COLOUR AND LIGHT IN THE SEVENTEENTH-CENTURY CHURCHES OF ARBANASSI, BULGARIA

Elza Tantcheva-Burdge
MA (Sofia), MSc (Plovdiv), MA (Sussex)

A thesis presented for the degree of
Doctor of Philosophy,
University of Sussex

May 2013

DECLARATION

I hereby declare that this thesis, whether in the same or different form, has not been previously submitted to any other University for a degree.

…………………………………………………………….

UNIVERSITY OF SUSSEX

ELZA STOYANOVA TANTCHEVA-BURDGE

THIS THESIS IS PRESENTED FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

COLOUR AND LIGHT IN THE SEVENTEENTH-CENTURY CHURCHES OF ARBANASSI, BULGARIA

SUMMARY

This thesis evaluates the use of colour and light in four seventeenth-century church interiors in Arbanassi, Bulgaria. The aim is to elucidate the appearance of the wall paintings in these churches in the context of the specific use of colour and in the lighting conditions pertaining when they were painted. The investigation both uses existing methods and also creates new scientifically-based ones to address questions concerning the extent to which colour and light were intentionally employed in ways evidenced by common patterns. The underlying hypothesis is that the decoration can be asserted as an embodiment of the ways colour and light were employed in Eastern Church decoration at that period in the Bulgarian province of the Ottoman Empire.

In all the churches examined the artists used palettes restricted to a small but constant number of hues. I discuss how they used light and colour contrast to manipulate the appearance of the images. As present the interiors are lit by electric light. The investigation into the interior lighting reveals that the natural lighting is of an even but low intensity, allowing the artificial lighting to dominate. I devised a methodology to assess the effect of the original interior illumination on the appearance of the naves in the context of Professor Chalmers and others in the computer reconstruction of historic sites under their original illumination.

By departing from conventional art-historical assessments, without merely accumulating technical data, my research challenges previously accepted presumptions and offers a means of revealing the optical complexity of the interiors. While this provides increased knowledge and understanding of the visual practices employed by the artists, the wider significance of this thesis lies in the way it bridges the existing division between science and the humanities and in its development of new methods for art historical research.

CONTENTS

CHAPTER THREE

CHAPTER FOUR

CHAPTER FIVE

PART II

ACKNOWLEDGEMENTS

During the research for and writing of this thesis I enjoyed assistance and encouragement from numerous people, to all of whom I am most grateful. There were so many that some will inadvertently have been omitted from these acknowledgements, for which I apologise.

I am indebted to many Bulgarian scholars, but first and foremost to Professors Lyuben Prashkov and Bisera Penkova from the National Academy of Art and Professor Gyorgi Gerov of the Crypt Museum of the Alexander Nevskii Cathedral, Sofia, for their encouragement and for the wealth of information they provided; to Dimitr Russev and Rositza Petrova from the Institute of National Monumental Arts, Sofia, and especially to the Institute's then director for providing the much-needed permission to carry out fieldwork in the churches of St Atanass and St Dimitr that are closed to the public and to Dimitrina Koseva for being a great support in my struggles with the Turnovo Museum Authority.

Thanks are also due to the late Isaak Isaakov, geologist, for providing data on the reflectivity of the building stone used in Arbanassi; to Dr Rositza Rutževa, for allowing me to consult the text of her doctoral thesis on the Church of St Atanass; to Dr Ivan Todorov and Dr Rositza Gradeva from the Institute of History of the Bulgarian Academy of Science, who helped me navigate through the Institute's enormous library; to Professor Lyuben Gyuzelev of the Institute for sharing his knowledge and vast experience; to the research section of the National Library 'Cyril and Methodius' in Sofia for preparing for me a comprehensive bibliography on Arbanassi and Turnovo; to the secretary of the Sofia Metropolitan who procured permission for me to visit the archives of the Bulgarian Patriarchy; to Father Petkov from the Plovdiv seminary, who provided guidance on aspects of the history of the Bulgarian Church and finally to Kremena Argirova, for helping me work through a number of issues that arose during my research.

I also owe special thanks to the Konica Minolta company for helping me to locate a spectrophotometer and for advising on the type of equipment I needed for my fieldwork. This led me to two people without whose encouragement and help this research could not have been completed: Professor Stephen Westland and Dr Vien Cheung from the University of Leeds. They generously allowed me to use the equipment from the Konica Minolta laboratory at the University and Dr Cheung then carried out all the necessary calculations for finding the nearest Munsell match for the colours recorded. I am also very grateful to them for many stimulating discussions, for the joint publications arising from my research and for their friendship.

Thanks are also due to a number of other scholars both from this country and abroad. I am grateful to Dr Catherine Oakes of Kellogg College, Oxford, for helping me to take the first steps in my chosen area of research; to Dr Robert Jordan from the Byzantine Institute, Belfast, for his patience and thoroughness in checking some of my early scripts; to Dr Dirk Krausmuller, Mardin University, Turkey for helping with the translation of some Turkish texts; to Dr Alice-Mary Talbot, Director of Byzantine Studies, at Dumbarton Oaks, Washington DC, for permission to use their library; to Natalia Teteriatnikov, also of Dumbarton Oaks, for enlightening conversations on Athonian church decoration; to the Revd Deacon Meliton Oakes of the Archdiocese of Thyateira and Great Britain, for instruction and literature on the Orthodox calendar and saints; to Dr David Saunders from the British Museum for providing information about the colour temperature of flame light; to Boris Pretzel, Dr Lucia Burgio and Dr Tim Stanley, all from the Victoria & Albert Museum, for advising on the range of seventeenth-century Islamic pigments and to John Allan, consultant archaeologist, for assisting my research into the orientation of church buildings.

I am greatly indebted to Dr Nasser Madani for technical help in producing the schematic analysis of the interaction of the church architecture with sunlight and to Mrs Joy Madani for proof-reading my text and providing much-needed encouragement.

I would like to record my gratitude to all at the University of Sussex who made this thesis possible, beginning with the authorities who awarded me a Seed Corn Scholarship, without which I would not have been able to undertake my research. I must also thank Professor Daniel Osorio and Dr Anderson, both of the School of Life Sciences, for advising on the type of colour chart to include in my photographs and for conducting some spectral data comparison in the early stages of my investigation. In the Department of Art History I am grateful to Dr Bente Bjornholt for her unwavering support and encouragement. Last, but by no means least, special thanks are due to my supervisor, Professor Liz James, who bore with exemplary patience my attempts to introduce scientific methods into art historical research and for the support and encouragement she gave me, particularly at the time of my viva.

Finally, affectionate thanks are due to my father, Professor Stoyan Tanchev, for making contacts and helping to obtain numerous permissions for me in Bulgaria and for his encouragement throughout, and to my husband, Peter Burdge, for supporting me through many difficulties despite, in the process, having to learn more about Arbanassi than he had intended.

LIST OF ABBREVIATIONS

PPH	Physical Properties Handbook
SPIE	Society of Photographic Instrumentation Engineers
PI	Problemi na Izkustvoto
AA	American Antiquity
ACS	Applied Clay Science
AOP	Arheologicheski Otkritia i Razkopki
APS	American Philosophical Society
ASTM	American Society for Testing and Materials
AV	Holy Bible, Authorised Version
BAN	Bulgarska Academia na Naukite
BMGS	Byzantine and Modern Greek Studies
BS	Balkan Studies
CA	Church Archaeology
DOP	Dumbarton Oaks Paper
DOS	Dumbarton Oaks Studies
DS	Daržaven Standard
GMSB	Godishnik na Muzeite v Severna Bulgaria
GSU	Godishnik na Sophiiskia Universitet
IBAD	Izvestia na Bulgarskoto Istorichesko Družestvo
IBAI	Izvestia na Bulgarskia Arheologicheski Institut
IF	Istoriko Philologicheski (klon)
IIGA	Izvestia na Instituta za Gradustroistvo i Architectura
IIMVT	Izvestia na Istoricheski Muzei Veliko Turnovo
IJDNE	International Journal of Design & Nature and Ecodynamics
JCN	Journal of Comparative Neurology
JOSA	Journal of the Optical Society of America

MAA	Mediterranean Archaeology and Archaeometry
MPK	Muzei i Pametnitži na Kulturata
NIV	Holy Bible, New International Version
OR	Optical Review
PSBKD	Periodichesko Spisanie na Bulgarskoto Knižovno Družestvo
SpBAN	Spisanie na Bulgarskata Academia na Naukite

LIST OF ILLUSTRATIONS

Images and photographs were selected from the data and the documentation obtained during fieldwork carried out in Arbanassi during August 2005 and September 2006, unless otherwise stated in the main text.

LIST OF TABLES

CHAPTER ONE

Introduction

1.1 Aim and Scope

Arbanassi is situated in the Balkan Peninsula, in the middle part of the present territory of Bulgaria. It was built on the top of the hills above the old capital Veliko Turnovo ('Great Turnovo') and about four kilometres from it (Figure 1).[1] Within the curtilage of the town of Arbanassi there is a cluster of well-preserved ecclesiastical and civil buildings dating from the post-Byzantine period which, in the Bulgarian context, began at the end of the fourteenth century. Bulgarian scholarship mentions at least twenty-one churches in the country with wall paintings identified as seventeenth-century and available for examination.[2] Seven of these churches are in Arbanassi. The other fourteen churches are widely dispersed around the country; thus the town presents a notable opportunity for research into the architectural and artistic practices of that era on the territory of the present day Bulgaria.

The aim of my thesis is to elucidate the appearance of the church decoration in Arbanassi in the context of the specific use of colour and in the lighting conditions pertaining at the time. My thesis focuses on the naves of four of the seven Arbanassi churches as a case study. The underlying hypothesis is that their

[1] The First Bulgarian Kingdom lasted from 684 to 1018, when Basil II (the Bulgarian Slayer) finally subjugated the Kingdom. In 1185 Turnovo (often transliterated as 'Tarnovo') became the capital of the Second Bulgarian Kingdom, after the successful uprising organised by the nobles Ivan Asen and Peter. It is accepted that this Kingdom lasted until the Ottomans conquered Vidin in 1396, although Turnovo fell in 1393.

[2] E. Manova, *Bulgarska Stenopis XVI-XVII vek* (Sofia,1985), pp. 7-11.

naves can be asserted as an embodiment of the ways colour and light were employed in Eastern church decoration at that historic period in the Bulgarian province of the Ottoman Empire.

The four churches on which my research centres are the churches of the Nativity of Christ (Figure 2), the Archangels Michael and Gabriel (Figure 3), St Atanass (Figure 4) and St Dimitr (Figure 5). The other three Arbanassi churches were omitted from the investigation because of difficulties in gaining access to their wall paintings. The wall paintings in the church dedicated to St Gyorgi were taken down for restoration and conservation work more than twenty years ago and are still not available for examination. The other two churches, dedicated respectively to the Mother of God and St Nicholas, are part of functioning monasteries and as such are under the jurisdiction of the Bulgarian Orthodox Church, which restricts access to them. More crucially, at the beginning of the twentieth century, the interior walls of both were whitewashed and the wall paintings completely covered, with the exception of a narrow border strip in the church of the Mother of God. The size and condition of the fragments that remain visible make them unsuitable for the purposes of the present investigation.

The photographs of the churches communicate the dramatic contrast between the austerity of their exteriors and the vibrancy of their interior spaces. All four churches are single-storey buildings of very simple construction, protected by heavy, overhanging roofs. The decoration of the naves of all four is predominantly figurative, with some floral or geometric borders between the compositions. The highly legible detailed pictorial compositions are executed on a very dark, almost black, background, creating a dramatic effect. The apparent high degree of contrast between the background and the coloured areas helps to emphasise the perceived brightness of the colours used. As this optical strategy has been employed throughout the church decoration, it is likely that the optical nature of colour was used purposefully and skilfully in the construction of the interior spaces and this is a case I will look to make in the thesis. The overall impression of the four interiors is of colourful, rather intense decoration, dominating the space. This impression is strengthened further by the contrast with the plain, rather dull appearance of the exterior.

Since the beginning of the twentieth century, various short studies have been published on the church architecture of Arbanassi. These have dealt mainly with issues of dating in the context of archaeological research.[3] They have also tried to ascertain the form of the original structures. The concern of the Bulgarian scholarship with recording the architecture and decoration of Arbanassi is associated with the lack of any documentary or other extrinsic evidence of the history of the monuments. Art-historical studies were principally preoccupied with the extent to which the architecture and decoration of the churches preserved pre-Ottoman visual practices.[4]

These subjects continued to be a focus of research in recent works that attempted to ascertain the degree to which the artists working in the Bulgarian Province of the Ottoman Empire developed a recognisable style within the general framework of the Byzantine art tradition that they followed.[5] The prevailing opinion of Bulgarian scholarship is that the decoration of the Arbanassi churches displays expressionist qualities and in that lies its particular

---

[3] B. Philov, 'Arbanassi', IBAD, No. 4 (1915), pp. 220-229; Philov, *Starobulgarsko Izkustvo* (Sofia, 1993, first published 1918; D. Kostov, *Arbanassi*,(Sofia, 1959); H. Vatchev, 'Enoriiskiat hram v Turnovskata Mitropolia prez XV – nachaloto na XVIII vek' (unpublished doctoral thesis, Archaeological Institute and Museum of BAN, 1998).
[4] B. Philov, 'Arbanassi', IBAD, No. 4 (1915), pp. 220-229; B., Philov, *Starobulgarsko Izkustvo* (Sofia, 1993, first published 1918).
[5] L. Prashkov, *Stenopisi v Tzurkvata Roždestvo* Hristovo (Sofia,1979); G. Gerov, 'Vreme' i 'Istoria' v Stenopisite ot Galeriata na Arbanashkata Tzurkva 'Rozdestvo Hristovo', *PI*, No. 4 (1996), pp. 3-13; A. Božkov, *Bulgarskijat Prinos v Svetovnata Kultura* (Sofia, 1999).

artistic merit. It also demonstrates, however, in the view of previous scholars, that the knowledge and skills of the Byzantines had been almost completely lost.[6] In other words, the primitive architectural structures and church decoration of the post-Byzantine period, having lost their grandeur and optical intricacy, preserved only the content of the Byzantine representational system, without its aesthetic and technical refinement.[7] However, the role played by the physical illumination of the churches, even in the context of the architecture of the buildings, has not previously been examined.

In the context of my thesis, I have made colour the main theme of my investigation into the Arbanassi decoration. Since light is a mediator of the visual experience and can modify the perceived appearance of colours, I discuss the colours of Arbanassi in the context of the interior illumination as well as in that of the decoration.

Theoretically, the appearance of a coloured surface is an optical phenomenon which occurs when the surface has been illuminated. Part of the incident flux (a technical term, indicating the light that falls onto the surface of an object or on the examined part of the surface area) is reflected back from the surface. Thus a sensation of the appearance of the colour of that surface is initiated at the point when the reflected part of the incident flux interacts with the retina of the eye, inducing electrochemical changes in the retinal cells. These changes are then

---

[6] L. Prashkov, *Stenopisi v Tzurkvata Roždestvo* Hristovo (Sofia,1979); B. Penkova, 'Za Njakoi Osobenosti na Postvizantiiskoto Izkustvo v Bulgaria', *Problemi na Iskustvoto,* No 1, (1999), pp. 3-8, M. Koeva, P. Jokimov, L. Stoilova, *Pravoslavni Hramove po Bulgarskite Zemi (XV–XX v.) (*Sofia, 2002).

[7] About the optical intricacy of Byzantine art and architecture see L. James, *Light and Colour in Byzantine Art*, (Oxford, 1996); I. G. Illiadis, 'The Natural lighting of the Mosaics in the Rotunda at Thessaloniki', *Lighting Research Technology*, No. 33 (2001), pp. 13-24; I. Potamianos, 'Light into Architecture: Evocative Aspects of Natural Light as Related to Liturgy and Byzantine Churches' (unpublished doctoral thesis, University of Michigan, 1996); N. Schibille, 'Light in Early Byzantium Church of Hagia Sophia in Constantinople' (unpublished doctoral thesis, University of Sussex, 2003).

translated into neurosignals that are relayed via the optical nerve to the brain of the beholder, completing the last element in the construction of the colour vision process.

In the framework of this account, my thesis introduces a possible new methodology for the study of colour and light in an art historical context where, in the absence of documentation, the monument is the only surviving evidence of past visual practices. I will begin by defining and describing the appearance of the colours comprising the palettes of Arbanassi and scrutinising the pigments with the aim of ascertaining the most likely colour agent (a technical term, indicating the chemical structure that defines the generic hue of a particular pigment).[8] This will involve an attempt to elucidate how and why conscious decisions might have been reached about the deliberate use of manufacturing processes as the means of achieving a specific colour appearance. Because of the mediatory role of the ambient lighting and its significance in the manipulation of the appearance of the visual colour, I will then examine the interior lighting in the churches. This will entail investigation into the natural and artificial illumination of each nave, aimed at defining the characteristics of the interior light dominating the interiors in the seventeenth century and the extent to which the nature of lighting affected the appearance of the colours in each church. This will allow me to seek answers to the questions how and why the compositional arrangement of colours can be associated with conscious artistic decisions.

The methodology relies heavily on scientific methods and scientific evidence. My investigation into the pigments used in Arbanassi will employ spectrophotometric analysis of the light reflected from each selected coloured surface,

[8]According to G. Wyszecki, G. and W. S. Stiles, *Color Science: Concept and Methods, Quantitative Data and Formulae* (New York, Chichester, Weinheim, Brisbane, Singapore, Toronto, 2000, first edition 1982), p. 487, *hue* is the attribute of colour perception denoted by the basic colour names: red, yellow, green and so on.

when illuminated by white light, within the visible part of the spectrum.[9] Such analysis is based on the correlation between the microstructure of every material and the specific spectral characteristics of the reflected light, where the set of those characteristics constitutes the fingerprint of the examined material. For the assessment of the interior lighting I will utilize the conceptual model in architectural theory, providing a link between the size and positioning of the windows in a building and the brightness of its interior. Finally, my investigation will make use of the scientifically established evidence of the optical interaction of juxtaposed colours that can enhance their brightness and/or colourfulness to analyse the compositional use of the colours.

The application of scientific methods to the study of art has been advocated since at least 1933, when Roger Fry called for such methods to be followed whenever possible.[10] At the end of the twentieth century John Gage pointed out that the use of such methods would allow new insights into works of art.[11] At the beginning of the twenty first century, in the first conventions dedicated to the use of scientific methods in the interpretation of art, leading art historians, such as Martin Kemp, physicists, conservators and colour scientists discussed the need for such methods and ways in which to collaborate in the promotion of a better understanding of art.[12] I believe that by using a scientifically-based methodology, I will be able to overcome the limitations of the lack of epigraphic material and to promote a new comprehension of the seventeenth-century dec-

---

[9] Restrictions imposed by the authority prohibited examination of the wall paintings within the infrared and the ultraviolet part of the spectrum.

[10] J. Schonwald, 'Scholars to examine scientific take of art', *University of Chichago Chronicle*, Vol. 2, No 14, (2003), pp. 3-4. http://chronicle.uchicago.edu/030417/art-sci.shtml [accessed 2004]

[11] J. Gage, *Colour and Meaning: Art, Science and Symbolism* (London, 1999), pp. 12-13.

[12] Martin Kemp, University of Oxford, presented a paper in 2003 at the two-day conference *Measuring Art: A Scientific Revolution in Art History* at the University of Chicago, on the application of the Hockney-Falco optical thesis to the life of Caravaggio. In the same year the Sackler Colloquia of the National Academy of Science were held in the Smithsonian Institution under the title *Scientific Examination of Art: modern techniques in conservation and analysis* in which Barbara Berry and Roy Berns took part.

oration of Arbanassi. Moreover, by addressing the issue of the interdependency of colour and light, one that has never been addressed in the context of Bulgarian art historical research, this investigation challenges the established scholarly approach to research into the churches.

In the first part of the thesis, my objective will be to examine the use of colour in the Arbanassi naves in an attempt to elucidate why their seventeenth-century decoration looks the way it does, in terms of how the colours involved interact optically with each other.[13] Therefore, in order to assess the artistic deployment of colour, it is necessary to identify the individual colours employed in each interior. This entails a detailed examination of the interiors to determine the general perceptual categories of colour hues which are included in each palette and how each hue appears in the different interiors.

Further, the specific appearance of each colour is linked to the microstructure of the chemical substance which is dominant within the paint mixture. Because of this phenomenon, the nature of pigments is also of great significance in the appearance of the individual colours. For each colour I will attempt to ascertain the pigment that determines its hue. It is in this context that I will discuss the likelihood of deliberate manipulation of the pigments by the artist in the process of the production of the paint in order to influence the final appearance of the painted surfaces. The experience of each colour within a pictorial composition or in everyday life is always in the context of the other, juxtaposed colours which comprise the scene; thus initially I will aim to define the compositional arrangement of the individual colours. I will also look for the presence of any common patterns of use within the design of the interior decoration and analyse the results of the optical relation between the colours involved.

---

[13] R. Arnheim, *Art and Visual Perception. A Psychology of the Creative Eye* (Berkeley, Los Angeles, London, 1974, first edition 1954) pp. 330-337.

Building on the results of my research, in the second part of the thesis I will address my second set of questions: how the lighting conditions in the seventeenth century affected the individual colours and ultimately how the images might have appeared at that time and consequently what are the indications, if any, that such effects might have been deliberately sought by the artist. The appearance of a coloured surface is encountered only within an illuminated environment and is the physiological response of the human eye to the light in the visible part of the spectrum, reflected from that surface. The level of illumination is crucial to the initiating of any colour perception while the spectral composition of the environmental light will determine the spectral characteristics of the part of the incident flux that is reflected. Consequently the latter will affect the experience of the colour of the examined surface. Therefore, I need to consider both the colour and the intensity of the interior lighting of the naves. In order to assess the interior lighting in the churches as it would have been in the seventeenth century, initially I will investigate the architectural structure of the churches and the fenestration of the naves in particular to assess the characteristics of the natural illumination of the interiors. This will be followed by an assessment of the effect of artificial lighting on the characteristics of the interior light. Artificial lighting alters the colour of the interior light and consequently the appearance of the colours present, and therefore ultimately has an impact on the appearance of the decoration.

I will explore the likely impact the characteristic artificial lighting in an Eastern church interior might have had on the perceived appearance of the Arbanassi colours by analogy with experimental results in the field of psychophysics. I will also re-examine the optical relations of the colours in the context of the seventeenth-century interior lighting. The perceived appearance is also closely associated with culturally-framed intellectual comprehension. In this context, church interiors are considered to be spaces which are meant to evoke specific associations in accordance with the biblically-based teaching of the Church. I will propose that the deliberate and skilful implementation of architectural, decorative and lighting design in the Arbanassi interiors attempted to make that divine realm visually explicit.

However, initially I shall put Arbanassi and its churches in their historic context within both the Orthodox world and the Ottoman Empire in order to establish their importance as a case study. In the rest of this chapter works that engage in any way with the use of colour in the Arbanassi decoration will be reviewed. I will also examine previous scholarship for art historical research into colour to contextualise my methodology and emphasise its significance. The structure of my thesis will also be explained in detail.

1. 2 Historical Background

Figure 6 shows the Second Bulgarian Tzardom after 1371, at the time when the Tzardom was divided into the Turnovo Tzardom, with Turnovo as its capital, the Vidin Tzardom, with Budin as its capital and the Dobrudja Despotate with Kaliakra as its capital.[14] According to Gjuzelev, the existence of these three principalities, each of them known as Bulgaria, is confirmed in Venetian sources from the late fourteenth century.[15]

[14] Figure 7 is a map representing the generally accepted version of the Bulgarian historical research of the situation in the Balkans at the end of the fourteenth century: Gandev, Ch. (ed.), *Istoria na Bulgaria*, Vol. III, (Sofia, 1983), p. 350.

[15] As seen in translation in a publication by the Bulgarian Government's Archive; V. Gjuzelev, (ed), *Venetzianski dokumenti za istoriata na Bulgaria i Bulgarite ot XII–XV v* (Sofia, 2001), pp.108, 136. Also Ch. Gandev, *Istoria na Bulgaria*, Vol. IV, (Sofia, 1983), pp.351-352, where the initial, 1970s, translation from the German traveller and writer Johann (Hans) Schiltberger (1380 –1440) appears.

In July 1393, after a three-month siege, Sultan Bayezid I captured Veliko Turnovo and the southern part of the country. Both because Veliko Turnovo was the capital and because of the prolonged resistance put up by the defenders of the city, the plundering and damage to which Turnovo and the surrounding area was subjected brought about the destruction of the majority of the existing buildings.[16] The demolished buildings included not only the royal palace and the aristocratic residences but the churches in the royal and aristocratic quarters of the fortress of Veliko Turnovo. Similar was the fate of the ecclesiastical district of Sveta Gora (the Holy Mountain) and a number of the churches and monasteries in the surrounding area. The Patriarch's church on Tzarevetz in Turnovo was converted to a mosque after the fall of the capital. Another church, SS Peter and Paul, became a seat of the last Patriarch Euthymius, but was restored only at the end of the fifteenth century, after which officially it became a residence of the Turnovo Metropolitan.[17] Scholars, nevertheless, take the view that some of the churches, as well as a number of the dwellings, survived at least to a degree that allowed them to continue to be used.[18]

Examples of the initial situation in the lands of the Ottoman Empire, which had previously belonged to the Bulgarian Kingdom, are given in the writings of Western travellers. All observers who visited the European parts of the Ottoman Empire in the fifteenth century, a few decades after the conquest of Byzantium, reported the total devastation that had occurred throughout the

---

[16] P. Petrov, *Sudbonosni Vekove za Bulgarskata Narodnost* (Sofia, 1975), pp. 29–61 and also in Vatchev, H., 'Enoriiskiat hram v Turnovskata Mitropolia prez XV – nachaloto na XVIII vek' (unpublished doctoral thesis, Archaeological Institute and Museum of the Bulgarian Academy of Science, 1998), pp. 5–10.

[17] G. Tzamblak, 'Pohvalno slovo za Euthymi' in Grasheva, L. (ed.), *Stara Bulgarska Literatura,* Vol. 2 (Sofia, 1982), p. 230. In H. Vatchev, 'Kum vuprosa za padaneto na stolichnia Turnovgrad pod Turska vlast' in *Akti na mezdunarodna konferentzia po sluchai na 600 godini ot prevzemaneto na Turnovgrad* (Veliko Turnovo, 1993), p. 252. The research also shows that there were partially destroyed churches, which were left unrepaired for many decades.

[18] Ch. Gandev, B. Tzvetkova, Grozdanova, 'Polozenieto na bulgarskoto selsko naselenie' in Gandev, *Istoria na Bulgaria*, Vol. IV, p. 63.

land.[19] Most importantly, these writings witness the difference between the state of buildings in and around Veliko Turnovo before and after the invasion. The settlement of Arbanassi is just four kilometres from the centre of Veliko Turnovo. Travellers' records, supported by archaeological excavations and scholarly research into some surviving medieval texts linked to the fortress of Veliko Turnovo, lead to the conclusion that before the conquest there were nearly fifty different places of worship in and around Veliko Turnovo.[20] They included a number of parish and monastery churches and some family chapels. These material and textual explorations also confirmed that several of those chapels were outside the city walls. There is no indication of the number and the kind of church buildings that survived the onslaught of demolition after the Ottoman conquest.

Scholars posit the existence of a second wave of destruction that led to the disappearance of most of the sites that had survived initially.[21] They associate this period with the first significant uprising against the Ottomans, led by the nobles Constantine and Fruzshin. This period began in 1408, twelve years after the final conquest of the Bulgarian Kingdom in September 1396, and lasted from 1408 to 1413.[22] This particular uprising is thought to have had a crucial effect on the area of Veliko Turnovo, including the curtilage of Arbanassi.[23]

---

[19] Gandev, *Istoria na Bulgaria*, Vol. IV, pp. 62–63.

[20] St. Dimitrov, N. Danova, G. Pletnyov, Z. Markova, T. Draganova, I. Dimitrov, Iv. Stojanov, P. Todorov, P. Goranov, N. Bonev, L. Spasov, K. Panajotova, *Istoria na Veliko Turnovo: praistoria, antichnost, srednovekovie*, Vol. I (Sofia, 1986), pp. 235–277.

[21] B. Tžvetkova, *Pametna Bitka na Narodite* (Varna, 1979), p. 104 and pp. 232–236; Vatchev, ' Kum Vuprosa za padaneto na stolichnia Turnovgrad pod Turska vlast' , p. 252.

[22] The defeat of the Bulgarian fortress of Nikopol in the northern part, in September 1396, is considered by scholars to be the date on which Bulgaria became part of the then rapidly expanding Ottoman Empire. The First Bulgarian Kingdom existed between 681 and 1018 and the Second Bulgarian Kingdom between 1188 and 1396. See Gandev, *Istoria na Bulgaria*, Vol. III, pp. 238–259.

[23] A. Protich, 'Sushtnost and Razvitie na Bulgarskata Tžurkovna Arhitektura', *IBAI*, (Sofia, 1921–1922), pp. 86–205.

During the first half of the fifteenth century the last functioning monasteries in and around Turnovo disappeared.[24] There is a strong link between the documented punitive raids by the Ottoman army and the devastation of the remaining ecclesiastical property in and around Veliko Turnovo. Research not only points to the destruction of existing sites, but also concludes that there is no evidence for any substantial construction of new ecclesiastical sites between 1408 and 1413, either in the Veliko Turnovo area or indeed anywhere in the Bulgarian province.[25] Prashkov and Penkova consider that there are a few examples of sporadic restoration activity in a few chapels.[26] Such activities were modest, often conducted in secret, and usually involved some kind of reconstruction on pre-existing medieval foundations.[27] They are usually associated either with the remnants of the upper classes or, in a limited number of cases, with an existing medieval monastery. In the latter cases, the restored buildings are small monastery churches. Decoration surviving from the first half of the fifteenth century is very simple.[28]

Against this rather desolate background, the Christian settlement of Arbanassi emerged between the late sixteenth and the early seventeenth centuries.[29] Most significantly, the population was able to engage in extensive church building.[30] The seventeenth century is considered to have been a time in which the Chris-

---

[24] Tžvetkova, *Pametna Bitka na Narodite*, p. 104 and pp. 232–236; Vatchev, ' Kum Vuprosa za padaneto na stolichnia Turnovgrad pod Turska vlast', p. 252.

[25] Protich, 'Sushtnost i Razvitie', pp. 86–205.

[26] Prashkov, *Stenopisi vTzurkvata Roždestvo* and B. Penkova, 'Za Njakoi Osobenosti na Postvizantiiskoto Izkustvo v Bulgaria', *Izkustvo*, No. 9 (1979), pp. 3-8.

[27] Prashkov, *Stenopisi vTzurkvata Roždestvo,* pp. 7–16.

