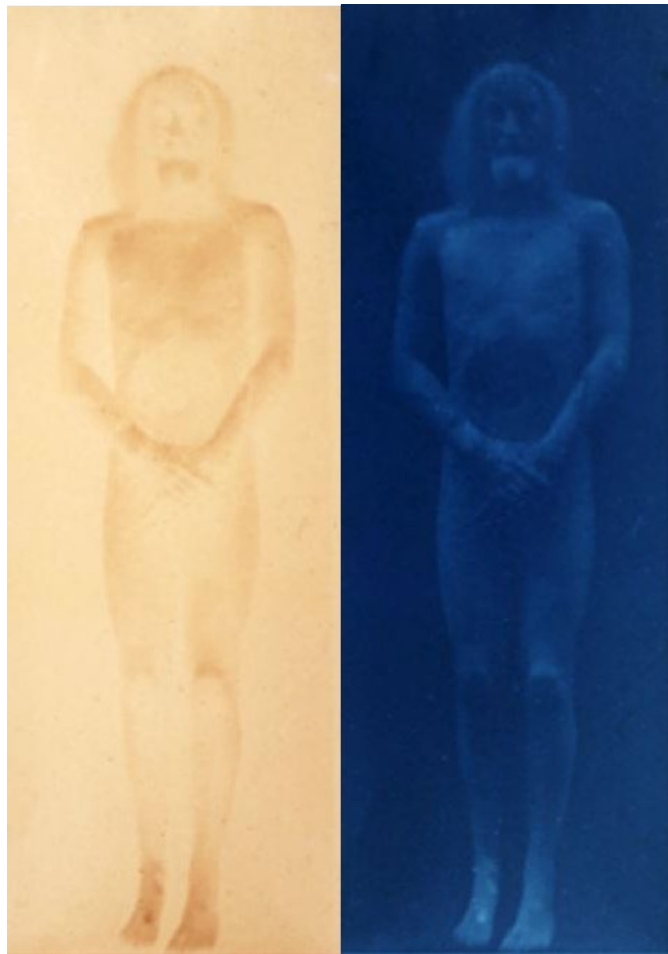
The solution to this triple problem is quite simple. The forgers made an initial image of the head at closer range employing a different lens. The remaining body (i.e. from shoulder to toes) was made with a larger lens at a greater distance. The dorsal image has very little detail and the head only consists of hair so in this case the forgers needed only one exposure with the larger lens. No-one would notice if the hair at the back of the head was slightly out of focus.

Subsequent Research

Between 1992 and the present day (2017) I have continued to, on occasion, make test

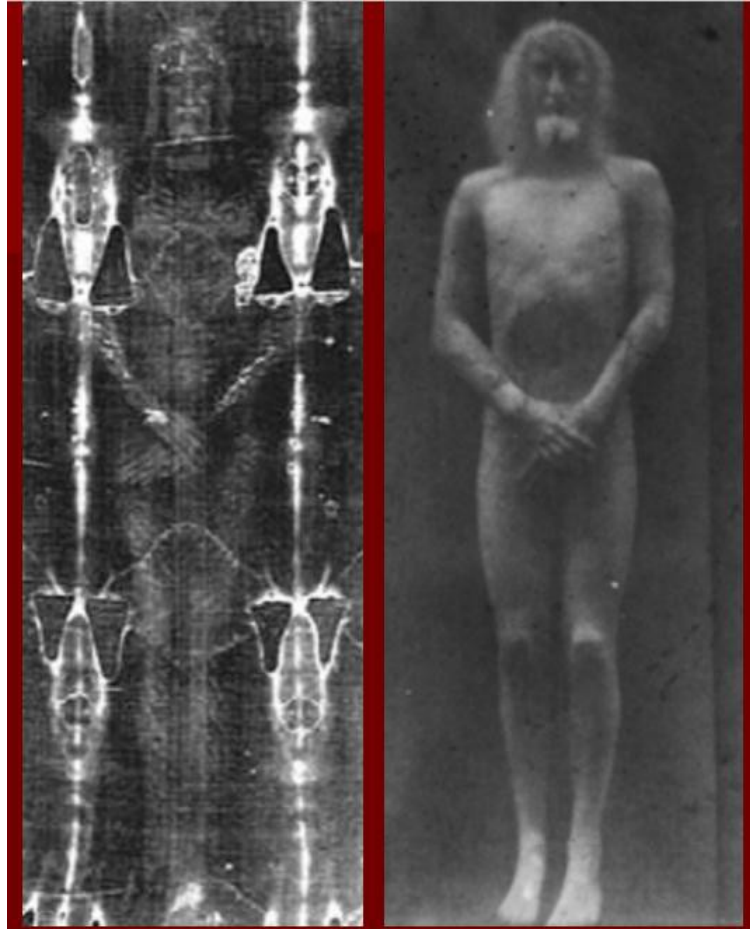
exposures to refine my original hypothesis. Indeed, a number of issues still needed to be confirmed or resolved. I will deal here with the more important ones.

Firstly, the positive image as found on the *Shroud of Turin* is obviously not *identical* to the *Shroud of Port Elizabeth*. Even though it shares all of the image characteristics listed earlier in this book, viz.: superficiality; high detail; thermal stability (the image is made by oxidation which has identical properties to a scorch and, inter alia, hot ironing will not damage the image); lack of pigmentation; three-dimensionality (the negative image appears exactly like a three-dimensional cast of the original positive subject); negative quality; directionless (no brush marks); chemical stability (the image cannot be removed by standard chemical agents. However, strong bleach will make the image less visible even though the structural damage to the polymers will remain); water stability and slight top-lit quality.



15/ On the left: a positive photograph of the negative image of the plaster-of-Paris “corpse” after washing in ammonium hydroxide - now known as the *Shroud of Port Elizabeth*. On the right, a negative image of the *Shroud of Port Elizabeth* showing a positive, three-dimensional image of the original plaster-of-Paris “corpse” (c. 1992). (Copyright: Mr Glenn Meyer).

I was also aware of an observation made by the STURP committee members that the weave of the *Shroud's* linen is tighter and smoother in the background areas where no “stain” appeared. The same phenomenon is present on all my images. Where the image is recorded on the cloth as an oxidation, the fibres are actually de-polymerised and damaged. Unaffected areas of the fabric are smoother and undamaged. This should be seen as yet another piece of evidence supporting the photographic hypothesis.



16/ A comparison between the negative photographs of the *Shroud of Turin* and the *Shroud of Port Elizabeth* (1992). CREDITS: 1978 Barrie M. Schwartz Collection, STERA, Inc. All Rights Reserved. COPYRIGHT: 1978 Barrie M. Schwartz Collection, STERA, Inc. All Rights Reserved.

It is interesting how many times, due to the fact that the *Shroud of Turin* does not look *exactly* like the *Shroud of Port Elizabeth*, that uninformed, armchair critics have pointed out that this alone is somehow “hard evidence” to disprove my theory! The best way to illustrate this kind of ignorance, is to imagine for a moment that no one had ever made a realistic portrait of a human face by employing say oil paint. Imagine that an image called *La Gioconda* is suddenly discovered and everyone (ignorant of the attributes of oil paint) starts to debate how it could possibly have been made. I suggest that it was made with oil paint and to prove my

point I paint a portrait of the *Laughing Cavalier* in oil. The ignorant respond “Oh no, that cannot be the technique employed because *La Gioconda* does not have a moustache”.

Instead of seeing the *potential* of the theory, uninformed critics, many of whom have never spent a second in the field, getting their hands dirty, feel quite justified in devolving to the lowest common denominator and simply denying what is clearly and plainly obvious. The facts are facts. Anyone wanting to produce an exact replica of the *Shroud of Turin* image, would need, inter alia, the following:

- The actual corpse or corpses employed by the original forgers in the late thirteenth century or early fourteenth century;
- The original lenses (most likely one for the head exposure and another for the body exposures because the head is 10% too small for the body); and
- They would also need to set up the *camera obscura* at the same latitude and time of year as that employed for the *Shroud of Turin*.

Indeed, these very problems have been what has kept me busy for the past twenty years or so. Here, some of the issues that I have tried to resolve, include:

- Given the obvious distortions in the face and body of the *Shroud of Turin* caused by spherical aberration, is it possible to ratiocinate the dimensions of the original lenses employed?
- Experimenting with reproducing the effects of working at a different latitude (in South Africa most of my tests have been carried out in Summer between 26° and 34° South of the Equator. Based on the shadows on the *Shroud of Turin* I estimate that the original image was made closer to 45° North of the Equator, most likely in Summer)?
- Confirming the suspected reason for the missing sections on the side of the face in the *Shroud of Turin* image.

The differences can immediately be seen when one compares the *Shroud of Turin* image with the *Shroud of Port Elizabeth* image. For example, the shadows of the latter are far more top-lit, whereas the *Shroud of Turin* image is more subtle and has an overall conformity as regards tonal quality. That does not mean that the two images were not made by similar processes.

To better illustrate the range of images that are possible with this technique I have included but a few examples in this book for the reader’s edification. One will immediately see more obvious similarities between the *Shroud of Turin* image and one made according to my photographic hypothesis.

Since late 2013, I have been mostly employing a synthetic 150 mm diameter quartz lens manufactured by MIL-OP Systems. Thanks to the extreme kindness of the owner, Mr Rudi Opperman, I now have a suitable lens with which to refine the image of the man's head as it appears in the *Shroud of Turin*. This lens focusses at exactly 1,145 mm from the lens.

Today, I almost exclusively rely on silver sulphate as my reagent. It makes the most sense given that it doesn't need to be measured and is literally self-working. Anyone who made a silver sulphate reagent with water six hundred years ago would have had exactly the same admixture I have today. This is because this chemical forms a soluble liquid at exactly .47% at room temperature. Any more silver sulphate added to this solution simply forms a precipitate at the bottom of the receptacle.

In all my tests I limit myself to making a head that resembles the *Shroud* image as closely as possible. To do this I have over the years, sculpted a number of "shroud-heads" as models. These have been tested in unpainted, raw white plaster-of-Paris states as well as in various painted skin shades from cadaverous grey to dead flesh.

I have also refined my small test-*camera obscura* which is specially designed to receive previously prepared linen specimens on two-dimensional supports instantly, at the correct focal distance. The camera can also be tilted to assimilate a different latitude. In this way I can reproduce conditions in Europe at say 45° North.

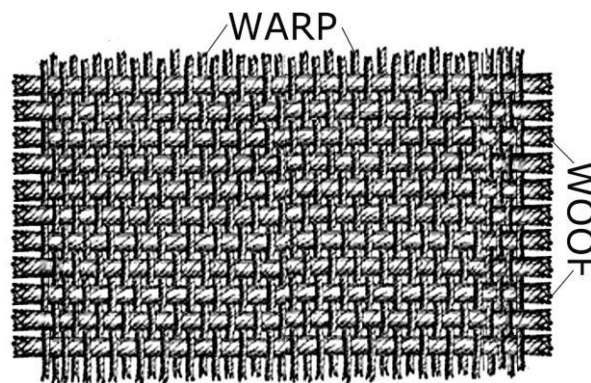
The results are fascinating, many of them more closely resembling the original *Shroud of Turin* image. Before I make a shroud-image I have to wash and boil my linen to try to remove all sizing agents such as starch. Sometimes I do not do this adequately and the results are strange/mottled images caused by areas of linen that did not oxidise properly during the image-making process. A good example of this can be seen in Plate 21. As a consequence, I have confirmed that the missing sections on the *Shroud of Turin* image are most likely due to the sizing agent once present in the warp threads of the linen cloth. Simply stated, sizing agent inhibits the contact between the linen and the silver salt. Thus, as the silver salt is reduced in the presence of light, the supporting linen is not so liable to oxidise as pristine areas do, due to the protective layer of size.

As the chemical reaction is marred by the presence of a sizing agent, those areas of linen are not affected so severely. When the silver atoms and ions are finally removed with ammonium

hydroxide, there is little or no record left in the sized linen to indicate where the silver-based image had once been. Only linen that comes into *direct* contact with the silver salt will become oxidised as the silver salt reduces in the presence of ultra violet radiation.



17/ A range of typical test heads, hand-made by the author and employed for test images with a small test *camera obscura*. These heads come in all forms and are also produced to simulate various skin tones. (Copyright: Author)



18/ Diagram showing the position of warp and woof threads in a typical woven fabric. In the case of the *Shroud of Turin* the warp threads were first sized to make them stronger on the loom before actual weaving with the woof threads commenced.

To duplicate this effect and make my images closer to the original, I have often resorted to screening off sections of the side of the face to see the effect. The result is an almost exact duplicate of the *Shroud* image but without spherical aberrations. For example on the original *Shroud of Turin* the image of the face has a short forehead and a long nose. This is due to spherical aberration. My images have normal foreheads and more regular noses. Even so, because I have sculpted my model Shroud-heads from the *Shroud* image itself, I believe I have got closer to ratiocinating what the original corpse looked like.

Regardless, it will be best for the readers to make their own deductions assuming they do fully understand the parameters of the problem at hand:



19/ A comparison between the image of the head on the *Shroud of Turin* (left) and a test head image made in 2009 for the BBC (both are positive photographs with negative images). Please note the absence of image on the side of both heads, which in the *Shroud* image actually runs, intermittently, the entire length of the cloth (warp threads). (Copyright: Author) CREDITS: 1978 Barrie M. Schwartz Collection, STERA, Inc. All Rights Reserved. COPYRIGHT: 1978 Barrie M. Schwartz Collection, STERA, Inc. All Rights Reserved.



20/ A comparison between the image of the head on the *Shroud of Turin* and the head image made in 2009 for the BBC (negative photograph with positive image. (Copyright: Author) CREDITS: 1978 Barrie M. Schwartz Collection, STERA, Inc. All Rights Reserved. COPYRIGHT: 1978 Barrie M. Schwartz Collection, STERA, Inc. All Rights Reserved.



21/ A positive and negative photograph of one of the series of a test images made in 2015 for the CNN Science programme titled: “Finding Jesus: Faith, Fact, Forgery: The *Shroud of Turin*”. NB: the pale mottling on the negative image and the corresponding dark mottling on the positive image indicates the presence of a sizing agent. (Copyright: Author)



22/ A positive photograph showing the negative image produced after three days in a test for the CNN Science programme titled: “Finding Jesus: Faith, Fact, Forgery: The *Shroud of Turin*” (2015). The left-hand image is as it appeared before the removal of silver sulphate. The right-hand image shows the image after the removal of silver sulphate with ammonium hydroxide. (Copyright: Author)



23/ A negative photograph showing the positive image depicted in Plate 22 (2015). (Copyright: Author)

VI

SPECULATIONS

No doubt, there will be those, who despite the evidence presented here, will still cleave to those unsubstantiated - yet nice and comfortable notions - which offer them the best terms for personal piece of mind and security. Indeed, for such persons, the very notion that the *Holy Shroud of Turin* is not the original burial cloth of the historical Jesus, will most certainly not be welcomed with open arms. I can only remind such individuals that their faith is ultimately based on pure irrationality. At best it is *solely* a personal opinion which cannot be substantiated by fact, reason or physical evidence. As a student of, inter alia, the Septuagint, Apocryphal Literature, the New Testament and Cognate Literature I can safely state that outside of the largely didactic rhetoric of certain biblical texts, no historical evidence exists that can prove that the Jesus of Nazareth of the New Testament even lived.⁸¹ That does not mean he definitely did not exist but certainly, even if he had, we still have absolutely no way of knowing what he really did or didn't do.

Regardless, from both an historical as well as Jewish perspective, to believe that a Jewish teacher, living two thousand years ago, was able to produce a shroud-image after his crucifixion and death is pure nonsense. In addition, no self-respecting Jew would have sanctioned the production of a naturalistic image at that time.

Seen from these contexts, most rational individuals would surely agree that a personal religious faith which is founded predominantly on the elusive qualities of an obscure artefact must be extremely shallow and inconsequential indeed.

⁸¹ Nicholas P.L. Allen, *Clarifying the Scope of Pre-5th Century C.E. Christian Interpolation in Josephus's Antiquitates Judaicae (c. 94 C.E.)*, Unpublished Ph.D. Thesis, Potchefstroom: North-West University, 2015; "Josephus and the Pharisees." in *Construction, Coherence and Connotations: Studies on the Septuagint, Apocryphal and Cognate Literature*. Edited by Nicholas P.L. Allen and Pierre J. Jordaan, 261 - 302. Berlin: Walter de Gruyter Publishers, 2017; "Josephus on James the Just? A Re-Evaluation of Antiquitates Judaicae 20.9.1" in *Journal of Early Christian Literature*, Vol .VII, No. 1, Pretoria: UNISA Press, 2017; and "Josephus, Origen and John the Baptist: Exposing a Christian Apologist's Deceit," in *Journal of Biblical Literature*, 2017 (publication pending).

From the moment I began this research I never thought that my ideas would be perceived as threatening and it was certainly never my intention to challenge anyone's religious faith. My aim at all times, was to attempt to rationally deduce the most plausible means by which a mediaeval artefact such as the *Shroud of Turin* could have been manufactured. To do this, I could at no time allow popular opinion (sanctioned or otherwise) to affect my judgement.

If like myself, you are the type of person who accepts the linguisticity of the world in which we live then you will also realise that our opinions concerning any topic can only ever be provisional. In this regard, the argument, as put forward in this book, is surely the most plausible one offered to date which has concerned itself with the manufacture of the *Shroud*, albeit within the present context of what we know about this artefact.

This is not an idle assertion nor should it be seen as in any way boastful. It is simply a statement of fact that may be supported or refuted according to the evidence available to us. Therefore, if the *Shroud* is indeed the only extant example of a form of mediaeval photographic technology (as I claim), then, we have little or no choice but to reassess our present understanding of any number of disciplines including the history of photography and the history of art. To this end, the information that I have shared with you in the previous five chapters is by and large substantiatable and subject to various forms of verification. In this limited sense at least, I may claim this information to be true. However, this information does not in any way shed much light on *why* this forgery was produced the way it was, *when* it was produced or *who* produced it.