[28] Penkova, 'Za Njakoi Osobenosti ', pp. 3–8.

[29] P. R. Slaveikov, 'Bulgaria pod Tursko Gospodaruvane I nai veche v XV–XVII' in *Chitalishte No. 5* (Sofia, 1873), pp. 388–410 and *P. R.* Slaveikov, 'Bulgaria pod Tursko Gospodaruvane I nai veche v XV–XVII' in *Chitalishte*, No. 6 (1873), pp. 483–503.

[30] Božhkov, *Bulgarskijat Prinos v Svetovnata Kultura* and particularly Prashkov, *Stenopisi v Tzurkvata Rozdestvo*, pp. 4–6; H. Haritonov, G. Chohadsžieva, S. Rutževa, *Arbanassi,* (Sofia, 2003),
pp. 10–13 and Gerov, 'Vreme' I 'Istoria', pp. 3–13, stresses that fact.

tian population of the Ottoman Empire, and Christians living in the Bulgarian province in particular, established a level of economic power that to a certain extent allowed them a degree of administrative influence.[31] The main reason is the social and economic status of non-Muslim subjects of the Sultan Suleiman the Magnificent (1522-1565) which also increased their disposable wealth.[32]

In Arbanassi itself in all probability the medieval churches of the monasteries of the Dormition of the Mother of God and St Nicholas and the parish church of St Gyorgi were destroyed somewhere between the end of the fourteenth and the middle of the fifteenth century. Permission for rebuilding a church could be granted by the Ottoman administration on the strength of the witness evidence of any two Muslims who could claim that they knew of the pre-conquest existence of a church at the location for which the application had been entered. Apparently, it was not difficult to find 'eyewitnesses' who were willing to attest that they remembered either a church building or the ruins of one in the place where the new church was intended. In exchange for helping to promote the application, such witnesses would be given financial rewards.[33] Moreover, the affluent citizens of Arbanassi seem to have had connections with the Ottoman court, which might have helped in obtaining the permissions.[34]

In the fifteenth century, Turnovo became a Metropolitan centre, one of the biggest in the Empire. There was a sizeable number of Muslim households in Turnovo, nearly 500, and this led to the transfer of the residency of the Turnovo

---

[31] E. Grozdanova, S. Andreev, *Bulgarite prez XVII vek* (Sofia, 1986), pp. 12–17.
[32] Gandev, *Istoria na Bulgaria*, Vol. IV, pp. 125–144.
[33] Gradeva, 'Ottoman Policy ..., pp. 14–36; Düzdağ, M. E., *Şeiyhülislâm Ebussuud Efendi Fetvalari Işiğinda 16. Asir Tütk Hayati* (Istanbul: Enderum Kitabevi, 1972), No. 463/464, pp. 105–106.
[34] V. Mutafov, 'Za etnicheskia, sotžialnia i stopanski oblik na selo Arbanassi prez XVII vek ', *GMSB*, No. 5 (1979), p. 83-93.

Metropolitan as an ecclesiastical centre to Arbanassi.[35] The policy at the time was that churches could not be built in settlements where there was a significant proportion of Muslims. This rule was created on the understanding that the two religious beliefs were theologically opposed and the governing Hanafite theological school insisted that the sounds of church bells would be offensive to the Muslim ear. At the same time, in the middle of the seventeenth century, in his notes from his travels around the northern parts of the Bulgarian province of the Ottoman Empire, the Catholic bishop and historian Peter Bogdan was impressed by the size of Arbanassi, which comprised 1,000 houses.[36] Christians at Arbanassi were of the Greek Orthodox denomination.[37] On average, the ratio of Christian to non-Christian households during the seventeenth century was 9:1.[38] Registers from the seventeenth century show that in Arbanassi there were already eleven serving clergy and by the beginning of the eighteenth century their number was thirty. [39] In the same documents it is mentioned that a few of the houses in Arbanassi were summer residences for a number of Orthodox bishops. [40] Most significantly, the population was able to engage in extensive church building.[41]

1.3 Arbanassi in the Seventeenth Century

[35] Iv. Tutundjiev, *Turnovskata Metropolia prez 17 vek i purvata polovina na 18 vek* (Veliko Turnovo, 1996), pp. 70–73. K. Dinkov, *Istoria na Bulgarskata Tžurkva* (Vratža, 1953), pp. 64–68.

[36] B. Dimitrov, *Peter Bogdan – Bulgarski Istoric i Politic ot XVII bek* (Sofia, 1984), p. 164.

[37] The continuation of this element was confirmed by the recent discovery that there was a Greek school in Arbanassi. A certificate dated from 1779, linked to the school, carries the name of Alexander Ipsilanti. Tutundjiev, *Turnovskata Metropolia prez 17 vek*, pp. 69–70.

[38] Dimitrov, *Peter Bogdan – Bulgarski Istoric,* p. 165.

[39] Tutundjiev, *Turnovskata Metropolia prez 17 vek.*, pp. 39, 42; Iv. Snegarov, ‘ Istoricheski vesti za Turnovskata Metropolia ‘ , *GSU*, *Bogoslovski Facultet*, Vol. XX, No. 5 (1943), pp. 3–136.

[40] A. E. M. Tachiaos, ‘Die Aufhebung des Bulgarischen Patriarchats von Turnovo‘, *Balkan Studies*, Vol. 4 (1963), No.1.

[41] Božhkov, *Bulgarskijat Prinos v Svetovnata Kultura* ; Prashkov, *Stenopisi vTzurkvata Roždestvo*, pp. 4–6; Haritonov,Chohadsžieva, Rutževa, *Arbanassi*, pp. 10–13 and Gerov, ‘Vreme’ I ‘Istoria’, pp. 3-13.

At the beginning of the seventeenth century Arbanassi reached its peak and became a powerful cosmopolitan, commercial and ecclesiastical centre, in which Christian culture flourished. The geographic position of the town and the policies of both the Ottoman Administration and the Eastern Church were the bases of the town's rapid development and its consequential growing prominence in the seventeenth century. In the context of the Ottoman Empire, such development of a predominantly Christian settlement was only possible in particularly favorable legal circumstances. In the case of Arbanassi, within the existing feudal system of land ownership, such circumstances were in place as early as the middle of the sixteenth century. In 1549 the town and the lands around it became part of the estate of the Grand Vizier, Rustem Pasha.[42] Immediately after that, because of the geographic situation of Arbanassi and with the help of the Vizier, citizens were given a comparatively privileged position to guard the nearby treacherous, but important passes.[43] The social class of those guards was designated *dervenjji* and they held a type of citizenship called *cerbesiet olub* or free citizens. A number of tax exemptions accompanied this social status of *dervenjji*. This type of citizenship was a privilege, usually reserved for Muslim citizens of the Empire.[44]

---

[42] The Grand Vizier was only one stage removed from the absolute power of the Sultan and they, together with the military ruling classes, governed the Empire. For details on the Arbanassi ownership see Tutundjiev, *Turnovskata Metropolia prez 17 vek*, pp. 12-14.

[43] In Str. Dimitrov, *Buntovni vijenia v Turnovsko I Istochna Bulgaria po vremetio na Chiprovskoto vustanie* in Istoricheski pregled, No 10, (Sofia, 1988), pp. 35-48.

[44] B. Tzvetkova, B., *Turski dokumenti za statuta na njakoi selishta vuv Velikoturnovski okrug prez XVII bek*, Izvestia na narodniat istoricheski musei vuv Veliko Turnovo (INIMVT), No III, (Varna, 1966), p.62. See also Inalcik, H., *An Economic and Social History of the Ottoman Empire* (*1300-1600)*, Vol. 1, (Cambridge, 1997), p.79-84 and Hammer, J., *Historija turskog/osmanskog carstva*, Vol. 1, (Zagreb, 1979). The citizens of Arbanassi first became serbesiet olub in 1538 by a decree (firman) from the Sultan Suleiman the Magnificent. Grand Vizier Damat Rüstem Pasha (1544-1553 and 1555-1561) was also his son-in-law.

Shortly after acquiring Arbanassi, the Grand Vizier added it to his *vakif* estate.[45] Within the administrative system of the Empire it meant that Arbanassi was a free, autonomously governed place, answerable only and directly to the Sultan. It was no longer a vulnerable peasant settlement with numerous obligations towards the government. The citizens of the town were now exempted not just from direct taxes, but also from any other obligations, except their duties to the landlord.[46] An Imperial Act from around 1555 made the free status final and absolute.[47] The Act legally confirmed the responsibility of the landlord to protect the lives, wealth and livelihood of the Christian citizens and to assist them to achieve as great economic progress as possible.[48] By the beginning of the seventeenth century Arbanassi had become a significant commercial centre, whose merchants traded within the Ottoman Empire and increasingly with Europe, Russia and Asia. [49] In Europe they had interests in Venice, Florence, Transylvania, Dubrovnik, Hungary and Poland; some of the merchants became involved in the commercial life of Persia and India.[50] A few of those merchants

---

45 A vakif was a kind of charitable trust established for religious purposes. For more details see H. Inalcik, *An Economic and Social History of the Ottoman Empire (1300-1600)*, Vol. 1, (Cambridge, 1997), pp. 79-88

46 Ibid, pp.96-97. See also Tzvetkova, B., *Turski dokumenti za statuta na njakoi selishta vuv Velikoturnovski okrug prez XVII bek*, Izvestia na narodniat istoricheski musei vuv Veliko Turnovo (INIMVT), No III, (Varna, 1966), p.63.

47 D. Kostov, D., *Arbanassi*, (Sofia, 1959), pp.12 and 21. The 'imperial act' was sufficient protection to the village during the time when state power was exceptionally centralized. It read '...incomers, whatever their rank and position and to whatever social category they belong, are not to enter the boundaries of these free and independent settlements by force'. (The translation into English is mine) However, by the eighteenth century the protection and security stated in the act could no longer be guaranteed and before the end of that century the town was irredeemably undermined by a major raid. The downturn in Arbanassi's fortunes began after prominent citizens became involved in an unsuccessful uprising at the end of the seventeenth century.

48 Almost all of the citizens were Eastern Christians - Albanian, Bulgarian, Greek, Wallach as well as some Russians, Armenians and Iberians (Georgians).

49 Karpat, K. H., *Studies on Ottoman Social and Political History: Selected Articles and Essays (Social, Economic and Political Studies of the Middle East and Asia*) (Leiden, 1974) pp. 111

50 Kostov, *Arbanassi*, p. 21.

even became heads of international commercial companies in Sibiu and Braşov.[51]

The *vakif* status of Arbanassi attracted Christians from near and far; significantly most of them were already prosperous merchants. Church registers from the seventeenth century, listing the names of deceased citizens, indicate that these merchants were drawn mainly from around the Balkans.[52] They are believed to have been members of powerful Transylvanian and Wallachian families or even remnants of the old Byzantine aristocracy.[53] With their existing connections, they may have played a role in the involvement of the Arbanassi merchants in the international Transylvanian wholesale market at Sibiu. Citizens of Arbanassi also took part in the international monetary trade of the towns of Sibiu, Braşov, Sviridov and Istanbul.[54] These activities, together with the income from their commercial activities, created substantial deposits, some of which were kept in the town by prominent members of the merchant class, called *beretlii*.[55] In the heyday of Arbanassi there were about 15 *beretlii*.

The economic success of the town, its protected status, the confessional unity of the population, and especially the geographic proximity to the Metropolitan town of Turnovo, determined the favoured place of Arbanassi within the autonomous administrative arrangements of the Eastern Church. By the beginning of the seventeenth century, Turnovo was the *de jure* residence of the Metropolitan, who actually lived in Arbanassi. This move led to the town be-

---

[51] St. Maslev, *Targovijata meždu Bulgarskite zemi i Transivanija prez XVI-XVII bek* (Sofia, 1991), pp. 131-135.

[52] Gandev, Ch., Tzvetkova, B., Grozdanova, 'Polozenieto na bulgarskoto selsko naselenie' in Gandev, Ch. *ed*., *Istoria na Bulgaria*, Vol. IV, (Sofia, 1983). Cantakuzeno, Bratijanu, Fillipesku, Brancuvjanu, Vakaresku, Stefanoviski, and others.

[53] Ibid.

[54] St. Maslev, *Targovijata meždu Bulgarskite zemi i Transivanija*, pp. 131-135, 262.

[55] *Beretlii* held a special certificate, a *berat,* signed by the Sultan, which entitled them to pay reduced customs duties and made them answerable only to special courts in Istanbul.

coming a significant religious centre. Throughout the century it was marked by exceptional constructional activity compared with the work undertaken in Turnovo. In the Metropolitan town, work was carried out on only two churches and in both cases these were only renovations or extensions. At the same time, within the curtilage of Arbanassi, there is a cluster of seven well-preserved church buildings, with extensive decoration dating from the seventeenth century. Five of the churches in Arbanassi are assumed to have performed the role of parish churches. These are dedicated respectively to the Nativity of Christ, the Archangels Michael and Gabriel, St Dimitr, St Atanass, and St Gyorgi. The remaining two churches, dedicated to the Mother of God and to St Nicholas, formed part of monastery complexes (Figure 8). Such a number of churches built and decorated in the same century, in the same Christian settlement, was itself a unique phenomenon in view of the restrictions on the construction of non-Islamic religious buildings.[56]

The focus of religious life in the Turnovo metropolitan clearly shifted from the town of Turnovo to Arbanassi. In the seventeenth century the monastic centres of Athos, Sinai and Jerusalem sent their representatives (taxidiots), on fundraising expedition to the town, where they usually spent half of year or more, between late summer and the first few months of the new year. More importantly, the monastic community of Athos had established and maintained a *metochion* in Arbanassi, underlining the pre-eminent status of Arbanassi in the life of the Eastern Church.[57] In accordance with these changes, a throne for the Metropolitan was installed the Church of the Nativity of Christ which *de facto* functioned as a Metropolitan church. Because of this, visits of the patriarchs of

[56] O. Todorova, *Pravoslavnata Tžurkva na Bulgarite prez XV-XVIII vek,* (Sofia, 1997), p. 60. Todorova suggests that there even might have been more than one *metochion*, but it is difficult to prove either that or the number of the establishments.

[57] Iv. Snegarov, *Istoricheski vesti za Turnovskata Metropolia*, *GSU, Bogoslovski facultet*, No. 20 (1943), pp. 112, 125.

the Eastern Church were paid to Arbanassi, rather than to Turnovo.[58] The most significant of these visits was the joint delegation in 1666, which included the patriarchs of Antioch, Jerusalem, Serbia and Georgia.

Under the administrative system of the Empire each faith community formed a group called a *millet* with its own governing body, answerable to the supreme governor of all, the Sultan. The foci of the cultural life of the Christians were the religious establishments and in particular the local monasteries and the parish churches. Those became centres of visual arts, literature and education. The majority of Balkan Christian subjects were part of the *millet-i-rum* and came under the spiritual supervision of the Patriarchate of Constantinople.[59] The Metropolitan of Turnovo was one of the most prestigious bishoprics in the Balkans and metropolitans were often nominated, and frequently elevated, to the post of Patriarch of Constantinople.

Within this setting, Arbanassi became one of the cultural centres in the Balkans. This function was easily assumed as lay citizens and clergy took on duties as patrons, contributing either money or time or both. The names of some of these donors are incorporated in the decoration of the Arbanassi churches. It is presumed that they paid for the construction, the lavish decoration of the interiors and for the commissioning of religious manuscripts and Bibles. Some of the interiors were re-painted in that period, even though they had originally been decorated only a few decades earlier.[60] The generous donors of Arbanassi maintained close ties with the most important literary centre in the northern territories of the Bulgarian Province of the Ottoman Empire between the seven-

---

[58] P. Stephanov, 'Gerasim II Kakavelas –Turnovski Metropolit i Tžarigradski Patriarch pres XVII vek' in *300 Godini Chiprovsko Vustanie*, (Sofia, 1988), p. 156.
[59] *Millet i rum* is a term used for an Orthodox Christian confessional community in the Ottoman Empire. See Sachedina,A.A., *The Islamic Roots of Democratic Pluralism*, (Oxford, 2001).
[60] Vatchev, 'Enoriiskiat hram v Turnovskata Mitropolia',pp. 182-189.

teenth and nineteenth centuries, Etropolski Monastery.[61] Evidence of a level of literary activity also being supported in the Arbanassi religious establishments exists in the form of a seventeenth-century manuscript of a religious text in which is a note, signed by *iereus* Stilian, indicating that the book was completed in the Church of St Dimitr, Arbanassi on 29th May 1622.[62]

Research reveals that the construction of the churches and their decoration spanned almost the entire seventeenth century.[63] The situation changed drastically after the widespread participation of about 60 prominent members of the Arbanassi merchant class in the failed uprising of 1689. After that event the wealth of Arbanassi declined nor was the settlement the safe haven it had previously been.[64] Consequently, only one complete interior - the inner narthex of the Church of the Archangels - and the east and the north walls of the Chapel of St Haralampii in the Church of St Atanass, are regarded as from the eighteenth century.

Only a limited body of scholarly research has been conducted in relation to the seventeenth-century Arbanassi church interiors. The lack of interest in seventeenth-century Arbanassi is a result of the traditional preoccupation of Bulgarian art historians with the material culture of the Bulgarian Renaissance, which is believed to have taken place during the eighteenth and nineteenth centuries.[65] The seventeenth and the eighteenth centuries have always been judged by Bulgarian scholarship to belong to different periods in the development of Bulgarian culture. The division is stylistic and aesthetic; in it the period from

---

[61] P., Mutafchiev, 'Iz Nashite Staroplaninski Manastiri' in *Izbrani Proizvedenia*, Vol. 2 (Sofia, 1970), p. 319.

[62] Tutundjiev, *Turnovskata Mitropolia prez 17 vek* ,p. 49.

[63] Haritonov, Chohadsžieva, Rutževa, *Arbanassi,* p. 51

[64] P. Stephanov, *300 Godini Chiprovsko Vustanie*, (Sofia, 1988), p. 150-167.

[65] Vatchev, 'Enoriiskiat hram v Turnovskata Mitropolia', pp. 191-192; Haritonov, Chohadsžieva, Rutževa, *Arbanassi*; Tuleshkov, *Bulgarski Stroitelni Tžentrove,* p. 56.

the fifteenth to the seventeenth centuries is judged inferior to both the art that predates the conquest and that of the Bulgarian Renaissance.[66] A study of the seventeenth-century Arbanassi interiors will complete the picture of the development of the art schools within the Turnovo area.[67] The number and variety of seventeenth century decorated interiors in Arbanassi provides a compendium of the visual practices in the seventeenth century. Therefore, discussion of the Arbanassi church decoration can also aid understanding of the visual practices in the seventeenth century within the context of Eastern Christian art in the Bulgarian Province of the Ottoman Empire as a whole.

1.4 Previous Bulgarian Scholarship on Arbanassi

There is only limited and exclusively Bulgarian scholarship on Arbanassi, usually in the form of brief sections in various works discussing the history, archaeology, architecture, art, and demography of the seventeenth century Bulgarian Province of the Ottoman Empire, or the Turnovo diocese in particular.[68] Often the publications mention the churches of the town and provide some description. Within the context of the archaeological studies are measured drawings of those churches prepared by Theophilov, Zimmermann and Vatchev, which I found to be the only reliable representation of the general plans and major elevations of the churches.[69] These drawings were indispensible when working away from Arbanassi.

[66] Božkov, A., *Bulgarskijat Prinos v Svetovnata Kultura (*Sofia, 1999), pp. 11-13.
[67] Božkov, A., *Turnovska Srednovekovna Hudozestvena Shkola (*Sofia, 1978).
[68] Al. Kuzev and V. Gjuzelev, *Bulgarski Srednovekovni Gradove i Kreposti*, Vol. 1 (Varna, 1981); E., Grozdanova and S., Andreev, *Bulgarite prez XVII vek* (Sofia, 1986); Tutundjiev, *Turnovskata Mitropolia prez 17 vek;* Vatchev, 'Enoriiskiat hram v Turnovskata Mitropolia'; Božkov, *Bulgarskijat Prinos;* T., Theopholov, 'Arhitecturno isledvane na cherkvata Sv. Gyorgy v selo Arbanassi' in MPK, Vol. XVII, No. 3 (Sofia, 1977), p. 18-27.
[69] T., Theopholov, 'Arhitecturno isledvane na cherkvata Sv. Gyorgy v selo Arbanassi' in MPK, Vol. XVII, No. 3 (Sofia, 1977), p. 25; for Zimmermann and Vatchev see Vatchev, 'Enoriiskiat hram v Turnovskata Mitropolia', pp. 349 and 345.

The most comprehensive investigation of the archaeology of the Arbanassi churches I found in Vatchev's research on the churches in the Turnovo diocese in the period from the fifteenth to the seventeenth centuries. His main objective was an examination of the single-chamber structures in the area. Vatchev provided documentation of the architecture and investigated and contributed to the history of their construction in the context of the use of the buildings. The greatest contribution of his work is that it presents the first ample archaeological presentation and documentation of the Arbanassi churches, including the creation of measured drawings of the majority of the buildings. However, it does not include any investigation into the decoration of the churches.

There are also a few publications that are exclusively dedicated to the presentation of Arbanassi. Amongst them is the 1903 work of Jordanov which, although outdated, presents a résumé of some epigraphic evidence from the seventeenth century, which has subsequently been lost.[70] These are *meneia* from the churches of the Archangels and St Dimitr and notes in religious books and Bibles. In the same work there are also résumés of interviews Jordanov conducted with some of the older citizens of the town. The publication is helpful in developing an understanding of the history and significance of Arbanassi. The information about the churches, however, is very limited, occupying just a short paragraph. The reason for the minimal attention paid to the churches is that, as with most scholars who worked before the 1960s, the author considered that they had neither aesthetic nor historic value.

By contrast, the most recent general work on Arbanassi, that of Haritonov et al, contains a chapter dedicated to the churches of the town.[71] The publication also

[70] Cited in Grozdanova and Andreev, *Bulgarite prez XVII vek*, p. 12.
[71] Haritonov, Chohadsžieva, Rutževa, *Arbanassi.*

offers chapters on its historic development and social history as well as a chapter on ethnography. The authors have chosen a concise format, where each chapter presents an overview of the research topic it is dealing with. This results in a lack of detail. Nevertheless, the work as a whole presents an informed, well-referenced summary of several foci of the scholarship on Arbanassi since the end of the nineteenth century. In this respect it has been a good point of departure as it gives access to a comprehensive bibliography and presents an outline of the state of the research into Arbanassi.

Most of the art-historical research on Arbanassi is associated with the Church of the Nativity. This includes the most systematic investigation of and the only monograph on an Arbanassi church, published by Prashkov in 1979.[72] This monograph resulted from an extensive conservation programme lasting nearly a decade, which restored the decoration of the church after it was cleaned of the soot with which it had been covered. In the monograph, Prashkov focuses on the form rather than on the colour of the decoration, engaging in a detailed and meticulous documentation of the architecture and the thematic and compositional arrangement of the decorative programme of the monument. For each chamber there is a comprehensive sketch, mapping the decoration in relation to the architecture and outlining the compositional arrangement of each scene.[73] These 'maps' have been helpful in the initial identification of the themes included in the representational system of the church. Because of some similarities within the thematic range and their representation, they have also been very useful in the identification of the scenes carried out in the other churches and especially in the Church of St Atanass.

---

[72] Prashkov, *Stenopisi v Tzurkvata Rozdestvo.*
[73] Ibid., pp. 23-45.

However, even though Prashkov engages in compositional and stylistic analysis of the decoration of the Church of the Nativity, the colours of the decoration are mentioned only in passing, in the form of a short indicative list, separate from the description of the compositions.[74] Here Prashkov refers to the generic names of six colours, denoting the hues of those colours present in the church's decoration. These are: red, green, yellow, white, grey, and black. There is no clear indication of the way the colours are juxtaposed within the compositions or of what materials were involved in the production of these colours, though in one instance Prashkov (only tentatively) suggests that, in the nave, azurite blue might have been employed.[75]

During the past fifteen years, various researchers have extended Prashkov's investigations into the wall paintings of the Church of the Nativity, concentrating on one section of the decoration at a time. The starting point of all these works is that the decoration is a means of instruction, illustrating different key sections of the biblical text. As a result, scholarship has engaged in an examination of the theological correctness of the interpretation and in deciphering the meaning of the images. For example, Klimukova published her work on the scenes in the outer narthex of the Church of the Nativity, in which she examined the extent to which these scenes illustrate faithfully the text of Psalms 148 to 150.[76] There are two more articles, this time by Kujumdjieva, one published in 1999 and the other in 2002, which examine the scenes from the didactic cycles of the lives of Joseph and Moses, again from the outer narthex of the Church of the Nativity.[77] These three works provide an impeccable cataloguing of the scenes. The focus of the researchers is on deciphering the content of the biblical text inscribed in

---

[74] Ibid., pp. 23-41.
[75] Ibid., p. 27.
[76] Klimukova, ' Psalmite v Konteksta na Starozavetnite Stzeni ot Tzurkvata Rozdestvo', pp. 19–29.
[77] Kujumdjieva, ' Dulgia Zivot na Edin Mit', 7-16, and Kujumdjieva, 'Tzikulut po istoriata na prorok Moisei v galleriata na tzurkvata 'Rozdestvo Hristovo', 33-42.

the background. Matters of colour do not appear to be of any concern. In the article by Klimukova, there is only one word indicating the hue of a colour. This is the word 'white', with reference to the headscarves and some parts of the clothing of the merry-making worshippers in the illustration of the third verse of Psalm 149.[78] In the articles by Kujumdjieva, engaging with the decorative programme of post-Byzantine church interiors does not imply an investigation into the use of colour, and colour names are not mentioned at all.[79]

There is only one exception among the latest art-historical works on Arbanassi, which is a short article by Rutževa, published in 1999, on the iconographic and stylistic characteristics of the Church of St Atanass.[80] Like Prashkov, she identifies the colours of the wall paintings by the generic names of their hues. However, she does not stop there, but at one point uses evocative and emotionally charged language to describe their appearance, attempting to represent in linguistic terms the visual experience of the colour compositions:

> [*Talking about rocks and hills*] 'On their grey and ochre background are ringing, and because of this are singled out, the dazzling red and blue tones of the clothes of the participants in the events. In the organisation and the colouristic construction of the scenes in the church of St Atanass the most active energy is held by the colours white and black. Compared to the calm blues, browns, greens and monochromatic grey and ochre tones, they seem to possess fluorescent qualities, drawing attention to the most significant elements of the represented gospel and biblical stories.'[81]

In this description, Rutževa indirectly draws attention to the importance of the beholder as the point at which the visual potential of the pictorial composition is realised. By doing so she describes the universal response to a particular

---

[78] 'Let them praise his name in the dance: let them sing praises unto him with the timbrel and harp.' [AV]
[79] For example, G. Gerov, 'Vodata cato granitža', *PI*, No. 2 (2002), pp. 31–57.
[80] Sv. Rutževa, 'Ikonographska I stilova harakteristika na stenopisnija ansamble ot tžurkvata Sv. Atanass v Arbanassi ot 1667', *PI*, special edition (1998), pp. 38–43.
[81] [My translation]

compositional arrangement of colour, namely the experience induced by the strong contrast between adjacent colours, which results in a visual enhancement. This was used as the principal tool in the construction of the decoration of the Church of St Atanass.[82] This phenomenon is called 'simultaneous contrast', and it explains why she likens the effect to the sensation produced by fluorescent colours. In my investigation I will scrutinise the compositional arrangement of the colours and investigate the extent to which 'simultaneous contrast' had been used in all the Arbanassi naves. A systematic use will suggest an informed and deliberate choice by the artist in order to intensify the visual impact of the interior decoration.

Describing colours in the way Rutževa has done contributes to a stylistic analysis. It is an attempt to present the role that colour plays in the architectonics of a particular pictorial composition. At the same time, one has to remember that, no matter how perceptive an account of the pictorial colours may be, it is still a personal impression of those colours, rather than an objective account of their appearance as they exist in that part of the wall painting. This implies the inevitable introduction of the perceptional distortion of an individual's observation, resulting from differences in the sensitivity of the observer to factors such as the contrast in the appearance (mainly colour hue and lightness) of adjacent colours, the ability of the eye of the beholder to refocus quickly on a new colour after previously focusing on a different one, the psychological effect of the beholder's previous experience of colour or colour combinations, the intervention of associative memory, the absence of reliable 'colour memory' and so on.

This form of description cannot be used in my comparative examination of the use of colour in these seventeenth-century interiors. Firstly, because of the

[82] R. W. G. Hunt, *Measuring Colour* (Kingston-upon-Thames, 1987, third edition 1998), p. 53; R. Gregory, *Eye and Brain: The Psychology of Vision* (Oxford and Tokyo, 1998), p. 89.

presence of subjective distortion in this type of description and the inability of the human brain to retain a consistent impression of the appearance of a colour, it is not feasible to describe the colours in this way and make a valid comparison between the content of the palettes used in each nave. Secondly, I will need to omit the optical interference of adjacent colours to enable me to define the independent visual experience of each colour included in the representational system of the four churches. Only by being aware of the independent appearance of each colour will I be able to understand, as fully as possible, the degree to which the compositional juxtaposing of colours had optically transformed their actual appearance.

1. 5 Methodology

In my quest to devise an adequate research method to assist the identification of the appearance of individual colours, I considered Mouriki's approach to identifying and recording colour in the context of the decoration of Nea Moni, Chios, in Greece.[83] In this method the use of colour is examined by identifying each discernable colour and recording its appearance as accurately as possible. This approach was, and still is, employed by Byzantinists internationally, mainly in the examination of mosaics. It aims to identify the regional colours within the image and the colour of the tesserae within each similarly-coloured area. This is because tesserae are highly textured, producing an irregular mosaic surface within which optical changes in the appearance of the colour of the tesserae occur. The colour of the individual tesserae can be considered uniform, as, especially from the distance at which they are observed, any small variations in colour will blend optically.[84] In painted wall decoration, the images are also composed by the arrangement of a number of coloured areas. Those areas are

[83] D. Mouriki, *The Mosaics of Nea Moni on Chios*, Vol. I (Athens, 1985).
[84] M. D. Fairchild, *Color Appearance Models* (Chichester, 2005), p. 143.

usually relatively evenly coloured, as in the Byzantine representational tradition images were constructed using line drawing and comparatively large colcolour blocks.[85] It is not expected that there will be much, if any, variation of colour within each block, because the paints were mixed in advance rather than on the wall.[86]

At the beginning of the second chapter of *Mosaics of Nea Moni on Chios*, Mouriki explains that the format of her method is not new for the study of Byzantine art and particularly as a method of studying mosaics.[87] According to her, this method was used in most of the published works on Byzantine mosaics in Constantinople and elsewhere, conducted under the aegis of the Byzantine Institute of America and later the Dumbarton Oaks Centre for Byzantine Studies. To a greater or lesser degree the same method has been adopted by Soviet Byzantinists for studying the medieval mosaics preserved in Kiev; it has also been applied in some recent studies on mosaics in Italy.