For this reason, I thought it may be beneficial to share with you some of my suspicions concerning these areas of investigation - suspicions which should be viewed with a great degree of circumspection since although they may be perfectly plausible explanations they must (without concrete evidence) still remain pre-eminently speculative.

The Cult of Christ

Most Christians would be perhaps a little surprised to know that the way they may relate to the sacred figure of Christ is in fact a relatively recent occurrence in the history of Christianity. Allow me to clarify this statement. At the Council of Nicea (325 CE), the Emperor Constantine I (The Great), in order to enforce some measure of compromise between the various discordant Christian groups, ensured a common creed for the Christian faith. This has survived more or less unchanged to the present day. Most notably, he may be

credited for establishing the committee which, inter alia, ultimately formulated the dogma of the blessed Trinity. This doctrine advocated the indivisibility of God, crediting him with one personality but paradoxically, three separate persons, viz: Father, Son and Holy Spirit.

From the fourth century until about 1200 CE, most persons who considered themselves “Christians” and to be part of “Christendom” tended to guide their prayers to the God-head, not directly, but via the mediation of their priests and the communion of their saints (hagiocentric system). Indeed, a definite hierarchy existed, which placed God in his persona as “Father” at the summit of an immense organisational pyramid, viz:



24/ A diagram illustrating the basic tenets of the hagiocentric system.

Apart from the many heresies which threatened to revise the more orthodox faith, it was generally accepted that Man was separated from God by virtue of his sinful state. Sin was punishable by death and to make matters worse, man was powerless to live a sinless life. The church dogmatically taught that the *only* way that God (Father) could resolve this impasse was by his incarnation as a man (Son) and by his death - a death which paid the

penalty for man's sinful state once and for all time. However, although Christians believed that Christ was their saviour, it was not until the late twelfth century onwards and the rise of humanism that it became more common for persons to pray directly to Christ as a “personal” saviour, or if you prefer, it became more acceptable for a believer to commune with Christ on a more intimate level.

Geary reminds us that only from the twelfth century onwards did the cult of Christ become a real factor in Christian worship. He explains that:

Not only did the importance of relics diminish in the face of competition from universal saints, but they were particularly affected by the growing importance of the cult of Christ. Obviously Christ was always at the summit of Christian devotion, but the summit was for most of the early Middle Ages often obscured by clouds. Even in monasteries the cult of Christ entered popular devotion by stages; and only gradually, in the course of the twelfth century, did it become rooted in lay devotion. The process moved from the cult of a physical relic of Christ, the host, which was to be treated rather like other relics, through a stage of competition between this relic and other lesser relics, to the final popular recognition that the Eucharist enjoyed a unique position in Christian worship.⁸²

Now I find it intriguing that even without the benefits of carbon-dating, it is perfectly possible from an art historical stance to make meaningful connections between the kinds of iconography employed in the image on the *Shroud* and the specific iconography of the late thirteenth and early fourteenth centuries. These latter assertions are supported by the details visible on the *Shroud*, all of which refer specifically to Christ's human suffering and indirectly to the *Eucharist*.

Indeed, the *Shroud* seems to refer to the Sacrament of the Holy Eucharist and can therefore be shown to date from a time when the Christian faith had become more focussed on the personality of Christ. This particular Christocentric development in the nature of Christian worship steadily supplanted the older hagiocentric forms of expression found before the twelfth century. This of course does not in any way imply that the role of saints was seriously undermined, merely that Christ steadily became the more focal point in Christian faith.

What is of especial importance here is the fact that the cult of Christ the King was specifically reserved for kings and emperors and only gradually began to enjoy lay devotion.

⁸² Patrick J. Geary, *Furta Sacra: Thefts of Relics in the Central Middle Ages*, Princeton: Princeton University Press, 1978, 28.

In addition to this, the growing interest in the centrality of Christ to the Christian faith, as epitomised by the teachings of St Francis of Assisi (died 1226 CE), helped to promote the concept that the faithful treat with their Saviour on a one-to-one basis. In this regard, greater emphasis was given to the incarnation of Almighty God as Jesus (Saviour) and as Emmanuel (God with us).⁸³ In other words, God as man, subject to human temptation and doubt and ultimately the pain and suffering of dying a human death.

This increasingly humanistic approach to the Christian faith may be further attested to by the fact that in 1264, Urban IV granted to the Catholic Church the new feast of the Blessed Sacrament (*Corpus Christi*). Cabrol explains that this feast “rapidly increased in importance as the piety of the later Middle Ages found in it an opportunity for an imposing manifestation of faith in the Real Presence of Christ in the Blessed Sacrament”.⁸⁴

The following excerpt from a prayer in preparation for Holy Mass sums up the feelings of a believer in this spiritual context:

Hail, noble and precious Blood, flowing from the wounds of my crucified Lord Jesus Christ, and washing away the sins of the whole world. Be mindful, O Lord, of thy creature whom thou hast redeemed with thy Blood. I am grieved because I have sinned, I desire to make amends for what I have done. Take away from me therefore, O most merciful Father, all my iniquities and sins; that, being cleansed both in body and soul, I may worthily taste of the Holy of holies. Grant that this holy feeding on thy Body and Blood, of which, though unworthy, I purpose to partake, may obtain the remission of my sins, the perfect cleansing of my offences...⁸⁵

Considering that by the thirteenth century, the transubstantiated bread and wine of the Eucharist were believed by the faithful to be far more important than other relics of saints (regardless of their actual manufacture, authenticity or pedigree), one wonders how the faithful, whether Latin or Greek, would have viewed the *Shroud* as a relic of Christ's passion, since it would have had to have been considered as not only the tangible linen burial cloth, which enclosed the Saviour's mortal remains but also as the corporeal remains of Christ's cherished sweat and blood - the self-same blood that was shed at Calvary for the atonement of the sins-of-the-world. In this context, this dehydrated blood and sweat (symbolic of Christ's passion) could not have been treated in quite the same way as the transubstantiated

⁸³ Matthew 1: 18-15.

⁸⁴ Abbot Cabrol, *The Roman Missal: in Latin and English According to the Latest Roman Edition*. 8th edition. London: Herder, 1931, 612.

⁸⁵ Cabrol, 16.

bread and wine manufactured according to the mysteries of a religious rite. Surely, had medieval Christians seen the *Shroud* they would have considered it to be the original, historical blood of Jesus Christ. For them, to be in the presence of such a relic of the passion would have been literally consanguine to being in the presence of Christ himself!

Humanistic iconography

If viewed from an art historical perspective alone, it is possible to see conspicuous similarities between the depiction of Christ's wounds (*stigmata*) as found on the *Shroud* and the manner in which Christ's passion is depicted in western art after the first quarter of the thirteenth century.

Indeed, before the thirteenth century, Christ is normally depicted in a very symbolical way and only gradually assumes the more humanistic characteristics we normally associate with Christ's passion, death and resurrection as this century unfolds. The older, more symbolic (two-dimensional) Byzantine portrayals of Christ as Judge (which were normally to be found high in the domes of churches and seemingly out of reach to mere mortals), were slowly supplanted by more naturalistic (three-dimensional) representations of Christ as a man who lived and existed in the world of men. This is most evident in the development of Italian painting between *c.* 1235-1335. If we briefly compare the works of such artist as Bonaventura Berlinghieri (active 1235), Cimabue (active 1285), Duccio (active 1311), Giotto di Bondone (active 1320) and Simone Martini (active 1340), we may observe this process quite clearly.

For example, one will notice the increasing emphasis in the depiction of the crucifixion of such features as the blood flowing from the wound in the side, the blood flowing from the *stigmata* and the blood flowing from the crown of thorns. Indeed, this development in western art is a direct result of the more Christocentric attitudes which were evolving in the church at this time, attitudes which became prominent at the same time that the teachings of St Francis of Assisi became dominant.

Likewise, the image of the man in the *Shroud* contains specific features which are synonymous with the kinds of humanistic iconography employed by the Roman Catholic world of the late thirteenth and early fourteenth century. In addition, it is very obvious that this iconography often takes precedence over the more traditional aspects of Christ's Passion which are supported (to a greater or lesser degree) by the biblical account of the trial, crucifixion and resurrection of Christ.

It should perhaps be mentioned at this point that we must not confuse two quite separate issues, namely: the actual style of painting as found in many examples of thirteenth and fourteenth century art (produced variously during the Italo-Byzantine, International Gothic and Proto-Renaissance periods) and the iconography employed in these works.

In this regard, we may safely state, that on the one hand there is a definite parallel between the kind of iconography employed in the *Shroud* and certain paintings (especially from the Italo-Byzantine period onward), between the years c. 1225-1350. On the other hand, many of these paintings, are also becoming more and more naturalistic in terms of their painting style. For example artists are increasingly looking at nature for guidance. Figures in paintings increasingly take on volume, walk on the ground and display emotion.

In opposition to this, the *Shroud* is, as it were, styleless, because of its means of production which is clearly dependant on either the physical remains of a dead man or his exact facsimile. In this sense alone, the “naturalism” of the *Shroud* would make it impossible to place definitively anywhere in the history of art. However, the iconographical details present on the *Shroud* do position it very firmly in the time period c. 1225-1350, when Christ's human suffering is particularly stressed. This is an emphasis which is evident not only in the paintings of this period but also in the details of fourteenth century mystery plays and poetry. Indeed, meditation on the passion of Christ was central to a medieval Christian. In this regard, Rieu confirms that this activity was the best act of faith and work an ordinary Christian could perform. His concentration helped him to understand the divine purpose and to avoid sin”.⁸⁶ In the same vein, Owst quotes an unknown fourteenth century divine who states that:

By moche more it is lausom to ous to have the ymage of Crist in the cros, that we in havynge mynde on the deth of Crist mowe overcome the temptaciouns and the venym of the fende, the olde serpent.⁸⁷

The following poems (typical of the times) stress the pathos of Christ's human body and his suffering as manifested through the divine symbols, such as the nail wounds, white (innocent) tortured flesh, scourged body, pricking thorns, and stretched arms etc. It should be noted that the examples that follow all derive from the meditations ascribed to St.

⁸⁶ E. V. Rieu [et al.], *Medieval English Verse*, Tr. B.E. Stone, London: Penguin, 1975, 33.

⁸⁷ Rieu [et al.], 33. Translated, the text reads: “It is most laudable for us to have in mind the image of the crucified Christ on the cross in order to overcome the temptations of that venomous fiend the old serpent (i.e. devil)”.

Augustine. Note should be especially taken of the third poem which could almost be a literary equivalent of the *Shroud* itself.

White was his naked breast,
And red with blood his side,
Blood on his lovely face,
His wounds deep and wide.
Stiff with death his arms
High spread upon the Rood:
From five places in his body
Flowed the streams of blood.⁸⁸

Look on your Lord, Man, hanging on the Rood,
And weep, if you can weep, tears all of blood.
For see how his head is hurt with thorn,
His face and spear-wound spat on in scorn.
Pale grows his fair cheek, and darker his sight,
Now droops on the Cross his body bright,
His naked breast glistens, now bleeds his side,
And stiff grow his arms extended wide.
Look at the nails in hands and in feet,
And the flowing streams of his blood so sweet!
Begin at the crown and search to the toe,
Nothing shall you find there but anguish and woe.⁸⁹

Man and woman, look on me!
How much I suffered for you, see!
Look on my back, laid bare with whips:
Look on my side, from which blood drips.
My feet and hands are nailed upon the Rood;
From pricking thorns my temples run with blood.
From side to side, from head to foot,
Turn and turn my body about,
You there shall find, all over, blood.
Five wounds I suffered for you: see!
So turn your heart, your heart, to me.⁹⁰

There are also (at first appraisal) striking similarities between the injuries depicted by the *Shroud* and the accounts of Christ's passion and death in the New Testament. Because of this assumption, many authorities (prior to 1988) were convinced that the image was a physical record of the historical Jesus Christ.

However, as has been seen already, a number of these details are purely naturalistic and refer directly to physiological trauma. In short, many of these details are not standard features of the classical (biblical) passion of Christ. It is also important to note that not all of these details would have been visible to the faithful before 1898. However, these details were

⁸⁸ Rieu [et al.], 36.

⁸⁹ Rieu [et al.], 38

⁹⁰ Ibid.

most definitely visible on the corpse necessary for the production of the image (at an unknown date prior to 1355).

These details may be summarised as follows:

DETAILS SUPPORTED BY SCRIPTURE AND TRADITION	
(Visible before 1898)	
Detail Found in <i>Shroud's</i> Image	Source of Information
The scourging of Christ	Biblical
Bruises caused by the falls on the way to Calvary	Traditional
The wounds in the feet	Assumed (not Biblical)
The wound in the side and the flow of blood and water	Biblical

DETAILS NOT SUPPORTED BY SCRIPTURE AND TRADITION	
(Visible before 1898)	
Detail Found in <i>Shroud's</i> Image	Source of Information
The application of a “cap” of thorns as opposed to a “crown” of thorns	<i>Shroud of Turin</i>
The “wounds” in the wrists as opposed to wounds in the palms.	<i>Shroud of Turin</i>
The “missing” thumbs.	<i>Shroud of Turin</i>

DETAILS SUPPORTED BY SCRIPTURE AND TRADITION	
(Visible on the <i>Shroud</i> only after 1898 with the aid of photography)	
Detail Found in <i>Shroud's</i> Image	Source of Information
Bruises on the face.	Biblical
Christ bears the Cross (indicated by bruised shoulders)	Biblical

DETAILS NOT SUPPORTED BY SCRIPTURE AND TRADITION	
(Visible on the <i>Shroud</i> only after 1898 with the aid of photography)	
Detail Found in <i>Shroud's</i> Image	Source of Information
The dislocated shoulder	<i>Shroud of Turin</i>
The torn beard	<i>Shroud of Turin</i>
The broken nose	<i>Shroud of Turin</i>
The distended stomach	<i>Shroud of Turin</i>
Possible <i>rigor mortis</i> .	<i>Shroud of Turin</i>

Table 1
Iconography of the *Shroud of Turin*

The Way of the Cross

It is no accident that the development of such Christocentric organisations as the Franciscans, the Clarisses and even the Knights Templar, occurred at this period in history, all of which modelled their spiritual life on Christ's supposed human existence. Even medieval Christian kings very often modelled their lives on the life and activities of Jesus Christ as a person.

For example, one may recognise this phenomenon in the saintly attitudes of persons such as King Louis IX of France (died 1270), outwardly, a most pious man, who actively persecuted heretics and the enemies of Christendom during his long reign. In Joinville's famous biography of this "virtuous" king's life, Louis is characterised as a saintly crusader king, one who has no other ambition but to humbly serve God and to ensure the welfare of his people. Under his guidance, his ministers were expected to be the paragon of Christian justice. Louis is represented by Joinville as even ending his life on the correct note, attempting to convert the infidel whilst on crusade in Tunis (1270) and dying as a martyr for his ideals.

Aside from these more fashionable interpretations of this feudal monarch's attributes, he is largely responsible for helping to popularise the Catholic spiritual exercise known as the Way of the Cross. This became increasingly prevalent as the likelihood of undertaking a pilgrimage to the Holy Land diminished after the Christian world lost all of its holdings in the Islamic world and the Crusading spirit was irredeemably lost. This moment in history is normally associated with the fall of the crusader castle at Acre in 1291.

The exercise of the Way of the Cross consists in meditating piously on the fourteen principal scenes of the Passion of our Lord, from his condemnation to death to his burial. Nothing helps better to inspire us with horror of sin, love of heavenly things and zeal for Christian perfection than the thoughts of our Lord's sufferings and death, so the Sovereign Pontiffs have attached to this exercise all the indulgences, both plenary and partial, which are granted to those who have the privilege of following the original Way of the Cross at Jerusalem. In fact the Way of the Cross is a miniature pilgrimage to the Holy land, a substitute for the actual visiting of the Holy Places, introduced in early times, though the present form of the devotion is relatively modern.⁹¹

It should be noted by non-Catholics, that being traditional, not all of the fourteen events that

⁹¹ Cabrol, 1410.

are meditated upon are mentioned in the New Testament. I have listed them in order of devotion as follows, *viz*:

- First Station: Jesus is condemned to death
- Second Station: Jesus receives his cross
- Third Station: Jesus falls the first time under his cross
- Fourth Station: Jesus meets his afflicted Mother
- Fifth Station: Simon of Cyrene helps Jesus to carry his cross
- Sixth Station: Veronica wipes the face of Jesus
- Seventh Station: Jesus falls the second time
- Eighth Station: Jesus speaks to the women of Jerusalem
- Ninth Station: Jesus falls the third time
- Tenth Station: Jesus is stripped of his garments
- Eleventh Station: Jesus is nailed to the cross
- Twelfth Station: Jesus dies on the cross
- Thirteenth Station: Jesus is taken down from the cross
- Fourteenth Station: Jesus is laid in the sepulchre

It struck me quite early on in my investigation, that any fine art undergraduate could have told the *Shroud* researchers that they were dealing with a late thirteenth century (possibly early fourteenth century) image and not a first century imprint from a crucified man. This fact alone may be simply deduced by observing in the *Shroud* image the deliberate emphasis on human suffering and iconography pertaining specifically to Christ's passion. In fact, the painted blood flows which relate to the *stigmata* are all in accordance with accepted thirteenth century traditions concerning the appearance of the crucifixion and the imagery of the Stations of the Cross with one possible exception, namely the "wound" in the "space of Destot".

It occurred to me, that perhaps the manufacturers of the *Shroud* were basing their image on the then relatively new and popular practice of the Way of the Cross - a practice which we have already noted became very popular as the possibilities for safe conduct to the Holy Land became increasingly more remote for the average Christian in the latter half of the thirteenth century. It can surely be no coincidence each and every station of the Way of the Cross, is either blatantly represented or explicitly implied in the image of Christ as found on the *Shroud*, *viz*:

First Station: Jesus is condemned to death:

On the *Shroud*, the crowning with thorns, and the results of various assaults to Christ's face are indicated. These obviously refer to the Roman soldier's mocking of Christ. Nonetheless, Christ also bears the marks of his scourging which (according to normal orthodox interpretation), was only authorised by Pontius Pilate, because he wished to spare Christ's life. However, according to this interpretation, the crowd wanted Christ to be crucified and were not appeased by Pilate's actions. Pilate was thus, compelled to condemn Christ to death.

Second Station: Jesus receives his cross:

There appear to be abrasions of the skin on both shoulders in the *Shroud's* dorsal image. This could understandably be viewed as evidence of a heavy object, such as the cross, rubbing on Christ's shoulders.

Third Station: Jesus falls the first time under his cross:

This event (and the other two falls) are normally indicated by bloodied knees in late thirteenth century Italian painting. The *Shroud* conforms to this imagery by displaying what physicians have identified as excoriations to the patellae.

Sixth Station: St Veronica wipes the face of Jesus:

On the *Shroud*, Christ's face has no blood on it apart from the blood clot in the shape of an inverted number 3. Interestingly enough the Veronica itself (another linen cloth which bears an *archeropteroi* type image of Christ's head), may very well have been an inspiration for the *Shroud* and Ian Wilson's comments on this aspect are worth noting.⁹²

Seventh and Ninth Stations: Jesus falls the second and third time:

Readers are referred to the third station of the cross.

Eighth Station: Jesus speaks to the women of Jerusalem:

We, the viewers, are with the "women" of Jerusalem.

Tenth Station: Jesus is stripped of his garments:

The *Shroud* depicts Jesus as naked. He also, very pointedly, assumes what medievalists

⁹² See Ian Wilson's account, *Holy Faces, Secret Places: the Quest for Jesus' True Likeness*, London: Doubleday, 1991, 20.

refer to as the *venus pudica* pose - a pose which is associated with nudity and loss of innocence.

Eleventh Station: Jesus is nailed to the cross:

Christ is clearly shown with the marks of the *stigmata* and the crossed arms may also refer to the crucifixion itself.

Twelfth Station: Jesus dies on the cross:

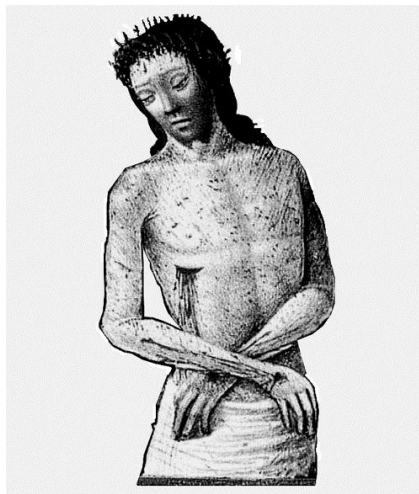
This is alluded to by the wound in the side (from which flows blood and water), and by the apparent detail of *rigour mortis*.

Thirteenth Station: Jesus is taken down from the cross:

This is obviously implied by the fact that the body bears the marks of the crucifixion at the time of the deposition.

Fourteenth Station: Jesus is laid in the sepulchre:

The *Shroud* itself, refers directly to this event, since it is posing as the very burial sheet placed in the sepulchre.



25/ A typical *Man of Sorrows* image. This one is based on the *Man of Sorrows* (Folio 75r) of *Les Très Riches Heures du Duc de Berry* by Jean Colombe (c. 1485 CE). NB: The Duc de Berry owned the *Shroud* for several years.

The Man of Sorrows

Although, as may be seen above, obvious correlations exist between the Way of the Cross and the events implied by the design of the image itself, the *Shroud* goes somewhat further by also including aspects of the Man of Sorrows. This latter type of meditative image was very popular by the early fourteenth century and portrayed the upper torso of the crucified

and tortured Christ, complete with bloody marks of the passion. Normally, this image shows Christ standing in the tomb, complete with the marks of the passion. Christ is, inter alia, either depicted pointing to his various wounds or shown as in Plate 25 with his arms crossed over at the wrists. These images are quite naturalistic as regards the details they contain, greatly emphasising Christ's human suffering. The link between the *Shroud Turin* and the Man of Sorrows imagery is extremely strong, indeed, not only were aspects of the *Shroud* modelled on this popular form of devotion but incredibly, the *Shroud* became itself a model for at least one version of the Man of Sorrows in the fifteenth century, a factor that will be given some consideration later in this chapter.

Icon or Relic

I often wonder how a person living in the late thirteenth century would have treated with this artefact (assuming of course, that they were ever privileged enough to see it before 1355) After all, the *Shroud* itself (although a manufactured object) obviously purports to be the original linen cloth that wrapped the crucified Christ, “imprinted” with his divine image - an image (albeit negative) which for the unsuspecting believer would have to have been considered to be miraculously composed of Christ's own precious blood and sweat. As can be appreciated, all of these factors, when viewed together, make it quite difficult to classify the *Shroud* (in terms of a more logocentric tradition) as being either an *icon*, a religious image or a relic. This problem is further compounded by the fact that this artefact, by virtue of its unique composition, cannot be safely categorised as being either Byzantine, Italo-Byzantine or Gothic.

For example, if viewed as an *icon*, one may be tempted to favour the interpretation that the *Shroud* is of Byzantine or even Venetian origin. This is because, without the benefit of photographic enhancement, the image on the *Shroud*, (i.e. as it would have appeared to the medieval viewer), depicts Christ with large owl-like eyes, whose feet point downwards, seemingly defying gravity. These factors taken together with the observation that the composition is strictly frontal, vertically symmetrical and appears to the uninformed spectator as a mere two-dimensional design, seem to relate the *Shroud* more readily with the accepted standards of early Byzantine iconography.

Another factor that supports this provisional interpretation, is that, by and large, the west tended to look down on the eastern churches' veneration of images. Geary points out that the Latin terms *veneratio* and *adoratio* were interchangeable by the ninth century and according

to the *Libri Carolini*, the proper objects of devotion were relics and not images, because the relics of saints (as *latria*), would share in the resurrection at the end of the world, whereas images were “more or less faithful representations and more or less beautiful, but they could not have any more than a didactic function. Any greater honor or veneration was reserved for relics alone”.⁹³

However, as has already been pointed out, with the benefit of modern photography, this flat, two-dimensional, negative image becomes a three-dimensional and highly naturalistic, positive image.

It is also not impossible that by staring at the image for a minute or so and then closing one’s eyes a pilgrim would have been rewarded with a three-dimensional image of the crucified Saviour (i.e. a physiological afterimage). Readers might want to try this themselves by staring for 30 seconds at one of the negative images in this book.

In this modern photographically enhanced guise, the *Shroud* suddenly concurs with many aspects of western art. It is especially typical of the more humanistic products of the late thirteenth century, when depictions of the crucifixion, both visual and textual, increasingly emphasised Christ's physical and human suffering on the cross. In particular, the *stigmata*, the wound in the side and the flows of blood (especially along the forearms) become increasingly more pronounced.

However, in terms of its unique means of production, the *Shroud of Turin*, regardless of whether it is actually western or eastern in origin, does not compare to any product made by man before the beginning of the nineteenth century - a consideration that has distracted researchers for well over a century.

The Hylomorphic Worldview

Although, as has already been ascertained, the late thirteenth century witnessed the genesis of what was to become the scientific era and by employing the levels of technology available to this period it is quite possible to produce a “photographic” or “solarographic” image on linen, medieval alchemists and natural scientists were more inclined to understand their world in terms of both symbol and allegory. For them, the world was filled with constant

⁹³ Geary, 42

reminders of God's divinity.⁹⁴

For example, important medieval thinkers such as Thomas Aquinas, in keeping with the Aristotelian principles of hylomorphism, held that all material substances were compounds of prime matter (which had the potential to become form); and substantial form. This latter aspect of a substance was what made it possible to determine what a particular substance was.

According to this theory it was possible to logically infer the existence of a metaphysical realm by contemplation of the concrete objects that make up the natural world. In other words by reflecting on the intrinsic nature of God's creations it was possible to make deductions about God himself.

In this regard, Johannes Scotus Erigena, the famous ninth century Irish philosopher, believed that the world was a grand theophany - one which manifested God through its primordial and eternal causes. He states that there “is nothing among visible and corporeal things which does not signify something incorporeal and intelligible”.⁹⁵

However, it was not possible, in terms of this philosophy, for essence and existence to exist as phenomenologically separate entities. They could however, be distinguished intellectually as the two consecutive metaphysical principles of every finite being. Only in God (as the uncreated, infinite and pure spirit), could these two principles be identical and in his *Summa Contra Gentiles*, Thomas Aquinas, (whilst comparing God unto light), tells us that: “God exists necessarily because His essence is existence: all other things receive or ‘participate in’ existence, and that which receives must be distinct from that which is received.”⁹⁶ Eco encapsulates this point well:

Even at its most dreadful, nature appeared to the symbolical imagination to be a kind of alphabet through which God spoke to men and revealed the order in things, the blessings of the supernatural, how to conduct oneself in the midst of this divine order and how to win heaven.⁹⁷

Thus, the medieval mind believed that the natural world mirrored the transcendent world

⁹⁴ Umberto Eco, *Art and Beauty in the Middle Ages*, New Haven: Yale University Press, 1986, 53.

⁹⁵ Eco, 56-57.

⁹⁶ Frederick Copleston, *A History of Philosophy. Volume II: Medieval Philosophy: Augustine to Scotus*. Westminster: Newman Press, 1965, 333.

⁹⁷ Eco, 54.

where symbols and the divine principles that they engendered were believed to have certain characteristics which may be related.

Having deduced to my satisfaction that it was perfectly possible for an alchemist or natural scientist living in the late thirteenth century to have utilised the specific substances, forms and processes that are pre-requisites for manufacturing a *Shroud*-like image, it also occurred to me that perhaps this photographic technique (far from being viewed as a fraudulent act), may have been considered to have been miraculous and/or divinely sanctioned. For example, a devout Roman Catholic who accepts the hylomorphic framework of the Eucharist will not consider transubstantiated bread and wine to be “forgeries” of Christ's body and blood.

In the same way, the hypothetical photographic manufacturers of the *Shroud*, apart from their indebtedness to certain aspects of Islamic (and even Chinese) scientific knowledge, may also have worked within the symbolic framework of their hylomorphic universe. Further, if there is any validity to this argument, it should be possible to find some symbolical correspondence between such substances and forms as linen, crystal, silver, ammonium hydroxide etc. It could, of course be argued that by their very nature, symbols can be made to signify any number of things, thus proving nothing. However, the fact that the *Shroud of Turin* could only have been manufactured by the use of very specific materials at a time (c. 1250-1300), when both Latin and Greek societies were by and large totally committed to a Christian worldview, must be taken into consideration here. Furthermore, when taken together, all of the substances which are critical to the success of this technique (i.e. making a photographic image), have a direct symbolical correspondence with the fundamental principles and tenets which underscore the Christian concept of the intercession of Christ and the atonement of sin. In this regard, the relevant forms and substances listed below, may be interpreted as follows:

The Square *Camera Obscura*

A dark, enclosed chamber may be viewed as a symbol of the earth (square) and the fallen and sinful state of man (darkness representing man's separation from God's divine light).

The Linen Cloth

Apart from its more obvious (and undisputed) reference to the burial cloth of Christ, linen is a symbol of purity. According to Pliny, linen was the most beautiful dress material or

pulchrioriam vestem,⁹⁸ and according to Ovid, Io (who was venerated as Isis in Egypt), was administered to by priests who were referred to as the linen-robed throng.⁹⁹ Thus, linen refers indirectly to the status of priesthood and symbolises the spirit of mediation. Twelfth century kabbalists referred to the eleven *Sephiroth* (aspects of God) which composed their tree of life. Here, the central *Sephirah* represented intercession as *Tiphereth* (beauty). Linen also speaks of the atonement of sin and release from divine punishment. In this regard, it was a man dressed in linen and carrying an ink horn, who went through Jerusalem to mark with a special sign those who were righteous in the eyes of God. Those who were not marked in this manner, were killed.¹⁰⁰

Even the word “linen” comes from the name of Linus who was the son of the sun God Apollo, whose priests, incidentally, also wore linen. Linus was planted in the sandy soil and his spirit resides in the flax plant.¹⁰¹ Linen-covered hands are raised as a sign of respect, and normally carry a crown which refers directly to the God-head (the highest *Sephirah* of the tree of life was known by kabbalists as *Kether* [crown]).

Linen may also refer indirectly to the Virgin Mary as only virtuous woman wore linen as opposed to promiscuous women who wore silk. In addition, the very art of weaving (i.e. the very fabric of the *Shroud*) may be seen as symbolic of the incomplete man.¹⁰²

The Crystal Lens

Crystal is as an overt Marian symbol and may be seen as the embodiment of the Virgin Mary as the *speculum sine maculum* (mirror without blemish), which in turn encapsulates the spiritual qualities of the immaculate conception. In Byzantine art, the Archangel Gabriel (who is associated with the Annunciation) is sometimes depicted holding a transparent “orb” in his left hand. From the twelfth century onwards, certain depictions of this “orb” are uncannily reminiscent of a large glass or crystal lens.

Two circles are normally employed to symbolise the upper and lower worlds i.e. heaven and earth or the macrocosm and the microcosm, and the union of these two worlds is the almond shaped zone of intersection or interpenetration which in turn represents the world of

⁹⁸A. D. de Vries, *Dictionary of Symbols and Imagery*. Amsterdam: North-Holland Publishing Company, 1981, 299.

⁹⁹ de Vries, 299.

¹⁰⁰ Ezekiel, 9: 1-11.

¹⁰¹ de Vries, 300.

¹⁰² See S. Olderr, *Symbolism: A Comprehensive Dictionary*, Jefferson: McFarland and Company, 1986, 147; J.C. Cooper, *An Illustrated Encyclopedia of Traditional Symbols*, London: Thames and Hudson, 1968 and de Vries, 495.

appearances. This almond shape (which is normally depicted in the vertical axis) is the *Vesica Piscis* or Mandorla, and is also coincidentally the shape of a bi-convex lens as seen in profile. According to Cirlot, the *Vesica Piscis* is also a symbol of perpetual sacrifice

that regenerates the creative force through the dual streams of ascent and descent, appearance and disappearance, life and death, evolution and involution. In terms of its morphology the Mandorla is cognate with the spindle of the *magna mater* and with the magical spinners of thread.¹⁰³

The substance of crystal by virtue of its transparency represents the “conjunction of opposites” and “matter seen through.”¹⁰⁴ It also refers to intuitive knowledge, translucence of thought, the spirit and the intellect and is associated with the human eye.¹⁰⁵ It is also related to the sacrament of baptism with water and crystal as fossil ice or frozen dew or tears is associated with both immortality and the firmament over the four living creatures.¹⁰⁶ Finally, crystal being formed of moisture falling from the sky like pure snow refers to the icy north and north is where God dwells.¹⁰⁷ It should be pointed out here, that anyone producing a *Shroud*-like image in the northern hemisphere would have had to have positioned the quartz lens in the north facing wall of the *camera obscura* in order to receive both the morning and afternoon light. This set-up is crucial to the success of the endeavour.

Silver

Silver is the symbol of purity, innocence and a clear conscience and refers in this context to the qualities of the Virgin Mary. Traditionally, chastity, fidelity and virginity are related to the Moon-Diana.¹⁰⁸ Silver also refers to the moon which in turn refers to the night. The moon is viewed as symbolising the opposite of day which is the empire of the golden sun. The doors of the palace of the sun (which rises out of the night) are made of silver. Silver also refers to the wisdom of God and according to Psalms, 12 : 6: “The words of the Lord *are* pure words: *as* silver tried in a furnace of earth, purified seven times”. Again, in Proverbs, 10 : 20 we find: “the tongue of the just *is as* choice silver”. Silver relates here to speech and indirectly refers to the incarnation of Christ, viz., “And the word was made flesh, and dwelt among us, and we beheld his glory, the glory as of the only begotten of the

¹⁰³ J. E. Cirlot, *A Dictionary of Symbols*, New York: Philosophical Library. 1971, 203- 4.

¹⁰⁴ de Vries, 1981, 121

¹⁰⁵ Ibid.

¹⁰⁶ Ezekiel, 1: 24.

¹⁰⁷ de Vries, 1981, 121.

¹⁰⁸ de Vries, 1981, 424.

father, full of grace and truth”.¹⁰⁹ Not surprisingly, silver is also related to mirror and to pearl, both of which are Marian symbols.

Apparatus, Condition or Substance	Symbolic Reference
Sunlight	Almighty God, Divine Spirit, Heaven, <i>Kether</i>
Crystal	Virgin Mary, Innocence, Purity, Sinlessness
Crossed Arms (<i>Vesica Piscis</i>)	Intercession, Divine Union, Perpetual Sacrifice, <i>Tiphereth</i>
Silver	Purity of Heart, Wisdom of God, Truth, Creation
Linen	Beauty, Purity, Priesthood, <i>Tihpereth</i>
Urine	Life Indicator of Man
Nakedness (<i>Venus Pudica</i>)	Shame, Loss of Control, Sin
<i>Camera Obscura</i>	the Earth, Darkness, Sin, <i>Malkuth</i>

Table 2
Some Medieval symbols and their significance

A Crucified, Naked Man

A naked man was used as the subject for the *Shroud* image. Nakedness itself, is a symbol of man's separation from God and signifies his uncleanness and impurity.¹¹⁰ Camille also reminds us that the sons of Noah covered their eyes so as not to see the nakedness of their father. Because of Noah's drunkenness, he demonstrates his loss of control which in turn leads to his shame.¹¹¹ It is important to remember here, that despite the fact the *Shroud* depicts nudity this was never really conspicuous before the advent of modern photography. In addition, in the *Shroud*, Christ crosses his arms over his pelvic region for the purposes of

¹⁰⁹ John, 1:14.

¹¹⁰ Ezekiel, 16:39 and 23:29.