Mouriki exploited the method almost to the limit in attempting to record and systematise as accurately as possible the subjective visual sensation of the individual colours used in the images. Her aim was to assess the use of colour in Nea Moni in the broader context of similar eleventh-century Byzantine or Byzantine-inspired art. Here is an example of the way she presents her description of the figure of the Archangel Michael from the decoration of the sanctuary in the Katholikon of the monastery of Nea Moni:

> The figure of the archangel is surrounded by two rows of gold tesserae, and his halo by one. The outline of the halo consists of two rows of tesserae in two shades of dark blue, the darker of which is on the outside. His hair, outlined in black, is rendered in olive, highlighted with small curved gold lines. …

---

[85] James, *Light and Colour.*, p. 35.

[86] Ibid., p. 34.

[87] Mouriki, *The Mosaics of Nea Moni*, p. 42.

> The light flesh areas of the face and the neck of the Archangel Michael are rendered by small marble tesserae in three shades, two of pink, one of cream marble, as well as white limestone for the highlights. Heavy shading in two tones of olive surrounds all parts of the face except the chin which is outlined by a row of red glass tesserae. … Under the nose there is a square shadow, immediately below are three superimposed rows of light pink marble tesserae, and directly below them a red line for the mouth which is continued at the sides in olive. The lower lip is rendered by three rows of deep pink marble and one row of red glass.[88]

This quotation can be taken as another attempt to record a personal experience of the scene and the appearance of each individual colour, very similar to the earlier example from the work of Rutževa. However, when examined in detail, Mouriki's investigation presents a strong contrast to the sporadic, emotional account by Rutževa. Instead, Mouriki employs a logical framework of systematic observation which structures her observation and makes the record appear less personal. Thus the text gives the impression of a meticulous map of the pictorial colours. Each zone of a different colour hue has a verbal indication of the generic name of the corresponding colour and a schematic registration of the degree of lightness, indicated simply by the adjectives 'dark' and 'light'.[89] This style of enquiry, although devised for mosaic decoration, will be effective in the initial stages of the survey when identifying the hues used in the construction of an image. Mapping the pictorial colours will assist in situating the colour in the context of the examined compositions. Such a step will facilitate my analysis of the optical relationship between the colours in the images that might affect the visual impression of each colour, and consequently the impression of the image and finally of the decoration.

---

[88] Mouriki, *Mosaics of Nea Moni*, p. 44.

[89] In her publication this type of description is called 'technical' and the full version of the text includes details of the state of preservation of the mosaics. Mouriki, *Mosaics of Nea Moni*, pp. 42-93.

The method used by Mouriki systematises the use of different colours for the purpose of placing the use of colour in the Katholikon of Nea Moni in the context of other eleventh-century mosaics:

> The 'palette' of the materials used in the mosaics of Nea Moni may be evaluated only by comparison with the colour charts of tesserae employed in other mosaic decorations of the Middle Byzantine period, always taking into account the scale of each of the decorations discussed. …In eleventh-century mosaic decorations, red, purple, dark blue, grey-blue, olive, green and brown are the typical colours for glass tesserae. With the exception of red, these colours usually possess three to five shades for each. Apart from their use as block colours for drapery and various objects, as well as for landscape and architecture, the choice of colours in glass for the shading of greyish-white drapery, normally rendered in grey Proconnesian marble and in white limestone, gives each ensemble its special colouristic physiognomy. From this point of view, the mosaics of Nea Moni, especially those in the naos, share closer affinity with the mosaics of Saint Sophia in Kiev. (It may be noted however that the greyish-white surfaces of drapery in the Kiev mosaics are dim in comparison.)[90]

This part of Mouriki's study draws attention to the fact that the colour scheme and the appearance of those colours in a work of art is of a specific nature, whereas the historical evaluation of a colour scheme or the appearance of colour is of a relative nature. In her attempt further to clarify and compare the appearance of a colour beyond the record of Mouriki's personal experience, she systematises the recognisable colours by associating the colours of the tesserae with the category of material of which they are made: stone; marble; or glass. One can presume that such a form of classification is particularly responsive to differences in the textures of tesserae made of different materials, as texture influences the appearance of colour.

In the case of Arbanassi, however, it is not possible to deduce the general category of the material of a colour from the visual examination of a painted area. This stems from the fact that the raw material was reduced to fine particles to

---

[90] Ibid., p. 102.

increase the covering ability of the paint.[91] Moreover, the colour might be a result of the mixing of one or more ground materials, carried out at the prepara-preparation stage of the paint.[92] Therefore, the identification of the materials of colour cannot be achieved by macro-analysis, but only by micro- analysis. I must add that there are no significant differences, either in the textures of the differently coloured surfaces or in the textures of the wall paintings, between the four individual naves. This is because texture in wall painting is associated with the methods of application rather than with the varieties of material, as is the case with mosaic.

Conservation science offers an array of examination techniques and tools, which give different insights into the process of creation and the state of a work of art at various levels of detail. These different methods of examination, primarily involving recording images from different spectral zones in controlled experimental conditions, aim to reveal information that is invisible to the naked eye. It is obvious that the desired level of precision determines the degree of complexity of the method. One level of identification is that of the general chemical class or type of the artist's material, using tests such as binocular or polarising microscopic analyses and/or reflectance spectrophotometry. The next level of micro-chemical tests studies the range of elements and the crystalline compounds present using methods that are based, for instance, on electronic microscopy, X-ray diffraction spectrometry, infrared (IR) to ultraviolet (UV) spectroscopy, and Raman spectroscopy. In works of art, where there are layers of paint that need to be investigated, spatial scanning techniques such as optical

---

[91] Very rarely the raw materials used in the production of pigments for wall paintings are not ground into a powder. For example, the blue colour of azurite is best revealed if the soft mineral is only crushed, rather than ground, but it is necessary then to find a suitable technique to attach the particles to the surface of the painting. Detailed investigation into the characteristics and the history of its use can be found in 'Azurite and Blue Verditer' by R. J. Getten and Fitzhugh, E. W. in A. Roy (ed.), *Artists' Pigment. A Handbook of Their History and Characteristics* (New York Oxford, 1997, first edition, 1993), pp. 23-35.
[92] James, *Light and Colour*, p. 34.

tomography are used for collecting information about a 'cross-section' of the layers. This is only a representative collection of the methods of examination used in conservation. The issues that need to be resolved by the use of those methods usually concern either the identification of the pigments and of the techniques used or the identification of the superimposed changes and a determining of their causes or the state of preservation and the levels of conservation and future restoration of the work that may be required.

The purpose of my investigation into the use of colour at Arbanassi is different from the aims of a conservation project in that it is limited to the identification and recording of the appearance of the colours included in the palettes of the naves. As the range of colour-producing materials forms the basis of the appearance of the palettes, I will look for evidence of the general type or class of pigments used in the decorations. Such an emphasis will allow me to assess to what extent the variations in the appearance of the same colour hue, as used in the decoration of different churches, can be attributed to the use of pigments that have a different colour agent. I will base my method of investigation on the examination of the specific optical properties of the coloured surface of the Arbanassi interiors in the visible part of the spectrum, and will use spectrophotometric analysis. The spectral characteristics of the portion of the incident flux that is reflected by a surface correlate to the general chemical type of the colour agent (a technical term describing the substance that determines the hue of the pigment) present. For example, in wall paintings, red induced by a material for which mercury sulphide is the main agent is expected to be a red in the orange part of the spectrum, but so are the reds from lead oxide, although their specific appearance is different. The use of spectrophotometry to associate a particular colour appearance with a specific pigment is widespread in documentation, historiography and conservation of works of art and architecture.[93] Since the end of the 1930s, spectrophotometry has been widely and routinely applied in the standardisation of appearance during the production of pigments.[94]

The question, then, is how to try to convey the specific sensation that a colour evokes in the eye of the beholder. I will turn again to Mouriki's research, as her description is marked by a particular meticulousness, giving the impression of fastidious exactness. This is her colour chart associated with the glass tesserae used in the decoration of Nea Moni:

> Red, in two values
> Clear brown or 'bottle glass' (the translucent glass used for the gold tesserae)
> Dark brown, in three values
> Dark brown-black
> Brown, in three values
> Purple, in four values
> Purple-black
> Black
> Dark blue, close to ultramarine, used in four values blue-black
> Light blue, in two values
> Grey-blue, close to Antwerp blue, in four values
> Olive, in four values
> Green, in three values
> Green-blue, in two values
> Yellowish-green, in two values. [95]

The result is detailed and relatively clear linguistic descriptions of colours. However, not only does the text give the names of the colours of the glass tes-

[93] R. L. Feller (ed.), *Artist's Pigments. A Handbook of their History and Characteristics*, Vol. 1 (Cambridge, 1986); A. Roy, *Artist's Pigments,* Vol. 2; E. W. Fitzhugh, *Artist's Pigments. A Handbook of their History and Characteristics*, Vol. 3 (New York, Oxford, 1997, first edition 1986); B. H. Berrie (ed.), *Artist's Pigments. A Handbook of their History and Characteristics*, Vol. 4 (London, 1985).
[94] N. F. Barnes, 'Spectrophotometric studies of artists pigments' in *Technical Studies in the Field of the Fine Arts,* Vol. 7 (1938), pp. 120-135. For example, Windsor and Newton have been using spectrophotometry to maintain the established standardisation of their artists' paints. I am grateful to Alun Foster, formerly of Windsor and Newton, for this information (private communications).
[95] Mouriki, *Mosaics of Nea Moni*, p. 105.

serae used at Nea Moni, but a close examination reveals the major difficulties of using only a linguistic method of describing the appearance of a colour. The ambiguity that becomes apparent has its roots in the inevitable introduction of a personal visual and perceptual distortion into what is presented as an objective and detailed description of colours. Because of this distortion, a description of colour may mean different things to different people. As a result, text that is seemingly explanatory, such as 'clear brown' or 'bottle glass', may mean quite different things to different people. It might be associated with different colours of glass bottles, whose particular colour is usually designed by the manufacturer in a tone and shade that will best preserve the product for which it is intended, for example beer or perfume. Such 'bottle glass' might have a slight green or yellowish appearance or it might even be colourless. In addition, the term 'bottle glass' might simply be unthinkingly associated with a particular bottle that is actually present, or with the memory of one.

The problem becomes even more intractable when there is an entry such as 'green-blue, in two values'. It is almost intangible, as one has first to deal with the description of a hue and where on the spectrum that green-blue is placed, and then to decide where on the scale of lightness one should place the prescribed two values of the particular hue, or even four values in the case of the colour described as olive.[96] The difficulties do not lessen when considering a slightly more complicated construction intended to help the reader to visualise the particular appearance of a colour. In the above passage there are also descriptions such as 'dark blue, close to ultramarine' or 'grey-blue, close to Antwerp blue'.[97] Mouriki and Hawkins intended to be utterly explicit by adding the phrases 'close to' before 'ultramarine' or 'Antwerp blue', but instead

[96] The term 'value' is associated with the perceptual lightness of an object. It is one of the parameters of the appearance of colour in the Munsell Colour Order System in which three coordinates define the appearance of each colour: hue, value, and chroma.
[97] Mouriki, *Mosaics of Nea Moni*, p. 106.

they only made them more ambiguous. This is because there was no attempt to define the degree or direction of that closeness or departure from a previously known, fixed appearance. For example, does the discrepancy appear in hue, in saturation, in value, or in all three?

This passage exemplifies the problems associated with Mouriki's method of attempting to use description as a basis for colour comparison. The intention of the method is to provide a thorough investigation and evaluation of the colour in the mosaics by identifying the coloured areas and creating a map of the colours used, which is then compared with the way colours are used in other monuments from the same period. However, natural limitations, both of the human perceptual system and more especially of the linguistic expression of a particular colour, prevent the aim of the study from being fulfilled.

Thus, methods that engage in a somewhat traditional way with works of art by attempting to describe the experience of visual colour by means of the perceptual system of the art historian, as exemplified by the works of Prashkov, Mouriki and Rutževa, do not appear to be adequate for describing and comparing colour. The subjective constraints are those imposed by the mechanisms of visual perception and memory, together with the limitations in the verbal communication of colour imposed by any linguistic representational system.[98] The objective constraints are associated mainly with the existing colour-reproduction systems in image-capturing devices, compounded by imperfections in printing and computer imaging.

To try to avoid the deficiencies of a linguistic representational system, this thesis will engage with colour in a different way. I will still use a general verbal description of the appearance of a colour, akin to the mapping of the colours in

[98] J. Gage, *Colour and Meaning: Art Science and Symbolism* (London, 1999), pp. 53, 56.

Mouriki's method, but it will be supplemented by a precise mathematical description of that appearance. This will avoid the demonstrated ambiguity and lack of exactness that come from using only a verbal description. This level of accuracy will also allow the description of the appearance of the colours used in Arbanassi to be employed in further study of the use of colour in seventeenth-century post-Byzantine art. To make the description of the colours of Arbanassi applicable to all research, I will utilize the internationally accepted code for the mathematical modelling of colour, the CIE colourimetric notation, CIELAB.[99] This describes the attributes of the appearance of colour, such as hue, lightness, and chroma.[100] It also takes into consideration the physiology of the human eye, which is the basis of the ability to recognise colours.[101]

Moreover, CIELAB is closely related to the Munsell Colour Order System, which categorises the attributes of colour appearance as 'hue value' and 'chroma'. The Munsell System consists of physical, printed colour examples, the appearance of which is strictly monitored, and which I will be able to use to exemplify the palettes of Arbanassi.[102] By doing this I will be able to present the colours of Arbanassi in a visual format and avoid the ambiguity created by Mouriki when trying to use the commercial names of artistic paints to familiarise the reader with the appearance of the colours of Nea Moni. The increased accuracy of the recording of the appearance of colours will assist me in better

---

[99] CIE is an abbreviation of *Commission internationale de l'éclairage,* the French name of the *International Commission on Illumination*, which is the international authority on light, illumination, colour, and colour spaces and is based in Vienna. It is a successor to the *Commission Internationale de Photométrie* (1913).

[100] In Wyszecki and Stiles, *Color Science,* p. 487 *chroma* is defined as 'the attribute of a visual sensation which permits a judgement to be made of the degree to which a chromatic stimulus differs from achromatic stimulus of the same brightness'.

[101] CIELAB was adopted by CIE in 1976 and is an opponent colour system based on the earlier (1942) system of Richard Hunter called L, a, b. Colour opposition theory correlates retinal stimulation by a colour to the distinctions between light and dark, red and green, and blue and yellow.

[102] Fairchild, *Color Appearance Models*, pp. 94–110.

assessing the interactions and the resultant optical distortions of colours in the context of a specific pictorial composition.

While the work of Mouriki provided a descriptive scheme of the visually perceived colours, James analysed Byzantine colour vocabulary and investigated texts that might have been formative for the perception of colour.[103] The subject of her investigation was the cognitive perception of light and colour and their role in the construction of the Byzantine representational system. Because of the angle of her investigation, she based her method on the tradition of the 'anthropological' school of art studies, where a work of art is considered as an historical social document. Even though James sought to define the cognitive aspect of colour perception by investigating the construction of the gaze, in the historic context of the middle Byzantine period, she devoted a whole chapter to the pigments used in the Byzantine era.[104] Most importantly, the conclusion of James's study underlined the need for investigation into the use of colour if one is to gain an understanding of the image.[105] Close examination of the structure of the work reveals that James continued her investigation within the psycho-physical framework in which colour is visually perceived: light–beholder–material. Because James is essentially interested in the production of meaning, the beholder is her focus because he or she is the one who codes and decodes light and colour in the context of culturally restricted conventions.

In contrast, I primarily consider the appearance of colour and its role in underpinning the construction of pictorial and interior space through the mechanisms of human visual perception. I will structure my investigation around the elements of visual perception: the material as the cause of colour and the interior

---

[103] James, *Light and Colour*, pp. 19–46.
[104] Ibid., pp. 19-46.
[105] Ibid, pp. 139-140.

light as a mediator of the visual perception of colour. I will analyse the decoration of the interior spaces with reference to the physiology of the eye, rather than to linguistic representations of perception. To do this, I need to scrutinise the physical light in the seventeenth-century Arbanassi interiors, and the quantity and quality of that light.

I have been unable to find any research on the use of natural light in the Arbanassi churches. When attempting to assess the natural interior lighting in the naves, I took into account the works of Illiadis and Schibille, as well as the framework in architectural theory concerning the natural illumination of buildings.[106] Both Illiadis and Schibille developed specific plausible methods that used the architectural design of the church building as a starting point for an assessment of how the architecture manipulates the daylight in the interior.

Illiadis treated the fenestration of a building as the ultimate source of illumination when he examined the pattern of direct sunlight in order to determine the intensity of the natural interior illumination. He scrutinised the relationship between the fenestration and the orbit of the sun and performed direct measurements of the intensity of the incoming light. Further on in his investigation, Illiadis demonstrated that the colour and texture of the materials used in the interior played a significant role in determining the level of brightness of the space, as did the shape of the window openings. For him, the building is an optical device that is designed with a particular purpose in mind.

Although his research is site specific, nevertheless, because he had structured his method around essential geometric correlations between the direction of sunlight and fenestration, it is capable of more general application. Because of

[106] Illiadis, 'The Natural lighting of the Mosaics in the Rotunda at Thessaloniki', pp. 13–24; Schibille, 'Light in Early Byzantium Church of Hagia Sophia'.

the fundamental nature of these correlations I adopted the principle of his method and applied it in the context of the architectural design of the four Arbanassi churches, with specific emphasis on the position and design of the nave fenestration. As did Illiadis, I will only make reference to the symbolic connotations of light in the Eastern Church, rather than make that a focus of my examination, as it was in the work of Schibille.

However, I could not perform direct measurements of the incoming natural light, as the external windows of the churches are permanently covered with wooden shutters, so I developed my own method which involved putting forward a theoretical evaluation of the relative brightness of the interior. Relative brightness is a technical term for the theoretical assessment of the brightness of a space expressed as the relationship between the illuminating surfaces of the openings and the volume of the illuminated space. The theoretical evaluation of the brightness of the natural illumination of the Arbanassi interiors proposed here can be applied in other art-historical studies faced with similar physical restrictions.

In the tradition of the Eastern Church, interior illumination of the churches is customarily achieved by a combination of natural and artificial lighting. Hence I will seek to ascertain the type and the characteristics of the original seventeenth century artificial illumination and how it might have influenced the appearance of the nave interiors. In my investigation I found only a single, rather speculative work by Gergova, on the kind of lighting device that might have been used in the Church of the Nativity of Christ.[107] In her paper, Gergova attempted to find parallels between the fragments of an unspecified piece of ecclesiastical furniture that had obviously been reused in the construction of an analoy and

[107] I. Gergova, 'Horusut v Tžurkvata Roždestvo Hristovo v Arbanassi', *PI*, No. 4 (1996), pp. 14–20.

some examples of preserved wooden polycandela.[108] Following this presumption, Gergova concluded that because the pieces incorporated in the analoy contain images of the apostles they must have come from a twelve-sided wooden polycandelon.[109] Her only basis for an association of the supposed polycandelon with the Church of the Nativity was the fact that the analoy comes from the nave, but there is no direct or indirect literary or material evidence to prove the validity of this particular part of Gergova's argument. Nevertheless, because research into the artificial lighting historically used in the interiors of Eastern churches indicates that polycandelon types of device have been consistently used throughout the centuries, by analogy I accept that polycandela were also employed in the Arbanassi interiors.[110]

Although it is impossible to specify the precise design of the ceiling-suspended devices that were used in any of the Arbanassi churches, an indication of their positioning is provided by the surviving hooks, which are structural parts of the four nave interiors. It is also reasonable to expect that mobile lighting devices, such as candlesticks and oil lamps, were present in all the nave interiors, but neither the exact position nor the intensity of the movable lighting can be stated. Nevertheless, I will work on the premise that there was an abundance of candles and oil lamps in the churches both because of the theological significance of light and because this has long been the tradition in the Eastern Christian church, as it still is.

---

[108] An analoy (a Bulgarian word which derives from the Greek αναλογιον) is a stand on which are placed icons for veneration. K. Parry, D. J. Melling, D. Brady, S. H. Griffith and J. F. Healy (ed.), *The Blackwell Dictionary of Eastern Christianity*, (Oxford, Malden, 2002, first edition 1999), p. 27. Polycandelon is a Greek word that is used for a lighting device, suspended from the ceiling, that holds a number of lights, candles or lamps. Polycandela is the plural form.

[109] Gergova, 'Horosut v Tžurkavata Roždestvo Hristovo', pp. 14-20.

[110] M. M. Postnikova-Loseva, 'Srebrjanye izdelija juvelirov Serbii i Dubrovnuka XV-XVII vv', *Muzej Primenjene Umetnosti* Zbornik, No. 15 (1971), pp. 67-109; D. Todorovič, 'Polijelej u Markovom Manastiry', *Zograph*, No. 9 (1979).

My ultimate goal is to assess the possible effect that the presumed seventeenth century nave illumination might have had on the appearance of the individual colours and, finally, on the appearance of the interior decoration as a whole. To fulfil this aspiration I had to acquire a suitable methodology that would enable me to ascertain the appearance of the naves under their original illumination, as at present the interiors are lit by electric light. For this purpose I consulted the recent collaborative work of Chalmers on computer reconstruction of historic sites in the context of the most likely type of illumination.[111] Together with Delvin, in examining the differences in the appearance of the frescoes in the house of Vetii in Pompeii, a methodology was used where, even though it was approximate, a physically and perceptually viable visualisation of the interior, under different illumination conditions, was achieved.[112] This work demonstrated the dramatic effect on the frescoes and on the interior as a whole of the probable original type of light, namely a 'flame light' i.e. that produced by the flame of a candle or oil-lamp, as would also have been used in Arbanassi.

However, I was not able to collect data that would have allowed for a physically accurate model of the naves, which was an essential precondition for carrying out a realistic visualisation of the interiors. This was a consequence of the prohibition on the use of laser generating measuring equipment inside the churches. Therefore, I had to devise a methodology which would enable me to simulate the original lighting conditions in the nave. My starting point was that, instead of a reconstruction of the naves, I used the actual spaces. As in the computer visualisation of the Pompeii room I attempted to replicate, as closely as possible, the characteristics of the original nave illumination.

---

111 E. Zanyi, C. Schroer, M. Mudge and A. G. Chalmers, 'Lighting and Byzantine Glass Tesserae' in *Proceedings of EVA 2007: Electronic Information, the Visual Arts and Beyond*, London, 2007.

112 Delvin, K., Chalmers, A., 'Realistic Visualisation of Pompeii Frescoes' at http://www.cs.bris.ac.uk/Publications/Papers/1000595.pdf

Because my examination is twofold, I will divide the thesis into two parts. The first part will examine the differences in the range and the appearance of the colours used in the decoration of the different naves. This part will consist of four chapters (chapters two to five). In chapter two, I will clarify the issues of dating and in particular verify through existing research the parts of each church that have wall paintings from the seventeenth century. In other words, I will outline the basis of this study. Chapter three will explain the scenes that were selected for examination and their suitability; it will also map the colours used in the scenes and define the palette of each nave. Chapter four will enquire into the general type of pigments used in the decoration of the four Arbanassi naves. Chapter five will describe the appearance of the colours in the palette of each church and present a colour chart of each palette. As part of that chapter, I will define the magnitude of the difference in the appearance of colours sharing the same hue. The conclusion of the first part of the thesis will move into the realm of visual perception and will examine how the way the colours were juxtaposed in the images has affected the perceived appearance of both the individual colours and the entire composition.

However, as the appearance of colour depends on the quality and quantity of the ambient lighting, the second part of the thesis will discuss how light was employed in the interiors of Arbanassi and how this determined the level and the colour of lighting. In the sixth chapter of my thesis I will scrutinise the relationship between the fenestration of the naves and the path of the sun, taking into consideration the impact of the shading devices available, notably the roof overhang. This will allow me to ascertain when in fact the interior would actually have received direct sunlight and when only indirect daylight would be available. In the context of the result of this investigation I will assess the brightness of the interior illumination. In the seventh chapter I will examine the artificial lighting, its type, distribution and the colour of the light produced. Finally, I will present an analysis of how the characteristics of the interior lighting affected the appearance of the colours of the decoration and thereby transformed the appearance of the interior space.

PART I

COLOUR

The opulence of colour in the decoration of the Arbanassi churches is observable in the illustrations of the interiors of the naves and discernible in the brief description of my own experience. My examination of Bulgarian scholarship on the churches has indicated that the existing research did not deal with the use of colour in the interior decoration. In Part One of the thesis, I will proceed to examine the range and use of colours included in the seventeenth-century palettes of the four Arbanassi churches under consideration: the Nativity of Christ, the Archangels, St Atanass and St Dimitr.

Initially I will identify the colours included in each of the palettes and look for emerging patterns in the juxtaposing of the colours within the examined compositions. This is because the artistic choices that affect the appearance of colour are not confined only to the selection of hues, but also to the compositional arrangement of the chosen colours within the wall paintings. Empirical research has demonstrated that there is a difference between the appearance of colours when they are viewed in separation, i.e. one at a time, and when they are examined in the context of a composition. This is associated with the optical interaction of juxtaposed colours, which can be classified either as simultaneous light contrast or simultaneous colour contrast.[113] For example, in the case of simultaneous light contrast, the sharper the difference in lightness of a juxtaposed pair of a light and a dark colour, the greater is the enhancement of the perception of the brightness of the light colour and respectively of the depth of the darker colour. At the same time, when a simultaneous colour contrast occurs, it enhances the colourfulness of the juxtaposed colours. For instance, when blue and yellow are placed next to each other within a pictorial composition, the blue is perceived to be bluer than when observed in isolation, while the yellow is yellower. Those colours occupy diametrically-opposite positions on the colour wheel. All the other pairs that are diametrically opposite are also associated with induced colour contrast. I will check for the use of either or both types of simultaneous contrast within the decoration of the Arbanassi naves.

When scrutinising the use of colour in art it is necessary to explore the colour materials used in the production of an artefact. In wall painting the colour depends on the pigments used. Exploiting the dependence of the appearance of a coloured surface on the material of which that surface is made, I will collect data representing the characteristics of the light reflected from the surfaces painted in each of the identified colours. Analysis of the data will allow me to assess and compare the kind of pigments most probably used in the seventeenth-century decoration of the naves, without disturbing the surfaces of the wall paintings.

---

[113] Berns, R. S., *Billmewer and Saltzman's Principles of Color Technology*, (New York, Toronto, 2000, first edition, 1981).

The results of that investigation will inform my study not only of the kind of pigments used, but also of the extent to which the differences in the appearances of the colours in the naves are a consequence of the use of pigments with different chemical natures. In the cases where the difference in the appearance of the painted surfaces cannot be attributed to such differences in the material used for the production of the paint, I will investigate the possibility that those differences are a result of the specialised methods of production of the paints. In other words I will be able to weigh up the likelihood of the deliberate manipulation of the final appearance of the paints used in the decoration of the Arbanassi churches by the artists through processes that alter the micro- and macro-structure of the pigments' raw material.

An analysis of the pigments identifies the materials used for the production of colour. For example, when lighter shades within the same hue are sought, it is necessary to prepare fine fractions at the preparation stage of the selected pigment. In some cases, the production of fine fractions was even a means of obtaining a different hue altogether as in the case of lapis lazuli. Here the finer fractions are perceived as greenish turquoise, while the coarser ground pigment retains its blue colour. Another deliberate intervention in the production of colour could be through heating the pigment to a high temperature before the grinding began, as in the case of the production of purplish tones from haematite-based raw material, which in its natural state only produces brownish red pigments.

To identify the particular appearance of the individual colours in isolation, I will re-examine the characteristics of the reflected light taking into consideration the physiology through which the eye will interpret those characteristics. This will allow me to juxtapose the appearance of the palettes of the Arbanassi churches. Moreover, it will enable me to ascertain the degree to which the compositional use of colour had affected the appearance of the Arbanassi decoration. For that purpose I will examine the compositional arrangement of colours in each interior, seeking for patterns of use that can be associated with the above mentioned simultaneous contrasts and the expected optical transformation of the appearance of the colours, when within the context of the pictorial scenes.

My investigation is structured as follows. In chapter two I will introduce the internal arrangement of the architectural structures of the churches and ascertain the dates of the wall paintings in the different chambers. This is a necessary preliminary stage of my investigation because the church interiors, as they exist at present, were constructed and painted from the sixteenth to the eighteenth centuries. The methodology I will use in chapter two is based both on a direct survey of the wall paintings and on an examination of the existing secondary sources on the site, which comprise historical, archaeological, and art-historical studies.

In chapter three I will make a visual identification of the colours (which I will term 'visual colours') in the palette for each nave. The process of identification is relatively easy and the number of colours is limited. In chapter four, I will attempt to identify the pigments used to produce the colours in the palettes of the naves. The appearance of a colour is closely associated with the structure of its pigments in both their micro- (molecular) and macro- (size of particles) aspects.[114] I will employ methodologies based on the quantitative description of the appearance of the colour as a function of the physical characteristics of the light reflected from the painted surfaces.

---

[114] K. Nassau, *The Physics and Chemistry of Color: The Fifteen Causes of Color*, (New York and Toronto, second ed., 2001, first edition, 1983), pp.35-276.

In chapter five, I will illustrate the appearance of the Arbanassi colours as a function of the response of the human retina to the light reflected from a surface painted in that particular colour. This constitutes the CIELAB description of the appearance of the colour.[115] CIELAB descriptions are accepted as the universal perceptual experience of a beholder under lighting conditions the characteristics of which are considered constant. This will enable me to gain an insight into the magnitude of the perceived differences between the appearances of a particular colour in the paintings of the different churches where they share the same basic colour agent. The CIELAB description of the surface colours will also permit me to construct a representative illustration of the palettes of the Arbanassi churches. This illustration is achieved using CIELAB to obtain the reciprocal Munsell chips. Acquiring knowledge about the perceived appearance of each individual colour will aid my analysis of the level to which the compositional use of colour influenced the visual perception of that colour.

[115] It needs to be remembered that all the investigations and the subsequent conclusions are made on the assumption that all the beholders had normal colour vision.

CHAPTER TWO

Questions of Dating

The aim of this chapter is to verify the date of completion of the different chambers in each church and to identify those that were painted in the same period, in this case the seventeenth century. This will establish the areas of the church that will form my focus. There is no consensus on the dating of the different churches, or even of their different chambers.