¹¹¹ M. Camille, *The Gothic idol: Ideology and Image-making in Medieval Art*. Cambridge: Cambridge University Press, 1990, 93.

modesty (i.e. the *venus pudica* pose) and no doubt to symbolise the crucifixion itself. Indeed, the depiction of the naked upper torso seems to have been quite acceptable to medieval mores.¹¹²

Urine

If dilute ammonium hydroxide (NH₃ [aq]) or urine was indeed employed to remove the unexposed silver nitrate from the *Shroud* it too would not have been out of place in terms of its symbolism, *viz.*, it is a life indicator of man (e.g. by tasting a patient's urine, a physician may diagnose a particular illness, such as diabetes), and a man may not urinate by the light of day.¹¹³ If urine was employed it could only have been employed, either at night or within the confines of the *camera obscura*.

These tantalising links between the substances needed to produce a *Shroud* and the values placed on these substances by medieval minds is to my thinking quite significant. It speaks of strong alchemical (possibly even cabbalistic) and hylomorphic world views. It speaks of strong cultural exchanges between Moslem east, the Byzantine world and orthodox Catholicism. It is for these reasons, that locations such as Venice and Constantinople would have to be considered the most likely centres for that requisite expertise, necessary to produce a *Shroud*.

Heresy

It has occasionally been suggested, that the *Shroud* may have been produced by an heretical group such as the Cathars or even the Iohnists. I would dispute this notion on the grounds that the Cathars and other associated heretical groups, had a particularly monophysitic attitude towards Christ's nature. Unlike the more orthodox faith, which believed Christ to be the incarnation of God, the Cathars pointed out that if Christ was the second person of the blessed Trinity and was in fact God, then logically speaking, he must be pure spirit and not matter. Spirit, for the Cathar, was incompatible with matter and thus, Christ was not incarnate. The Cathars associated spirit with incorruptibility, infinity and divinity whereas material things were deemed to be corruptible, finite and sinful. It should be quite evident that a physical relic (such as the *Shroud of Turin*) which bore physical evidence of Christ's

¹¹² de Vries, 1981, 483.

¹¹³ Smullen, 112.

passion (sweat) and his life-saving blood (albeit in the form of an image) would have been antithetical to the teachings of such heretical groups as the Cathars.

Conspiracy Theories

Some researchers such as Harris, have jumped to the conclusion that the *Shroud* was simply “a fake conceived by popes to impress the laity and the clergy.”¹¹⁴ There are a number of very good reasons to refute this allegation, that is:

- the image depicts a naked Christ whose wounds do not conform (in all cases) to accepted Roman Catholic tradition. If the *Shroud* was produced in the west and dates from around 1250-1355, it (and its creators) would have had been in grave danger of falling foul of the Inquisition.
- in the fourteenth century representatives of the Roman Catholic church were very quick to try and stop the *Shroud's* veneration as the actual burial cloth of Christ when it was first put on exhibition by Jeanne de Vergy (1355).¹¹⁵ The Catholic Church is hardly likely to have tried to prohibit the veneration of a relic that it had gone to so much trouble to produce in the first place, suggesting that it was not Western in origin. Indeed, it was not until 1471 (at least 120 years *after* the *Shroud* was first known in France) that Pope Sixtus IV went so far as to *recognise* the *Shroud* as an important relic of the passion of Christ. Even then, the *Shroud* had to wait until 1506, before a Pope (Julius II) accorded the *Shroud* its own Mass and Office (*The Feast of the Holy Shroud*, May 4th).

The *raison d'être* behind the *Shroud*

Therefore, there are strong reasons to suspect that the *Shroud* was originally made (not for the general masses (*plebs Christi*), but for a particular client (such as a king, emperor or even a closed religious community), one which was particularly adept (for medieval times) at distinguishing between obvious fakes and genuine relics of the Christian faith. This prospective client would have been an orthodox Roman Catholic and would have been particularly well versed in the symbolism of the passion of Jesus Christ.

In this regard, the *Shroud* would have been seen as tangible proof that Christ (as God incarnate) had died a physical death, and that he rose again (in accordance with accepted orthodox beliefs and (as has been explained already), in opposition to the teachings of the Cathars and other heretical Christian groups in existence at this time). It is assumed that this client would have had to have been in a particularly exalted position to have even dared to

¹¹⁴ See also Stevenson and Habermas, 129-34.

¹¹⁵ Wilson, 1978, 221.

risk an accusation of heresy from the Holy See and its representatives (in particular the Dominican order and the Inquisition).

The degree of realism found in the *Shroud's* image points to the fact that the creators of this relic went to a great deal of trouble to guarantee that their patron would be satisfied with its claim to authenticity. The crucified man whose image now appears in the *Shroud* was specifically chosen for his appearance (i.e. age group, stature, racial features *etc*). In this regard, the detail of the man's pigtail is particularly important as this is a good indication that the man may have been a Jew and even possibly a rabbi. If one considers the wholesale slaughter of the Jews in many of the cities of the Rhine and Danube which occurred regularly after the preaching of a Crusade,¹¹⁶ the many pogroms directed against Jews and such events as “striking the Jew” which were common place in the thirteenth and fourteenth centuries, then the death of a single Jew by Frank or Greek would have been considered a small matter. Of course this still does not rule out the possibility that the unfortunate man who was employed for this image was a Moslem or even an acquiescent Christian ascetic - one who conceivably, willingly played the role of Christ for the purposes of producing this relic.

Obviously, apart from the *Shroud*, there exists no other document that can single-handedly support my photographic hypothesis. In addition, there still exist a number of unanswered questions concerning the *Shroud's* origins and the possible reasons why it was produced the way it was.

Therefore I can only presume, that the creators of this relic employed this photographic technique rather than more traditional approaches for at least two main reasons, namely:

- it automatically guaranteed a naturalistic (humanistic) image of the highest order;
- its means of production, being quite natural, and employing substances with strong symbolic meaning, may have been believed to have been divinely sanctioned;¹¹⁷

But, although it is possible that the image as it appeared in the late thirteenth and early

¹¹⁶ Readers may want to read the details pertaining to these medieval atrocities in Hugh Trevor-Roper, *The Rise of Christian Europe*, London: Thames and Hudson, 1989, 106-8 and also Paul Johnson, *A History of Christianity*, London: Pelican, 1990, 245.

¹¹⁷ Alchemists believed that the physical world operated according to divine principles. For example the “philosopher's stone” was believed by many to be mercury, which in turn was likened to Christ by virtue of the fact that it amalgamated with gold and silver, when removing these precious metals from impure alloys.

fourteenth centuries would have appealed to both Roman Catholic and Greek Orthodox Christians alike, it also contains details which seem to contradict orthodox mores (i.e. wounds in the “space of Destot”, nakedness etc.). However, these seemingly “unorthodox” details are present because the body of a real man was used (either as a life cast or as a cadaver).

In addition to and as result of, this factor, the *Shroud* is unique in the history of art, in that it has characteristics which make it difficult to categorise as definitively Byzantine or Gothic.

There can be no doubt that, (originally) it was intended by its creators (for whatever purpose/s) to be viewed as the physical imprint of Christ - an imprint made with His sweat and blood. This would have been viewed by the faithful as *the* actual Blood which was shed at Calvary for the sake of all humanity.

Thus it would seem that (apart from the overtly unorthodox and naturalistic details) the *Shroud* would both satisfy the predominantly materialistic western world's growing preoccupation with relics and the need for tangible (physical) remains of sacred personages as well as appealing to the Greek Orthodox Christians who in turn would have been able to view the image on the *Shroud* in much the same way as they would an *icon*. Indeed, without the benefit of having seen the image reversed (i.e. as a positive image), as we in the twentieth century have, the *Shroud* appears flat and two-dimensional, the eyes look larger than life and the feet point downwards, defying gravity as indeed is peculiar to much Byzantine symbolic depictions of divine and sacred persons.

Thus, the *Shroud* would appear to be both Holy image and Holy relic and seems to bear testimony to a period of communication or dialogue between not only West and East but also Latin and Greek.

The de Charny Connection

Having explored some of the possible responses that the *Shroud of Turin* might well have elicited from thirteenth century Christians, I have become increasingly convinced (for reasons already stated), that this encolpia of the Eucharist was not originally intended for the eyes of the vulgar. The wealth of symbolic detail which this image contains convinces me that this incredible product of medieval ingenuity was originally intended for somebody/something very special and as I have already indicated this could have been

either a king (or other senior member of the nobility) or even a closed religious community. However, one small fact exists which at first appraisal, seems to contradict my obvious assumptions, but which if looked at in more detail, not only supports my notion but more importantly points quite clearly at a possible origin.

In this regard, it is certainly worth speculating as to how its first recorded owner turns out not to be a king or a closed religious order but a very minor French noble. In short, how exactly did an individual like Geoffroi de Charny, liege lord of Lirey and Savoisy, end up possessing such a prominent artefact as the *Sudaria Christi*? If acquired honestly, then how could he have raised the monies necessary to have purchased something as obviously unique and technologically advanced as the *Shroud*?

We are fortunate that, Geoffroi de Charny is a relatively well-documented historical figure. We know very precise details concerning his life, like the fact that he loved and wrote chivalric poetry, that he was captured by the English at Calais on December 31, 1349 and during the years 1350-51 he was a prisoner of war in England. We also know that he was highly favoured by his king, because the King of France, Jean II (1350-1364), paid the ransom of 12000 gold ecus necessary for the release of de Charny and his subsequent return to France in or about July 1351. In 1353 he is known to have obtained from his beloved King Jean II, financial aid for the establishment of the collegiate church at Lirey. In this connection, Henri de Poitiers (Bishop of Troyes 1353-70) issued a letter to de Charny on 28 May 1356, in which he praised the Seigneur de Lirey for his efforts at having completed the building of this little wooden structure.

Shortly afterwards, on September 19, 1356, Geoffroi de Charny died a hero, using himself as a human shield to protect his King against an English attack on the field of Poitiers. The following year (1355) de Charny's widow, Jeanne de Vergy, exhibited the *Shroud* at her husband's newly built church in Lirey.

What is most enticing, however, is the fact that whilst still alive, Geoffroi de Charny also obtained his king's permission to create an order of Knights¹¹⁸ which was closely modelled on the Knights Templar order. This fact seems even more peculiar, when one considers that the Knights Templar (originally an order of military monks) had been publicly defamed and officially disbanded at the bequest of Jean II's great-uncle (Philippe IV) and with the “blessing” of Pope Clement V, a mere generation earlier.

¹¹⁸ Order of the Star (1352).

Despite this historical background, de Charny and Jean II founded the Order of the Star in January 1352.¹¹⁹ Unfortunately, as has already been mentioned earlier, de Charny, together with the majority of his Knights (about 150 in total) died to a man, protecting their King at the battle of Poitiers (1356). At this battle, the infamous Black Prince, captured Jean II and held him for a colossal ransom of three million *livres tournois*.¹²⁰ France was at its lowest ebb at this time. Apart from the plague which was about to decimate many European populations, English troops were marauding the countryside, raping and pillaging as they went. Most French people were hard pressed for food and ready cash. The great historian H.A.L. Fisher informs us that when Petrarch travelled through the French countryside some five years after the battle of Poitiers he reported that

it had been so wrecked and ravaged by the English armies that he could scarce persuade himself that this was the same flourishing land which he had previously known. Arson and pillage, murders and rape, burning crops and mutilated cattle, marked the progress of the proud island race and their continental levies.¹²¹

It is suspected that these harsh economic realities forced Geoffroi de Charny's widow, Jeanne de Vergy, to commence with her expositions of the *Shroud* at the little, wooden collegiate church at Lirey in or about 1355.

However, I should stress here, that no real evidence survives from this period, which proves beyond doubt that Geoffroi de Charny ever *knew* of the *Shroud's* existence, only that his wife exhibited it immediately after his death. In this regard, the slim possibility must always exist, that Jeanne herself acquired this object in an attempt to raise funds for not only herself but also to contribute towards her King's ransom. The only evidence possibly mitigating against this interpretation is the recorded comment of Geoffroi de Charny's granddaughter Margaret who said that the *Shroud* "*fut conquis par feu messier Geoffroy de Charny*".¹²² This may be interpreted as "the *Shroud* was obtained by the late Geoffroi de Charny".

One fact, that has only recently been verified¹²³ is that Geoffroi de Charny was the nephew of the last Templar Preceptor of Normandy, namely, Geoffroi de Charnay. Although relatively unimportant, his surname, like most Christian names during the medieval period, is spelt

¹¹⁹ Wilson, 1991, 222-223.

¹²⁰ See Maurice Keen, *The Pelican History of Medieval Europe*, Aylesbury: Pelican, 1973, 251.

¹²¹ H. A. L. Fisher, *A History of Europe*: Vol. 1, London: Fontana, 1970, 337.

¹²² Andre Perret, "Essai sur l'Histoire du Saint Suaire du XIVe au XVIe siècle", *Mémoires de l'Académie des Sciences, Belles-lettres et Arts du Savoie, Sixième Série, Tome IV*, 1960, 81.

¹²³ See the genealogy of the de Charny (de Charnay) family, as presented by Noel Currer- Briggs, *The Shroud and the Grail*, London: Weidenfeld and Nicolson, 1987.

slightly differently according to the convention of his day. To avoid confusion, I will adhere to this convention, in my own text.



26/ Illustration of a lead pilgrim badge or medal (c. 1355-60), bearing the coat of arms of both Jeanne de Vergy and Geoffroi de Charny, which clearly heralds a cloth bearing a dorsal and frontal image of the crucified Christ. Notice that certain conspicuous details that are found on the present day *Shroud of Turin* are clearly indicated on this medal, such as the blood flows across the small of the back and from the wounds in the feet. This is possibly the most important evidence found to date which proves that the *Shroud* presently housed in Turin is the same as the one originally exhibited at Lirey in the mid-fourteenth century.

This prominent Templar, Geoffroi de Charnay, was executed together with the last Grand master of the Order, Jacques de Molay in March 1314, during the reign of the Capetian king Philippe IV (The Fair).

Because (on face value) it would seem that Geoffroi de Charnay attempted to revive the Templar movement (at least in spirit) and because he is not only directly related to a very senior Templar but was most likely named after him, it is obviously assumed that the *Shroud* may have some links to either the Templar movement or the de Charny (or de Charnay) family itself. These possible links become even more plausible when one even briefly reviews the circumstances that led up to the Templar's eventual downfall in the early fourteenth century.

The Knights Templar

Ostensibly, the Poor Knights of The Temple of Solomon had been founded in 1118 by a group of French nobles for the avowed purpose of protecting the pilgrim routes to the Holy Land. They not only took the oath of obedience to the Church (Pope) as well as the oath of celibacy but in addition, they took an oath of poverty. They shared all their goods, their only

real possession, being the sword with which they would defend the pilgrim route and smite the enemies of Christ.

The order established a headquarters in Jerusalem in the old mosque of al-Asqa which stands next to the site of Christ's reputed ascension into heaven, a most sacred spot for three major religious groups, having been the site (respectively) for the Altar of David, the Temple of Solomon, Herod's Temple and even Hadrian's Temple of Jupiter. Between 685-691 CE Mohammed's successor, Caliph Umar had built the famous Dome of the Rock, a structure which the Christian pilgrims believed to be the original Temple of Solomon.

They very soon became the vanguard of the new crusading movement, and were quickly emulated by other similar military orders such as the Hospitallers and the Teutonic Knights. Before very long the Order had accrued enormous donations in the form of money and more importantly property. In fact they ultimately owned lands in every European country including the Byzantine Empire. Kings bequeathed to them enormous tracts of land, such as the King of Aragon, who in the early twelfth century gave the Templars a third of his kingdom. Templars became ingrained at every level of Christian society often playing important (albeit clandestine) roles in politics at the highest level.

It is believed that before the middle of the twelfth century, that next to the Papacy itself, the Poor Knights of The Temple of Solomon had become the most wealthy and politically powerful force in the Christian world. Indeed, by the thirteenth century, the Templars had maritime holdings in every major Mediterranean Port and had very close ties with the Venetians. They also held Bristol and the Port of La Rochelle. It is also well known that the Knights Templar order increasingly made treaties with the Moslems in order to protect their holdings in the Holy Land, especially when military force was not a feasible option.

In this way, there was much dialogue between “Frank” and “Saracen” which gave rise to much intercultural exchange between the two groups. There is much evidence for this cross-fertilization of ideas during the Crusades, especially during the many periods of truce and there are many accounts of “Saracens” being employed by religious military orders such as the Knights Templar, for their skill in carving, masonry, metalwork, textiles and even interpretation. This was because the Islamic expertise in these areas was very often, far in advance of the Latin speaking west: “They lack our faith: we lack their works.”¹²⁴

¹²⁴ E. Simon, *The Piebald Standard: A Biography of the Knights Templars*, London: Cassell, 1959, 56-9.

It is also accepted, that because of their close contact with Greek, Islamic and Jewish philosophies, they absorbed many aspects of Gnostic, hermetic and even cabbalistic teaching. However, this interaction between the Catholic west and Islamic east did not always include the reading of Arabic literature. Arabic (and other Semitic tongues) was quite alien to the western Europeans. In this regard, Simon explains that because of Arabic's "literally infinite" vocabulary and its extreme flexibility, it was "too taxing for the type of memory trained in putting a limited verbal raw material with a comparatively rigid grammar through every permutation of concept and expression."¹²⁵

Nevertheless, the Templars (or at least the inner circle of that Order) are reputed to have been privy to many branches of secret and arcane knowledge. Considering their dealings with the Byzantines, Venetians and the Moslems, it should not surprise anyone that they developed great prowess in such diverse fields as navigation, cartography and masonry. In this regard, two prominent Templar researchers, Michael Baigent and Richard Leigh ask the following pertinent question concerning the Templars' secret knowledge:

What was the nature of this knowledge? Was it truly "occult" in the sense charged by the Inquisition, involving forbidden magical practices, obscene and blasphemous rites? Was it political and cultural - pertaining, for example, to the origins of Christianity? Was it scientific and technological, encompassing such things as drugs, poisons, medicine, architecture, cartography, navigation and trade routes? The more closely one examines the Templars, the more such questions as these tend not to resolve themselves, but to proliferate.¹²⁶

The order's strength (and ironically, the cause for its final downfall), resided in the fact that the Templars owed their allegiance to the Pope. By 1187 Jerusalem was lost to the order and in 1291, Acre, the last foothold of the Catholic West in the Holy Land also fell to the Moslems. The Templars initially withdrew to their holdings in Cyprus and Venice. The Hospitallers withdrew to Rhodes and later to Malta, from where they continued their struggle against the Moslems by sea. Subsequently, with the crusading ideal now at its lowest ebb, the Templars returned home, which invariably meant France. Unfairly, the Templars were often viewed as the cause for the failure of the crusading ideal, despite the fact that they had valiantly defended Christian holdings in the Moslem east with very little support and working against insurmountable odds. Many Templars were members of the French nobility and this fact did not go unnoticed by the French King at this time, viz: the sociopathic, Philippe IV (The Fair) (1285-1314).

¹²⁵ Simon, 59.

¹²⁶ Michael Baigent and Richard Leigh, *The Temple and the Lodge*, London: Corgi, 1990, 71.

This unpleasant French king had, by 1305, ensured that the Pope was under his total control. In fact, unlike his predecessors, who had all traditionally ruled from Rome, the puppet Pope Clement V (1305-1314) lived at Avignon which was within the sphere of influence of the Capetian monarchy. Thus began the so-called “Babylonian Captivity” - a period of breakdown and crisis for the Catholic Church. Philippe now had control of all church taxation (which irritated the English) and started to persecute certain French nobles on trumped up charges in order to gain their lands. He also, of course, conveniently blamed the Templars for the loss of Acre in 1291.

Not wanting Europe's best troops to return to their French lands and knowing how powerful the Templars were politically, he had orders to arrest every Templar in his realm written and sealed. These orders were sent to all corners of France with strict instructions that they should not be opened until Friday 13 October 1307. On that fateful day (hence the superstition surrounding this date), the orders were read and as a result large numbers of Templars were arrested throughout the kingdom of France. In true theatrical style, Philippe, through his minister Nogaret, accused the Templar order of such heinous crimes as heresy, sodomy and blasphemy. However, because the Templars were largely prepared for this eventuality, generally speaking, Philippe's agents could only locate the older and more senior members of the Order.

It would appear that the Order believed that they would eventually come to prove their innocence and that ultimately, their movement would be redeemed. The accuracy of this notion is borne out by the large numbers of younger members who either merged into the local community or who joined other military orders such as the Teutonic Knights and the Hospitallers. This clearly shows that the Templars were always aware of the impending threat to their once assured existence.

Philippe IV never found the Templars' fabled treasure nor did he get his hands on the many Templar vessels that were moored in the Seine and at La Rochelle. The Templars had gathered all their relics and treasures, collected their stockpiles of arms, and slipped away with their fleet well before the orders for their arrest were read out on that ominous Friday morning.

Much speculation has been given as to the possible fate of the Templar movement.

Researchers such as Michael Baigent and Richard Leigh have convincingly argued that large numbers of Templars sailed to Scotland where they originated amongst other things, the Freemasonry movement.¹²⁷ Andrew Sinclair (himself a descendant of Scottish Templar bloodlines), also points out the very close links that existed between the Templar movement and the Venetians, both of whom were renowned for their skills as master mariners and confirms a strong Scottish connection with the Order after 1291.¹²⁸

Unfortunately, those Templars who were not able to escape Philippe's clutches were subjected to harsh terms of imprisonment and brutal, inhuman torture. It is no wonder that so many Templars confessed to the fabricated charges of heresy, sodomy and blasphemy, some even admitting to abhorrent acts like trampling and spitting on the symbol of Christ's cross. Most of these unfortunates either ended their lives in prison or in the flames. In this context, in March 1314, the two highest ranking Templars, Jacques de Molay (Grand Master of the entire order) and Geoffroi de Charnay (Preceptor of Normandy), after spending seven years in prison, were burnt to death on the Ile de Juife in the Seine. There is a legend that from the flames, Jacques de Molay ordered both Clement V and Philippe IV to join him before God's seat within the year. Whatever the truth behind this account, it is quite true that within the year both Philippe and his puppet Clement were dead. Rumours abound to this day, that they were both poisoned by Templar agents.

Is it merely a coincidence that the last Preceptor of the Knights Templar in Normandy should be directly related to the first suspected owner of the *Shroud*? Did Geoffroi de Charny know about the *Shroud* whilst he was alive, or did his wife acquire it after his death? If we are to support the notion that Geoffroi de Charny did know about the *Shroud* but chose to keep its existence a secret for some inexplicable reason, then we must also presume that he kept its existence so secret, that not even the canons of his church in Lirey knew about it until the time his wife started holding expositions of the cloth (sometime between 1356-7).

To be sure, they certainly do not appear to have been privy to the *Shroud's* existence before this time, because the official records of the consecration of the collegiate church in Lirey in 1353, (which Geoffroi de Charny both founded and built) do not make any mention of the *Shroud*. This is strange when one considers that many other relics contained in the little wooden church are listed at this time.

¹²⁷ Baigent and Leigh, 98-115.

If Geoffroi knew about the *Shroud*, why did he keep its existence so quiet and how could a minor French Noble have possibly acquired such an incredible relic in the first place? Can we really believe that he or his wife had the technological expertise to have made it themselves?

As far as I am concerned, the facts speak for themselves, the de Charny (de Charnay) family could have had no love for the Capetian Monarchy as represented by the infamous Philippe IV (The Fair), but they would have supported his great-nephew, Jean II, since he was not a Capetian but a member of the Valois dynasty. This dynasty had only come to power as recently as 1328 and would not have had quite the same distrust of the Templar ideal. Indeed, the other military orders survived for many years, some even to the present day in one form or another.

Thus it would have been quite in order and safe for Geoffroi to revive something that was still fresh in the mind of the De Charny family. It would seem reasonable to support the notion that this family had hidden the *Shroud* during the troubles of 1307-1314 in the hope that it would be responsible for refuelling the Christocentric spirit of the original Templar order at some future date when the threat to the movement had been removed once and for all. If Baigent, Leigh and Sinclair are correct, the surviving Templars who were ensconced in Scotland by this time, had already broken their vows of celibacy and had taken wives, thus ensuring their survival in a world which had rejected them and their ideals. In a similar way, Geoffroi de Charny followed suit, by resurrecting a Templar-like organisation in France which also allowed for its members to be non-celibate.

Within this plausible (albeit speculative) scenario, we may assume that the cloth known as the *Shroud of Turin* was in existence by at least 1307 and was manufactured no earlier than the late 1280s at a time when the Knights Templar order was preparing for the inevitable, viz: the end of the crusades. It will be remembered that the Order was originally founded for the express purpose of protecting the Christian pilgrim routes to the Holy Land. However, as we have already noted, the physical need for such long and dangerous pilgrimages was gradually supplanted by the more pragmatic practice known as the Way of the Cross. As early as the mid-twelfth century, no less a King than St Louis himself seems to have pre-empted this tendency. To be sure, between 1242 and 1248 he had Sainte-Chapelle built in Paris. This most beautiful Gothic palace chapel was designed to act as a sort of giant reliquary, within which such important relics as the crown of thorns might be housed. Thus,

¹²⁸ Andrew Sinclair, *The Sword and the Grail*, London: Arrow Edition, 1993, 1-26.

the need to make a pilgrimage to the Holy Land became less significant, once it was comprehended by the faithful, that the most important relics of Christendom were now to be found in Europe itself.

Within this scenario, a truly remarkable relic (such as the *Shroud*), would surely have been considered very precious indeed. Considering that the technology required to produce this relic relied heavily on the best of Islamic scientific knowledge, was produced with cloth that was produced in the Moslem-Byzantine world and contains a complex iconography fit only for the most adept theologian I would not be surprised if the *Shroud* was either manufactured by the Knights Templar at one of their *outremer* holdings on the eastern side of the Mediterranean or was made specifically for them by Byzantine or Venetian agency.

The Geographical Site for the Production

Because of the wealth of circumstantial data now available, it is possible to pinpoint the most likely site for the production of the *Shroud*.

The linen fabric of the *Shroud* is intermingled with a specific species of cotton which is only found in the Middle East. This means that the original fabric employed for this relic could only have been obtained from the following states that existed between *c.* 1200-1355 CE, these are:

- the Middle Byzantine Empire (1025-1204);
- the Byzantine (Latin) Empire 1204-61);
- the Nicaean Empire (1204-82);
- the Late Byzantine Empire (1261-1453);
- the Sultanate of the Rum Seljuks (*c.* 1100-1360);
- the Ottoman Empire (1301-1683);
- the Kingdom of Cyprus (1192-1489);
- the Ayyubid Empire (1171-1250);
- the Earldom of Tripolis (1102-1289);
- the Kingdom of Armenia Minor (1198-1375);
- the Principality of Antioch (1098-1268); and
- the Mameluk Empire (1250-1517).

It is not that likely that someone in the west would import a single piece of linen from the middle east simply to make a one-off image (regardless of the technique employed), unless they had regular and easy access to their source. Generally speaking, this means the site of production is more likely to have been towards the eastern side of the Mediterranean region, or in countries which had strong Islamic/Byzantine influence. Apart from the areas cited

above, the next most likely regions would be modern day Spain, Italy, Venice, Cyprus and Greece. The most unlikely European countries would have to be Scotland, France, England, Germany etc.

I also know that the top-lit quality of the figure that appears on the *Shroud* is especially significant if my explanation concerning the *Shroud's* manufacture is in any way accurate. Specifically, my own tests carried out in Port Elizabeth (situated 34° south of the equator) showed that the sun was at a much higher angle in relationship to the “corpse” than would have been the case with the cadaver employed for the original *Shroud*. I have calculated that to duplicate the *Shroud* in the Northern Hemisphere during the summer months and to approximate the highlights that occur on the original image would require me to set up my exposure somewhere between 45° and 49° north of the equator. It is surely no coincidence that Venice lies a few minutes north of the 45° line of latitude, whereas all the other likely spots, such as Cyprus, Syria, Israel etc. all tend to be situated south of the 35° line of latitude. The only real exception is Constantinople, which is still situated too far south at approximately the 41° line of latitude.

This possibility is strengthened by the following factors, viz:

- the recent 1988 carbon-dating which places the *Shroud* at some point between 1260-1355;
- the specific iconography employed by the *Shroud* which agrees with both Proto-Renaissance as well as Byzantine imagery (c. 1275-1325); and
- the fact that at this precise moment in history (i.e. c. 1250-1350), many branches of Islamic knowledge, especially mathematics and optics were being absorbed into the Christian world via Byzantine, Venetian and Genoese agencies.

The Leonardo Fallacy

It has been suggested in recent years that Leonardo da Vinci should be considered the originator of the *Shroud*. There are various arguments put forward why this particular artist should be responsible, some like Anthony Harris (1988) argue that his genius was needed to manufacture an outstanding relic, so that Pope Sixtus VI, sometime before 1484, might better satiate his need for greed and corruption.¹²⁹ After all, according to Harris's logic, if a Pope like Sixtus VI could hire artists like Ghirlandaio, Botticelli and Perugino to produce

¹²⁹ See Harris, 1988, 91-93.

“sumptuous works of art” why not also employ Leonardo to make a really good *Shroud* to impress the laity. In support of this nonsensical argument, Harris mentions that Leonardo looks exactly like the image of Christ in the *Shroud of Turin*!¹³⁰

In a similar vein, the co-authors, Lynn Picknett and Clive Prince, clearly borrowing from Harris, also think that because Leonardo had a big nose and a beard, he looks like the image of Christ in the *Shroud of Turin*. They unsuccessfully strive to demonstrate (1994), that the present day *Shroud of Turin* was forged by Leonardo during the reign of Pope Innocent VIII in 1492! Within these various contexts, all of these authors, have the insurmountable task of convincing their readers that the *Shroud* at Lirey (c 1355-1418) and the *Shroud* at Turin (1578-present) are *not* the same artefact.

Moreover, in the light of my own, well-documented publications, commencing in 1993, which had already postulated the theory that the *Shroud of Turin* was produced by means of a primitive form of photographic technology sometime before 1355, I was astounded to discover that in the case of Picknett and Prince, these authors (i.e. sometime in 1994), also specify “photography” as the very means by which Leonardo manufactured this relic. However, for some inexplicable reason, they themselves admit that they did not come up with this possibility themselves. Rather they claim that they were brought up to speed by letters supplied by an enigmatic individual named “Giovanni”. We are also supposed to believe, seemingly without cohesion or incentive, that Giovanni happily described a photographic process employed by non-other than Leonardo da Vinci himself¹³¹ In hindsight, this highly unlikely scenario seems to have been a round-about way of not having to give credit where credit was in fact due.

Apparently, their real involvement with the *Shroud* and their commitment to a Leonardo connection, started soon after they were tipped off by this particularly well-informed “Giovanni” who they also claim was an emissary of a secret society called the Prieuré de Sion. This society, incidentally, (according to Baigent, Leigh and Lincoln¹³²), was responsible for, amongst other things, the creation of the Knights Templar movement in the early twelfth century. Of course, now it is well known that the contemporary existence of this organisation was a hoax and therefore Picknett and Prince’s claims are also proven to be blatantly untrue. I, for one, would love to know who did in fact inform this couple about the

¹³⁰ Harris, 94.

¹³¹ Picknett and Prince, 62 – 106.

¹³² Michael Baigent, Richard Leigh and Henry Lincoln, *The Holy Blood and the Holy Grail*, London: Corgi, 1991, 116-119.

photographic hypothesis at the time.

For those readers who are not familiar with the terrain, it should perhaps be pointed out that the pedigree of the *Shroud of Turin* or if you prefer, the *Sudaria Christi*, is relatively well documented back to the year 1389, when the then Archbishop of Troyes, Pierre d' Arcis wrote his famous *Memorandum* to the anti-pope Clement VII. Here, he requested that the *Shroud's* owners (at that time being Jeanne de Vergy and her son Geoffroi II de Charny), be forbidden to hold religious expositions at the Collegiate Church in Lirey.

One of the main reasons for d'Arcis's letter is perfectly clear, viz: the *Shroud of Lirey* was luring pilgrims and their much sought after money away from the coffers of the Cathedral at Troyes situated some 20 kilometres to the north-west. Notwithstanding, d' Arcis, irrespective of his real motives, employs good old fashioned rhetoric to convince the pope of the *Shroud's* unworthiness as an object of devotion and informs his reader that the self-same *Shroud* had been previously condemned as undesirable some “thirty-four years or thereabouts” before his own time by his predecessor, Archbishop Henri de Poitiers. This gives us 1355 as the earliest claimed date for the *Shroud's* existence.

Picknett and Prince, in their attempt to give credence to their theory (i.e. the *Shroud* was exchanged in 1492), set out to prove that the known pre-1492 descriptions of the *Shroud* (both textual and visual) do not concur with the appearance of this relic as viewed today.

In this regard their “argument” revolves largely around two main pieces of “evidence”, viz: The above cited *Memorandum of Pierre d' Arcis to Clement VII* and a lead pilgrim badge (see Plate 26), commemorating an exposition of the *Shroud* at Lirey in the fourteenth century and which was discovered in the Seine as recently in 1855.

In Archbishop Pierre d' Arcis's *Memorandum*, he mentions that his predecessor, Henri de Poitiers, discovered that the *Shroud* at Lirey was a forgery and “how the cloth had been cunningly painted, the truth being attested to by an artist who had painted it, to wit, that it was a work of human skill and not miraculously wrought or bestowed”¹³³. From this translated statement, Picknett and Prince infer that the *Shroud* at Lirey originally contained a painted two-fold image of Christ, which somehow proves that the present photographic image on the *Shroud of Turin* must be a *later* product.

¹³³ d'Arcis, Pierre de, “Memorandum of Pierre d'Arcis to anti-pope Clement VII”, *Collection de Champagne*, v.

I cannot, in any way, accept this line of reasoning. For one, this sole statement by a man (d' Arcis) who might never have seen the *Shroud* himself, is not valid evidence that the *Shroud of Lirey* was a painted cloth in opposition to the negative, pigmentless, image we associate with the *Shroud of Turin* today. After all, if the *Shroud* was (as I suspect), produced by means of either Byzantine, Venetian or Islamic photographic technology, prior to say 1355), then who (living in France in the late fourteenth century), would have had the necessary words to describe what they saw? Should we not, rather, be asking why d' Arcis goes to some trouble to explain why the image is not really as “miraculous” as people at that time supposed it to be? Why employ such terminology if the image was so obviously painted? In addition, the authors themselves make mention of the important fact that when the *Shroud* was briefly exhibited at Liège in Belgium in 1449¹³⁴ a commission instituted by the local Bishop examined the cloth and determined that it was painted. What painted cloth needs a commission to decide whether it is painted, unless the image is so atypical of normal painted images as to demand closer examination?

As already explained, the other piece of evidence that Picknett and Prince subpoena, concerns the well-known lead pilgrim medal (see Plate 26). This is a crude visual souvenir of one of the numerous *Shroud* expositions held at Lirey (presumably no earlier than 1355 and certainly no later than 1418). In support of this interpretation, this medal clearly shows both the coat of arms of the man who is believed to be the first owner of the *Shroud*, viz: Geoffroi I de Charny (died 1356) as well as his wife Jeanne de Vergy.¹³⁵

Picknett and Prince contend, that the image depicted therein is *not identical* to the image which we have now come to associate with the *Shroud of Turin*. Again this opinion is highly questionable. By their own acknowledgment, it is hardly fair to expect a medieval craftsman to accurately recreate the image we see today, on a diminutive piece of lead.¹³⁶ Yet, despite these restrictions, this anonymous craftsman has still managed to portray (albeit stylistically) a rectangular support containing a two-fold depiction of a man with his arms crossed over his pelvic region, such that it corresponds to the present day image. In addition, the artist has carefully described the herringbone weave which is characteristic of the present day *Shroud of Turin*. Nonetheless, despite these striking correspondences, Picknett and Prince make the following bogus statement,

154, fol. 138. Paris: Bibliothèque Nationale. [Manuscript c. 1389 CE.]