The proposed period of completion varies between the Middle Ages and the eighteenth century. Harbova considered that the churches of Arbanassi had begun their existence as family chapels in the Middle Ages, including the building of the Church of the Nativity of Christ.[116] However, Prashkov, in his monograph on the same church, writes that it took three consecutive constructional stages before the architectural plan and the decorative system of the church were finalised.[117] According to Prashkov, the whole process lasted from the end of the sixteenth century to the end of the seventeenth century. Other research has also suggested that it is not an exception but a general tendency that the surviving post-Byzantine church complexes developed over a considerable period, sometimes incorporating earlier, medieval chambers.[118]

There is a limited body of historical and archaeological studies, carried out from the 1950s to the end of the 1990s, on the origins of Arbanassi. These publications

---

[116] M. Harbova, 'Nauchna hipotheza za Arbanassi (starinnoto Zagorie) kato element v staroprestolnia Turnovgrad', *Akti na II[ija] Meždunaroden kongres po Bulgaristika, Izobrazitelno Izkustvo I Arhitektura*, Sofia (1988), pp. 137–156.
[117] Prashkov, *Stenopisi vTzurkvata Rozdestvo*.
[118] S. Bojadjiev, *Bulgarskata Arhitectura pres Vekovete* (Sofia, 1982); M. Koeva, *Pametnitzi na Kulturata pres Bulgarskoto Vuzraždane* (Sofia, 1977).

usually subscribe to one of two opposing opinions where the dating of the churches is concerned. The dividing point between the two schools of thought is the end of the fourteenth century, the time of the fall of the Bulgarian Tzardom. One group of researchers mainly seeks to date the first stage of construction by the architectural style of the churches. This group puts forward the case that the churches of Arbanassi were in existence before the Ottoman invasion, but as chapels, and were later extended to their present size. Scholars belonging to this group include Shurkova and Harbova.[119] The other group of researchers includes scholars such as Popgeorgiev, Kostov, Tzonev, Mitjaev, and Mavrodinov, and each of these considers the churches to have been built and developed after the fall of the Bulgarian Tzardom.[120] Nevertheless, there is no established consensus within either scholarly group on the dating of the churches.

In the first group of historians, Shurkova worked on the dating of the Church of the Nativity of Christ at the end of the 1950s.[121] She used the church as a case study and applied her findings about the dating of this particular church, defined as pre-Ottoman, to the rest of the Arbanassi churches. Shurkova's argument for such an approach was based on the presumption that the close stylistic similarities between the architectural designs of the individual buildings were in themselves enough to lead one to assume that all the churches are from the same historic period. Shurkova speculated further, suggesting that the Arbanassi churches appeared initially as small chapels that served the needs of the courtiers who lived out of town. In her opinion, this was the likely explana-

---

[119] L. Shurkova, 'Hristovata tžurkva v Arbanassi', *IIGA*, Vol. XII (1959), pp. 331–350; Harbova, 'Nauchna hipotheza za Arbanassi', pp. 137–156;.

[120] Popgeorgiev, 'Selo Arbanassi', pp. 1-38; Kostov, *Arbanassi*; Tžonev, Zv., *Manastirite I Starinnite Tžurkvi v Arbanassi* (V. Turnovo, 1934); Kr. Mijatev, *Arhitekturata v Srednovekovna Bulgaria* (Sofia, 1965), pp. 35–40; Mavrodinov, *Ednokorabnata i Krestovidna Tžurkva po Bulgarskite Zemi* (Sofia, 1931).

[121] Shurkova, 'Hristovata tžurkva v Arbanassi', pp. 331–350.

tion because of the geographic proximity of Arbanassi to Turnovo, but she did not present any actual evidence for it.

To support her hypothesis of the pre-Ottoman existence of the churches, Shurkova also conducted epigraphic research on Ottoman documents. They indicated that the construction of new churches was prohibited by the Ottoman authority until the end of the sixteenth century.[122] She then proceeded to conduct a formal comparative analysis of the Church of the Nativity and those churches dating from the time of the Second Bulgarian Tzardom that could be found within Turnovo's town walls. From the very beginning Shurkova accepted architectural style as a guiding characteristic for the dating of a building; her conclusion was that the Church of the Nativity and the rest of the Arbanassi churches must have been built before the Ottoman invasion, in all probability in about the fourteenth century. To explain the present size of the churches, she proposed that the original chapels were extended later, but she did not attempt to specify when this happened.

There are methodological problems with the argument offered by Shurkova, in that her far-reaching generalisation about Arbanassi church architecture is based on one particular building, the Church of the Nativity. Having proposed that Arbanassi was effectively an aristocratic suburb of Turnovo, she offered no evidence in support of her hypothesis other than geographical proximity. It can be argued that, although such proximity makes her hypothesis somewhat plausible, nevertheless the geographical relationship of the two settlements cannot be accepted as convincing proof. Because Shurkova read too much into this proximity, she failed to place the architectural form of the Arbanassi churches in the context of archaeological studies of ecclesiastical architecture in the pre-

---

[122] Bojadjiev, *Bulgarskata Arhitectura pres Vekovete*, pp. 154–155; Koeva, M., *Pametnitzi na Kulturata*, pp. 7; Penkova, 'Za Njakoi Osobenosti', pp. 3–8.

sent territory of Bulgaria at least, if not in the Balkans as a whole. As a result, she did not investigate the possibility that the churches might have been constructed after the sixteenth century, while still following a previously estab-established architectural form. However, architectural historians, for example Bojadjiev and Koeva, present plenty of material evidence that, in the first centuries after the Ottoman conquest, church architecture was very simple, following the tradition in chapel building from the end of the Second Bulgarian Tzardom.[123] In view of the above, it is difficult to accept Shurkova's conclusion concerning pre-Ottoman existence, either in the individual case of the Church of the Nativity or in the case of the churches of Arbanassi in general.

Despite the weaknesses in Shurkova's argument, Harbova adopted her hypothesis and in fact attempted to provide some evidential backing.[124] Initially, Harbova suggested that the close stylistic association between the ecclesiastical architecture of Turnovo and Arbanassi must be a sign of the previously existing greater geographical integration between the settlements. She proposed an association of Arbanassi with the Bulgarian court and attempted to justify her presumption. Her assertion about the noble origins of Arbanassi was made on the strength of the information found in a publication of 1859 called the *Handbook of Commerce*, which asserted the Bulgarian ethnic background of the village. This publication claimed to be a translation of an earlier Greek work. There, Arbanassi is mentioned as a village known also as Zagorie, where 2,000 Bulgarian aristocrats and other courtiers lived 'in the old times'.[125]

Harbova went further in her conclusion about the level of association between Turnovo and Arbanassi. She put forward the suggestion that Arbanassi had

[123] Bojadjiev, *Bulgarskata Arhitectura pres Vekovete*, pp. 154–155; Koeva, *Pametnitzi na Kulturata*, p. 7.

[124] Harbova, 'Nauchna hipotheza za Arbanassi',pp. 137–156.

[125] Vatchev, 'Enoriiskiat hram v Turnovskata Mitropolia'.

more than an association with Turnovo, and had actually been a district of the capital. Harbova was initially prompted to draw this conclusion on the basis of her formal analysis of the churches of Turnovo, after examining a number of medieval sites in the immediately surrounding area. In a way this is the route that Shurkova took, but Harbova went a step further. Because she did not have any archaeological evidence for the inclusion of Arbanassi in the fortification system of Turnovo, she compared the plans of the fort of Trapezitza with those of the stronghold of Arbanassi proper. Trapezitza was the fortified nucleus of Turnovo and included the palace and the Patriarchal Church. Harbova's argument was that the plan of Arbanassi showed the same characteristic concentration of churches as Turnovo proper, and there was no evidence at that time that Arbanassi had its own fortifications. Because of this and the hypothesis of the links to the court, Harbova concluded that Arbanassi must have been within the Turnovo town boundary. However, in the 1990s, archaeological investigation of the fortifications around Turnovo and Arbanassi established that there was no evidence that Arbanassi was included within the city walls. In fact, Arbanassi had its own defence system based on the heavily fortified stone houses of the village.[126]

In her claims about the court connections of Arbanassi, Harbova did not take account of earlier research on the name used for Arbanassi in a 1925 publication. This is the work of Ishirkov on the linguistic problems surrounding the name 'Zagorie' and all its variations. [127] Nor did she consider the 1959 publication by Kostov on Arbanassi and its domestic architecture.[128] In his work, Ishirkov concluded that the name 'Zagorie' was used to mark the area behind

---

[126] Zl. Genova, H. Vatchev, 'Sondažni prouchvania v Arbanassi, Velikoturnovsko' in *AOP* (Lovetch, 1991), p. 180.

[127] A. Ishirkov, 'Oblastnoto ime Zagora ili Zgorie v Minaloto i Sega' in *INEM,* Vol. V (1925), pp. 80–89.

[128] Kostov, *Arbanassi*.

the mountain slopes surrounding Turnovo, rather than being linked to the particular settlement of Arbanassi.[129] At the same time, epigraphic research on surviving ecclesiastical and Ottoman archives led Kostov to believe that the 1859 publication was in all probability a mixture of fact and fiction, especially where the claim for the royal connections of Arbanassi was concerned.[130] A much later publication by Andreev confirmed the study by Ishirkov and argued successfully that the village could more probably be associated with the Albanian diaspora after the fifteenth century.[131]

To conclude, neither Harbova's nor Shurkova's work offers enough evidence or sufficient arguments to support the hypothesis that the churches of Arbanassi as a whole were constructed in the period before the fall of the Bulgarian Tzardom.

Examination of the works of the second group of scholars does not help to answer the question of when the churches were built either, as there is no consensus within this group as to the time of construction. These scholars take the view that the churches of Arbanassi were constructed after the Ottoman occupation, but opinions oscillate within the period from the fifteenth to the eighteenth centuries.[132] Here I need to stress that the dating of the churches is not their prime aim, as it was for Shurkova and later for Harbova, but is mentioned only as an ancillary matter. For example, Popgeorgiev in the popular history of the archaeology of the village of Arbanassi, Kostov in his short monograph on Arbanassi and its architecture, and Tzonev in his review of the

---

[129] Ishirkov, 'Oblastnoto ime Zagora', pp. 80–89.
[130] Kostov, *Arbanassi*, pp. 7–10.
[131] J. Andreev, 'Gorna Orjahovitza prez epohata na Turskoto vladichestv' in *Rjahovetž*, Vol. I (V. Turnovo, 1994), pp. 102–110.
[132] Among those are Mavrodinov, *Ednokorabnata i Krestovidna Tžurkva po Bulgarskite Zemi*; D. Papazov, 'Selo Arbanassi. Lichni spomeni i subrani Danni' in *SpBAN*, klon IF, Vol. 17 (XXXI) (Sofia, 1937); Philov, 'Arbanassi'; Prashkov, *Stenopisi vTzurkvata Roždestvo*; Popgeorgiev, ' Selo Arbanassi' , pp. 120–123 and all the other scholars I mention in this chapter.

architecture of the churches and monasteries of Arbanassi considered that the churches were constructed during the seventeenth and the eighteenth centuries.[133] Mijatev in his investigation of the medieval architecture of Bulgaria thought that all the churches were erected in the seventeenth century. His was the generally accepted view until the 1970s.[134]

At the same time Papazov, in his eclectic collection of memoirs and historical data, proposed that all the churches existed in the sixteenth century, but did not exclude the possibility that they might perhaps have been built earlier.[135] Papazov did not give any further explanation or propose a particular date or even century for that earlier construction period. The variety of opinions is also illustrated in the dating of the best-researched of all the churches, the Church of the Nativity. For example, Papazov did not exclude the possibility that the church was in existence in the pre-Ottoman era. At the same time Mavrodinov took the view that only the nave and the inner narthex predate the seventeenth century, and then by no more than a century.[136]

So, is it in fact possible to date the churches or at least some of their chambers? If it is, then because of the comparative nature of my investigation I will look for evidence that will allow to me to identify at least a particular part of each church as having been built and decorated within the relatively narrow temporal frame of the seventeenth century. All the Bulgarian scholars present a relatively comprehensive list of the chambers, but do not take into account the decoration of the churches. The latter can provide significant clues to help establish the period in which the churches were built, because traditionally in the

---

[133] Popgeorgiev, 'Selo Arbanassi', pp. 102–123; Kostov, *Arbanassi*; Tžonev, *Manastirite i Starinnite Tžurkvi.*
[134] Kr. Mijatev, *Arhitekturata v Srednovekovna Bulgaria*, pp. 35–40.
[135] Papazov, 'Selo Arbanassi. Lichni spomeni', pp. 62–94.
[136] Mavrodinov, *Ednokorabnata i Krestovidna Tžurkva*.

Eastern Church, the decoration of the interior follows immediately after the completion of the construction and therefore decoration can play a significant role in the dating of churches.[137] However, it needs to be noted that the decoration can give an indication of the construction period only if it can be proved that the extant decoration is the initial one and that it was indeed applied shortly after the period of construction. Therefore, it is essential that I analyse the available epigraphic and archaeological research on the site in the context of my own observations on the interior decoration. In the process, it will be crucial to verify the authenticity and the number of the decorative layers to be able to comprehend the constructional history. I will begin with an examination of the Church of the Nativity and the research linked to it.

2.1 Church of the Nativity of Christ

The Church of the Nativity of Christ is situated in the south-western district of Arbanassi. In its present form, the building is constructed on an east-west axis and is situated in the south-eastern part of a large churchyard. The overall dimensions of the church are: height (to the ridge of the roof) 6.20 metres, length 28.80 metres, and width 10.40 metres. The roof is more extensive and has a greater overhang on the north side than on the south. The single apse is asymmetrically situated on the southern half of the east wall. A blind arcade runs along two-thirds of the north wall and the whole of the west wall (Figure 9).

The interior resembles a maze and consists of a nave, an inner and an outer narthex, and a small chapel at the end of the outer narthex, dedicated to St John the Forerunner. In the 1960s, Božkov concluded that in all probability the entire church complex had been built and decorated during the seventeenth century.

---

[137] B. Chifljanov, *Liturgica* (Sofia, 1996), pp. 45–58; Arch. Avksenii, *Liturgica* (Plovdiv, 2003), pp. 73–81.

His conclusion was based on both iconographic analysis and citation of dates appearing in some of the commemorative texts in the church interior.[138] At the time of his examination, the interior walls were covered with layers of soot and other soiling particles, but the wall paintings and the dates were still apparent, though very darkened.

During the 1970s, cleaning and conservation work was performed on the church, resulting in a re-evaluation published by Prashkov in 1979.[139] There it was proposed that the church had been built in two phases, the first of which was accomplished in the second half of the sixteenth century.[140] The dating was again based on a stylistic analysis of the newly discovered earlier decorative layer and a date incorporated in the commemorative text of one of the paintings. This layer was found only on the walls of the nave, which suggested that the nave was acting as an independent chapel at that early stage. The former exterior west wall of the nave later became the east wall of the inner narthex, and the wall paintings that now decorate that wall are an earlier decorative layer exposed by the removal in the 1970s of eighteenth-century wall paintings. Just above the entrance to the nave, the identifiable commemorative text includes a clearly legible date of 1597. This date is considered to indicate when the first phase of the construction might have been completed.[141]

[138] Božkov, 'Bitovite elementi v stenopisite ot Arbanashkite tžurkvi, pp. 99–132.
[139] Prashkov, S*tenopisite na Tzurkvata Roždestvo*, pp. 47–54.
[140] Prashkov, S*tenopisite na Tzurkvata Roždestvo*, pp. 53–54. Prashkov reached this conclusion after an initial investigation into the thickness of the walls of the monument. He writes that these archaeological findings led him to believe that the nave was used as an independent ecclesiastical building which was later enlarged into the present complex church interior. At present the wall paintings from the east wall of the inner chambers have been removed and are waiting to be displayed in the local district museum of Veliko Turnovo. There is also a partial wall painting in the lower register of the south wall, removed to expose the earlier decorative layer.
[141] V. Gerasimova-Tomova, 'Nadpisite kum tzurkvata Rozdestvo Hristovo v Arbanassi' in Prashkov, S*tenopisite na Tzurkvata Rozdestvo*, p. 210 and E. Kiriakoudis, 'The original founders: inscriptions and frescoes in the Church of the Nativity of Christ at Arbanassi in Bulgaria', *Cyrillo-Methodium*, Vol. VIII–IX (1984–1985), pp. 319–331.

The second phase of construction is considered to have been completed during the seventeenth century. From the various commemorative texts located in different parts of the church, it is apparent that this phase went on for nearly fifty years. The earliest of these dates is to be found above the doorway into the chapel of St John the Forerunner. The donor's inscription there gives the date of completion as 1632. Chronologically, the next date, 1638, is in the inscription that can be seen in the inner narthex.[142] There are also numerous commemorative inscriptions in the outer narthex that indicate that the chamber was painted after the completion of the chapel. All the inscriptions in the outer narthex are from the period between 1643 and 1649. The latest date can be found inside the nave, again above the entrance. There the inscribed date is 1681 and it has been accepted that this is in all probability the year of completion of the church.[143]

To summarise, the wall paintings from the second constructional phase in the interior of the Church of the Nativity were executed during the seventeenth century, although some of them were applied to an earlier building. In addition, the surviving records of the conservation work undertaken during the 1970s and the only monograph on the Church of the Nativity, by Prashkov, indicate that the wall paintings are original, with no evidence of alteration. It can be concluded that, with the exception of the scenes from the east wall of the inner narthex and an area in the main nave, where the lower layers have been exposed, the scenes in all of the chambers date from the seventeenth century. Therefore, to create an even base for my comparative analysis of the use of colour and light in the Arbanassi churches, I will look for evidence that the other three churches were either wholly constructed and painted in the same century or at least have in common a part of the interior that was created within the seventeenth century.

---

[142] Gerasimova-Tomova, 'Nadpisite kum tzurkvata Rozdestvo', p. 205.
[143] Prashkov, *Stenopisi vTzurkvata Roždestvo*, pp. 72–75.

2.2 Church of the Archangels Michael and Gabriel

The second-largest church, dedicated to the Archangels Michael and Gabriel, is situated in the south-eastern district of Arbanassi. In its present form, the building is constructed on an east-west axis, and is situated in the southern part of a large churchyard (Figure 10). Its overall dimensions are: height (to the ridge of the roof) 12.06 metres, length 24.10 metres and width 12.80 metres. The pitched roof is symmetrical and has a relatively large overhang. There are two apses, the smaller of which is situated in the southern half of the east wall. The exterior walls are decorated with shallow alcoves, the depths of which are much less than the thickness of the walls. The interior is again an intricate architectural composition and comprises a nave, an inner narthex, an outer narthex, and a small chapel at the end of the outer narthex, dedicated to St Paraskeva. The outer narthex is completely whitewashed. The chapel of St Paraskeva is awaiting restoration because the wall paintings have been badly damaged by prolonged exposure to damp, and access to the chamber is prohibited at present. The only decorated chambers available for inspection are the nave and the inner narthex. They do not have the same abundance of donors' inscriptions as the Church of the Nativity, but in each chamber there is a single commemorative text that indicates the completion date.

The text in the nave seems to be the earlier of the two, but presents some problems. It is confusing when considering the meaning of the text and even more so because the inscription is partially damaged. Unfortunately, the most damaged part of the text is the one containing the date, of which the last two digits are missing. Initially, Popgeorgiev in 1904 suggested the reading 'The divine temple of the sacred home of Archangels Michael and Gabriel was built with the means of Sir Hajji Niku Kultukli and his wife Kiriaki to be their memorial in the year 1600'.[144] In the 1950s, an alternative reading was proposed by Kostov and, instead of 'built with the means…', he suggested 'reconstructed with the means…' and did not propose any numbers for the missing digits.[145]

In the 1970s a series of probes was made into the decoration in the nave, showing that only on the walls of the apse and on the adjacent north wall is there an earlier decorative layer. During the course of my investigations, I interviewed Sava Rusev, one of the conservators who took part in the conservation programme at the Church of the Archangels in the 1970s.[146] He confirmed that only in the nave did the conservationists find fragmentary evidence of an earlier decorative layer, but that it was not possible to date that layer, as they did not carry out any material analysis.

In the 1990s, archaeological excavations that took place near the church revealed evidence of sheets of painted plaster having been buried in close proximity to the building.[147] Detailed investigation of the pieces of buried decorative plaster led to the conclusion that the surviving parts of this earlier decoration of the nave and the fragments found in the excavation matched in style and technique. Based on these findings, Vatchev concluded that the nave had been damaged by natural disaster or by a punitive Ottoman action; there are, however, no records to clarify this. With a lack of surviving documents to

---

[144] Popgeorgiev, 'Selo Arbanassi', p. 107 is the earlier source showing this dating. One of the latest publications on Arbanassi and its churches, Haritonov, Chohadsžieva, Rutževa, *Arbanassi*, p. 51, provides a slightly earlier dating. According to this work, the nave of the Church of the Archangels Michael and Gabriel dates from the end of the sixteenth century. However, the authors do not provide any explanation or argument in support of the claim and on this basis it is difficult to assess its veracity and therefore difficult to accept.

[144] H. Vatchev, 'Prouchvania v dvora na tzurkvata Sv. Arhangeli Mihail i Gavrail v Arbanassi ', *IRIMVT*, Vol. XX (V. Turnovo, 2004), pp. 199–208.

[145] Kostov, *Arbanassi*, p. 88.

[146] The interview took place during my 2006 field trip to Bulgaria, when I also researched in the archives and libraries of the Bulgarian Academy of Science and the museum authority of Turnovo. I am very grateful to Mr Rusev for his cooperation.

[147] Vatchev, 'Enoriiskiat hram v Turnovskata Mitropolia', pp. 195–199.

indicate the architectural history of the church, he accepted the stylistic and compositional analysis of the wall painting of the nave made in an earlier publication from the 1970s by Mardi-Babikova.[148] Vatchev upheld her opinion that the decoration of the nave was in all probability from the second half of the seventeenth century. Although the majority of scholars date the decoration of the nave as being from the seventeenth century, none of them seeks to ascribe a particular year to its completion.[149]

In contrast, the text above the doorframe of the inner narthex is well preserved, and bears the names of the two artists who executed the wall paintings, Michael from Solun (Thessalonica) and Georgi from Bucharest, together with the exact date of completion, 1 August 1760. Probes confirmed that this is the only decorative layer ever applied on the walls of the chamber. The prevailing opinion is that the chamber was constructed in the seventeenth century, together with the nave. However, some scholars take the view that while the nave was decorated immediately after its construction, the inner narthex was decorated much later, hence the presence of the eighteenth- century date of 1 August 1760.[150]

The conservation work undertaken during the late 1970s and early 1980s provides no grounds for suggesting that the wall paintings in the church have been altered either wholly or in part.[151] Research also shows that the decoration of the inner narthex is outside the timescale of my research, even though it has been applied on a seemingly seventeenth-century architectural construction. Examination of the existing research indicated that the approximate dating of

---

[148] V. Mardi-Babikova, *Arbanashkite Tžurkvi* (Sofia, 1978), pp. 6–7.

[149] This can be found in Mijatev, *Arhitekturata v Srednovekovna Bulgaria*; Koeva et al., *Pravoslavni Hramove po Bulgarskite Zemi (XV–XX v)*, pp. 335–340; Popgeorgiev, 'Selo Arbanassi', pp. 109-111; Kostov, *Arbanassi*, p. 5; Mardi-Babikova, *Arbanashkite Tžurkvi*, pp. 8–9.

[150] Mardi-Babikova, *Arbanashkite Tžurkvi*, pp. 14–15.

[151] This was suggested by the conservator and photographer Sava Rusev in a private communication.

the decoration of the nave makes it the only chronologically suitable interior for use in my research.

2.3 Church of St Atanass

The Church of St Atanass is situated in the north-eastern district of Arbanassi. In its present form, the building is a construction elongated along an east-west axis (Figure 11). It is protected from the elements by a pitched roof and is situated in the southern part of a large churchyard/cemetery. The overall dimensions of the building are: height (to the ridge of the roof) 5.30 metres on the east and 6.50 metres on the west wall, length 18.35 metres and width 10.64 metres. On the south side, the roof is more extensive and has a greater overhang than on the north. The single apse is asymmetrically situated in the northern half of the east wall. All the walls are plain with the exception of the west wall, which is adorned with three shallow alcoves, one of which is above the entrance door and contains a painting of the patron.

The interior comprises a nave, an inner narthex, an outer narthex and a small chapel dedicated to St Harallampii at the end of the outer narthex. At present, the inner narthex is closed to the public because of serious disrepair. The rest of the interior is covered with reasonably well-preserved decoration.

Scholars cannot agree on the date of completion of the nave. There are three dates associated with the chamber. The earliest is 1613, which is to be found in the composition of an icon, *Bringing Christ down from the Cross,* situated on the top row of the iconostasis of the nave.[152] The second date is 1637. This can be

[152] I. Gergova, *Ranniat Bulgarski iconostas 16–18 vek* (Sofia, 1993), p. 19.

found in the text of the June menelogion of the Church of St Atanass.[153] However, it has been argued that the menelogion originally belonged to a church with the same patron in a village with the same name, but which was destroyed by the end of the sixteenth or the beginning of the seventeenth century.[154] The third date is 1667 and is part of a rather confused donors' text on the west wall of the nave. The end of the text reads 'The Turnovo Metropolitan of the Turnovo Metropolitan Sir Sir Sir (*sic*) Gerasim in 1667'.[155] The most recent research on the site accepts this latter date; Sir Gerasim was probably the Turnovo Metropolitan at the time, Gerasim II Kakavelas (1658–1673).[156] The text was revealed during cleaning and conservation carried out between 1971 and 1972.[157] Probes into the decorative layer found no trace of any previous decoration. Because the two earlier dates are associated with objects that are not a permanent part of the church structure or decoration, the risk is that they were introduced from another, earlier church, or were made in advance, when the works were planned or started. It is only the later date that can reasonably be considered to indicate the date of completion of the nave.

[153] Vatchev, Enoriiskiat hram v Turnovskata Mitropolia, pp. 200–201. A menelogion is a type of liturgical manuscript including texts on the life of different saints.
[154] It has been found written in the June menaion (the fixed cycle of services) of the Church of St Atanass. Rutzeva in Sv. Rutzeva, 'Ikonografia i Stil na Stenopisite v Tzurkvata Sv. Atanass, Selo Arbanassi' (unpublished doctoral thesis, University of Veliko Turnovo, 1997) argues that the book was bought from a church with the same name, but from near the town of Liaskovetz, which was in the same diocese as Turnovo. According to the research in documents published by D. Minev in *Grad Liaskovetz – minalo, segashno sustojanie I deitzi. Istoricheski I stopanski prinos* (Sofia, 1944), p. 33, and also in Zv. Tžonev, *Istoria na grad Gorna Orjahovitza I okolnostite mu – Liaskovetz I Arbanassi* (Veliko Turnovo, 1932), p. 45, the church existed until the end of the sixteenth or the very beginning of the seventeenth century in a village that had the same name.
[155] Snegarov, 'Istoricheski vesti za Turnovskata Metropolia', p. 112.
[156] The main work on the Church of St Atanass is Rutževa, 'Ikonografia i Stil na Stenopisite'. Later the same author published an article: Rutževa, 'Ikonografska i stilova harachteristika na stenopisnia ansamble ot tzurkvata Sv. Atanass '. In both she defends the year 1667 against the other possible datings, 1613 and 1637.
[157] Rutževa, 'Ikonografska I stilova harachteristika na stenopisnia ansamble ot tzurkvata Sv. Atanass', p. 39. The work was carried out under the supervision of Dragomir Peshev from the Institute of National Culture and Monuments, Sofia.

The outer narthex and the chapel of St Harallampii are considered to be the second building stage of the church complex.[158] They are situated on the south side of the building and have been dated by a text located above the middle window of the chapel, which gives the names of the artists, Tzojo and Nedjo, and the year of completion, 1724.[159] In all probability, the chapel was built after the plague in 1717, and dedicated to St Harallampii, who is associated with intercession for health and long life.

The wall paintings of the nave can be considered to have been accomplished within the chronological frame of the present research. Furthermore, the conservation work undertaken at the beginning of the 1970s found no sign that the decoration had been altered in any way.[160] However, the wall paintings of the outer narthex and in the chapel dedicated to St Harallampii were executed outside the timescale of this research and therefore will not be included in my investigation.

2.4 Church of St Dimitr

The Church of St Dimitr is situated in the centre of Arbanassi. In its present form, the building is constructed on an east-west axis and is situated in the south-eastern part of a large churchyard (Figure 12). The church comprises a nave, an inner narthex, an outer narthex and a small chapel dedicated to St Gyorgi at the end of the outer narthex. Its overall dimensions are: height (to the

---

158 Rutževa, 'Ikonografia i Stil na Stenopisite '.

159 The earliest mention of the date is in Popgeorgiev, 'Selo Arbanassi', pp. 102–123. The translation of the text can be found in Kostov, *Arbanassi*, p. 94. According to Kostov, the text reads that 'all the church (chapel) was painted by the teacher Tzojo and Nedjo in the year 7234 after Adam', i.e. 1724. The reading is confirmed in Gergova, *Ranniat Bulgarski iconostas 16–18 vek,* pp. 9–10.

160The work was carried out under the supervision of Dragomir Peshev from the Institute of National Culture and Monuments, Sofia, and this is a note that I found when examining the project journal of the Institute.

ridge of the roof) 6.20 metres, length 25.70 metres and width 10.80 metres. On the north side, the roof is more extensive and has a greater overhang than on the south. There are two apses on the east wall, the more prominent of which is asymmetrically situated in the southern half of that wall. Both apses have individual roofs. The other walls are plain.

The Church of St Dimitr has not been the subject of any systematic investigation, but it has been mentioned in various publications since the beginning of the twentieth century.[161] The dating of the wall paintings in the nave to 1621 is suggested by the donor's commemorative text inscribed on the inside of the west wall of the nave.[162] There is also a document in the Turnovo Metropolitan archive that suggests that the church was built and decorated by May 1622.[163] Further evidence of the existence of the church during the first part of the seventeenth century exists in the February menelogion belonging to the Church of St Dimitr.[164] Therefore, it can be concluded that the wall paintings in the nave of the church, at least, are from the seventeenth century and in all probability were executed in 1621.

It is not easy to make a conclusive deduction about the completion date of the other chambers, the inner and outer narthexes, and the nave of the chapel. Nikolova, after examining only the wall paintings, proposes two stages of decoration: the first in the seventeenth century and the second in the eighteenth

[161] Popgeorgiev, 'Selo Arbanassi', pp. 1-38; Kostov, *Arbanassi*; Tžonev, *Manastirite i Starinnite Tžurkvi*.
[162] The text has not been investigated further, nor has it yet been published. I am grateful to the group of conservators and restorers who gave these indications of dating in private conversations.
[163] The text of the document is published in Iv. Tutundjiev, 'Ekzarhii na Tžarigradskata Patriarshia v Bulgarskite zemi prez XIV-XIX vek' in *Turnovska Knisžovna Shkola*, Vol. 7 (V. Turnovo, 2002), pp. 111-123.
[164] Papazov, 'Selo Arbanassi. Lichni spomeni ', p. 53.

century.[165] Kostov is even more cautious and suggests only that the present floor plan was already in existence in the first decade of the eighteenth century, when a second decorative layer was added.[166] The problem faced by these scholars is that, for some unknown reason, in the last decade of the nineteenth century all the walls were whitewashed with lime.[167] It was the removal of the lime layer in the 1970s, during a restoration and conservation programme, that first led to the hypothesis that the chapel had existed since the sixteenth century.[168] The main body of the church was added at the beginning of the seven-seventeenth century and the entire interior, including that of the chapel, was redecorated by 1621.[169] There is no evidence of any additional decoration that can be linked to any date later than this.

Throughout the church, the original seventeenth-century decoration survives only partially because in 1913 the church was badly damaged during a very powerful earthquake. It lost its roof, the south and west walls of the inner narthex, nearly the entire south wall of the nave, and the north wall of the chapel and the outer narthex.[170] The building was repaired in the 1930s when all the walls in the nave were simply whitewashed.[171] The conservation work of the 1970s uncovered original wall paintings in the nave, which are to be found on the west wall (almost complete), around the doorway into the nave on the north wall and in the apse (only partially surviving). Part of the seventeenth-century

---

165 Ja. Nikolova, 'Gradoustroistvo i arhitektura' in *Istoria na Veliko Turnovo* (Sofia, 1986), pp. 231–282.
166 Kostov, *Arbanassi*, pp. 93–94. Kostov writes about the existence of a tombstone in the chapel dedicated to St Nestor. The name of a pilgrim, called Boletza, was carved on the stone and also the year of his death, 1718.
167 Popgeorgiev, 'Selo Arbanassi', p. 1-38.
168 Kostov, *Arbanassi*, pp. 93–94.
169 I. Gergova, 'Tzurkvata na Arbanashkijat Manastir Uspenie Bogorodichno' in *Problemi na Izkustvoto'* , Vol. 1 (1999), pp. 9–10.
170 Kostov, *Arbanassi*), pp. 92–93.
171 The date of the restoration – 1937 - is carved on one of the stones placed in the northern wall of the chapel.

layer has also been removed for stabilising. Furthermore, the scene of *The Dormition of the Mother of God* on the west wall has been partially restored and an area of contemporary painting has been added to complete the damaged wall painting.[172] The decoration remaining in the chapel awaits cleaning as at present it is covered with layers of limewash and so cannot be used in the present investigation.

Part of the existing decoration covering the west, east and north walls of the nave was executed within the chronological frame of the seventeenth century. The conservation work undertaken at the beginning of the 1970s found no sign that the wall paintings in the nave had been altered in any way, except for the scene of *The Dormition of the Mother of God* situated in the central upper section of the west wall.[173] Therefore, the majority of the preserved scenes from the nave are relevant to my research. The decoration of the inner and outer narthex and that in the chapel dedicated to St Gyorgi is either outside the timescale of the research or is not in a state that will allow its use for the purpose of this thesis, as the final stages of its cleaning from the limewash have not been yet completed.

Consulting the available body of research on each church reveals that the popular dating of the churches as all from the seventeenth century cannot be sustained. In each church, the nave is the only chamber that was decorated or even constructed during that century. Therefore, my examination of colour and light in the seventeenth-century churches of Arbanassi needs to engage exclusively with the space and decoration of their naves.

---

[172] That the project was conducted by the architect Kuzupov is suggested by a note that I found in the archive of the Institute of National Monuments.
[173] The work was carried out under the supervision of Dragomir Peshev from the Institute of National Culture and Monuments, Sofia.

CHAPTER THREE

The Arbanassi palettes: a visual assessment

In the previous chapter, I established that authentic and accessible seventeenth century interior decoration existed in the naves of four churches in Arbanassi: the Nativity of Christ, the Archangels Michael and Gabriel, St Atanass and St Dimitr. In principle, the most immediately noticeable characteristic of the interiors of all the churches is the colourfulness of the decoration, which was apparent when the interiors were initially examined. The walls and the ceilings were found to be covered with intensely coloured paintings. Only in the case of St Dimitr was this not so, as most of the interior decoration was lost at the time of the 1913 earthquake or during the subsequent prolonged exposure of the walls to the elements.

The aim of this chapter is to identify the range of colours used in each interior and to consider how that range may be compared across the churches. My initial task is to assess the degree to which the soiling and ageing of the painted surfaces might have altered the original appearance of the colours. In some cases, change can occur because of restoration, but usually it is because of the cumulative result of chemical or photochemical processes occurring since the completion of the work. All of these factors that have potentially affected the appearance of the colours are crucial in assessing the validity of the investigation into the colours of the seventeenth-century interiors. I will show that the wall paintings of Arbanassi in their existing state are nevertheless suitable for the purposes of the proposed comparative research.

Next, I will discuss the stability of form and content of the decoration in the Arbanassi interiors. I will contextualise this discussion by situating it outside of the Ottoman Bulgarian province. Because of the spiritual supremacy of the Constantinopolitan Patriarchy and the Athonite monasteries in the life of the Orthodox community, Bulgarian material will be framed in the light of its Greek relationship, with particular emphasis on the links with Mount Athos.

This will be followed by a discussion as to whether it is necessary, for the accomplishment of my aims, to embark on a detailed examination of the entire representational system of each nave or whether is it enough to examine only part of the wall paintings. I will demonstrate that a limited number of the compositions will be sufficient for my investigation. I will then proceed to delimit the colours included in the palette of each church (i.e. the number and the general type of hues), mapping the colours in the selected scenes. I will also demonstrate that the decoration of the naves exhibits clear evidence of the historic continuity of Byzantine church decoration through its thematic and spatial organization.

There are three dimensions that can be used to describe any colour sensation: hue, saturation and brightness. Hue is the main distinguishing characteristic and is associated with the general colour terms such as 'red', 'blue', 'green'. Saturation of colour is the dimension that identifies the intensity of the visual experience and is associated with the colourfulness of colour. The terms describing this dimension are, for example, 'pale', or 'deep'. Brightness of colour is a relative term and describes the comparative lightness of one colour in relation to the lightness of another colour. Words such as 'bright' or 'light' or 'dark' are used to indicate the brightness of a colour. Where indication of the saturation or the lightness of a particular colour will contribute to a better description of its appearance I will use terms representative of the significance of those two dimensions: saturation and brightness.

3.1 The Authenticity of Colour

The processes of ageing, soiling and cleaning which took place during the years after the completion of the wall paintings could present a significant disadvantage to my research, because they might have changed the appearance of the colours of the decoration from that which they had in the seventeenth-century. I will examine the possible effect of each of these processes on the painted surfaces and assess their effect on the present investigation. Ageing results from changes in the chemical structures of the pigments. In the case of the Arbanassi wall paintings, the stability of the chemical structures can be expected to be reasonably good as most of the pigments used before and during the seventeenth century were inorganic in nature. Inorganic substances have proved to be reasonably stable when exposed to the usual environmental conditions. However, it is necessary to bear in mind that when exposed to direct sunlight for long enough, the stability of chemical structures can be changed and as a result of discolouration the appearance of the painted surface changes. The extent to which the changes occur varies according to the light-fastness of the particular pigment. Nevertheless, all the churches have a very restricted number of architectural openings and those are of relatively small dimensions. There were additional restrictions on the amount of natural light entering the building. It is accepted that all the openings were provided either with wooden shutters (in the case of the windows) or with wooden doors (in the case of entrances into the buildings).[174] There is no archaeological evidence for the

---

[174] Prashkov, *Stenopisi vTzurkvata Roždestvo*, pp. 55-56.

existence of original glazing.[175] It follows that the periods of exposure of the interior to natural light were limited and therefore it is reasonable to conclude that photochemical changes, if any, can be considered negligible, with the exception of the Church of St Dimitr.

It is more likely that the second factor, the soiling processes during the ages, will be responsible for any changes in the appearance of the wall paintings. Airborne pollutants are usually responsible for soiling the surfaces of church interiors. In the case of Arbanassi, the most significant soiling would have occurred because of the internal lighting system used. Available research suggests that it consisted of candles and oil lamps.[176] These would have emitted carbon and other particles into the air, which would subsequently have settled and gradually built up on those interior surfaces which could not be cleaned regularly, particularly the painted surfaces of the walls and ceilings. Because of its carbon component, the black film would either have completely covered or at the very least modified the appearance of all the colours.

The degree of soiling of the surfaces in the different churches was similar. The churches were in continuous use for approximately three centuries, from the time they were completed up to the end of the 1940s, when the communist authorities closed them. The decorative layers that have been examined were executed between the 1610s and the 1680s, with only 70 years separating the earliest and the latest completion. On average, the churches functioned for 300 years. The time of exposure can be considered long enough to make it permissible to ignore the initial difference of 70 years, which is less than 25% of the whole period.

---

[175] Vatchev, ' Enoriiskiat hram v Turnovskata Mitropolia', pp. 23-78.
[176] Gergova, 'Horosut v Tžurkavata Roždestvo Hristovo', pp. 14-20; Arch. Avksenii, *Liturgica*, p. 178; D. Todorovič, 'Polijelej u Markovom Manastiry', *Zograph*, No. 9, (1979); G. Galavaris, 'Some aspects of the symbolic use of lights in the Eastern Church', *BMGS*, Vol. 4, (978), pp. 69-78.

The thickness of the soiling matter would be important only in those investigations where the level of the dirtying of the colours was a significant factor, but that is not the case in this research and, in any event, the layer of black is no longer there. Between the beginning of the 1970s and the end of the 1980s, the wall paintings of the four churches, the Nativity of Christ, the Archangels Michael and Gabriel, St Atanass and St Dimitr, were restored by cleaning their surfaces. The few surviving records indicate that the methods used were carefully chosen, as the aim of the conservationists was to preserve the colour and form of the pictorial compositions as authentically as possible. The most widely employed method was the careful mechanical removal of the black film.[177] The only changes that are of interest are those that might have occurred because of possible chemical reactions between the painted layer and the soiling layer. However, it could be argued that such changes would have been much the same in each church because the composition of the soiling layer would probably have been nearly identical. This is because of the comparable methods of the artificial illumination of the interiors, candles and oil lamps, and each church would have been built and decorated using much the same techniques.

The processes used in the cleaning and conservation of the wall paintings of the four churches were of the same kind, meaning that any differences in the present appearance are proportionate to such differences as originally existed. In fact, the conservation techniques were limited mainly to securing loose areas of the painted layer of plaster, and that meant interfering only with the back of that layer. Moreover, the cleaning techniques were carefully chosen from the selection of techniques available to the team of conservers and restorers in the

[177] L. Prashkov, "Razkrivane, konservirane i restravrirane na ikonata Archangel Mihail ot 1663 ot Manastira Sv. Troitža krai Turnovo" in Prashkov, *Vuprosi na konservatžiata I restavratžiata*, Vol. 2, pp. 7-16.

1970s and 1980s in their attempts to preserve the appearance of the wall paintings as close to the original as possible.[178]

It can therefore be concluded that the nave decoration of the four churches: the Nativity, the Archangels, St Atanass and St Dimitr, provide the necessary basis for the comparative investigation into the colour used in the Arbanassi seventeenth-century wall paintings. It seems fair to say that any proportionate differences in the present appearance of a particular hue in the different churches will be equal or very nearly equal to those that would have been evident at the time the wall paintings were executed.[179]

Before moving on to identify those parts of the decoration in each nave that will form the basis for my investigation into the range of colours used in the naves I will examine the spatial and compositional arrangement of their decoration. I also will place it in the historic context of the development of the post-Byzantine tradition in the first three centuries of the gradual Ottoman conquest of the Balkans. Particular attention will be paid to the pivotal role the Athonian monastic community played in that development.

3.2 Interior Decoration – An Historic Introduction

The decoration of the four naves consists of scenes from the New Testament and images of various saints. In all the naves, the wall paintings are organized in registers in accordance with Byzantine church tradition.[180] In this tradition, the registers display a theological hierarchy, with images of Christ and the

---

[178] Private communications and interviews with Prof. Prashkov between 2004 and 2006.

[179] R. Meyer, *The Artist's Handbook of Materials and Techniques,* (Chatham, 1991, first edition 1951), p. 373.

[180] Manova, *Bulgarska Stenopis XVI –XVII vek,* pp. 54-65; Philov, *Starobulgarsko Izkustvo*, pp. 85-104; Arch. Avksenii, *Liturgica*, pp. 77-81.

Mother of God occupying the upper registers and the minor saints the lower register.[181] In the centre of the ceiling of the main body of each nave the images are associated with the high heavens: Christ, God the Father, the Holy Trinity and the heavenly host. The register below is devoted to Christological and Mariological cycles. The Christological cycle is found on the north wall and the Mariological cycle on the south wall, as is the case in the nave of the Church of the Nativity. In the churches of the Archangels and of St Atanass the order appears the other way round, the Christological cycle unfolding on the south wall while the Mariological cycle is depicted on the north wall. Both cycles have been destroyed in the church of St Dimitr.

In each church there are two additional images depicting the life of Mary, one on the west and the other on the east wall. In the semi-dome of the apse in the east wall of all the naves is the Mother of God Platytera (Πλατυτέρα). In the Platytera type of image, Mary, with her arms raised in prayer, faces the beholder. Christ is depicted on her breast in a mandorla (aureole).[182] On the west wall, in the space between the ceiling and the head of the doorway, the scene of the Dormition (falling asleep) of the Mother of God is in the first register. In all the churches, the scene depicts the Mother of God on her deathbed, surrounded by the apostles and angels and with Christ holding her soul.

The final lower register on the north and south walls consists of full-size depictions of saints. After the fall of Constantinople, but especially after the fifteenth century, when the Ottomans expanded their presence on the Balkans, a gallery

---

[181] This is the direction in which the registers are counted. The first register is immediately after the ceiling and there are usually two or three further registers below the first. Prashkov, *Stenopisi vTzurkvata Roždestvo*, pp. 63-73.

[182] This is a popular type of icon in which the Mother of God is depicted with her arms outstretched and on the front of her chest is a medallion shape bearing the image of the Christ-Child . For a more extensive introduction to the iconographic type, elaborating on the theology behind it, see L. Ouspensky, 'Our Lady of the Sign' in L. Ouspensky and V. Lossky, *The Meaning of Icons* (Crestwood, New York, 1999, first edition 1952 in German), pp. 77-78.

of warrior saints and martyrs in the first register became the expected pattern for church decoration. This was not only throughout the present Bulgarian territory, but also in church decoration throughout the present territories of Greece, Serbia and Macedonia. Ultimately the iconographic type originated in Byzantine art. The warrior saints and martyrs became popular in the ninth to tenth centuries, being well-liked amongst the military elite and the army in general. In Bulgarian mediaeval ecclesiastical art the images were popular from the twelfth century. After the Ottoman invasion, belonging to a particular religious denomination replaced the sense of national or even ethnic identity, which consequently led to an implied assumption that any Christian warrior was both a martyr for the Christian faith and ultimately a defender of the hypothetical Fatherland.

For example, amongst the Balkan saints and martyrs depicted in both churches are St Demetrious of Thessalonica and St Govdelii, associated with Crete. St Triphon and St George of Sofia were Bulgarian martyrs for the faith in the early stages of the Ottoman occupation. Others are saints and martyrs venerated throughout the Orthodox world, as for example St George the Victorious, St Minas or St Procopious of Jerusalem. In both naves they were depicted as full figure warriors either in full armour, or in tunics and cloaks but with the equipment of warriors - swords or spears - but very often also carrying a cross.

Traditionally, since Byzantine times, on the west wall, to the left of the entrance door, is a full-figure image of the Archangel Michael, the commander of the heavenly host. To the right of the doorway there is invariably the scene of the Emperor Constantine of Byzantium and his mother Helena. In all four churches, they are represented holding the cross. The space between the bottom of this last register and the floor, a distance of about a metre and a half, is either fitted with a row of tall seventeenth century chairs for use by the congregation or is occupied by a lower band of geometric patterns (Figures 13-16).[183]

This survey indicates that the main subject in each register is similar in every Arbanassi nave, while the overall organisation of the decoration is akin to that in the Byzantine tradition. There is a general tendency to allow for a more comprehensive selection of scenes in a cycle than is found in Bulgarian churches from the period before the Ottoman invasion. The cycle of the passion of Christ in the Church of St Atanass is the most extreme example of these practices. Here the number of the scenes is such that the cycle is accommodated over one and a half registers.

There are also variations between the churches, pertaining to the choice of the scene representing a certain part of a biblical story in the individual churches. For example, in the cycle of the passion of Christ, the scene of Christ on the cross appears in two of the churches; St Atanass and the Archangels. In the Church of the Nativity, the scene of the road to Golgotha replaces that scene. Even in a familiar composition referring to a specific event, such as the scene of the Dormition, the compositional arrangement in each nave differs to a greater or lesser extent. The discrepancies, however, are in the detail, such as the number of the saintly figures around Mary's bed, their garments, additional personages or some other minor compositional elements. Thus it can be concluded that the freedom of interpretation as displayed by the Arbanassi decoration is of an ancillary nature as, in all these cases, the enumerated permutations of the nave decoration do not compromise the biblical teaching in any way, but only enhance the didactic qualities of the decoration.

---

[183] In the Church of St Dimitr the seats are not preserved, but the presumption is that there had been a row of them all around the chamber as in the other churches, Vatchev, 'Enoriiskiat hram v Turnovskata Mitropolia', p. 202.

In fact Bulgarian research since the 1930s maintained that the increase of the instructive merits of the decorative programmes used in Bulgarian churches appears to be a characteristic development in the first centuries of the post-Byzantine tradition.[184] Scholars concluded that the particularly descriptive qualities of the Arbanassi decoration indicated the high significance placed by the seventeenth century Church and society on the Christian narrative. The conquest was considered to be the key factor in the conscious preservation of the Byzantine iconographic tradition through the post-Byzantine era and particularly in the first few centuries.[185] In a broader sense, the demonstrated stability of form was linked to the struggle of the Church to safeguard Orthodox Christian identity under Ottoman rule where the nature of the religion of the conqueror was antagonistic.[186]

However, the conscious preservation of the Byzantine iconographic tradition in the first centuries of the post-Byzantine era was not simply in opposition to the

[184] B. Philov, 'Znachenie na Atonskite manastiri za Bulgarskata tžurkovna živopis', *Otetž Paisii: onshtestveno-kulturno-politichesko spisanie*, No. 9, (1930), pp. 125-127; Prashkov, 'Razvitie i razprostranenie na ikonata v Bulgaria', pp. 112-117; Prashkov, *Stenopisi vTzurkvata Roždestvo*, pp. 93, 95, 102; Manova, *Bulgarska Stenopis XVI –XVII vek,* pp. 54-56; Rutževa, 'Ikonographska i stilova arakteristika na stenopisnija ansamble', pp. 38-43; Mitjaev, Kr., "Dekorativnata sistema na Bulgarskite stenopisi", *Sbornik v Chest na V. Zlatarov*, No. 49, (1973), pp. 135-149; Gerov, G., *An Iconographical Theme from Mount Athos and its Spread in the Bulgarian Lands: the miracle of the archangels at Docheiario*, (Thessalonica, 1987).

[185] B. Philov, 'Znachenie na Atonskite manastiri za Bulgarskata tžurkovna živopis', *Otetž Paisii: onshtestveno-kulturno-politichesko spisanie*, No. 9, (1930), pp. 125-127; Prashkov, 'Razvitie i razprostranenie na ikonata v Bulgaria', pp. 112-117; Gerov, G., *An Iconographical Theme from Mount Athos and its Spread in the Bulgarian Lands: the miracle of the archangels at Docheiario*, (Thessalonica, 1987).

[186] After the invasion, for the non-Muslim minorities, belonging to a particular communion replaced the notion of belonging to a state. Hence, in the post-Byzantine era, temporal references were made to the high officials of the Church, in a way that parallels the time-frame provided by the reigns of various emperors or by the duration of the imperial houses, as in Byzantine times. For example, there is an inscription stating that the decoration in the outer narthex of the Church of the Nativity was executed in the days of Partenious, Patriarch of Constantinople, while the decoration of the nave of the Church of St Atanass was referenced by the name of the Turnovo Metropolitan Gerasim II Kakavelas (1658-1673). Another sign identifies the paintings as from 1643.

Ottomans, but was also a response to the assimilation policy of the Western Church. The Council of Florence, in 1439, had agreed the reunification of the Latin and Orthodox Christians in exchange for the West guaranteeing the protection of Byzantium.[187] Nevertheless, in reality, the anti-Western lobby in the Eastern Orthodox Church, which included many Athonites, prevailed, and the treaty was not implemented.[188] However, there is evidence that the Roman Catholic Church embarked on missionary work amongst Eastern Orthodox Christians in the Balkans.[189] This intensified during the sixteenth century. In addition, as interaction and trade with the West increased during and after the reign of Suleiman the Magnificent (1522-1560), examples of Western religious art were imported by Christian merchants. Western artefacts such as lamps, icons and prints began to appear even on Athos.

Western stylistic influences became increasingly discernible in some interiors of significance to the Eastern Church. For example, a Cretan painter who signed himself Theophanes Painter worked in St Nicholas Anapausa (1527) in Meteora. There, in his representation of the Last Judgement, the anatomy of the nude

---

[187] F. L. Cross and E. A. Livingstone (ed.), *The Oxford Dictionary of the Christian Church* (Oxford, 1997).

[188] From its establishment, Athos was regarded as one of the greatest strongholds of Eastern Orthodox Christianity. Its first foundations, which appeared in the tenth century, were the result of the combined initiative of visionary monks and pious Byzantine emperors and nobility. The Monastery of the Great Lavra was established in the second half of the tenth century, with the help of lavish gifts of money and precious objects from the Emperor Nikephorus II Phokas (963-969). The Monastery of Iviron was founded in about 980 with the patronage of the Emperor Basil II (976-1025). All Orthodox nations of any significance acquired and maintained foundations on Athos from the Middle Ages. During the twelfth and thirteenth centuries, the monastic establishment became cosmopolitan, with the appearance of the first Slavic monasteries, housing respectively Russian, Serbian and Bulgarian monks. The first known Slavic monastery was founded by Zelianos and became a Russian monastery in 1142; the Monastery of Chelandariou became Serbian in 1198 and in the thirteenth century the Monastery of Zographou, Bulgarian, after the establishment of the Second Bulgarian Tzardom (1185-1396).

[189] E. Mutafov, 'Živopista na Aton prez prizmata na novite nauchni izsledvania. Razmisli', *PI*, No. 1 (2012), p. 4.

body can be discerned in *putti*- and *bambini*-like figures.[190] Those elements can also be detected in some of the later wall paintings of Theophanes Painter in the Monastery of Stavronikita on Athos (1546). These historic evidences raise questions concerning the extent to which Western imagery was introduced into the Eastern iconographic tradition. Can any elements within the Arbanassi decoration be associated with any degree of Western influence, bearing in mind the links of the Arbanassi merchants with Europe? Moreover, what steps did the Church take to secure the preservation of its visual tradition and its continuity?

The only indication of any Western influence in the decoration of the Arbanassi churches is the posthumous portrait of Hajji Gjorgy and his heir. It is situated in the outer narthex of the Church of the Nativity, to the right of the door, and was created between 1643 and 1649 (Figure 17).[191] The main tools used in the construction of the image are line and flat juxtaposed areas of single colours.[192] However, thematically and compositionally the painting deviates from the established tradition. Donors were typically represented either in an act of worship, as for example in the donor portrait from the katholikon of the Bachkovo Monastery (1643), or in the context of a composition symbolic of the dedication of their wealth to the veneration of particular saint, as in the other donor portrait that can be found in the Church of the Nativity (Figure 18). In both these types of composition, the image of a particular saint dominates the scene. For example in the Bachkovo katholikon it is the Mother of God (Figure 19), while in the Church of the Nativity it is St John. By contrast, in the portrait of the donor and his heir heavenly reality is not present, but is sought as a con-

---

[190] Penkova, B., 'Za Njakoi Osobenosti na Postvizantiiskoto Izkustvo v Bulgaria', *PI*, No 1 (1999), 3-8 and X. Proestaki, Western influences in 17th century post-Byzantine wall Paintings' in the *proceedings of* Byzantinoslavonica, (Prague, 2010). Putti and bambini are representations of young children or babies which became very popular in Baroque art. Putti are often winged, cherub-like figures.

[191] E. Tantcheva, 'At the Crossroads of East and West: Donor Portraits in the Church of the Nativity of Christ in Arbanassi', *Ikonotheka*, No. 22 (Warsaw, 2010).

[192] James, *Light and Colour in Byzantine Art*; Prashkov, *Stenopisite na Tzurkvata Rozdesto Hristovo.*

text in which the portrait is set, reminding the beholder that the sitters are worthy of saintly company.

Moreover, as in the best of the Western tradition, the focus of the composition has been shifted from the transient world, to the intimate space of man.[193] Even within the simple, almost schematic mode of the composition, the artist managed to convey the sense of quietly affectionate relations between the sitters. The way the figures of the donor and his son are arranged in the simple compositional space creates an illusionary sense of the youth walking towards the massive adult figure. The donor stands in the right half of the compositional space, with his body facing the beholder, but his head turned towards the much smaller figure of a young man. The fact that his son holds a flower, which appears in the middle of the void between them, charges the scene emotionally by allowing the viewer to witness the act of attention of the son towards his father. Instead of being portrayed as a 'servant of God' with an ancillary place to the immediate saintly figure(s), the sitter is himself the object of his son's adoration. To conclude, while stylistically following the visual tradition of the Eastern Church, the portrait is conceptually very different from the traditional form of a donor portrait.

The increasing presence of imported Western artefacts and images of worship, as well as evidence of the introduction of some representational and compositional strategies borrowed from Western visual practices, eventually provoked an antagonistic reaction. Conserving the form of Byzantine art became part of the survival strategy for the preservation of doctrine. [194] A directive was given by the Church Synod to benefactors and artists to maintain the 'purity' and the

---

[193] For more details see E. Tantcheva, 'At the Crossroads of East and West.'
[194] Gerov, G., Vodata kato granitža, *PI*, No. 2 (2002), pp. 31-57; Vassilev, A., *Erminii, Tehnologii i Ikonographija* ; Prashkov, *Stenopisite na Tzurkvata Rozdesto Hristovo.*

'true' nature of any drawn or painted images by only using as references Greek and Russian examples from the past.[195] As a result of this policy the representational system of the Eastern Church began to show some signs of stagnation. Even members of the Cretan iconographic School, who were close to Europe, remained conservative in their approach and only a very few of them adopted new themes or changes to the traditional form of representation, and then only after the seventeenth century.[196] Thus, it is not surprising that the unconventional portrait in the Nativity appears to have been deliberately damaged, as the rest of the wall-paintings throughout the church are well preserved.

In this context, the combination of its spiritual significance to the Orthodox Church, its autonomous status and the availability of funds allowed Athos to become the greatest artistic focus of the Orthodox world in the first century and a half after the Ottoman conquest.[197] The availability of funds permitted the invitation of leading artists, but ones adhering to the Byzantine visual tradition, to work on the numerous building, renovation and restoration projects of Athos.[198]

---

[195]Russia had received Christianity from Byzantium in the tenth century, was still a Metropolitan of the Patriarchate of Constantinople and so effectively under its jurisdiction. The Russians had rejected the decisions of the Council of Florence thereby proving their loyalty to the Church. Russian art was considered to be doctrinally sound. See Božkov, 'Bitovite elementi v stenopisite ot Arbanashkite tžurkvi, pp. 99-132

[196] R. Cormack, *Byzantine Art*, (Oxford, 2000), pp. 200 and 212.

[197] Until the end of the fifteenth century the community relied on the generosity of foreign rulers - Russian, Moldovan, Wallachian and Serbian - just for the survival of the community. Their donations mainly helped to retain monastic estates that had been confiscated in 1454 by Mehmed II, in breach of earlier agreements. However, by the beginning of the sixteenth century all of these principalities, except Russia, had become Ottoman vassals, which made the monasteries dependant on donations from the newly emerged Christian merchant community within the Empire.

[198] For example, the best sixteenth-century wall painter, Theophanes Strelitzias, also known as Theophanes the Cretan, and his son Simeon worked for a long period on Athos. Theophanes and his son and assistants painted in several Athonian monasteries; Great Lavra, Sravronikita and Pantocratoros. Another Cretan studio, led by one Tzortzis, who came initially from the Strelitzias's studio, was invited to decorate the katholikon of the Docheiariou Monastery. His paintings appear to be more schematic than those of Strelitzias and have greater expressionist quality. In the katholica of the monasteries Iviron and Ksenophon are wall paintings signed by two Cretans, Marko and Anthonii, while the decoration of the chapel of St Nichola in the Great Lavra was signed by one of the best-known painters from northern Greece, Phrangous Cathela-

Some of these artists were also commissioned to organise and conduct the training of iconographers, where the teaching practices were based on the copying of existing examples.[199] Both groups, those who worked on Athos and those who were trained there, travelled to the different parts of the Empire, following commissions, hence the importance of Athos in the continuation of the Byzantine visual tradition.

The overview of the Arbanassi nave decoration indicated that it followed the overall arrangement and stylistic characteristics of the Byzantine tradition in church decoration. At the same time Arbanassi had direct and close links with the Athonite community. These included the existence of an Athonite *metohion* in seventeenth-century Arbanassi, the regular annual visits of Athonite monks to the town and the traditional ties of the resident Turnovo Metropolitan with Athos.[200] It is therefore worth considering whether the painters of Arbanassi had in fact come from or had any association with Athonite monasteries or Athonite projects.

Unfortunately, there is no indication of the identity of the painters who worked on the Arbanassi decoration in the seventeenth century. Moreover, there is no

---

nous. See Mutafov, 'Živopista na Aton prez prizmata na novite nauchni izsledvania. Razmisli', *PI*, No. 1 (2012), pp. 3-10.

199 Strelitzas and his son were admitted to the brotherhood of the Great Lavra. This allowed them, together with other painting monks, to expand the training. Subsequently, workshops developed in a number of monasteries. Among the most active workshops at the beginning of the seventeenth century were those in the monasteries of Dionisiou, Docheiariou and Zographou. For further details see Philov, B., 'Znachenie na Atonskite manastiri za Bulgarskata tžurkovna živopis', *Otetž Paisii: onshtestveno-kulturno-politichesko spisanie*, No. 9, (1930), pp. 123-128.