¹³⁴ Wilson, 1978, 241

¹³⁵ Wilson, 1991, 21-26; 78-79.

There is one feature, however, that is clearly visible on the medal that is *not present* on the Turin Shroud - a curious thick twisted band, like a rope, across the width of the cloth at the small of the figure's back. What this is is anybody's guess.¹³⁷

This is a deliberate red-herring. What these authors fail to tell their readers is that on the medal, a “thick twisted rope” not only traverses the small of the dorsal figure's back, but may also be observed as an ambiguous relief pattern to either side of the feet in both the dorsal and the frontal impressions. All of these patterns, including the “twisted rope” run at right angles to the direction of the body image.

Is it not interesting that on the *Shroud of Turin* may be found a line of trickled blood running across the small of the dorsal figure's back and that the scorch marks which now appear on the cloth as a result of fire damage in 1532 may very well conceal the continuation of this pattern beyond the boundaries of the figure itself. Blood is trickled quite freely at the site of the feet, more so on the dorsal image than the frontal depiction. This latter feature is reflected quite accurately on the lead pilgrim medal from Lirey. As an aside it is also worth mentioning here, that when the Clarisses repaired the *Shroud* after the fire of 1532, they remarked at the time about what they perceived to be “chain marks” running across the small of the back of the image! If, as these authors assert, the *Shroud* had been switched by 1492, then what were these poor nuns of Saint Claire referring to, between the years 1532-4? After all, no “chain marks” appear on the *Shroud of Turin* today, so quite obviously the Clarisses misinterpreted the line of trickled blood as did the anonymous artist who produced the pilgrim medal before 1418.

Why do these authors attempt to mislead their reader on this issue if not to gain credibility for the highly speculative theory that Leonardo forged the image on the *Shroud* a full 135 years after it first came to light? Couple to this, the fact that the recent 1988 carbon dating strongly supports a date for this piece of cloth (i.e. 1260-1390), which pre-dates (at the very best) Leonardo's birth by 62 years and we are left in no doubt that this theory has little or no foundation.

It is important to note, that the authors do not overtly take issue with the validity of the carbon dating (1994:21-2), instead, they subtly emphasise that the dating indicated (with a 99.9 per cent certainty) a date between the period 1000-1500. However, this 500 year range

¹³⁶ Picknett and Prince, 108-9.

¹³⁷ Picknett and Prince,

encapsulates a far narrower and more likely 130 year period for the *Shroud's* production, viz: 1260-1390. Indeed, based on this statistical principle, the most probable date would have to be somewhere between about 1250-1325, whereas dates approaching the years 1000 or 1500 respectively, would have to be (statistically) the least likely candidates. The co-authors conveniently gloss over this point in order to favour a year (1492), which in fact falls within eight years of the least possible date. In this context, Picknett and Prince's loaded statement should be ignored, viz:

The carbon dating results told us the period of history we should be concentrating on, and immediately we realised that not only did this time span include the heyday of faked relics, but it also included the lifespan of Leonardo da Vinci.¹³⁸

Firstly, Leonardo da Vinci died in 1519 (nineteen years beyond the time span indicated i.e. 1000-1500) and secondly, if the carbon dating “told” them the period of history with which they should focus on, then why do they employ the same carbon-dating data to cast dispersions on the assumptions of those persons (such as Curren-Briggs) who believe the *Shroud* to date from before or around 1204? After all 1204 is closer to 1250/1325 than 1492.

In truth, the only way that one could accommodate Picknett and Prince's notions, would be to assume that Leonardo da Vinci, in the year 1492, somehow removed the original painting on an antique piece of linen of middle-eastern origin. Then, in a single attempt, making no mistake, he produced his own photographic image. He did this with no consideration of the destruction made to a sacred relic that only 21 years previously had been heralded by Sixtus IV as the true shroud of Christ.

If we accept this, we must also accept that the Savoy family willingly sent it out of their jurisdiction in 1492 to be tampered with by a Florentine artist. This makes no sense considering that they had already spent fifty gold franks in 1464 to ratify their ownership of the *Shroud*. In addition, all this time (1471-1502) they were busy enlarging and upgrading their Church at Chambéry for the express purpose of housing their prize possession.

It should also be noted that additional evidence exists which more than conclusively proves that the *Shroud of Lirey* and *Shroud of Turin* are one and the same artefact. I mentioned

¹³⁸ Picknett and Prince,

earlier on that I strongly suspect the iconographical details as found on the present day *Shroud* conform very closely to the Man of Sorrows imagery, which as I have already mentioned was popular by the fourteenth century. However, one version of the Man of Sorrows exists which seems to have completed the cycle of influences, in that it is in its own turn, clearly dependant on the present day *Shroud of Turin*.

In this regard, a comparison should be made of the upper torso of the man who appears in the *Shroud of Turin* and a painting by Jean Colombe (c. 1430-1493). This image (see Plate 25) depicts the Man of Sorrows being contemplated by Duke Charles I of Savoy (died 1489) and his wife, the Duchess Blanche of Montferrat from folio 75 of the *Très Riches Heures de Duc de Berry*. This well-known book of hours was originally commissioned by Duke Jean of Berry (1340- 1416), who incidentally was also the second youngest son of King Jean II of France. This book was commenced in the early years of the fifteenth century by the Brothers Limbourg, who worked for the Duke de Berry and as fate would have it, they died in the same year as their patron (i.e. 1416). The book was finished some seventy years later by another master, viz: Jean Colombe in 1485.

The depiction of Christ in this image (see Plate 25) is clearly based on the iconography which appears on the *present day Shroud*. Unlike most other depictions of the man of Sorrows, Christ does not indicate his wounds, rather he poses with his arms crossed in the *venus pudica* pose. The rivulets of blood which flow from his wounds are directly comparable to those found on the *Shroud*. The same applies to the whip marks and the distinctive colour and forked shape of the beard. Indeed, Colombe has repeatedly depicted Christ's head in an identical fashion throughout the *Très Riches Heures*. For example, he refers to the *Shroud* directly in his *Deposition* which shows Christ being laid to rest on a long thin piece of linen cloth.

It should be further noted that Charles I of Savoy and Blanche of Montferrat, depicted in this image, were both direct descendants of Jean de Berry and not only inherited the *Très Riches Heures* but the *Shroud of Lirey* as well. There can be no doubt that both the image (as found on the *Shroud of Turin*) and this particular image of the Man of Sorrows, supported by many other paintings in this book, share identical iconographical details. This is a factor which further supports the notion that the *Shroud of Lirey* (c. 1355) and the *Shroud of Turin* (c. 1575) are indeed one and the same item.

VII

CONCLUSIONS

General Observations

It has been my main contention, that if the *Shroud of Turin* is approached from a phenomenological perspective, it will be possible to ratiocinate the process by which it came into being.

In other words, regardless of its original context and irrespective of the specific period in human history that it originates from, if the *Shroud* was made by human-beings, then it will be possible to reconstruct its mode of production. Similarly, even if part or all of this process were due to natural causes (i.e. made according to the laws of nature and without direct human involvement) it will still be possible to deduce the cause of the *Shroud of Turin's* manufacture/creation.

The Photographic Hypothesis

In terms of the delimitations of this particular piece of research it would be fair to say that a number of positive conclusions may be made concerning the plausibility of someone having had the practical knowledge and equipment necessary to produce a photographic negative image before 1355 CE, viz.:

From the documented evidence that has been reviewed thus far, the following factors are of particular importance:

The *Shroud* has been carbon-dated by the radiocarbon laboratories of Oxford, Tucson and Zurich to the precise period in time (i.e. 1260-1390) when there was a particularly great interest in the subject of optics throughout both the Christian and Moslem world, namely: 1250-1350. This factor (in the light of supporting evidence) cannot be considered a coincidence. Further, even if the carbon-dating is proven to be in any way inaccurate, we can still have no doubt that by virtue of the iconographical details contained in the *Shroud's* image that it could not have been produced before 1200 CE.

The Arabic natural philosopher, al-Haytham was perfectly aware (both theoretically and practically) of the principles of the *camera obscura*, the nature and cause of pinhole images and the action of light well before 1039 CE. Indeed, it would seem that most of the knowledge relating to optics which was available in the Christian west for the three centuries after this date was heavily dependent on Islamic scholarship. In addition, many of the theoretical insights into the subject of optics (largely attributable to al-Haytham) had often been compromised by certain western natural philosophers, notably Bacon.

The natural philosopher/chemist (Albertus Magnus) knew (practically) how to manufacture what we now term silver nitrate (in solution) (at least before his death in 1280) and was well aware of the “staining” effect that this substance had once exposed to the environment. However there is no evidence for or against him assuming either air, heat or light to be the vital conditioning factor.

Both natural and synthetic quartz are extremely brittle and hard materials. Accordingly, one would perhaps want to believe that a medieval artisan would not have had the proficiency to produce such technologically advanced pieces of apparatus as rock-crystal, bi-convex lenses. However, the evidence clearly shows that a bi-convex lens had been produced in glass by at least 1200 BCE. In addition, it is known that magnifying glasses were produced in both glass and optical quality rock-crystal (quartz) well before the second century CE. One is also reminded here, that the tenth and eleventh century Moslems (of Fatimid Egypt), managed to produce hollow, pear-shaped, cut rock-crystal ewers.¹³⁹ One of these lapidary masterpieces (from Cairo) measures a full 18 cm in height, is not only hollowed and decorated in relief but includes the inscribed name of the caliph al-Azis Billah (975-96 CE).¹⁴⁰ In addition, the discovery of the spectacle lens (Genoa, Florence and Venice) dates from 1275-80.

There can be no question that the *Shroud of Turin* contains a wealth of information which could never have been discerned by a person living before 1898 (i.e. when Pia made the first positive images of this relic). In other words, it is inconceivable that an artist (living in the late thirteenth or early fourteenth centuries) would have gone to such impossible lengths, i.e. torturing and crucifying a man and then painting/dying/staining/printing the totality of this visual information in the negative according to the principles of modern photographic theory.

¹³⁹ Jonathan M. Bloom, *Arts of the City Victorious: Islamic Art and Architecture in Fatimid North Africa and Egypt*, Yale University Press, 2007.

¹⁴⁰ B.S. Meyers and T. Copplestone, *Asian Art: An Illustrated History of Sculpture, Painting and Architecture*. London: Hamlyn, 1987, 285.

From the documented evidence of the early pioneers of modern photography,¹⁴¹ it transpires that in *all* cases, a silver salt like silver nitrate was the natural choice for the first experiments involving light-sensitive chemicals. In addition, the first recorded attempts by all of these pioneers to “capture” the images of nature were in the negative.

It is possible to produce and stabilise (fix) a negative image comparable in each and every way to the image as found on the *Shroud of Turin* by employing only four substances/chemicals all of which (collectively) are known to have been available during the thirteenth century and also, were quite possibly in existence by the tenth century: quartz, organic material (linen), silver salt, and ammonium hydroxide (including urine). In addition, a person can produce an image with these materials without necessarily having knowledge of modern chemistry, physics or fine art.

Conclusions

After considering all the documented evidence relating to the phenomenon of the *Shroud of Turin* and having successfully duplicated the characteristics of the image with technology known to have existed (at the very least) by 1280 CE, there can be no doubt that the image that occurs on this relic was produced by means of a photographically related technique - one which would have been very similar to the hypothetical account given earlier and of which more will be said later. It is also quite certain that even the most skilled realist painter of our own time (armed with the knowledge of the principles of photographic science and technology) could not manually duplicate (with pigment, powder, stain or dye) the image as it appears on the *Shroud*. This fact alone should convince anyone that the *Shroud* is not “simply” a painted/dyed/stained/printed/chalked product. There is quite simply, no other alternative but to accept the fact that someone (before the age of modern photography) used some primitive photographic related technique to produce this image.

The following is a categorisation (given in chronological order), of the methods and techniques which would have been needed to produce the image as it appears on the *Shroud of Turin*:

- As the image was made in the northern hemisphere, more likely during the summer

¹⁴¹ B. Newhall, *Photography: Essays and Images*, New York: Secker and Warburg, 1980. 13-355.

season, the *camera obscura*'s aperture would have faced northwards. The two lenses employed were made of ground rock-crystal (quartz). The larger lens would have been bi-convex (converging lens) in form and could not have been much smaller than 100 mm in diameter and some 7 mm across its axis (i.e. a thin lens). It would have had a focal length not far off 1000 mm. The other lens was also bi-convex, possibly smaller and had a shorter focal length – possibly around 500 mm.

- The subject (recently deceased/embalmed corpse or life-cast) was positioned outside the *camera obscura* (opposite the lens aperture). The corpse was suspended in such manner that it hung from the head and shoulders and its feet hung downwards. The subject was first faced towards the aperture and was illuminated by the sun such that the left side of the body received the morning sun and the right side of the body received the afternoon sun equally during the course of a solar day.
- Inside this fairly large *camera obscura*, the linen cloth (originally measuring well over 4.5 meters in length) and previously saturated with a very dilute silver sulphate solution (0.47%) was affixed to a vertical screen in such a manner that some two meters of its length were rolled up on the floor and the remaining two meters were attached to the screen.
- The screen was moved to a position about one meter from the aperture and four-fifths of the cloth was then masked off, allowing only the image of the subject's head to be focussed onto the cloth. This image of the head was made via the smaller of the two lenses and at a much closer image/subject conjugate distance (i.e. a focal length of some 500 mm).
- Each day the image of the subject's head was focussed onto the linen cloth. Each morning the aperture was opened and each late afternoon the aperture was closed off.
- After a period not exceeding three days a faint purple-brown negative image of the subject's head formed on the uppermost fibrils of the linen sheet. The aperture was closed off and by the light of candles or torches, this head image was then masked off and the remaining image section of the body from neck to feet exposed. The screen was now moved some four meters from the aperture due to the need to focus an image upon it via the larger lens. This newly exposed section of cloth received the remaining image of the body (sans head).
- Simultaneously, outside the *camera obscura*, the suspended subject was moved to a position some 4000 mm from the lens aperture.
- Each day the remaining image of the subject was focussed onto the linen cloth. Each morning the aperture was opened and each late afternoon the aperture was closed off.
- After a period not exceeding three days a faint purple-brown negative image formed on the uppermost fibrils of the linen sheet. The aperture was closed off and (by the light of candles or torches) the sheet was removed from the screen. The sheet now contained both the image of the man's head as well as the rest of his body from neck to toes. The cloth was turned around lengthways, so that the previously unexposed two-metre section was attached to the screen and the exposed portion of the sheet (which now contained the frontal image and the head) was rolled up. The unexposed section was now positioned such that it could in its turn receive the image of the subject (corpse) positioned outside the *camera obscura*. To this end the subject (or indeed a different subject, if a fresh corpse was needed) was now turned so that it faced away from the aperture and its dorsal view

was now illuminated by the sun for at least three days (i.e. the right side of the body received the morning sun and the left side of the body received the afternoon sun).

- Each day the image of the corpse was focussed onto the linen cloth. Each morning the aperture was opened and each late afternoon the aperture was closed off.
- After this second period of exposure a faint purple-brown negative image of the dorsal view of the subject formed on the uppermost fibrils of the linen sheet. The aperture was closed off and (by the light of candles or torches) the sheet was removed once more from the screen. The sheet now contained the dorsal and frontal images of the two subjects. In the darkened environment, the linen cloth was saturated with ammonium hydroxide and left for a few minutes after which it was repeatedly washed in fresh water. This action may have been repeated several times, depending on the concentration of the ammonium hydroxide. The image was largely indiscernible at this stage, but as it dried became more straw-coloured in appearance.
- After drying the cloth in the sun, scourge marks (consisting predominantly of slightly diluted blood mixed with red ochre) were applied by hand to the image. These were applied by the use of at least two stamps (which ensured a regular bipartite scourge pattern).
- After the application of scourge marks, undiluted blood (with or without an iron based binder) was literally painted/dribbled along the arms and trickled across the small of the back. A thin paint brush was more than likely used for the blood flows in the hair, the inverted “3” blood clot, the wound in the side, and the *stigmata*.
- The *Shroud* may have been given an additional cursory soak after this and then left to dry. Regardless, after centuries of handling, the blood has abraded off the cloth and all that remains today are a few particles which are trapped in the fibrils. The *Shroud* may have originally been trimmed around its border to disguise those areas at the extremities of the cloth that did not come into contact with silver nitrate. Indeed, impregnated areas that do not actually receive an image directly are still slightly darker in tone than pristine sections.
- The obvious distortion to the image of the body and face is caused by a spherical aberration of the original two lenses employed. The head is 10% too small for the body in the frontal image because the head and body were made at different times to each other and with different lenses and different focal distances.

Although I have covered some of the plausible accounts concerning the basic methods employed in order to produce the image as it now appears on the *Shroud* it should be pointed out that it will never be possible to recreate the exact details that occurred when the *Shroud* was originally produced (c. 1250-1355), and a number of issues (which unfortunately must remain forever speculative) should be noted.

- Firstly, it is possible that a life-cast was made from a human subject (exactly as was used by this author for the purposes of experimentation), and that this model and not an actual corpse was used as the subject. If this was, in fact done, the period of exposure could have been extended considerably (without fear of decomposition to the subject). However, from the evidence of the *Shroud's* image itself, including such details as the

swelling of the face and the dislocation of the shoulder it seems far more likely that a corpse (preserved, embalmed or otherwise) was in fact employed.