200 At least one *metohion* - a kind of ecclesiastical embassy - is known to have existed in Arbanassi, next to the Church of the Nativity. Christians emerging as wealthy merchants replaced the princely support that had dominated charitable giving between the tenth and the fifteenth centuries. This was combined with the well-organised system of gift collection by the *metohia* and by monks travelling through the Balkans begging for alms. There is evidence that Arbanassi was high on the list of Athonite alms-begging monks and they visited the community every autumn during the seventeenth century.

real evidence that associates those painters with a geographic location. Instead the examined Bulgarian scholarship on the four churches put forward hypothetical suggestions about possible direct or more remote affiliations of the artists either with Athos or with the Greek mainland. For example, Rutževa advocates that the artistic group which painted the nave of the Church of St Atanass had travelled to Arbanassi as part of the cortège of Athonites going to the Synod in Moscow in 1665 and that the artists were personally invited by the Metropolitan Gerasim II Kakavelas. This assumption was made in the context of the coincidence that the wall paintings in the nave are estimated to have been executed between 1665 and 1667.[201] She goes further to suggest that the members of the group were not likely to have been Athonites, but were probably from Epirus.[202] Her presumption was based only a hypothesis that Hellenised Albanian Christians from the Epirus area settled in Arbanassi after the failed uprising of Skanderbeg.[203]

Nor is there any certainty about the even more convoluted allusions made by Nikolova, who suggested a possible, but indirect, association of the artists who decorated the nave of the Archangels and Athos. After finding some stylistic analogies between the seventeenth century decoration in the Archangels and a photographic record of sixteenth-century wall paintings in sites associated with the legendary painter St Pimen (who originally came from the Zographou monastery on Athos), she concluded that the artists of the Archangels must have been trained by followers of St Pimen.[204] The sixteenth-century paintings she refers to are from the Dragalevski and Cherepishki monasteries. However, the

---

201 Rutževa, Sv., *Ikonografia I stil na stenopisite v tzurkvata Sv. Atanassii, selo Arbanassi*, (unpublished doctoral thesis, University of Veliko Turnovo, 1997), p. 189.
202 Ibid, p. 188-189.
203 Ibid, pp. 76-79
204 More information on the work of Pimen and the legends surrounding him can be found in G. Todorov, "Dalbok Bulgarski Renesans – zivotat I deloto na St Pimen Zographski" in *Kultura* 2001, vol.39

original association of these church interiors with St Pimen had always been very tentative, as the allusions had been made not on the basis of evidence, but on traditions, mentioned in texts published in the 1920s and 1930s.[205] Moreover, even if Nikolova's suggestion was correct, the connection with Athos is so indirect and remote as to be difficult to sustain.

There are two different hypotheses about the links between Athos and the painters of the Church of the Nativity. Independently, at the end of the 1970s, both Prashkov and Penkova tentatively proposed that the artists who worked in the Church of the Nativity might have been from Linotopi, in Northern Greece. They based their theory on the hypothesis that Arbanassi might initially have been settled by Hellenised Albanians from that part of the Empire after the failure of Skanderbeg's uprising. There is, however, no evidence for such a connection and the fact that the argument is centred on a second hypothesis undermines to an extent the credibility of their theory.

Again, in the 1980s Gerasimova-Tomova, after an analysis of the texts found in the Church of the Nativity, concluded that the painters might have been local.[206] Her conclusion was based on the fact that Greek inscriptions throughout the decoration showed mistakes which linguistically could be explained as having

---

[205] See G. Todorov, "Dalbok Bulgarski Renesans – zivotat I deloto na St Pimen Zographski" in *Kultura* 2001, vol.39 for stories about the life of St Pimen. There are a few fragments supposedly painted by him in eight katholica in the area around Sofia and in the south-west part of present-day Bulgaria, Serbia, Montenegro and Macedonia. These are the monasteries: Kurilovski, Seslavski, Cherepishki, Suhodolski (Serbia), Dragalevski (where fragments were found in one of the earlier decorative layers) Slivhushki, Podgumerski (Montenegro) and Planinichki (Macedonia). See PI, 2007, pp. 51-55.

[206] Her work was a response to the tentative proposals of both Prashkov and Penkova that the artists who worked in the Church of the Nativity might have been from Linotopi, in Northern Greece and might also have worked on Athonian projects in the seventeenth century. Gerasimova-Tomova, V., 'Nadpisite kum tzurkvata Rozdestvo Hristovo v Arbanassi' in Praskov, L. *Stenopisite na tzurkvata Rozdestvo Hristovo v Arbanassi (*Sofia, 1979). Prashkov put forward that hypothesis in Prashkov, *Stenopisite na tzurkavata Roždestvo*, while Penkova had it expressed in the context of her work Penkova, B., 'Za Njakoi Osobenosti na Postvizantiiskoto Izkustvo v Bulgaria', *PI,* No 1 (1999), 3-8.

being written by people whose first language was within the Slavonic group. Bulgarian is one of the Slavonic languages.

Around the same time Božkov hypothesised about the possibility that some of the founders of the Trjavna School were involved in the decoration of the Church of the Nativity. This proposition came as a result of a comparative stylistic analysis of works attributed to Vikentii and his brother Simeon with the wall paintings in the Nativity. By extension, Božkov's theory allows for the possibility of links between at least one of the painters of the Church of the Nativity, Vikentii, with Athos. In the archives of Zographou Monastery, Philov found some indication that Vikentii from Trjavna arrived in the monastery as a twelve year old boy to be trained as an icon-painter. However, because the association of Vikentii and the decoration of the Church of the Nativity is hypothetical, it is difficult to accept unreservedly the association of the painters of that church with Athos.[207]

Little research has so far been carried out on the remaining paintings in the Church of St Dimitr, so no opinion has been expressed by Bulgarian scholars as to any possible association of the painters who worked on the decoration with Athos or Athonian projects. However, in the light of the results of my examination of the existing research into the other three churches, it can be concluded that, although it is conceivable that the painters of the Church of St Dimitr might have had associations with Athos, it will be difficult to find any evidence. This lack of evidence can usually be attributed to the turbulent history during Ottoman rule, not only of the Turnovo area, but of the Balkans as a whole.

Although the attempts of the scholarship to identify the artists of Arbanassi and to ascertain where they come from provide no satisfactory answers to either

[207] Božkov, A., *Trevnenska Zivopisna Scholla* (Sofia, 1967); Philov, *Starobulgarsko Izkustvo.*

question, still less confirm any clear connection with Athos, nevertheless, if the compositional content of the seventeenth-century decoration of the churches is examined for evidence of such connections, some direct thematic parallels with Athonite tradition can be drawn in the context of the decoration of the Church of the Nativity. For instance, the scene of *The Tree of Jesse*, in the inner narthex of the church (1638) is a particular interpretation of the theme that has been described by Prashkov as having many compositional parallels with earlier Athonite examples.[208] Chronologically, the earliest of them is in the refectory of Great Lavra (1535) and he considers its compositional pattern to have been followed in the Church of the Nativity.[209] Prashkov also noted the existence of the same basic version of the scene, even though not identical, in front of the refectories of two other Athonite monasteries: the Dionysiou (1553) and Docheiariou (1568) Monasteries.[210]

Another example is in the Menologion Cycle, in the outer narthex of the Church of the Nativity. There is a scene named *The Young Boy is Saved* (1643-1649), in the section of the decoration associated with the Archangels Michael and Gabriel. The compositional arrangement of the scene has been directly associated with the sixteenth century decoration of Docheiariou Monastery (1568).[211] In fact Gerov claims that the composition in the Church of the Nativity is almost identical to the one in Docheiariou, except for one slight adaptation; in the Church of the Nativity, the scene is placed in a corner where the wall meets the

---

[208] Prashkov, *Stenopisite na tzurkavata Roždestv,* pp. 13-15.
[209] The theme is not found only in the decoration of Eastern Orthodox churches. It had also been used in medieval and renaissance Europe, but was stylistically very different. In Europe, more often than not, interpretations of the theme are associated with stained glass windows. Prashkov, *Stenopisite na tzurkavata Roždestvo.*
[210] Gerov, G., *An Iconographical Theme from Mount Athos and its Spread in the Bulgarian Lands: The Miracle of the Archangels at Docheiario* (Thessalonica, 1987).
[211] There it is part of a special cycle, dedicated to a legend about the involvement of the Archangels Michael and Gabriel in the founding of Docheiariou.

vaulted ceiling of the outer narthex, so the top right corner of the composition had to be relinquished.

The existence of such a level of compositional and thematic similarity between elements of church decoration on Athos and churches throughout the Orthodox world provoked discussion amongst scholars about the likelihood of the use of templates. Technically, the creation of templates/cartoons or sketches would have been feasible as paper was not a scarce commodity in the Ottoman Empire.[212] It is believed that painters who travelled to work on Athos and those who were trained there, prepared cartoons and/or sketches from existing compositions. The hypothesis is that in the post-Byzantine period, cartoons were used on some occasions to transfer a particular composition in its entirety, as seems likely in the case of *The Young Boy is Saved* in the Church of the Nativity.[213] Still, more often than not, both the cartoons and sketches were thought to have been used by the artists mainly as an aid to the development of new work.[214] Such a scenario appears conceivable, as there are other examples elsewhere which both thematically and compositionally show a close association with the Athonian interpretation of the themes of *The Tree of Jesse* and *The Young Boy is Saved.*

Both themes appear to have been popular in the sixteenth and seventeenth centuries throughout the Orthodox world, especially with other monastic communities. For example, interpretations of *The Tree of Jesse,* close to the Athonite tradition, can be encountered in Moldavia on the exteriors of some of

[212] Such a practice had been in existence since the late Middle Ages as paper was relatively easily accessed. Even before the Ottomans there was a large production of paper in Constantinople which continued to function up to the eighteenth century. In the sixteenth and seventeenth centuries the Ottomans also imported paper, mainly from Poland.

[213] R. Cormack, 'Painter's Guide, Model-Books and Craftsmen: or Memory and the Artist?' in M. Bacci (ed.), *L'artista a Bisanzio e nel mondoChristiano-orientale*, (Pisa, 2007), pp. 11-29.

[214] Ibid.

the painted monasteries of Bucovina: Moldovita (1537), Voronet (1540s) and Sucevita (1602-1604). There is also a similar scene of *The Tree of Jesse* in Epirus, the Philanthropinon Monastery (1560), as well as in the seventeenth century refectory of the monastery of Bachkovo (1643).

The Young Boy is Saved can be found in churches in the present territories of Serbia, Romania and Russia. For instance, the scene was depicted at Serbian monasteries in Piva (dated as from 1604 or 1606) and the Holy Archangels in Kuceviste (from the first half of the seventeenth century).[215] The scene can also be found in the Church of St Nicolas in Yaroslavl (1641).[216] It is also part of the Cycle of the Miracles of the Archangels in the Romanian monasteries of Plaviceni (seventeenth century) and in the Church of the Archangel Michael at Topolnitza Monastery (1673).[217] The theme continued to be popular through to the nineteenth century. For example, again as part of the cycle of Miracles of the Archangels, it can be found in the nineteenth century decoration of the Church of the Holy Archangels in Bachkovo Monastery executed in 1846 by Mosko Odrinchanin.[218]

To summarise, the style and organization of the Arbanassi decoration showed consistency with the overall Byzantine model of church decoration. The relative repetition of themes prevailed as in the example of two typically Athonite compositions that were found in Arbanassi but can also be traced across the Orthodox world. Although it is conceivable that the Arbanassi painters, or some of them, might have been associated through projects or training with Athos, there is no actual evidence as there are no surviving cartoons or sketches

[215] J. Radovanovič, 'Jedno čudo arhandjela Mihaila u Lesnovu', *Zbornik za likovne umetnosti*, No. 10 (1974), pp. 47-68.
[216]V. Brjusova, *Freski Jaroslavlja XVII-nač. XVIII veka*, (Moscow, 1982), pp. 40-41.
[217] C. Pillat, *Pictura murala in epoca lui Matei Basarab*, (Bucharest, 1980), p. 25.
[218] Gerov, G., *An Iconographical Theme from Mount Athos and its Spread in the Bulgarian Lands: The Miracle of the Archangels at Docheiario* (Thessalonica, 1987), p. 223.

that can be linked to the Arbanassi decoration, despite the apparent parallels with existing Athonite decoration. From the existing evidence, however it becomes clear that the Athonian tradition was the decisive element in the development of the Arbanassi interior decoration.

3. 3 Locating colour

Because of the boldness with which the images are constructed and the lack of shading it is easy to identify the colours that are used in each scene. I suggest that it is possible to fulfil the aims of the present examination by investigating in detail a very limited number of images rather than scrutinising every scene in the decoration. The reasons are that a preliminary examination of the colours used in each interior showed very little variation between the appearances of each general colour as found in different scenes chosen randomly in a single nave. The examination was carried out using a SLR digital camera and a GretagMacbeth ColourChecker colour rendition chart.[219] The ColourChecker chart was favoured as it is widely used by imaging specialists. The chart has been used effectively in similar applications, for example in the VASARI project of the National Gallery.[220]

An image was taken of every scene in each nave interior, with the GretagMacbeth ColourChecker colour rendition chart, which is composed of coloured square surfaces. Each surface has strictly controlled spectral properties (because the characteristics of the light reflected from each square are expected to be constant).

[219] I am grateful to Dr Anderson for performing the needed colourimetric computations.

[220] D. Saunders, J. Cuppitt, 'Image processing at the National Gallery: The VASARI project' in *National Gallery Technical Bulletin*, No. 14, (1993), pp. 72-86; K. Martinez, J. Cupitt, and D. Saunders, 'High resolution colorimetric imaging of paintings' in *Proceedings of SPIE*, (1993), pp. 25-36; J. Cupitt, D. Saunders, and K. Martinez, 'Digital imaging in European museums' in *Proceedings of SPIE*, (1997), pp. 144-151.

The method used in my preliminary examination of the appearance of the colours of the decoration in the naves involved identification of the spectral characteristics of the surface painted in a particular colour. At this stage of my investigation I compared the spectral properties of the surface of the wall paintings with the spectral properties of the surface of one of the squares in the GretagMacbeth colour rendition chart. This was performed in order to ascertain the level of constancy of the appearance of each colour throughout the nave. For example, the spectral properties of a red square were chosen to be referential parameters against which to check the spectral properties of the red colour used in the representational system of a particular nave.[221] Because of the fluctuating nature of the interior illumination, it was necessary to have a stable standard illumination to secure the validity of the comparison. For that purpose, each image of the scenes was taken when all the external and internal lighting was excluded and the only illumination was that produced by the camera flash. In this way, care was taken that the characteristics of the incident flux were relatively stable. Subsequently all the images were downloaded and the differences in the appearance of the colour of the painted surface and that of the nearest colour of the chart were compared. This established that the appearance of the identifiable colours in each nave can be considered perceptually constant. Therefore, it is possible to fulfil the aims of the present examination by investigating in detail only a very limited number of images rather than trying to scrutinise every single scene in the decoration.

I have compared the place and the compositional and colour content of the images in the decoration and have found that in each nave the scenes of SS Constantine and Helena and of the Archangel Michael truly satisfy the criteria set earlier; these images are always in the first register and are therefore easily

[221] I am grateful to Prof. Osorio for advice on the matter of suitable colour targets.

accessible and have similar compositions. The preliminary examination using a SLR digital camera and a GretagMacbeth ColourChecker colour rendition chart indicated that the colours in the combined palettes of the two compositions represent the full range of hues used in the decoration of any particular nave.

I will now describe the scenes of SS Constantine and Helena and the Archangel Michael on the west wall of each nave using a method akin to that used in the study by Mouriki, where she mapped the colours of the decoration in the katholikon of Nea Moni.

3.3.1 Church of the Nativity of Christ

Preliminary examination of the decoration of this church indicated that the artistic palette comprised the following colours: two shades of red, green, yellow, beige, brown, white, grey and black.

A full-figure image of the Archangel Michael, directly facing the beholder, can be found on the left side of the doorway of the nave (Figure 20). His face and limbs are painted beige and the details are delineated in brown paint. He is clothed in a grey tunic and armoured in black and grey with some yellow colouring. At the end of the tunic there is a border embellished with rows of white dots suggestive of precious stones or pearls. The details of the armour are outlined in alternating dark and light lines. The dark lines are in black over the predominantly grey parts of the armour and in brown over the predominantly yellow parts. On his shoulders is a richly draped bright red paludamentum or cloak and he wears yellowish coloured calcei (soft leather shoes, a cross between a shoe and a sandal). The folds in the clothing of the Archangel are indicated by black lines, which in places are juxtaposed with white highlights. Two brown wings, with white detailing, frame his body. In his right hand, the

Archangel holds an upright whitish sword. In his left hand, he holds a black-grey orb with a white cross on it. The colours used in this scene are white, beige, bright red, brown, grey, and black.

The composition of the scene of SS Constantine and Helena is very simple (Figure 21). He stands to the left, and she to the right of the yellow-coloured Holy Cross, which is embellished with white and bright red precious stones. All the smaller elements of the cross as a whole are outlined in a dark colour. Both figures face the nave and each clutches the cross with the hand nearest to it. With the other hand, they gesture towards it. Their faces and the hands are beige coloured and the details are outlined in dark, almost black lines. Both are dressed in tunics, St Constantine in a black tunic and St Helena in a deep red to purplish stola, with a pink floral pattern on it, suggestive of rich brocade. The shapes of both tunics are seemingly outlined in places in light or dark colours, which are difficult to identify, but which might be expected to have been more definite at the time they were painted.

St Constantine also has a bright red paludamentum, the outline and folds of which are delineated in dark brown. However, at the places where the paludamentum overlies the black tunic, the artist has painted small white dots, suggestive of some kind of embellishment. This treatment does not extend beyond the section over the tunic. Furthermore, where the paludamentum appears to be behind the folded arm of the saint, there are signs that the parts of the arm clothed in black, next to the red of the paludamentum, appear to have been painted white in the past, but the painted layer is rather worn at present.

Both SS Constantine and Helena wear yellow pallia, long bands that either hang from the collar or from a circle dropped over the head, and belts. The belts are encrusted with white and red decoration. Small white shapes in the form of dots outline the shape of the pallia. Larger shapes in the form of rhomboids are outlined in deep brown. The collar of the pallium of St Helena is covered by the drapes of her short white palla (a scarf, wrapped around the shoulders). The folds of the palla are drawn in black.

The saints wear yellow crowns, elements of which are outlined in a dark colour, and there are white dots arranged over them, suggestive of embellishment with precious stones. All the smaller elements are also outlined with a dark colour. There are also fine white details around the image, painted on a dark background. The colours used in the scene of SS Constantine and Helena are white, yellow, bright red, deep red to purple, brown, green and black.

The Archangel Michael and the figures of SS Constantine and Helena have haloes, which are outlined in alternating black and white lines which give an impression of an aura radiating from the main body of the halo. On a close inspection of the yellow surface of the haloes, flakes of gilding can be detected. All the compositions in this last register, including the figures of these two saints, are placed on a complicated background. It consists of four stripes in different colours: starting from the bottom a black band with a spray of red and yellow, next a yellow band followed by a green one and finally a black band. The black band of the background is visually a much darker black than that used for the tunic of St Constantine and the tone is almost even, while, in places, the tunic has a cloudy appearance. Although Prashkov did not provide any evidence in his monograph, he suggested that the tunic and possibly the upper part of the background, which is coloured black at present, were originally blue. James writes that often, instead of blue coloured paint, a thin layer of white paint was applied over the layer of black, a technique that created a perceptual sensation of a blue colour in the eye of the beholder.[222] It is difficult, however, to speculate about the original appearance of this part of the decoration.

3.3.2 Church of the Archangels Michael and Gabriel

In this church, the artists used eight hues in total to construct the decoration of the nave. These are: red, purple, yellow, beige, brown, white, grey and black.

Above the doorway of the nave is a painting of a model of a domed church building, supported by the two patrons of the church, the Archangels Michael and Gabriel (Figure 22). The image of the Archangel Michael is again to the left of the doorway, but is stylistically very different to the depiction of the Archangel Michael in the Church of the Nativity. His light beige-coloured face is here in three-quarter view and the elements of the face are drawn in black. His body is facing the nave. The Archangel Michael is presented in white armour, with red-brown ornaments and a short grey tunic. Close examination of the image revealed that the white areas and the red-brown bold details are painted using particularly thick impasto.[223] The red- brown elements are outlined with a fine black line. On the shoulders of the Archangel is a bright red cloak. He wears light grey leggings and white-coloured calcei. His white wings are stylised, but with a lack of the fine detailing found in the treatment of the Archangel's wings in the Church of the Nativity. In his right hand he holds an upright black sword and with his left hand he supports the model of the church. All the details and folds in his clothing are outlined with black paint. The result is a sharp light contrast allowing the separate forms and details to be well distinguished from the surroundings. There is, however, a lack of intricate ornamentation, unlike the image from the Church of the Nativity; the image is

---

[222] James, *Light and Colour*, p. 30.
[223] A technique by which paint is laid very thickly on part or all of an already painted surface.

highly stylised and uses a very restricted palette consisting of red, yellow, brown, white, grey and black.

The composition containing the figures of SS Constantine and Helena shows the same overall simplicity, similar to that in the Church of the Nativity of Christ. The only difference is that St Constantine is to the right and St Helena is to the left, with the Holy Cross between them (Figure 23). The cross is yellow with darker ornamentation and the saints each simultaneously hold it and point to it. St Constantine is dressed in a tunic that again can be considered black, but it has a cloudier appearance compared to that in the depiction of St Constantine in the church of the Nativity. Without carrying out at least some chemical analytical tests, it is not possible to understand the cause of that appearance. One possibility is that it is due to the deposition of salts that are the result of a chemical reaction. Another possibility could be the use of white or blue pigment, as for example, azurite. St Constantine also has a purple-red, seemingly brocade, paludamentum. The intricate patterning of the fabric was obviously added after the basic red-purple background colour was applied. These are technically more accomplished than the floral detail in the stola of St Helena in the Church of the Nativity. The demarcation of the folds in the fabric of the paludamentum is achieved by the addition of fine black lines and appropriate interruptions in the elaborate pattern. There is a particularly skilful representation of the movements of the fabric through the complicated ornamentation of the paludamentum.

This time, St Helena is in a bright red plain stola. Both saints have yellow pallia with ornate detailing. St Helena wears a short white palla. The cross, the palla, the pallia, the bottom of the tunics and the paludamentum are outlined with a dark brown colour and so are the suggested folds of the clothing. Both saints wear crowns, the elements of which are outlined in black. Their faces and hands are painted in a beige colour with all the details drawn in dark brown. In this instance, the colours used in the scene are white, yellow, bright red, deep red that borders on purple, brown, beige, grey, and black.

All three, the Archangel Michael and SS Constantine and Helena, have ornate haloes with stars in low relief. There are also flakes of gold leaf, indicating that in the past the haloes were gilded. As in the Church of the Nativity, the haloes have alternate black and white outlines, creating an effect of radiating light even in their present damaged state. The figures are placed on a background consisting this time of three different coloured stripes. The lowest one is brown, the next is light grey to white, and the topmost is a black band (Figures 22-23). The colours used in the two scenes comprises white, yellow, bright red, deep red that borders on purple, brown, beige, grey, and black.

3.3.3 Church of St Atanass

The nine colours found in the nave of this church are: red, blue, green, yellow, beige, brown, white, grey and black.

Here again the image of the Archangel Michael is to the left of the doorway and again there are some stylistic differences in the treatment of the image compared to the previous two churches (Figure 24). The head of the Archangel is in three-quarters view and inclined towards his left shoulder. This part of the image is constructed using light beige and dark brown for the face and black and grey for the hair. The body of the Archangel faces the nave and is dressed in armour, painted using black, grey, brown, and white, covered by a blue, almost black tunic. The armour is very ornate and every detail is painted in a dark colour and extensively highlighted. Close inspection shows that the tunic has been painted in black with light-coloured highlights in bluish white. Over the shoulders of the Archangel is a bright red cloak. The cloak has received similar treatment to the tunic, in that the folds of the fabric are emphasised by the application of lines, darker or lighter, to the basic bright red tone of the cloak. He wears grey leggings and beige-coloured calcei with some brown details. Two brown wings with fine white highlights frame his body. In his right hand, he carries a black sword with a white hilt, which he holds with the blade pointing downwards. In his left hand, he holds a beige object with brown detailing that cannot easily be identified, but which might be a horn or cup. The palette of the image comprises white, beige, bright red, brown, grey, and black.

The composition of SS Constantine and Helena is arranged identically to that in the church of Nativity of Christ, with the saints standing on either side of the yellow cross (Figure 25). The flesh of their faces and hands is painted using beige and brown colours. Especially in the face of St Constantine, there is an apparent attempt to use a gradation from beige to brown. However, outlining is the predominant technique used to draw the details of the face and the hands. The cross is embellished with white dots and blue and bright red rhomboid details, the latter outlined with dark brown.

St Constantine is here dressed in a light blue and black, seemingly brocaded, tunic and St Helena in a bright red brocaded stola. The borders of their tunics are embellished with a geometric pattern, probably suggestive of embroidery. Both wear yellow-coloured crowns that at present are difficult to distinguish from the background yellow of the haloes as their dark outline looks worn in most places. Both saints wear pallia and all the details are again outlined in a dark colour. St Constantine also has a deep brown and black paludamentum, lined with fur and fastened with a bejewelled bulla or brooch. Elements of the figures and the cross are outlined with a continuous dark line as are the other the elements in the composition. The colours used in this scene are white, yellow, bright red, brown, light blue, grey, and black.

All the images have haloes that have lost their gilding, except for the minute fragments remaining. The haloes are drawn in the style of those of the churches of the Nativity of Christ and the Archangels Michael and Gabriel, with alternating dark and white outlines. The background consists of three bands: a black band with a spray of grey at the bottom, followed by a green band and finishing with a black one at the top (Figures 24-25). The colours used are white, yellow, beige, bright red, light blue, brown, grey, and black.

3.3.4 Church of St Dimitr

The palette of the nave of the Church of St Dimitr comprises the following colours: two distinct shades of red, yellow, beige, brown, white, grey and black.

In the nave, the image of the Archangel Michael can be found, as expected, to the left of the doorway (Figure 26). His face and hands are painted in brown and highlighted in beige. His posture is almost identical to that of the image in the Church of the Nativity of Christ, but in his left hand he holds a scroll, rather than an orb. The writing on the scroll has vanished as the wall painting is in a comparatively poor condition. The Archangel is dressed in armour which has intricate ornamentation painted using deep, medium and light grey, white, deep brown red and yellowish brown and no half tones. The colours of the skirt of the short tunic worn beneath the armour are the same as those used for the armour.

There is a deep, nearly brown red cloak draped over the Archangel's shoulders and the folds of the fabric have been outlined using darker red and brown lines.

He wears red calcei and yellow grey leggings. In his right hand the Archangel raises a white sword, point uppermost. His wings are in brown and grey with fine white detailing on the top and much thicker light grey detailing in the area under the wings. The palette of the scene comprises white, yellow, beige, dark red, brown, grey and black.

The compositional arrangement of the scene depicting SS Constantine and Helena is close to that in the churches of the Nativity of Christ and St Atanass. The Holy Cross between the saints is yellow and plain, with a thick dark red outline of the vertical element on St Helena's side (Figure 27). St Constantine is dressed in a brocaded black tunic and a deep red paludamentum. St Helena is in a bright red stola embellished with white dots and a short white palla with a red pattern, the arrangement of which suggest the folds in the fabric. Both have yellow pallia with white beaded detailing. The pallia and the borders of the clothing of the saints are outlined with white rather than with a dark colour. They wear crowns and, while the crown of St Helena is only schematically marked with a deep red colour on the background of the halo, that of St Constantine is a flat red coloured shape. The colours used in the scene are white, yellow, red, deep red, brown, grey and black.

The Archangel Michael and SS Constantine and Helena have yellow haloes with the same treatment as in the other naves, the main shape of the halo being outlined first with a black and then with a white line (Figures 26-27). The background to the figure of the Archangel Michael consists of three bands of different colours. Starting from the bottom, there is a deep reddish band, next a grey band and finally a black one. The background to SS Constantine and Helena is predominantly grey, with the top part of this register being black.

3.3.5 Summary

This visual examination has allowed me to locate and to enumerate the colour hues used in the construction of the decorative systems of the naves. Earlier I explained that the hues associated with each of the pairs of scenes considered (the Archangel Michael and SS Constantine and Helena) are also representative of the entire hue palette employed in the decoration of each particular nave.

Because my thesis seeks to establish the use of colour in the production of images in the seventeenth-century art of the churches of Arbanassi, next I will consolidate and compare the content of the seventeenth-century palettes. A summary of the colours used in each nave is presented in a tabular format below (Table 1). This table has five columns; in the first column are the names of the hue colours and in the other four are shown the colours used in each church, with one column for each church. The colours used in each church are marked with the nearest colour representation allowed by Microsoft Word.

This systematisation of the colours used in the seventeenth-century decoration of the four Arbanassi churches makes evident the limited, but stable gamut of the artists' palettes. The colours used in all the churches are limited to a range of eight to ten. Of those, only seven are present in all the churches: red, yellow, beige, brown, white, grey and black. The use of greens is restricted to two of the four churches, the Nativity of Christ and St Atanass. In only one of the churches, St Atanass, is blue used, very sparingly and a pale blue at that.

Table 1: Palettes of the churches of Arbanassi, identified in the preliminary visual investigation.