- Secondly, if a corpse was suspended by a rope or beam it would not appear exactly as is perhaps more idealistically depicted in my hypothetical model. Indeed, to ensure that the corpse(s) did not move about for the minimum period of six days exposure to the sun, the hands and feet would have had to have been bound. In this regard, it is quite possible that the painting (with blood) of the *stigmata* on the wrists served a double purpose, that is: to depict the nail wounds and to cover the image of the binding rope. This notion is supported by the strange blood flows which run across the small of the man's back. Perhaps these were placed there in order to disguise a rope or binding which was originally visible on the image. Also, if the thumbs were bound together to ensure the hands stayed together without a visible rope binding, this would also account for the “missing thumbs” phenomenon.
- Thirdly, the corpse itself could have been suspended in many ways. One possibility, is that a metal spike or bolt was driven into the man's skull. This was attached to either a rope or a thin beam (made of wood or metal), and which was in turn attached to a gibbet or frame some distance above the level of the head. This rope or supporting beam would have been painted matt black in order to cut down reflectivity. Alternatively, the corpse may have been suspended by a rope that was attached to a bolt, which had first been driven into the back of the torso. This rope would have run up the spine and would have been supported by a gibbet (as in the previous example). In this scenario it would have been necessary for a binding to have been tied around both the neck and the supporting rope. This action would have ensured that the head of the victim did roll forward and that it maintained an upright posture.
- Lastly, it is equally possible that the corpse was attached (vertically) to a board (painted matt-black), by means of either metal nails or pins and/or ropes. In all of the above mentioned scenarios it is quite possible that the corpse was also painted matt white. This action would have increased the reflectivity of the surface which not only would have sped up the exposure time but would also have helped to inhibit decomposition of the corpse.

Further Research

It would be imperative that suitably qualified persons conducted a series of non-destructive tests which dealt specifically with the *Shroud's* photographic qualities. In this context it will be well-nigh impossible to verify that either silver nitrate or silver sulphate was the specific light-sensitive chemical employed, because all that mostly remains is oxidised linen.

I believe that atomic silver still resides in the fibrils of the *Shroud*. Here we are talking about parts per million (if not parts per billion). However, it would be possible to calculate the characteristics of the lens or lenses used for this exposure based on the minor distortions that are quite apparent in the image (i.e. the head and feet are smaller in scale than the centre of the body).

Regrettably, the Catholic Church (together with the modern scientific community) is once again uncertain as to how this artefact should be treated - many having too conveniently labelled it as a “fake”. However, I am certain that time will prove my suspicion, that this incredible product of medieval ingenuity, will come to be more correctly regarded as one of the most significant embodiments of the late thirteenth century, not only because of its wealth of socio-theological content but more precisely because it is quite possibly, the single, greatest technological and artistic masterpiece ever produced for its own time.

The *Shroud of Turin*, far from deserving our condemnation as some fraudulent product of the middle ages, should be viewed as an outstanding example of medieval ingenuity. Until now the *Shroud of Turin* has been venerated as one of Christendom's greatest relics, a miraculous production “made without human hand”. Time will show that in fact it is both an important embodiment of the religious and socio-political environment of the thirteenth century. Indeed, the *Shroud of Turin* is concrete evidence of a lost technology which prematurely heralded the dawn of the scientific age while still claiming to be *archeioptera*, literally “made without human hand”.

APPENDIX

In this appendix, I have set out the course that the practical investigation took from its inception in late 1989 until the production of the first successful “shroud” image on linen in 1992.

Phase One

My first objective was to formulate the optimum ratio of a yet to be specified silver salt to distilled water solution, in order to obtain (after exposure to sunlight), a good tonal range of reduced silver on a linen support.

I also needed to ascertain if any chemicals available in medieval times such as ammonium hydroxide, urine, ascorbic acid, gallic acid, borax, sodium chloride etc. could serve as developers and/or fixers.¹⁴²

In this connection phase one of the investigation sought to answer the following questions, namely:

How long did it take a specific light sensitive sample to discolour when exposed to direct sunlight?

What was the darkest tone that a sample could obtain?

How much of the discolouration would remain in the linen after soaking in distilled water?

What affect would certain chemicals, (available in medieval times) that is: ammonium hydroxide, borax, sodium chloride

have on the exposed samples and would they fix the discolouration?

Was it even possible to capture a negative image of a three-dimensional subject with the aid of such primitive light sensitive reagents?

¹⁴² See G. Testi, *Dizionario di Alchimia e di Chimica Antiquaria*, Roma: Casa Editrice Mediterranea, 1950; Hoefer, 1866; Lynn Thorndike, *A History of Magic and Experimental Science: During the First Thirteen Centuries of Our Era. Volume I, II III and IV*, New York: Macmillan, 1923a, 1923b, 1934a and 1934b and Singer [et al.].

The following methodology was applied, that is:

At the commencement of this experimentation it was envisaged that four sets of cloth samples would be prepared with light sensitive reagents (i.e. two employing silver nitrate and two employing silver chloride).

Based on the visual results of these tests it was assumed that a decision could be made as to the formulation of a more accurate recipe. In this regard, any result would be compared with the data from the *Shroud* as regards to colour, tonal range and effect on the linen fibres (as examined under a microscope).

The four recipes that I decided to commence with for these various samples were as follows:

Reagent A: silver chloride (2 % solution);

Reagent B: silver chloride (1 % solution);

Reagent C: silver nitrate (2 % solution);

Reagent D: silver nitrate (1 % solution);

However, almost immediately, this proposed scenario had to be altered. This was due to the fact that silver chloride (which is a precipitate) cannot form a solution in distilled water.¹⁴³

However, silver chloride can be dissolved in ammonium hydroxide, but it was found that this mixture was only partially sensitive to light.

The silver nitrate, on the other hand, was easily dissolved in distilled water. It was for this reason that the silver chloride was scrapped as a potential candidate for future testing. This was in retrospect very short sighted of me, not because I rejected the silver chloride itself, but more importantly because I never considered at this stage the other light sensitive silver salt, namely: silver sulphate. Indeed, I rejected this reagent at the outset because I believed it to be (like silver chloride) insoluble in water.

¹⁴³ A solution of sodium chloride contains sodium ions and chloride ions whereas a solution of silver nitrate contains silver ions and nitrate ions. If these two solutions are mixed together a chemical reaction occurs which results in the formation of a white silver chloride precipitate. This happens because silver chloride is not soluble in water whereas sodium and nitrate ions are. Therefore, if the precipitate is washed regularly the sodium and nitrate ions are eventually removed leaving the relatively pure silver chloride precipitate behind.

Therefore only reagent C and D were employed for phase one. To this end, four pieces of linen cloth were stretched on a wooden support and painted by brush with reagent C. This action was repeated with reagent D.

The four pieces painted with reagent C were termed C1, C2, C3 and C4.

The four pieces painted with reagent D were termed D1, D2, D3 and D4.

C1 and D1 were placed in direct sunlight and timed as to any general discolouration. Sample C1 turned a dark mauve-brown within 10 minutes. After 24 hours C1 was a deep chocolate brown. The fibres were discoloured far more strongly on the side facing the direct sunlight.

Sample D1 took 30 minutes to discolour to a pale burnt sienna. This discolouration did not alter significantly after 24 hours. As with C1, only one side of the linen cloth was seriously affected by the action of sunlight.

It was obvious from this test that reagent D exhibited very similar characteristics to the image on the *Shroud of Turin* (both in terms of coloration and the condition of the fibre), and it was decided to only continue testing with reagent D. To this end, D2 was placed in direct sunlight but was covered by a light proof piece of card. Every five minutes this card was moved across the face of the linen sample to test for gradation of tone. After 30 minutes it was confirmed that a wide range of tonal variation could be achieved from pale yellow-brown to a pale burnt- sienna (the latter tone appearing exactly like a scorch mark).

D2 was placed in a bath of ammonium hydroxide (5% solution) and then after one minute, was rinsed under running water. The tonal range became fainter, but still clearly discernible. In addition, this “image” after ammonium hydroxide treatment was permanent and could be freely exposed to the sun with no further discolouration taking place. This result was extremely important (and almost too easy to obtain) because right from the beginning of these tests it was confirmed that ammonium hydroxide (NH_3 (aq)) can fix the discolouration of silver nitrate on linen cloth. Of course at this time I did not understand why I was obtaining the result I was. All I knew for certain was that it worked.

D3 was placed in direct sunlight with an object on top (i.e. a pair of scissors), after ten minutes this cloth was placed in a bath of ammonium hydroxide (5% solution). After one

minute the cloth sample was washed in running water and then slowly dried in the dark room. This negative image of a pair of scissors is now quite permanent.

D4 was placed on the screen in the *camera obscura* and exposed to the image of the plaster head. The image itself, was focussed by the employment of the double-lens apparatus. The image conjugate distance and object conjugate distance totalled some 3000 mm. The day of the test was a mild one with scattered cloud. It was assumed that if a negative image could be achieved on such a moderate day then a hot, clear day would produce even better results. Surprisingly, after eight hours there was no perceptible change to the sample.

I therefore, decided to repeat the above test on a hot, clear day and with a reduced image conjugate distance - thus bringing the sample closer to the light source. This of course has the effect of making the image smaller than life-size. In addition, it was decided to employ the services of the small test *camera obscura* for this type of test. This initiated phase two of the practical investigation.

Phase Two

I now endeavoured to produce a naturalistic, negative image of the plaster head on a sample of linen cloth impregnated with reagent D.

In this connection, phase two of the investigation sought to answer the following question, namely:

Was silver nitrate (1% solution) sufficiently sensitive to record the tonal variation of a focussed image of a three-dimensional object on a hot clear day?

A fresh piece of linen cloth (10 x 20 mm) was prepared 24 hours before each test with reagent D.

The image of the plaster head was focussed (by means of the double lens) onto the rear wall of the small test *camera obscura*. Because of the reduced image conjugate distance only a half life-size image was produced of the original head.

After eight hours of exposure there was no perceptible change to the linen sample. In addition, it was not possible to develop any hypothetical latent image by using either borax or ascorbic acid. In fact, the admixture of ascorbic acid (1% solution) to the sample caused

the entire cloth to turn dark orange-brown almost immediately.

It was realised at this stage that the following factors applied to the use of silver nitrate (1 % solution) which had been painted onto linen material and allowed to dry slowly in a darkroom before exposure, namely:

silver nitrate (reagent D) impregnated linen samples changed colour within two minutes of exposure to direct sunlight.

these silver nitrate samples could produce a good tonal range equal to and better than the image on the *Shroud of Turin*.

the silver nitrate samples displayed (visually) the same characteristics (in terms of coloration and the condition of the linen fibres) as found on the *Shroud of Turin*.

the silver nitrate samples could not record an image that was focussed with the double-lens construction, regardless of the weather conditions, the length of exposure in one day, or the distance of the sensitised cloth from the lens.

It was realised that there was only one possible explanation to this latter problem, namely: the double-lens apparatus was blocking out part of the spectrum necessary to effect a change to the silver nitrate solution (reagent D).

Considering that the samples could change colour rapidly on even overcast days but not inside the house or at night under normal tungsten light it was realised that the glass lenses were the sole cause of the problem and that some information was needed concerning the refractive indices of glass and the ultraviolet spectrum.

Ultraviolet Light

It should be remembered that human vision (and most modern photography) is limited to the visible spectrum. More specifically, the extent of human vision is limited by the sensitivity of the eye's cone receptors to wavelengths from about 380-700 nm.

However, this range may be extended under special circumstances. For example some individuals can perceive wavelengths below 350 nm and if confronted by a strong infrared

source, the human eye may detect wavelengths in excess of 900 nm.¹⁴⁴

The ultraviolet spectrum extends from 1 nm to 380 nm and below 350 nm is for all intents and purposes invisible to human perception. However, this narrow band of the electromagnetic spectrum accounts for 10 % of the sun's radiation which due to the absorption of the earth's ozone layer and atmosphere, is cut to less than 4% by the time it reaches sea-level as UV.

This amount is also subject to the conditions of the atmosphere and seasonal changes. In addition, as was deduced from the initial experiments undertaken to produce a negative image with silver nitrate, it seemed that only the violet and ultraviolet spectrum has any immediate affect on a silver nitrate solution. Unfortunately, all optical materials, e.g. glass, air, water etc. have strong absorption bands in the UV region and apart from quartz and calcium fluoride (fluorite) make poor transmission lenses or mediums.

The ultraviolet spectrum may be split up into a number of sub-divisions. The following divisions are adequate for the purposes of this investigation¹⁴⁵ namely:

- Near UV or “black light”: 320-380 nm.
- Middle UV: 200-320 nm.
- Vacuum UV (VUV): 1-200 nm.

This latter division contains the so-called “Schumann region”: 120-200 nm.

If one looks at the table showing the UV transmission limits of some selected optical materials (table), it will be seen that quartz cannot transmit UV below about 185 nm. This should not be seen as a problem because even oxygen cannot cope below about 190 nm.

Indeed, the gelatine that constitutes most modern photographic emulsions has a transmission limit of as high as 250 nm which leaves very little of the UV spectrum available for most photographic work.

However, it was never necessary to use gelatine for these tests, thus the employment of a

¹⁴⁴ C. R. Arnold [*et al.*], *Applied Photography*, London: The Focal Press, 113-4.

¹⁴⁵ Arnold [*et al.*], 257.

quartz lens extended the electromagnetic spectrum by an additional 130 nm, (i.e. 320-190 nm) - the only area of the spectrum that could in fact make an impression on the silver nitrate solution in a short time-span.

I soon discovered that optical glass will only allow the light spectrum range 320-380 nm and that only quartz was capable of allowing penetration by the spectrum between 180 - 250 nm. Below this point ultraviolet rays cannot penetrate even oxygen or water.

Thus, it was apparent that silver nitrate responds to that part of the spectrum which glass cannot cope with i.e. middle ultraviolet spectrum.

If one considers that due to the protection of the earth's atmosphere only 4% of the Sun's total UV output actually reaches sea level, then it becomes clear why the exposure time had been so slow (in comparison to more modern emulsions).

It also became clear that silver nitrate could be prepared without the necessity of a darkroom, in fact the solutions could be mixed at night by candle light, or even by day as long as the curtains were drawn.

The Quartz Lens (40 mm diameter)

It was necessary at this stage to produce a quartz lens. To this end a number of tests were made with glass lenses of either bi-convex or plano-convex structure. These tests were undertaken in order to ascertain the correct specifications for any proposed manufacture of a quartz lens (as regards its focal length) at a later date.

In this regard, it was found that a single lens of .75 power (bi-convex) was able to produce a focussed image of a human head with no apparent image fall-off problems. The lens eventually chosen as a model for the envisaged quartz lens had a diameter of 50 mm.

As has already been shown, these dimensions and powers of magnification compare favourably with the lenses which were available literally millennia before the medieval period.

A number of attempts were made to produce a lens from rock crystal but it was found to be extremely difficult to acquire a large enough example that was both optically clear and

flawless. In addition, professional lens makers found that the quartz cracked very easily if too much heat was generated during the grinding and polishing stages of production.

These factors threatened to undermine any further attempts at conducting experiments with the silver nitrate solution, but fortunately, due to the kindness of Mr Dan van Staaden and Mr Derek Griffith, both of the CSIR (Council for Scientific and Industrial Research) in Pretoria, a synthetic quartz, bi-convex lens was made available to me for testing purposes. This lens was far from ideal, having a diameter of 40 mm, a thickness of 4 mm and a dioptre of 2. Even so, this lens was able to focus a three-quarter size image of the original subject and was certainly able to be used for any testing with UV radiation, an event which launched phase three.

Phase Three

The primary objective of phase three was almost identical to that of phase two, namely to produce a negative, naturalistic image of the plaster head but employing the (CSIR) quartz bi-convex lens and a piece of linen cloth prepared with reagent D.

The piece of linen material prepared with reagent D was placed in the small test *camera obscura*. The synthetic quartz lens was inserted into the aperture and the plaster head was set up opposite the lens. The area behind the head was blocked off with a screen which in turn was covered with a non-reflective black cloth. An attempt was made to give the linen cloth eight hours of exposure on a hot, clear day.

It must be noted that the small test *camera obscura* was set up in such a manner as to ensure an equal amount of sunlight in the morning as in the afternoon, i.e. the exposure was set to commence at 08:00 and to end at 16:00. The subject was a plaster head. The image achieved was three-quarters life size. I discovered that after eight hours of exposure, a faint negative image of the subject was obtained. However, on fixing this image in ammonium hydroxide (5% solution), the image virtually disappeared, leaving only a trace of its former intensity.

I realised at this point that UV was indeed responsible for the image on the linen cloth (impregnated with reagent D) but that after only eight hours of exposure the material which composes the linen fibrils (i.e. cellulose, hemicellulose, lignin, pectin etc.) had not been adequately oxidised. To be sure, all that was happening was that the vast majority of the silver nitrate solution (both reduced and unreduced) was being washed out during the

“fixing” process.

Of course, I realised that I could have mixed the solution with gum Arabic or some other binder in an attempt to better adhere the reduced silver to the linen fibrils. This action, however, would have contradicted the physical evidence as found on the *Shroud of Turin*. That is, unless a binder had been employed which was then completely washed out at some time during the process. I therefore decided to find a solution to this problem which did not employ binders of any description.

Phase Four

I commenced phase four in a very positive state of mind, having established that my original hunch was beginning to bear some fruit, so-to-speak. However, my real objective had still to be obtained, namely, to produce a negative, naturalistic image of the plaster head employing a quartz bi-convex lens and linen cloth prepared with reagent D.

I placed another piece of linen material prepared with reagent D in the small test *camera obscura*. The synthetic quartz lens was again inserted into the aperture and the plaster head was set up opposite the lens as for phase three.

An attempt was made to give the linen cloth 24 hours of exposure on three successive, hot, clear days. At night the aperture was masked to protect the cloth from any background radiation. What a blow to my confidence, when I discovered that after 24 hours of exposure that the entire surface of the cloth (containing both the image and the background areas) was discoloured to such an extent that no clear image was discernable. I realised that the reagent was turning brown on its own accord (i.e. independent of the action of UV) at a constant rate. This discolouration had a different appearance to the discolouration caused by the action of UV radiation. Of course any chemist will tell you that silver nitrate is an oxidising agent - a factor I was totally unaware of at the time - but at least I knew that if I could somehow make the silver nitrate solution less reactive I might have more success. I therefore halved the concentration of reagent D (i.e. I mixed up a 0.5 % solution of silver nitrate in distilled water) and christened it reagent E.