Colour	**Nativity**	**Archangels**	**St Atanass**	**St Dimitr**
Bright Red				
Dark Red to Purple			N/A	
Blue (pale)	N/A	N/A		N/A
Green		N/A		N/A
Yellow				
Beige				
Brown		Red Brown		
White				
Grey				
Black				

The colours of the paints are determined primarily by the pigments used in their production. Within the frame of Byzantine and post-Byzantine studies, there is a continuity in the general colours present in artists' palettes. For example, Underwood, Jenssen and Majewski and Plesters investigated the churches of the Kariye Camii in Istanbul (fourteenth century), the Church of the Panagia Amasgou at Monagri in Cyprus (twelfth and sixteenth centuries) and the Church of Hagia Sophia in Trebizond (thirteenth century).[224] In all of them consistency of the palette was found to be present. The palette includes the following seven colours: yellow, red, brown, green, blue, black and white. In the context of the Bulgarian scholarship, Prashkov, for example, remarks on the uninterrupted continuity of the general content of the palettes within the decoration of all churches built at any time before the eighteenth century that

[224] V. Jenssen and L. Majewski, Appendix to S. Boyd, 'The Church of the Panagia Amasgou, Monagri, Cyprus and its wall paintings', *DOP 28*, (1974), pp. 329-345; J. Plesters, 'The materials of the wall paintings' in D. Talbot-Rice (ed.), *The Church of Hagia Sophia at Trebizond*, (Edinburgh, 1968), pp. 225-234, P. A. Underwood, *Kariye Djamii*, Vol.1, pp. 300-308.

are still in existence on the present territory of Bulgaria.[225] The most commonly present hues named by him are the following: black, white, brown, yellow, red, blue and green. Prashkov noted that some palettes also include purple. The tradition of the occasional use of this particular colour in wall paintings can be traced back to Byzantine times.[226]

In all the cases mentioned above, the researchers, with the exception of Prashkov, took account of the process of the production of colours, arguing that when considering the use of colour, it is necessary to take account of how and from what the pigments are obtained. In accordance with their findings, one possible explanation for the limitations of the gamut of the seventeenth-century palettes is in the origin and the kind of the pigments available at the time. The colours presented in Table 1 were derived mainly from a variety of naturally occurring pigments, as the production of commercially-produced artificial pigments did not begin before the nineteenth century.[227] Therefore, it is only to be expected that there was a limited number of pigments available and therefore the colours that could be obtained would similarly be limited in number.[228]

A close examination of the decoration of the Arbanassi nave interiors indicated that in all probability the main technique used by the artists was fresco - painting onto wet plaster - which then in places was over-painted, very often using the technique of impasto. Prashkov showed that the walls were not plastered in a single application, but areas of the plaster were gradually added to each other.[229] His opinion is that the artists were responsible for the final layer of plaster over which, in accordance with the fresco technique, they painted immediately after those layers were applied. The artists located the joints between the areas

---

225 Prashkov, *Stenopisi vTzurkvata Rozdestvo*, pp. 75-77, 80-84.
226 James, *Light and Colour*, pp. 30, 32.
227 Ph. Ball, *Bright Earth*, (London, 2001), pp. 32-35
228 Prashkov, *Stenopisi vTzurkvata Rozdestvo*, pp. 75-77, 80-84.
229 Prashkov, (ed.), *Vuprosi na Konservatžiata i Restavratžiata*, Vol. 2, (Sofia, 1985).

of plaster in the areas of the decorative frames which surround each scene in the decoration. These areas contain either a single scene, as in the Church of the Archangels, or a collection of scenes, as in the Church of the Nativity.

It is also necessary to consider the technical restrictions imposed by the chemistry of the painting technique.[230] For example, the technical limitations associated with the fresco technique are linked to the strongly alkaline nature of wet plaster. This implies that not all pigments are stable during the carbonation process at the drying stage or are able to create a chemical bond with the top layer of plaster.[231]

Despite the comparative similarities in the compositional use of colour and the number of the pigments used, the particular appearance of the same general hue varies not only between the churches but also within the same interior and even within the same scene. For example, red varies in hue between bright red and almost orange to purple red in the nave of the Church of the Nativity. In the scene of SS Constantine and Helena from the nave of the Church of the Nativity, the paludamentum of St Constantine is bright red while the stola of St Helena is deep to purple red. Examples of the differences within the same colour hue can be observed in the appearance of the colour green, as used in the churches of the Nativity and St Atanass, or the bright red in the Church of the Archangels, which is visibly different to the red in the nave of the Church of St Dimitr.

These differences raise an immediate question: if there were variations in the appearance of the same generic colour, were they due to the use of different pigments? Therefore, next I will focus on defining the most probable kind of

---

230 Jenssen and Majewski, 'Church of the Panagia Amasgou, Monagri, Cyprus', pp. 329-345; Plesters, 'The materials of the wall paintings', pp. 225-34, Underwood, *Kariye Djamii*, Vol. 1, pp. 300-308.

231 D. V. Thompson, *Materials and Techniques of Medieval Paintings*, (New York, 1956), pp. 68-69; Meyer, *The Artist's Handbook of Materials and Techniques*, pp. 372-373;

pigments. Moreover, it is necessary to consider the possibility that other factors were at work that led to the creation of variations in appearance within the same colour hue, especially when they were derived from the same basic pigment. I will also make conjectures as to the economic cost, the availability of funds and the possible pigment sources.

CHAPTER FOUR

The Pigments of Arbanassi

In this chapter I will deal with the technical production of each colour that appears in the naves of the four selected Arbanassi churches. I will explore the likely types of pigment, the level of availability at the time the churches were painted and technical details of the processes involved in paint preparation. These are only a few of the possible lines that an investigation into the material nature of colour could follow.

Determining the types of pigment will make possible a more thorough assessment of the Arbanassi palette than was permitted by the initial visual identification of the individual colours. For example, knowledge about the types of pigment will shed light on the scope that the Arbanassi palettes offered to the artists in the context of the painting techniques used in the naves. Technical details of the processes involved in the preparation of the paint, such as grinding and mixing, will provide information as to how the handling of the pigments might have contributed to the final appearance of a colour.

Moreover, identification of the type of pigments will permit me to situate the use of colour in the naves in the context of artistic practices in the Ottoman Empire and elsewhere in the Orthodox world. At the same time information about their availability will allow consideration of the costs and the accessibility of the pigments.

Thus the main objective of this chapter is to establish the chemical nature of the colour agent that might be responsible for the appearance of each of the colours, as the chemical nature of a pigment defines its type. Although pigments are complex chemical mixtures, it is the single chemical structure that determines the colour of each pigment that is usually used to identify the chemical nature of each pigment. For example, when the colour agent of a pigment is mercury sulphide, vermilion red will be obtained. However, when the main colour agent is calcium carbonate, the result will be white. In nature, the first pigment, red, can be obtained from the mineral cinnabar and the second, white, from limestone.

For the identification of the chemical structure that is the most probable colour agent, I will employ a method based on the following premises: the colour of a painted surface is very much dependent on the main colour agent of the paint; light is an electromagnetic radiation which can be presented in the form of a continuous set of wavelengths; and the optical properties of every chemical substance are strictly specific to that substance. Within the conceptual framework of these premises, the characteristics of the light reflected from the surface of any substance constitute the colour of that surface. The characteristics of the light also constitute the footprint of the material of which that surface is made.[232]

This last correlation allows an investigation to be carried out comparing the data (comprising a set of wavelengths in the visible part of the spectrum) collected for every hue as found in each of the four naves, with the same type of data, this time for one or more standard samples. The term 'standard sample' is normally used to indicate a chemical known from previous analysis of pigments to have its colour-inducing properties attributed to a particular main colour agent. I will advance my investigation by first compiling a list of these standard chemicals before proceeding with the identification.

[232] R. S. Berns, *Billmewer and Saltzman's Principles of Color Technology*, (New York, Toronto, 2000, first edition, 1981), p. 94.

To define the list of standard chemicals, I will examine research carried out on the pigments in the context of art-historical and conservation studies directly associated either with Arbanassi or with relevant research into post-Byzantine art from the Bulgarian province of the Ottoman Empire. This will be followed by a comparative data analysis, based on the table at the end of the previous chapter, which systematised the hues included in the separate palettes used in each of the naves. Next, I will situate my study by taking the discussion beyond the limitations of the seventeenth-century Bulgarian province of the Ottoman Empire and examining the use of pigments within the wider Orthodox world. This will be done in view of the cosmopolitan nature of the Arbanassi community and the contacts it had throughout the Orthodox communion. Moreover, because Arbanassi was at the time part of the Ottoman Empire, I will consider the general availability within the Ottoman Empire of pigments, their cost and the economic climate at the time.

As Islamic and Christian cultures existed and developed side by side, I will also need to place the use of pigments in the Arbanassi interiors in the context of the use of pigments by Islamic artists at the time. In particular, I will be seeking to find any parallels in the range of pigments used in wall paintings in seventeenth-century Islamic interiors.

In the concluding part of this chapter I will articulate what knowledge about the pigments used in Arbanassi contributes to the investigation of the use of colour in its interiors.

4.1 The Pigments: An overview

There has been no systematic work published on the pigments used in the decoration of any of the churches in Arbanassi. In the introduction to the thesis I explained that scholarly publications concentrate on documenting the themes and compositions of the church decoration, including the only monograph on the Church of the Nativity of Christ by Prashkov.[233] When colour names are mentioned in these publications, it is mainly in connection with the style or the meaning of the compositions, or the colour names are simply enumerated, as in the monograph. Because the subject of colour is not a prime concern of these investigations, pigments are consequently not discussed. The archive diaries of the Institute of National Cultural Monuments, however, contain entries indicating that thin-layer chromatography analyses were carried out at some stage on several churches, in connection with their conservation or restoration programmes.[234] For example, there is an entry suggesting that at the end of the 1970s, when the wall paintings of the Church of the Nativity of Christ underwent cleaning, such analyses were carried out. There are also entries, this time from the first half of the 1980s, associated with paper chromatography analyses carried out on the Church of St Dimitr and the Church of St Gyorgi. Chromatography is a group of analytical techniques used to identify the components of a mixture. It involves the removal of physical samples from the surface of the wall paintings in the form of fine dust, scraped from the examined surfaces. The dust is then mixed with solvent and the mixture is run through an inert material, fine Al_2O_3 (aluminium oxide), silica gel or special paper. Because the components of the mixture move through this medium at different speeds, they separate, leaving a characteristic length mark. These lengths are then compared with the lengths of the marks left by the mixture of the solvent and a single chemical component suspected to be present in the pigment from the sample.

---

[233] For example, Kujumdjieva, 'Dulgia Zivot na Edin Mit', pp. 7-16 and Kujumdjieva, 'Tzikulut po istoriata na prorok Moisei', pp. 33-42. Also Klimukova, 'Psalmite v Konteksta na Starozavetnite Sženi', pp. 19-29; Rutzeva, 'Ikonografska I stilova harachteristika', pp, 38-43 as well as in Prashkov, *Stenopisi vTzurkvata Roždestvo*.

[234] The records were examined during the autumn of 2006, as part of my fieldwork.

The results of the chromatographic analyses for the three churches of the Nativity of Christ, St Dimitr, and St Gyorgi were filed in the archive of the Institute of National Cultural Monuments for future reference. Regrettably, in the early part of 1990, the cellars of the Institute's building were partially flooded, and among the archives that were lost or badly damaged during the flood was the data relating to Arbanassi. Further, I have been unable to find any record of investigations carried out on the other two churches, the Church of the Archangels Michael and Gabriel and that of St Atanass. To be able to comment on the subject of the materials used in the production of the Arbanassi colours, I need to compile an entirely new set of data on all the churches. To fulfil this task, my first step will be to identify the pigments that might have been present and the main colour agents that might have been readily available for use in seventeenth-century Christian art from the Bulgarian province of the Ottoman Empire.

At the end of the previous chapter I pointed out that in both Byzantine art and the art created between the Middle Ages and the end of the seventeenth century, found within the borders of the present Republic of Bulgaria, there is a notable consistency in the number of colours (hues) used in church decoration. Two main reasons were suggested; limited availability of colouring substances in nature and the limitations on the kind of pigments that could be used, because of the specific restrictions on the chemical structure by the painting techniques of *buon fresco*, used in the decoration of the naves. If there was a limited, constant number of pigments in use in the seventeenth century, it can be presumed that any record of those used in church decoration from the period between the Middle Ages and the end of the seventeenth century should allow for the compilation of a list of the most probable pigments from Arbanassi, and their main colour agents.

During the 1970s and 1980s, extensive research was conducted not only on the churches of the Nativity of Christ and of St Gyorgi in Arbanassi but also on almost all significant historical sites around Bulgaria and on a number of surviving individual works of Bulgarian art. In 1984 Nenov published the summarised results of these investigations as part of a handbook for restorers and conservators.[235] His publication has a section that deals with the chemistry of the pigments used in wall paintings between the thirteenth and the nineteenth century in various monuments throughout the territory of the Republic of Bulgaria. Nenov systematised the pigments according to the colours they produce, and not in association with the monuments in which they were initially found. Notably, he recorded the pigments under the name of the colour hue they induced, using the chemical formula of their colour agent and the name of the minerals in which they naturally occur. He also noted the historical period of use of the pigment.[236]

Because Nenov arranged his research in such meticulous fashion, it is possible to recognize those pigments that were in circulation in the seventeenth century. I summarise the information found in Nenov in Table 2 below. In the first column is the name of the colour hue identified by him. In the second column are the chemical formulae of the main colour agents reported by Nenov. In the third column each colour name is associated with the pigment in which it is normally found.

The table displays a limited number of colour hues used during the seventeenth century. Against each colour entry, without exception, there are several pigments. Thus the entries in the table show four different colour agents for the colour brown, three for each of the colours red and yellow, and two for the col-

---

[235] N. Nenov, *Practikum po himichni problemi v konservatžiata*, (Sofia, 1984).
[236] Ibid., pp. 93– 120.

ours blue, green and black. However, because there is a correlation between the specific microstructure of a substance and the way that substance interacts with the incident light, different pigments reflect a very distinctive part of this incident light.[237] It is reasonable to expect that the use of different pigments can be associated with the possibility of achieving variations in the particular appearance of a generic colour.

Table 2: The pigments used in art found around the present territory of the Republic of Bulgaria, according to Nenov (Nenov, *Practikum po himichni problemi v konservatžiata*, 1984).

Colour	**Formula**	**Mineral/Pigment**
Red	Fe_2O_3, Pb_3O_4, HgS	Red Ochre, Minium, Cinnabar
Blue	$Na_2Al_6Si_4O_{24}$ $2CuCo_3.Cu(OH)_2$	Lapis Lazuli, Azurite
Green	FeO etc. $CuCO_3.Cu(OH)_2$	*Terre verte*, Malachite
Yellow	$Fe_2O_3.nH_2O$, $Fe_2O_3.nH_2O+1\%MnO_2$, $Fe_2O_3+15\text{-}20\%MnO_2$	Yellow Ochre (Mars), Burnt Sienna, Umber
White	$CaCO_3$	Lime, Limestone
Black	$Ca_3(PO_4)_2.CaCO_3.CaSO_4$, C	Bone Black, Vegetable Black
Brown	$Fe_2O_3.H_2O$, Fe_2O_3 etc., $Fe_2O_3.H_2O+8\text{-}16\%\ MnO_2$, Fe_2O_3, MnO_2 etc.	Sienna, Burnt Sienna, Umber, Burnt Umber

[237] A sketch of the optics behind pigment mixing can be found in A. P. Laurie, *The Painter's Methods and Materials* (New York, 1967), pp. 113–114.

Prashkov wrote about obtaining a different blue colouring from the two different pigments shown in the table, lapis lazuli and azurite.[238] Both pigments are characterised by an intense blue colour, but in the first instance it might not be possible to recognise whether a surface is painted with lapis lazuli or azurite. Pastoureau, however, proposes that the appearance of azurite-induced blue is somewhat inferior to the blue of a paint produced using lapis lazuli.[239] Research suggests that the difference is very subtle and is revealed only under close examination, when it can be detected that the lapis lazuli has distinct pinkish nuances, while the azurite is distinctly colder, with green nuances.[240]

In conjunction with this research, Prashkov indicated that azurite was almost exclusively used for the production of the colour blue in post-Byzantine wall decoration, while lapis lazuli was very seldom used and only in post-Byzantine icon painting, even though it is possible to use lapis lazuli in wall paintings.[241] For example, both lapis lazuli and azurite were used in the decoration in the main church of the Kintsvisi Monastery in Georgia, dedicated to St Nicholas.[242] Lapis lazuli was used in the earlier wall paintings from around the thirteenth century, while azurite was used in the part of the nave decoration of the church that dates from the fifteenth century.

Prashkov also wrote about the use of the two different pigments associated with the greens: malachite and green earth (generally referred to as *terre verte*).[243] In comparison with the blues, the appearance of the colours created

---

[238] L. Prashkov, 'Razkrivane, konservirane i restravrirane na ikonata Archangel Mihail ot 1663 ot Manastira Sv Troitža krai Turnovo' in Prashkov, L. (ed.), *Vuprosi na konservatžiata I restavratžiata*, Vol. 2 (Sofia, 1985), p. 9.
[239] M. Pastoureau, *Blue: History of a Colour* (Oxford, 2001, first edition, 2000), pp. 21–22.
[240] R. J. Gettens, and E. W. Fitzhugh, 'Azurite and Blue Verditer' in Roy, *Artists' Pigment*, pp. 23-35.
[241] Prashkov, 'Razkrivane, konservirane i restravrirane na ikonata Archangel Mihail' in Prashkov, (ed.), *Vuprosi na konservatžiata*, Vol. 2, p. 9.
[242] V. Tjaželov and O. Sopolitzin, *Malaja Istorija Iskustv*, (Moskva, 1975), pp. 152-157.
[243] Prashkov, 'Razkrivane, konservirane i restravrirane na ikonata Archangel Mihail', pp. 9– 10.

by each of these two green pigments is significantly different. The pigment produced by grinding the semi-precious malachite stone has blue undertones and is usually bright.[244] On the contrary, the *terre verte* colours are muted, with undertones varying between olive and yellow, and are much paler than the colours obtained from malachite. According to Prashkov, in the post-Byzantine era malachite was predominantly used in icon painting, while *terre verte* was used in both icon and wall painting. In the much wider context of Byzantine and post-Byzantine research on church decoration, there can be found instances where both malachite and *terre verte* were used. For example, in an analysis of the pigments used in the Church of the Panagia Amasgou at Monagri in Cyprus (twelfth and sixteenth century), Hagia Sophia in Trebizond (thirteenth century) and Kariye Camii (fourteenth century), greens were found to be mostly *terre verte* and only occasionally ground malachite.[245] The use of either lapis lazuli or malachite might have been dictated by economic factors and the desire for recognition of an elevated social status, however it cannot be excluded that, when available, the use of those pigments was linked to artistic preferences.[246]

There are examples in post-Byzantine art of the intentional use of colour in order to achieve a desired appearance. For instance, the Bulgarian conservator Sharenkov examined the texts of different erminii from the eighteenth century. These were instruction manuals kept by artists at the time. The research was partly carried out in search of technical details of art production during the post-Byzantine era.[247] As a part of the investigation, Sharenkov scrutinised the colour terminology used in the erminii, and was particularly careful in looking for the correct contemporary colour descriptions. By doing so, he was able to

[244] Ball, *Bright Earth*, p. 69.
[245] Jenssen and Majewski, 'The Church of the Panagia Amasgou, Monagri, Cyprus', pp. 329–345; Plesters, 'The materials of the wall paintings', pp. 225–234; Underwood, P. A., *Kariye Djamii*, Vol. 1, pp. 300– 308.
[246] Tjaželov, V. and Sopolitzin, O., *Malaja Istorija Iskustv*, (Moskva, 1975), pp. 152, 154.
[247] A. Sharenkov, *Starinni tractate po Tehnologija i Tehnika na Živopista*, Vol. 1, Kn. 2 (Sofia, 1994).

present evidence that eighteenth-century post-Byzantine artists often sought to associate the specific appearance of a colour with the final use of that colour.

Sharenkov also noted that the text of the erminii indicated that, in order to manipulate the appearance of a colour hue, the artists not only used different pigments, but sometimes also purposefully handled the pigment material differently. In the context of red vermilion, Sharenkov pointed out that the contents of the erminii associate the nuances of the vermilion colour in some instances with the various degrees of fineness of the fractions into which the mineral cinnabar was ground.[248] This method of manipulating the appearance of a colour at the pigment-preparation stage has been known at least since Byzantine times.[249] Another way in which the appearance of the vermilion red was controlled seems to have been through the particular method of production of the mercury sulphide-based pigment.[250] In the text of a different collection of erminii, examined this time by the art historian Vassillev, I was able to find notes indicating that the purest and brightest red came from man-made mercury sulphide. Its appearance differs from the duller and somewhat unpredictable appearance of the naturally obtained mercury sulphide occurring in the form of the mineral cinnabar.[251] The impurities inherent in a raw material can vary not only according to the source (the geographical place where the material was mined), but also *within* the source, during the mining of different layers of the material. These impurities and their varying condition can explain the difference in the appearance of natural and man-made vermilion.

The evidence in these sources opens the question as to the extent to which there is any support for the possibility of the conscious seeking of a particular appearance in the Arbanassi church decoration. In the previous chapter I found

---

[248] Ibid., p. 72. Also Nenov, *Practikum po himichni problemi v konservatžiata*, p. 113.
[249] James, *Light and Colour*, pp. 26–35.
[250] A. Vassillev, *Erminii, Texnologia i Ikonograpphia* (Sofia, 1976), pp. 208–209.
[251] Ibid, p. 209.

that in a single nave, and even in the same scene, the same generic hue was presented differently. For example, in the scene of SS Constantine and Helena from the nave of the Church of the Nativity, the paludamentum of St Constantine is a bright red colour. Within the same scene, the stola of St Helena is red too, but it is a different red, a deep, almost purple-red. In the Church of the Archangels Michael and Gabriel, the paludamentum of St Constantine is red-purple, but the stola of St Helena is bright red. The colour of the paludamentum of St Constantine in the Church of St Atanass mutates further and this time is deep reddish-brown. Lastly, in the nave of the Church of St Dimitr, the paludamentum of St Constantine is painted in a deep red, while the stola of St Helena is bright red.

From these examples, and most clearly in the case of the appearance of the paludamentum of the Emperor, it becomes evident that the artists of Arbanassi must have exercised preference in the choice of particular colour appearances. If there is clear evidence that the artists sought a particular appearance of colours, then it can be presumed that they either employed different pigments or possibly manipulated the pigments' appearance at the production stage. When comparing the results of the examination of the selected images in the naves of Arbanassi (Table 1) with the information on the most widely used colours in the seventeenth century (Table 2), found in Nenov, there is a difference in the number. In Nenov, the number of reported colours is seven: red, blue, green, yellow, white, black and brown. In Table 1 the colours identified in the decoration of the Arbanassi naves are nine: reds in various degrees of brightness (bright to deep red), purple, blue, green-yellow, beige, brown, white, grey and black.

In the first instance, it can be argued that a basic red pigment might have been manipulated or a different pigment altogether might have been used for the purpose. However, there are three additional colours found in Arbanassi, which are not mentioned in Nenov's account. These are purple, beige and grey.

One possible explanation is that all these colours were produced from pigments not mentioned in Nenov's research and specific to Arbanassi. Another explanation could be that these particular colours were produced by pigment mixing and there is evidence that in the post-Byzantine period this was occasionally practised.[252] However, chemical analysis has confirmed that the practice of the physical mixing of different pigments was generally very limited.[253]

To summarise, a review of existing Bulgarian research on the historic use of pigments and the production of colour indicates that in the seventeenth century there were seven main generic colours. Analysis of the results of the visual examination of the Arbanassi decoration pointed towards deliberate artistic choice in the selection of a particular colour and its exact appearance. The desired colour appearance was, in all probability, achieved either by the selection of different pigments or by deliberate manipulation at the production stage of a pigment, by grinding and sometimes by mixing. Because my research aims to understand the way in which colour was implemented in the Arbanassi naves, my next step will be to establish the most likely types of pigment used there.

4.2 Method and Results

At the beginning of this chapter, I explained that the results of the initial investigation into the pigments of the churches of the Nativity, St Dimitr, and St Gyorgi, carried out during the 1970s, were lost in the early part of 1990. I also explained that it was not possible to repeat the chemical analysis carried out in the 1970s because the Regional Museums Authority, responsible for the churches, has imposed a number of restrictions. These include a complete prohibition

[252] Sharenkov, 'Tehnologija na živopisnite materiali na Vuzroždenskata ikonopis' in Prashkov, *Vuprosi na konservatžiata I restavratžiata*, Vol. 1, pp. 72, 74.
[253] Prashkov, 'Razkrivane, konservirane i restravrirane na ikonata Archangel Mihail' in Prashkov, *Vuprosi na konservatžiata I restavratžiata*, Vol. 2, p. 10.

of the removal of specimens from the wall paintings, even micro-specimens that could be used in micro-chemical tests such as polarising and electron microscopy and X-ray spectrometry.[254] Therefore, alternative, non-invasive, analytical methods of pigment identification needed to be employed.

In the mid-1980s, R. Feller recommended a few truly non-invasive techniques as suitable for the preliminary technical examination of the painted surfaces of an artefact. These were reflectance spectrophotometry, X-ray fluorescence, and infrared, ultraviolet and radiographic photography.[255] Of these non-destructive methods, spectrophotometry was the method most acceptable to the Museum Authority of Turnovo, which has jurisdiction over the Arbanassi churches. It helped that the Institute for National Cultural Monuments had already approved investigations using similar apparatus, the tristimulus colorimeter. Choosing spectrophotometry allowed the same equipment to be used both in the identification of the pigment and in the definition of the appearance of the colours. The latter will be discussed in the next chapter, where I will attempt to describe the perceptual impact of each colour on the eye of the beholder and to estimate the perceptual differences between the appearances of the same hue in the different naves.

The method of spectrophotometric examination has long been used in the history of studies of artists' pigments. In 1938, N. F. Barnes employed spectrophotometry to describe accurately the colour of 52 inorganic and organic pigments.[256] All the inorganic pigments were those with well-known chemical formulae for the main colour agent, such as $ZnCrO_4$ (zinc yellow), $Cu(C_2H_3O_2)_2.3\,CuAs_2O_4$ (emerald-green), $Co_3(PO_4)_2$ (cobalt-violet).[257] Barnes' aim was to provide a method of accurate colour control for the benefit of the artist,

[254] Feller, *Artist's Pigments*, p. 11.
[255] Ibid., p. 11.
[256] Barnes, 'Spectrophotometric Studies of Artists Pigments', pp. 120–138.
[257] Ibid., pp. 120–138.

as the rapid influx of pigments following the development of synthetic pigments exposed the inadequacy of the subjective methods of describing the appearance of a colour. He used the optical properties of each pigment to create what he called an 'accurate and permanent specification' of the colour it induces.[258] Like Barnes', my investigation will utilise the optical properties of pigments in conducting a spectrophotometric examination. However, my investigation will follow an opposite line of enquiry to his. Instead of creating a spectral description of a well-known substance, I will use known spectral descriptions to 'identify' unfamiliar substances. For that purpose, I will employ spectral descriptions of pigments identified by Nenov's research as having been used in seventeenth-century wall painting, and will compare them with the spectral description of the colours in the naves of Arbanassi.

A spectrophotometric examination consists of 'illuminating the sample with spectrum light of substantially a single colour and measuring the proportion of such light reflected'.[259] The single-colour light mentioned by Barnes is a single spectral colour and is represented by a narrow band of electromagnetic spectra, selected from the visible part of the spectrum and usually no wider than 10 nm. When each of these narrow bands of electromagnetic radiation meets the examined surface, only a certain 'portion' of the radiation in every 10 nm band will be reflected by the examined surface. Each of these 'portions' will be delineated by a specific spectral characteristic, which is compared to the 'constant' spectral characteristic of the relevant 10 nm band, before interaction. This comparison is carried out at every 10 nm band and the results of these comparisons can be numerically recorded or can be delineated in the form of a continuous graph, called a spectral reflectance curve, for the particular surface colour.[260] In the rest

---

[258] Ibid., p. 120.
[259] Ibid., p. 121.
[260] The definition of reflectance factor is more complex, but it does not concern this investigation.

of the text, I shall for brevity refer to any spectral reflectance curve as a 'spectral curve'.

Various instruments are used in these types of investigation, collectively called 'spectrophotometers'. For the investigation of the Arbanassi churches, the Konica Minolta CM 2600-d spectrophotometer was employed. This particular equipment is light, compact, and versatile; qualities that were demanded by the need to transport the equipment overseas. More importantly, the repeatability of multiple measurements taken by the same spectrophotometer is high, with a variation of only 0.1% across the spectrum. In addition, the Konica Minolta CM 2600-d is known for its high level of compatibility with other makes of spectrophotometer. The implication is that, when the occasion requires, the spectrophotometric data can be compared with spectrophotometric data collected later, even though a different spectrophotometer might have been used. This will allow the measurements I collected for the present investigation to be used in any future investigations into the colours of Arbanassi or even in more general ones such as into the use of colour in seventeenth-century post-Byzantine art. A further advantage was that the technical design of the apparatus enabled time-consuming preparation of the sampled area to be avoided. Instead, the examined areas had only to be cleared of loose particles and surface dust by using a small pair of bellows. This was necessary because the presence of such matter alters the spectrophotometric readings significantly, as it reflects light differently.

In order to avoid possible distortion of the measurements, areas of the wall paintings that appeared to have been damaged or where the colour appeared discoloured have been excluded from the investigation. Each recorded result is an average of sixteen individual measurements for each colour. Repeated measurements are recommended when equipment fitted with a xenon bulb is used, as in the case of the Konica Minolta CM 2600-d, because of its uneven emission.[261] The equipment flash illuminates the examined surface and the reading of the reflected light is recorded in the memory of the apparatus. The relative smoothness and evenness of the wall surfaces allowed the opening of the target mask to be placed flat over the measured area.[262] This positioning is a prerequisite for accurate measurement as it prevents light pollution of the results. The intensity of the incident light, before interaction with the samples, was estimated using the white calibration plate CM-A145 (reflectance standard).

Spectral curves collected from the wall paintings in Arbanassi present the percentage of the reflected light from the coloured surface across the spectrum as a function of the wavelength and in comparison to the light reflected by the reflectance standard. The wavelength(s) of the spectrum over which the spectral curves peak (showing the maximum scattering in the case of an opaque material) indicates the colour of the sample, and is influenced by both the micro- and the macro-structure of the pigment. However, of more importance for an investigation concerned with the main colour agents of the pigments at Arbanassi is the area of minimum scattering. This is because that particular area of a spectral curve was found to constitute the 'fingerprint' of the underlying microstructure of the colour agent.[263] I need to stress, however, that spectral curves allow only an indication of the nature of the colour-inducing chemical, but do not allow the establishment of the actual chemical composition of the pigment/paint mixture. Nevertheless, the degree of certainty offered by the method of direct comparison of the spectral curves is sufficient for the purpose of my investiga-

---

[261] Hunt, *Measuring Colour*, pp. 81–84.
[262] Ball, *Bright Earth*, pp. 78–79. He talks about the sometimes elaborate preparation of the walls, before painting commenced.
[263] Nassau, *The Physics and Chemistry of Color*, pp. 27–31.

tion in this chapter, which first and foremost is to ascertain the most likely colour agents for the pigments used in the different churches.[264]

In constructing the spectral curves for each particular hue found in the Arbanassi naves, I will use the spectral data in the visible part of the spectrum (380 nm and 720 nm), collected at each 10 nm interval in every nave, using the specified Minolta 2600-d spectrophotometer. In the same graphic figure, I will also place the spectral curves constructed from the measurements of the pigments specified by Nenov, each of which might have been instrumental in the production of a particular Arbanassi hue (Table 2).[265] The coordinate system in which the spectral curves are constructed is defined by the wavelength (λ) values on the horizontal axis on a scale of 400 nm to 700 nm and on the vertical axis defined by the values of the reflectance factor or simply reflectance (%).[266] The value of the reflectance varies between 0% and 100%.