Phase Five

My objective remained exactly as it had been before. It was necessary for me to produce a

negative naturalistic image of the plaster head employing a quartz bi-convex lens and linen cloth prepared with a reagent which was less sensitive than reagent D.

To this end a piece of linen material prepared with reagent E (0.5 % solution) and was placed in the small test *camera obscura*. The synthetic quartz lens was inserted into the aperture and the plaster head was set up opposite the lens as for phases three and four.

An attempt was made to give the linen cloth 24 hours of exposure in strong sunlight and this time I hit pay dirt. I was rewarded with an excellent negative image of the plaster head after three days of exposure. This was despite the fact that the weather had not been ideal during this three day period (a factor which made this positive result all the more surprising at the time).

The image displayed a good tonal range and also a three-dimensional quality similar to that when observing the inside of a plaster-of-Paris mould taken from life. In addition, I observed that the negative image of the plaster head was more intense in the region corresponding to the area of highest reflectance. In this particular case, I had wrapped a white linen sheet over the original flesh-coloured, plaster bust to simulate long Christ-like hair. In the negative photographic image of the bust, this white linen head covering was noticeably more detailed than the negative image of the face itself. I realised that the head covering (because it was made of white linen) had reflected more UV radiation than the flesh coloured areas of the plaster head. In other words, it was fairly obvious that not only highlights such as cheeks, forehead, nasal ridge, chin *etc*, but also, more reflective (whitened) areas were contributing to the formation of the negative image on the prepared, light sensitive, linen cloth.

I also noticed that no perceptible discolouration had occurred elsewhere on the linen cloth, only those areas subjected to UV radiation were noticeably affected. This latter point is most important, because it seemed to imply that under perfect weather conditions such a piece of prepared cloth will not become too discoloured, as long as it is not displayed in direct sunlight. This means that the cloth (without fixing) may be left uncovered indoors for a short period (two to three hours) even on bright and sunny days. In addition, such a cloth may be transported outside for very short periods on heavily overcast days. In short, it is quite possible to impregnate a small piece of linen cloth with reagent E outside of a darkroom, dry it in the shade and then “load” it into the *camera obscura*.

On fixing the phase five image in ammonium hydroxide (5% by volume), a great percentage

of the detail was lost, However, that detail which remained, although extremely subtle, is quite visible under certain lighting conditions. An enhanced negative photograph of the image reveals a fairly good positive image of the plaster head (Plate 11).

In the light of this breakthrough I decided to increase the length of exposure and to increase the reflectivity of the plaster head in a further series of tests.

Phase Six

I desired to achieve an image which could be more easily compared to the image on the *Shroud of Turin*. To make the plaster head more Christ-like, a beard and moustache (based on the *Shroud of Turin* image) were added. In addition, in order to increase reflectivity, the head and beard were painted white.

The prepared linen cloth was placed in the small test *camera obscura*. The synthetic quartz CSIR lens was inserted into the aperture and the “improved” plaster head was set up opposite the lens as for phases three, four and five and an attempt was made to give the linen cloth 24 hours of exposure over a three day period.

A series of rain storms interrupted the exposure. Because of this factor, the exposure time was erratic in the sense that it received more morning light than afternoon light over a six day period. Nevertheless, I calculated that (excluding the periods the small test *camera obscura* was under cover from the rain), the cloth was exposed for a total of 20 hours.

The image produced on this occasion (despite the bad weather and reduced exposure time) was much better than the one produced in phase five. This was obviously due to the fact that the “improved” head was more reflective than before.

The image was fixed with ammonium hydroxide as before and although much of the detail was lost the remaining image was much clearer than for phase five.

It should be further noted that this image was only fixed eight days after it was removed from the small test *camera obscura* (or 14 days after its original preparation). In all this time the cloth had not become discoloured in any area other than that exposed to UV radiation.

Although this test (phase six), had been ruined by the weather it had confirmed many of the assumptions that had been made up until this time and it was now possible to repeat this

test with more confidence.

Phase Seven

The plaster head was set up exactly as it had been in phase six and the prepared linen cloth was placed in the small test *camera obscura*. The synthetic quartz lens was inserted into the aperture and the “improved” plaster head was set up opposite the lens as for all previous tests. An attempt was made to give the cloth a six day exposure in good weather. I exposed this particular piece of cloth for seven consecutive days of which two were cloudy. The image that was achieved on this occasion was outstanding, as can be immediately seen by observing the enclosed photographs.

This image was fixed in ammonium hydroxide (5% solution) and the results recorded. In this regard, one will notice that in the fixed version of the phase seven image, the subtle, yellowed image of the bearded head on the linen cloth is almost identical to the image on the *Shroud of Turin*. The highlights such as the bridge of the nose show (even after fixing) a delicate gradation of tone. The eyes appear owlsh, the moustache is clearly demarcated. The image only appears on the surface of the fibrils and no image is visible on the reverse of the linen cloth.

Dr Petr Schürek

At about the same time I was conducting my tests, I made contact with the Port Elizabeth branch of the CSIR (Centre for Scientific and Industrial Research). This institution specialises in textile research and during the latter months of 1993 I made the acquaintance of one of its scientists - Dr Petr Schürek - who happened to be an expert in the subject of organic fibres (especially linen). Petr kindly agreed to undertake a series of tests for me - tests that would hopefully throw some light on what was happening with my test pieces which “contained” a negative image. In this regard, I knew at this stage, *how* to make the images and realised that if my hypothesis was correct, then my particular method of obtaining a *Shroud*-like image may also have explained how the *Shroud of Turin* images were produced. However, I needed the insights of a chemist, one who could explain to me precisely what was happening at the molecular level. Only then could I compare my results objectively with the results of the 1978 STURP commission. Petr and I became good friends over the months and he had some good ideas concerning the exact chemical reactions that

were taking place with my test pieces. Before long he had developed a scientific “model” which could account for the cause of image formation on my test pieces and which also supported my notion that my fibres were being oxidised in some way.

I should mention that at this stage, I thought that perhaps the ammonium hydroxide (NH_3 [aq]) was affecting the linen fibres, perhaps even dissolving them briefly, such that small particles of reduced silver were being trapped in their matrix, thus contributing towards the image formation. Petr, however, thought that the image was caused completely by the effects of oxidation. To prove his hunch concerning the precise way this was occurring, a series of tests were initiated which were designed to prove once and for all the causes of image formation as found on my test pieces produced back in 1992 (phase seven).

The reader should be reminded at this point of some very pertinent details supplied by the 1978 STURP commission, information which if compared with my own tests will confirm beyond a shadow of a doubt that the *Shroud of Turin* is in fact a negative photograph of a human subject. To this end, the more pertinent results of the 1978 STURP commission are reassessed briefly below.

Infrared reflectance spectroscopy

As a result of a series of infrared reflectance spectroscopy investigations made by Accetta and Baumgart in 1978 it was possible to compare the spectral features of selected *Shroud* features (i.e. areas of “bloodstain, body image, “pristine” linen and scorch and water marks caused by an accidental fire in 1532). In particular, it was found that no notable differences existed between the spectral features of the scorch marks and those areas of the linen which contained details of image. Accetta states that the image areas are

those parts of the cloth containing the anatomical attributes of the figure in the cloth. Generally, spectra were taken in those areas where the image was visually dense...Spectral comparisons of linen and a moderate scorch (...) display similar features in the 3-5- and 8-14- μm bands(...). In general, scorch spectra are invariant with respect to visual intensity, showing nearly identical reflectances in both spectral bands. Furthermore, there exists almost negligible spectral variation between scorches and bare linen...laboratory observations of scorches on linen are similar to scorches on the *Shroud*. Also shown is a marked similarity between image and scorch areas in both spectral bands.¹⁴⁶

Accetta goes on to conclude that the “spectral similarity of the image areas to known

¹⁴⁶ Accetta, J.S. & J.S. Baumgart, *Applied Optics*, 19, 1921-1929 (1980).

scorches is noted and is consistent with observation in terms of color in the visible region of the spectrum, however; this result is not without ambiguity since spectral similarities are characteristic of most areas examined as shown by the data in both spectral bands.¹⁴⁷

Photomicrography

It will be recalled, that another member of the STURP team, Samuel Pellicori, produced a series of photomicrographs of the *Shroud* in 1978. He noted that although there was a notable difference between the scorch marks and the water marks of 1532, he did observe certain similarities between the scorch marks and areas of image. Pellicori informs us that the water stains

had some distinct characteristics, notably that they penetrated the linen's threads to all depths, including around bends and into crevices in the fibre, which made for a darkish brown saturated appearance. The water stains also have an abrupt boundary where the unwetted areas begin. The scorches on the other hand, altered the coloring of the bulk of each fibril to a constant density - that is, also regardless of bends and crevices. But as might be expected from a scorch, these marks had a diffuse and gradual boundary.¹⁴⁸

Pellicori also tells us that the body image itself is

a uniform, light sepia yellow color on the points of highest relief of the threads, or in other words, on the outermost surface of the Shroud. There is no indication of any artificial coating or pigments on the surface of these darkened fibrils. Some areas, presumably those where contact between the body and Shroud was more complete or direct, simply have more of the darkened fibrils. The images of the cheek, eyes and fingers are primarily registered on the upper crowns of the threads. Yet even in the darkest and atypical of areas - the heel and nose - the image stain does not penetrate to the reverse side of the cloth and shows no evidence of any mixture of blood.¹⁴⁹

Apart from his comment about the possible “contact” between body and cloth, an assumption that has frustrated much of the research into this phenomenon thus far, Pellicori's comments confirm that some correspondence exists between the distance of the original body from the linen cloth and the actual intensity of that image.

¹⁴⁷ Ibid.

¹⁴⁸ Pellicori, S.F. & S.M Evans, *Archeology*, 34, 34-43 (1981).

¹⁴⁹ Ibid.

Visual comparisons between the image characteristics of the *Shroud of Turin* and the 1992 test image

The various STURP reports concur with the visual observations made of the test sample produced in 1992. To this end, a visual comparison of the image as found on the *Shroud* and on the above mentioned test piece, reveals that both images have the following common characteristics, viz:

- a straw-yellow discolouration of the upper fibrils of the linen material;
- the appearance of being photographic negatives which are only visually coherent at distances upwards of two metres; and
- no pigment, powder, dye or stain.

The image as produced in 1992 was produced by the actions of UV radiation (195-240 nm), on a linen cloth sample (300 X 200 mm) saturated in a dilute solution of silver nitrate (0.5%). This image (which took at least four days to form), was originally a dark purplish-brown colour. After immersion in a dilute solution of ammonium hydroxide (5%), this image appeared to lose much of its detail and simultaneously assumed its present straw-yellow colour. However, when re-photographed by more conventional means, the negative print reveals a highly detailed, positive image of the original subject.

Towards formulating a theoretical model for image formation

From this visible result, the following hypothesis may be conjectured:

- after initial exposure to the sun, the purplish-brown image is caused by reduced silver nitrate in the presence of UV radiation;
- after immersion in an ammonium hydroxide (NH_3 [aq]) solution, most (if not all) of the silver is removed from the linen cloth; and
- the resultant straw-yellow image is formed not by the presence of silver but by a structural (chemical) alteration to the linen (cellulose) itself.

To examine this hypothesis a number of tests were conducted:

Verification of the photographic hypothesis

To confirm the exact concentration of any possible residual silver nitrate, an ICP-MS analysis of the digested cloth was undertaken. For this purpose four samples of linen material were prepared as previously mentioned. The analyses were performed in triplicate on both blank and treated samples, viz:

- three samples, each measuring 300 X 200 mm, and labelled A¹, A² and A³ respectively, were saturated in a solution of silver nitrate (1%). These were exposed to the sun until they had turned a uniform dark purplish-brown and were dry to the touch.
- These samples were each immersed in a solution of dilute ammonium hydroxide (5%), cursorily washed, dried naturally in sunlight and sealed in sterile plastic envelopes;
- three samples, each measuring 300 X 200 mm, and labelled B¹, B² and B³ respectively, were left untreated and sealed in a sterile plastic envelope.

Sample ID	Ag concentration (μg^1)	ppm
B ¹ (untreated)	<0.0002	2
B ² (untreated)	<0.0002	2
B ³ (untreated)	<0.0002	2
A ¹ (treated)	0.4	400
A ² (treated)	0.2	200
A ³ (treated)	0.2	200

Table 3
ICP-MS test results

These tests were sent to Plymouth University where Dr E. H. Evans determined the exact levels of silver contained in these samples by employing the following method, viz:

Sub-samples (0.5g) were cut from each of the six linen samples, and heated gently with concentrated nitric acid (10ml) for approximately 2 hours (i.e. until nitrogen oxide fumes ceased to be given off). The sub-samples were then boiled down to approximately 2 ml and then quantitatively transferred to 25 ml volumetric flasks and made up to volume with deionised distilled water. 250 μL of indium solution ($10 \mu\text{g ml}^{-1}$) was added as an internal standard. Analysis was performed using Inductively Coupled Plasma Mass Spectrometry. Evans noted

that the digestion had not been completely successful, as some undigested material (possibly colloidal in nature) settled out at the bottom of each flask. Although it is quite certain that most of the analyte remained in solution, given the high acid concentration, Evans advises that the following test results should only be regarded as semi-quantitative viz: Considering that the treated samples analysed by Evans had higher concentrations of silver nitrate than was employed in all of the test pieces which contained an image and in addition were not washed as vigorously as for pieces containing an image, it is certain that the residue of silver (in a sample containing an image) will be far lower than the figures reflected above. It should also be borne in mind that the concentrations of silver in a piece of linen saturated with silver nitrate (1%) (before being washed with ammonium hydroxide) would be about 10 000 ppm. This result very strongly indicates that the permanent image as found on the test piece is formed solely by a chemically induced alteration to the linen fibres (cellulose) and not by silver.

Viscosity and Methylene Blue Tests

In the light of the preceding data, it was necessary to deduce what changes were occurring to the linen material which could account for the straw-yellow discolouration of the upper fibrils. Dr Petr Schürek undertook a series of standard tests to determine if there was a change in the degree of polymerisation of the cellulose and hemicellulose in the treated linen samples when compared to untreated linen samples. These were conducted in accordance with the procedures as laid down by the British Standard Method test for the determination of the cuprammonium fluidity of cotton and certain cellulosic man-made fibres.¹⁵⁰

The following results were obtained, viz:

- the degree of polymerisation (D.P.) was reduced from an average of 2800 (for treated linen) to an average of 2100 (for untreated linen).

In addition, a standard methylene blue test was conducted in accordance with the procedure as described by Earland.¹⁵¹ This test which is dependent on the absorption rate of methylene blue by cellulose indicated that the cellulose of the treated linen samples was more oxidised than that

¹⁵⁰ BS 2610:1978

¹⁵¹ Earland, C. & Raven D. J. Experiments in Textile and Fibre Chemistry, London, 1971.

of untreated linen samples.

Discussion

In the light of the work undertaken by the STURP commission in 1978 and from the data reviewed here, it is possible to propose a hypothetical model for both the nature and the causes of the structural alteration which occurs to the cellulose of organic fibres such as linen, cotton and hemp when they are saturated in silver nitrate solution, exposed to UV radiation and immersed in dilute ammonium hydroxide, viz:

The silver nitrate or silver sulphate is reduced by the actions of the UV range of the light spectrum. This reduction (in the case of silver nitrate) may be expressed chemically as



and is thus responsible for the production of free radicals which cleave the molecular chains which form the cellulose structures of the linen fibrils. These cleavages (oxidation) are possible in certain places along the cellulose polymers (i.e. both branched and linear structures). It should be kept in mind that linen is a very complicated structure and that it would be very difficult to state with any degree of certainty, the specifics of these cleavages. In this regard, the following diagram (Table 4) is a proposed model which explains one possible occurrence of photochemical degradation of a typical carbohydrate polymer (such as may be found in an organic fibre such as linen).

Table 4a represents a section of a carbohydrate polymer, if this is saturated with a silver salt and subjected to UV radiation, photochemical degradation of the carbohydrate polymer will result. In the case of silver nitrate, the silver ions would reduce to silver atoms, releasing radicals which would cause a photochemical degradation of the carbohydrate (cellulose) polymer. In addition, the nitrate anions may also form radicals which would speed up the process of photochemical degradation. In the case of silver sulphate, the silver ions would reduce to silver atoms, releasing radicals which would cause a photochemical degradation of the carbohydrate (cellulose) polymer. It is unlikely that the sulphate anions form radicals to any significant degree (if at all) and this point is supported by the fact that it takes longer to produce a “shroud” with silver sulphate than with silver nitrate.

Table 4b shows subsequent hydrolytic cleavages that would occur as a result of the

photochemical degradation.

This chemically induced oxidation of the cellulose, which is structurally similar to oxidation caused by natural ageing and scorching is proportionally more prevalent on the upper-most fibrils which constitute the linen threads and is presumed to be more intense in low crystallinity zones. It is also important to note that in addition to the possible cleavages caused directly by the action of either silver or nitrate ions (free radicals) as stated above, the possibility equally exists that these free radicals could give rise to an energy transfer. Briefly stated, as a result of the action of UV radiation, the generated radicals could cleave the hydrogen bond of the hydroxyl group of cellulose. This in turn could liberate a hydrogen ion which could also be responsible for yet further cleavages in any of the following cellulose groups, viz:

- the carboxyl group;
- the ketone group; and
- the aldehyde group.

It is quite certain that it is not possible to achieve the very specific qualities of image as found on the *Shroud of Turin* and the 1992 test samples by any artistic or natural process which involves the use of vapours, dyes, pigments, powders or stains. It is known that the *Shroud* was most likely manufactured sometime after the mid-thirteenth century (definitely not later than 1355 CE), and is not miraculous. It would seem therefore, (subject to further corroborative testing of the *Shroud* itself), that the hypothetical photographic technique as elucidated earlier in this article, the only plausible explanation for image formation on the *Shroud of Turin* and implies very strongly that persons living in the late thirteenth or early fourteenth century were indeed privy to a photographic technology which was previously thought to be unknown before the beginning of the nineteenth century.

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