I established that the maximum number of colour hues used in the construction of the decorative systems of the Arbanassi naves was ten. Preliminary examination of the spectral curves of all hues in each church indicated that the colours beige and grey have spectral curves with rather complex profiles, in contrast to the spectral curves of the other colour hues found in the Arbanassi decoration. Such profiles usually indicate that the colour is achieved by using more than one pigment and therefore that more than one colour agent is responsible for the production of that colour. These two colours form only one-fifth of the en-

---

[264] A more precise method that involves the construction of K/S graphs that are independent of concentration has not been used in this stage of the investigation. However, I had already carried out such an examination for the colour red. For further details, see E. S. Tantcheva, V. Cheung, and S. Westland, 'Spectroscopic analysis of the interiors of seventeenth-century churches in Arbanassi', in *Colour Science for Industry,* Proceedings of Midterm Meeting of the AIC, Hangzou (2007), pp. 363– 366.

[265] Nenov, *Practikum po himichni problemi v konservatžiata*.

[266] Although CIE recommends the use of the term 'reflectance factor', for simplicity I will be using the term 'reflectance'. See Standard E 284, *Annual Book of ASTM* (American Society for Testing and Material) *Standards* (Philadelphia, 1997).

tire palette, but this confirms what I determined earlier, that in the post-Byzantine period mixing was used in the production of colour, but only on limited occasions. In these cases where the colour is a rather complicated mixture, simple spectral-curve analysis cannot be employed successfully. Grey is expected to be a mixture of black and white and more predictable than beige, but for the beige colour, in order to reach any conclusion about the possible number and kind of colour agents involved, a micro-chemical investigation will be required.

For the rest of the colours, the sequence in which the hues will be investigated is as follows: the first set of five figures will examine the chromatic colours, namely red – bright and dark, yellow, green and blue. The next set of two figures is dedicated to all the browns. The final set of two figures examines the achromatic colours, white and black.

4.2.1 Reds

In the initial visual classification of the colours in the palettes of Arbanassi, I identified two general shades of red: bright and dark. They were distinctly different not only in their lightness but also in their chromaticity, so I will investigate them separately in two figures. Even though in each of the reds I defined further variations, I will use my initial classification of bright and dark red when performing the identification of the likely pigments, and naming their main colour agent. According to Nenov, three standard red pigments were used up to the end of the eighteenth century.[267] Taking into account that in that period such pigments were produced from natural sources, these three reds are probably red ochres from red iron earth pigments, vermilion red from cinnabar and orange-red from minium or red lead, as it is also known. The main colour

[267] Nenov, *Practikum po himichni problemi v konservatžiata*, pp. 112–113; Sharenkov, 'Tehnologija na živopisnite materiali' in Prashkov, *Vuprosi na konservatžiata I restavratžiata*, Vol. 1, pp. 71–72.

agent for the red ochres is red iron oxide, for cinnabar it is red mercury sulphide, and for minium it is lead oxide.

4.2.1.1 *Bright Reds*

The spectral analysis of the data collected from the bright reds in the churches of the Nativity, the Archangels and St Atanass suggests that they all have iron oxide as the main colour agent.[268] According to Helwig, the factors that affect the actual colour of iron oxide pigments are composition, particle size and shape, as well as the proportion and nature of the other associated mineral structures.[269] Cornell and Schwertmann assert that the size and structure of the particles are primarily responsible for the colour of the red iron oxides. For example, oranges and reds from iron oxides are associated with crystals of the minerals lepidocrocite (orange) and hematite (red). Bright reds are associated with hematite with crystals of a size between 0.1 μm and 1.5 μm, where the red displays an increasing orange nuance as the particles decrease from 0.48 μm to 0.1 μm.[270] When hematite particles are ground very fine, < 0.1 μm, then the colour of the pigment is orange. The similarity of the bright red in the churches of the Nativity, the Archangels, and St Atanass can therefore be explained to a great extent by the use of red iron oxide pigments with comparably sized particles and a similar iron oxide structure. In all probability, the main mineral is hematite and the size of the particles is 0.48 μm to 0.1 μm, as the colour falls in the red–orange band of the spectrum. In the case of the Church of the Archangels, where the bright-red colour is clearly in the red band of the spectrum, the most likely form of the iron oxide mineral is again hematite, but the size of the particles is probably larger, between 0.1 μm and 1.5 μm. To confirm the size of

---

[268] For details of the spectral analysis see Appendix I.

[269] K. Helwig, 'Iron oxide pigments: natural and synthetic', in B. H. Berrie, *Artists' Pigments: A Handbook of Their History and Characteristics* (London, 1985), Vol. 4, pp. 53–55.

[270] R. H. Cornell and U. Schwertmann, *Iron Oxides: Structures, Properties, Reactions, Occurrences, and Uses* (Weinheim, 2003, first edition 1996), p. 135.

the particles and to examine the impurities, it would be necessary to conduct additional micro-chemical and microscopic analyses.

The profile of the spectral curve of the bright red of the Church of St Atanass displays a certain association with yellow, as well as with red iron oxides.[271] On the one hand, the reason might be that such yellow iron oxides occurred in the natural source of the pigment in concentrations significant enough to induce a change in the spectral curve. On the other hand, yellow ochre might have been deliberately added by the artist when preparing the paint.[272] As suggested earlier, limited mixing of pigments was employed by the artists to achieve the desired colour appearance. This was characteristic of both the Byzantine and the post-Byzantine periods.[273]

Examination of the spectral curve of the bright red in the Church of St Dimitr indicates that the painters used vermilion red, rather than iron oxide red.[274] Moreover, the red from St Dimitr exhibits a much lower lightness of the bright red colour than the bright reds in the other three churches. Such a tendency suggests a prolonged exposure of the vermilion painted areas to direct sunlight.[275] This is because vermilion is the only colour that becomes darker, rather than lighter, when exposed to direct light. This is a result of the photo-induced partial structural conversion of the cinnabar (red α-sulphide) to metacinnabar (black α'-sulphide).[276]

---

[271] Appendix I.

[272] G. Buxbaum, (ed.), *Industrial Inorganic Pigments*, (Weinheim, 2005, first edition 1993), p. 101.

[273] Nenov, *Practikum po himichni problemi v konservatžiata*, pp. 12– 13; James, *Light and Colour*, p. 31; Grigorov, G., 'Vurhu spesifikata na podxoda pri konservatžija na suvremenata kavaletna živopis' in Prashkov, *Vuprosi na konservatžiata I restavratžiata*, Vol. 1, pp. 29–35.

[274] Appendix I

[275] R. L. Feller, 'Studies on the darkening of vermilion by light' in *Report and Studies on the History of Art* (Washington, 1967), pp. 99–111.

[276] Gettens, Feller, Chase, 'Vermilion and Cinnabar' in Roy, *Artists' Pigments*, Vol. 2, pp. 167–168. In interiors with low levels of lighting, cinnabar can even be expected to preserve to a great ex-

A prolonged exposure of the decoration of the Church of St Dimitr is evident from the history of the building. Following the earthquake of 1913, the church lost its roof and stayed open to the elements for over a decade.[277] After reroofing, new, larger windows were installed in the south wall of the nave and in the apse. The wall paintings were cleaned mechanically in the 1970s and, in all probability, the top layers, the darkest ones, were removed. Observations during fieldwork showed that, because of the way the windows are positioned in relation to the west wall paintings and because of the massive overhang of the roof, direct light reached the paintings through the large windows in the south wall for only a very short time in the very early morning. This limited exposure to direct sunlight, combined with the use of the *buon fresco* technique in the execution of the wall paintings, would not be expected to result in intensive darkening of the wall paintings after cleaning had been completed.[278] Research has proved that there is a lesser degree of photo-transformation of the α-sulphide into α'-sulphide when the *buon fresco* technique is used than when using *fresco secco*.[279] Still, some minimal darkening might be expected to have occurred since then.

A further consideration needs to be taken into account when trying to reconcile the facts that vermilion is a bright-red pigment, but the spectral curve for this church indicates a much darker red than the iron oxide bright reds in the other examined churches. Because of the prolonged exposure of the wall paintings to

---

tent the bright-red appearance of colour. Thompson, *Materials and Techniques of Medieval Painting*, p. 107.

[277] Popgeorgiev, 'Selo Arbanassi', p. 112.

[278] *Buon fresco* is a technique of painting directly onto freshly plastered walls with alkaline resistant pigments mixed with water.

[279] Gettens, Feller, Chase, 'Vermilion and Cinnabar' in Roy, *Artists' Pigments*, Vol. 2, p. 168. This is contrary to the statement made by Thompson in Thompson, *Materials and Techniques of Medieval Painting*, p. 103, but assumes that the more sophisticated analytical techniques of today provide the better answer. Fresco secco is a wall painting technique where the pigment has been mixed with water and egg and is applied on moistened plaster or over an already painted surface.

strong direct sunlight after the 1913 earthquake, it is likely that the photo-transformation went deep. Though the metacinnabar can usually be found in the very top layer, control experiments show that rapid and massive darkening occurs only when the direct light is strong and penetrates below the surface layers.[280] This may explain why the bright red found here is not only of a different chemical nature, but also lacks vibrancy, despite the removal of the blackened top layer.

Another peculiarity of the spectral curve of the bright reds in the Church of St Dimitr is that they demonstrate a slightly higher absorption in the blue band than do the reds in the other churches. According to Gettens, Feller and Chase, when vermilion-red pigment (which in the seventeenth century was usually made of ground cinnabar) is mixed with white, the spectral curve can tend towards a higher rate of absorption in the blue band.[281] An alternative explanation for the profile of the spectral curve for this church is the possibility that cinnabar was mixed with iron oxide. This deliberate adulteration cannot be excluded as a possibility, but to identify the presence of iron it would be necessary to carry out a micro-chemical test using hydriodic acid, which dissolves the α-sulphide from the cinnabar, but does not affect the iron oxide in the hematite.[282]

From the comparative analysis of the curves for the bright reds used in the churches, it can be concluded that two main colour agents were used: red iron oxides and mercury sulphite. Minium was not used in any of the churches as an individual main pigment, although the addition of minium to the bright reds cannot be excluded. This type of practice is documented by Bulgarian research-

---

[280] Gettens, Feller, Chase, 'Vermilion and Cinnabar' in Roy, *Artists' Pigments*, Vol. 2, p. 167.

[281] Gettens, Feller, Chase, 'Vermilion and Cinnabar' in Roy, *Artists' Pigments*, Vol. 2, p. 172. However, for high probability of identification, it is necessary to carry out X-ray diffraction and other micro-chemical analyses.

[282] Helwig, 'Iron oxide pigments' in Berrie, *Artists' Pigments*, Vol. 4, p. 80. In order to obtain hydriodic acid, a crystal of potassium iodide needs to be added to a drop of dilute nitric acid.

ers, even though their findings are not directly associated with the Arbanassi decoration.[283] However, without conducting additional investigation using methods involving microscopy, X-ray diffraction and further micro-chemical tests, it will not be possible either to prove or to exclude the presence of minium.[284]

4.2.1.2 Dark Reds

A comparative examination of the characteristics of the spectral curves associated with the dark reds in the two churches of the Nativity and of the Archangels is indicative of the presence of iron oxides. However in comparison with the iron oxide pigments used for the preparation of the bright reds, which were found to occupy the red-to-red-orange part of the spectrum, the dark reds, even though these are again iron reds, show their maximum scattering in the purple band of the spectrum.[285]

Research shows that this kind of difference in the nuance of reddish iron colours is attributable to the physical size of the pigment's particles rather than to any significant chemical changes. For example, Kampf reports a blue-red appearance of hematite, when the particles are between 1 μm and 5 μm. The minimum particle size was later corrected by Cornell and Schwertmann to 1.5 μm.[286] Iron oxide has been used for the purple colouring of artefacts since antiquity.[287] James, writing about the use of colour in Byzantine artistic practices, also mentions that it is not unusual for this particular colour to be based on an

[283] Sharenkov, A., 'Tehnologija na živopisnite materiali ' in Prashkov, L. (ed.), *Vuprosi na konservatžiata I restavratžiata*, Vol. 1, p. 72; Nenov, *Practikum po himichni problemi v konservatžiata*, p. 14.
[284] Gettens, Feller, Chase, 'Vermilion and Cinnabar' in Roy, *Artists' Pigments*, Vol. 2, pp. 171–172.
[285] Appendix I.
[286] Cornell and Schwertmann, *Iron Oxides*, p. 169.
[287] Helwig, 'Iron oxide pigments' in Berrie, *Artists' Pigments*, Vol. 4, p. 53.

iron oxide paint pigment.[288] The purple colour must have been obtained by thermal reduction of haematite between 450^{0}C and 600^{0}C.[289]

Assessed visually, the dark reds in the Church of St Dimitr can be described as brown-red in appearance, compared with the variations of red colours in the other two churches from red-purple through purple-red to dark red. The profile of the spectral curve from the dark red in this church again bears more resemblance in the area of maximum absorption to the spectral reflectance curve of cinnabar than to that of iron oxide. Plausibly, therefore the brown-red colour can be accounted for by the natural colouration of cinnabar. In this particular case, the nuance may also be a combined effect of the initial colour of the mineral source and of the size of the pigment particles. The more finely the pigment is ground, the brighter the colour, and therefore larger-sized particles might be the reason for the particular appearance of the dark reds in the nave of the Church of St Dimitr.[290]

A further comparison of the spectral curves from the three churches shows that the cinnabar dark reds display a comparatively lower saturation and lower lightness than the iron-ochre dark reds. Undoubtedly, the exposure to light after the earthquake in 1913 had its darkening effect on the cinnabar colour by its partial transition into metacinnabar. However, the darkening might also be a result of the optical effect caused by adulteration of cinnabar-based pigments. Red earth has been documented as a substance used in antiquity for adulterating cinnabar, so the presence of a significant amount of purple-coloured iron

[288] James, *Light and Colour*), p. 30.
[289] Helwig, 'Iron oxide pigments' in Berrie, *Artists' Pigments*, Vol. 4, p. 56.
[290] Sharenkov, 'Tehnologija na živopisnite materiali' in Prashkov, *Vuprosi na konservatžiata*, Vol. 1, p. 74.

oxide cannot be excluded.[291] However, to establish the precise content of the paint, further micro investigations are needed.

To summarise, the findings of the investigation into the red colours in the naves of the Arbanassi churches leads one to the conclusion that red oxide was the main source of red, both dark and bright. The other main material used for the preparation of red paint was ground cinnabar. Detectable variations in the appearance of the red colouring in three of the churches are assumed to have been caused mainly by variations in the size of the pigment particles. Another cause might have been the presence of naturally occurring or deliberate additions. In any event, the mutations in the profile of the spectral curves of the iron oxide reds suggest that some of the differences in the appearance of the iron reds could well have been a result of variations in the impurities in the raw material. Such variations are very often linked to the use of different sources of raw material, owing to the variation in the composition of the different strata or areas. The different appearance of the reds in the Church of St Dimitr compared with the rest of the churches is in all probability because of the different nature of the pigment used, namely cinnabar, and the variations in the size of the particles of the pigment as well as the adulteration of the paint pigment.

When questioning the production of a particular colour, it is necessary to consider its availability. For example, for the production of good-quality iron oxide-based paints, it is necessary to obtain earths with a high iron content, which are rare. The geographical distribution of the iron earths has been studied and the scholarship indicates that there would not have been any difficulty in obtaining iron oxide-based earth pigments within the borders of the Ottoman Empire.[292] For instance, since antiquity, Asia Minor, Cappadocia and the town of Sinope in particular were known from literary sources as sites of good red

---

[291] Helwig, 'Iron oxide pigments' in Berrie, *Artists' Pigments*, Vol. 4, p. 48.
[292] Helwig, 'Iron oxide pigments' in Berrie, *Artists' Pigments*, Vol. 4, p. 5.

pigments. These places had been part of the Ottoman Empire since the fifteenth century. Moreover, there would have been at least two possible sources of high-quality raw material for the red earth pigments. There is a local source of reasonably high-quality red earth near Arbanassi, around the town of Troyan. The settlement is less than a hundred kilometres from Arbanassi and to this day is known as 'the red ceramics' centre, because of the fine clay mined there.

Where cinnabar is concerned, in the seventeenth-century Ottoman Empire it would have been relatively easy to obtain good-quality material. There is a source at Mount Avala, which is near Belgrade in present-day Serbia.[293] That area had been under Ottoman rule since 1521. However, further micro-chemical investigations are needed in order to establish that the iron oxides and cinnabar did indeed come from one of those areas.

4.2.2 Yellows

Yellows are used with great frequency in the decorative systems of Arbanassi, often as a substitute for gold. Nevertheless, the yellows are not standardised and there is a range of nuances that result in a considerable difference in appearance from church to church. The identified degree of difference might be the result of the use of different pigments or different sources, or of variations in the particle size of the same pigment, or of some combination of these factors. According to Nenov (Table 2), up to the beginning of the eighteenth century several shades of yellow were used in church wall painting: yellow ochre, sienna and raw umber.[294] All of these are in the main group of yellow earth pigments and the general mineral structure from which these pigments are obtained is known as goethite. The main colour-inducing component of goethite is

---

[293] http://rruff.geo.arizona.edu/doclib/hom/cinnabar.pdf
[294] Nenov, *Practikum po himichni problemi v konservatžiata*, pp. 108–110.

iron oxide.[295] The range of colours that can be created with the pigments suggested by Nenov varies from light and dark yellow to almost brown. The differences arise from the specificities in the crystal structures of the different types of iron oxide and, in particular, from the inclusion of different types and amounts of impurities.[296] For example, impurities that introduce cobalt ions can produce green undertones and the presence of manganese ions is associated with olive-brown to black undertones.[297]

Nenov writes that wall paintings that predate the eighteenth century are found to have iron oxide yellows, but that the exact colour of the pigment is dependent on the amount of manganese oxide (MnO_2) present.[298] He also states that, in the context of Bulgarian churches generally, the amount of manganese oxide usually varies between 15% and 20% MnO_2.[299] In all probability this particular impurity is responsible for the seemingly yellow-painted areas in the interiors of Arbanassi which, on closer inspection, appear to be more light brown with a slight green undertone, rather than yellow. The type and amount of impurity is usually associated with the geological structure of the place from which the raw material for the pigment was collected. For example, earth pigments containing high-quality yellow iron oxide were readily available in the Ottoman Empire in the seventeenth century. Even today high-quality yellow earth pigments, mainly of the umber variety, can be found on Cyprus, which was under Ottoman rule from 1571.[300] The source has a characteristically high content of manganese oxide, which at present averages between 12% and 15%. Within the source areas there are locations where manganese impurities can be as low as 5% or as

---

[295] Hradil, D., Grygar, Th., Hradilova, J., Bezdička, P., 'Clay and iron oxide pigments in the history of painting', *Applied Clay Science* No. 22, (2003), pp. 223–236.
[296] Nenov, *Practikum po himichni problemi v konservatžiata*, pp. 108–109.
[297] Cornell and Schwertmann, *Iron Oxides*), pp. 135–136.
[298] Nenov, *Practikum po himichni problemi v konservatžiata*, p. 109.
[299] Nenov, *Practikum po himichni problemi v konservatžiata*, pp. 109–110.
[300] http://www.reisenett.no/map_collection/historical/shepherd/Ottoman_Empire_1481– 1683.jpg [accessed 2008].

high as 20%.[301] However, for some clarification of whether the iron-yellow pigments for Arbanassi were mined at any particular source on Cyprus, it would be necessary to conduct a full micro-chemical analysis.

Examination of the yellows in the naves shows that the main colour agent for them in all the churches is iron oxide.[302] Their hues can be found in the yellow-green area of the spectrum, though they all differ in lightness. The lightest yellows are in the Church of St Dimitr and the darkest in the Church of the Nativity, while all have similar saturation. Comparative analysis of those parts of the spectral curve led me to the conclusion that in all probability the yellows in the churches of St Dimitr, the Archangels and St Atanass have as the main component of their yellows the type of pigment recognised as yellow ochre. The presence of sienna, especially in the case of the yellows from the Church of the Archangels, cannot be excluded either.

Spectral data from these three churches indicate some variations in the appearance of the yellow colour for each nave and most of all in the lightness of those yellows. It might be suggested that the latter differences can be attributed to the processes involved in the preparation of the paint.[303] Together with variations in impurities, especially manganese and cadmium, variations in the yellow colours in the naves might have been controlled additionally by choosing particular degrees of fineness of the pigment particles. For example, when the size is <1 μm the colour is yellow, but below 0.8 μm the yellows become darker, and if the size falls from 0.8 μm to 0.05 μm the yellows appear darker still, but more saturated.[304] In all the spectral curves, the profiles in the areas of maximum scattering indicate green undertones, which can be attributed to impurities, but, according to Buxbaum and Pritzen, changes in the profile of the

301 Berrie, *Artists' Pigments*, Vol. 4, p. 61.
302 Appendix I.
303 Ibid.
304 Buxbaum, *Industrial Inorganic Pigments*, p. 100.

spectral curves can be controlled through changes in the size of the particles.[305] The general rule is that the smaller the size of the goethite particles in the pigment, the more apparent are the green undertones of the yellow earth pigment and the reduction in the lightness of the appearance of the resultant colour.[306]

The profile of the spectral curve of the Church of the Nativity in the violet part of the spectrum has a closer resemblance to the darker varieties of the yellow iron pigments, sienna and umber, and this is particularly so in the area of the minima at 470 nm. However, the use of yellow ochre cannot be excluded without an examination of the ultraviolet parts of the spectral curves.

Thus the yellows used in the interior decoration of the naves of Arbanassi can be described as iron yellow earth pigments, although at this stage of the investigation it is not possible to state the exact variety of the pigment for each interior. The examination also suggests that the undertones of the colours can be attributed to the nature and concentration of impurities present, especially the manganese ions. In the case of the Arbanassi yellows, the olive undertones can be explained largely by the relatively high percentage of manganese in the yellow earth pigments, up to 20%. Furthermore, the particular appearance of the yellows may have been additionally manipulated by controlling the degree to which the pigments were ground, as the physical size of the goethite particles has an impact on the lightness and the undertone of the paint. There is also a possibility that the differences in the appearances of the yellow colours in the naves of Arbanassi result from a combination of all these factors that was, perhaps, deliberately sought.

4.2.3 Blue

[305] Ibid., pp. 99–120.
[306] Ibid., p. 100.

There is only one interior where a very pale, but noticeably blue colour is present: the nave of the Church of St Atanass. My examination of the decoration revealed that the colour is only used on the west wall, and most of all in the image of St Constantine. His richly brocaded tunic is ornate in pale blue over a black background.

According to Nenov the two pigments that were used in the production of blue, up till the end of the seventeenth century, were azurite and lapis lazuli. I included only a standard sample of azurite. The choice was made on the strength of the evidence that, in the visual part of the spectrum, both azurite and lapis lazuli have almost identical spectral curves. The difference is noticeable in the NIR examination.[307] Instead of lapis lazuli I included a smalt standard sample, as advised during my fieldwork.[308]

Although in literature there are also reports that synthetic copper blues have been in use at least since medieval times, I have not included a standard sample representative of the group.[309] This is because the copper blues, even though their micro-structure is close to azurite, are unstable.[310] After a time the colour

---

[307] J. K. Delaney, E. Walmsley, B. H. Berrie, and C. F. Fletcher, 'Multi-Spectral Imaging of Paintings in the Infrared to Detect and Map Blue Pigments' in *Scientific Examination of Art: Modern Techniques in Conservation and Analysis (Sackler NAS Colloquium)*, (Washington, 2005), pp.120-136. Prashkov, in his writings on the conservation and restoration of post-Byzantine art, mentioned only the use of azurite and no other pigment. L. Prashkov, 'Razvitie i razprostranenie na ikonata' in *Bulgarsko Vuzroždensko Izobrazitelno i Priložno Izkustvo* (Sofia, 1985), p. 9.

[308] The suggestion was made in 2006 by Petrova, then conservator in the Institute of National Culture and Monuments, in private communications. Although smalt seems to be a slightly unusual choice, nevertheless the use of this pigment had been known as early as the fourteenth century in Italy. See Ball, *Bright Earth*, pp. 133-134. Because of the connection of the Arbanassi merchants with Italy, the possibility of importation cannot be excluded. Haritonov, Chohadsžieva, Rutževa, *Arbanassi (*Sofia, 2003), p. 7; J.Thissen, 'Smalt' in Roy, *Artists' Pigments*, Vol. 2, pp. 113-130.

[309] R. D. Harley, *Artists' Pigments c.1600-1835: A Study in English Documentary Sources*, (London, 1982, first edition 1970), pp. 46-49; Thompson in Thompson, *The Materials and Techniques of Mediaeval Painting*, pp.151-155 gives a number of old recipes and suggests that use of copper blues was widespread in the Middle Ages and later. See also Roy, *Artists' Pigments*, Vol. 2, pp. 31-32.

[310] Thompson, *The Materials and Techniques of Mediaeval Painting*, p. 154.

of the copper blue paints turn blue to green but there is no evidence of such mutation in the appearance in the images in the nave of St Atanass; the paint is definitely blue.

Comparative examination of the spectral curve collected from the ornamentation of St Constantine's tunic reveals that though there is a significant probability that the pigment used in the nave of St Atanass was azurite, the possibility that lapis lazuli was used cannot be excluded without the performance of micro-analysis.[311] This is despite the apparent dissimilarities between the profile of the spectral curves of the azurite and the paint. Such dissimilarities, it could be argued, are due to the fact that the concentration of pigment in the paint is low and the possibility of contamination during preparation and application cannot be excluded. The availability of high quality azurite in the Ottoman Empire can be expected to have been good as both Armenia and Hungary, known as suppliers of the best azurite, were at that time within the Empire.[312]

4.2.4 Greens

The final chromatic colour that I investigated was green. There are only two interiors, those of the churches of the Nativity and of St Atanass, where green tones were used. In both churches, green is employed in the middle section of the background to the scenes from the first register and in some details in the other registers. The colour in the Church of St Atanass is much lighter and has a yellow tint, while that in the Church of the Nativity is darker and can be considered closer to 'pure' green. One possible cause of this difference in nuance might have been the use of different green pigments in the two interiors. Nenov

---

[311] Appendix I.

[312] Harley, *Artists' Pigments c.1600-1835*, pp. 46-47. Armenia was under the Ottomans between the 1500s and the 1820s and Hungary between 1571 and 1699.

speaks of the identification of two different pigments that were in use up to the beginning of the eighteenth century: *terre verte* and malachite.[313] *Terre verte*, although not strictly considered to be an iron oxide pigment, contains varied but significant amounts of iron oxide together with manganese, aluminium, and silicon. It was, and still is, inexpensive to buy. The greens that could be obtained vary from pure green to yellow-green with various degrees of lightness, but the colours are usually dull. Meyer and Grissom write about the significant variations in the colouring of the *terre verte* associated with different sources. They say that the pigments derived from some sources have a pure green tone while others are more yellow and yet others are even bluer in comparison to the pure green.[314] For example, since antiquity, Cyprus and Smyrna in Asia Minor have been known as sources of material of superior quality.[315] James writes that the dark yellow-green of *terre verte* can be described as dark olive, which shows yet another variation in colour, exemplifying the array of nuances that can be obtained from this particular pigment.[316]

This shift was explained by Grissom.[317] He writes that variations in colour identified with yellow can be associated with burnt *terre verte*. The particular spectral curve presented by Grissom has the dominant wavelength shifted to 572 nm.[318] Moreover, he also speaks of a possible shift in the maximum area of scattering of *terre verte* towards yellow, rather than blue, when the pigment is mixed with white.[319]

---

313 Nenov, *Practikum po himichni problemi v konservatžiata*, p. 106.
314 Meyer, *The Artist's Handbook of Materials and Techniques*, p. 81 in the section on green pigments; Grissom, C. A., 'Green Earth' in Feller, *Artists' Pigments*, Vol. 1, pp. 141–149.
315 Ibid., pp. 148–150; Sharenkov, 'Tehnologija na živopisnite materiali' in Prashkov, *Vuprosi na konservatžiata I restavratžiata*, Vol. 1, p. 73.
316 James, *Light and Colour*, p. 30.
317 Ibid., pp. 141–149.
318 Ibid., pp. 144–145.
319 Ibid., p. 145.

Green pigment was obtained by grinding malachite, which is composed predominantly of naturally occurring copper carbonate.[320] Malachite was expensive, but could produce a very vivid colour provided it was not ground too fine.[321] Malachite is closely related to azurite, and the green paints produced using ground malachite have a blue undertone.

Upon examination, the spectral curves of the greens in the churches of St Atanass and of the Nativity do not display this seemingly characteristic dip for malachite. On the contrary, they both display a shoulder in the short wavelength, which is characteristic of *terre verte*. Therefore, it can be concluded that *terre verte* is the probable pigment employed in the greens of the two interiors.

Spectral data from the two churches also displays characteristics of lighter shades of a colour, which are better observed in the curve from the Church of St Atanass.[322] The visual manifestation of this particular difference is that the green in the Church of St Atanass can be described as being the lighter of the two, but also as the one with an undertone more definitely yellow than that used in the Church of the Nativity. This could be attributed to the use of white pigment to lighten the mixture, as reported by Grissom.[323] However, this also is a characteristic of the burnt variety of *terre verte*.[324]

The highly perceptible differences between the greens in the two interiors were, in all probability, the result of the use of the same pigment but from two different sub-varieties of the green earth pigment, *terre verte* and burnt *terre verte*. It is possible that the *terre vertes* used in the naves of the Church of the Nativity and the Church of St Atanass were mined in separate locations. In the course of

---

[320] Laurie, *Painter's Methods and Materials*, p. 93.
[321] R. J. Getten and E. W. Fitzhugh, 'Malachite and Green Verditer', in Roy, *Artists' Pigments*, Vol. 2, p. 185.
[322] Appendix I.
[323] Grissom, 'Green Earth' in Feller, *Artists' Pigments*, p. 145.
[324] Ibid., p. 145.

analysis of the spectral curves, it was suggested that the green colour observed in the nave of St Atanass might result from the addition of a certain amount of white pigment. Still, the possibility cannot be excluded that the colour is a result of the presence of naturally occurring impurities, which produce a similar effect. At the same time, the absence of a significant amount of impurity could be the cause of the much brighter, more clearly green colour found in the nave of the Church of the Nativity. However, an extensive range of analyses would be necessary to locate geographically the particular source of the *terre verte* used in the two churches, and the exact composition of the paints.

Green is the last in the range of chromatic colours used in the palettes of the Arbanassi churches. Before investigating the achromatic colours, I will explore the browns, as brown occupies an ambiguous place between the chromatic and the achromatic colours.[325]

4.2.5 Browns

Browns are not considered to be in the range of spectral colours. They are not included in the CIE chromaticity diagram of hue and saturation. In that context, the further a colour is from the white centre of the illuminant, the darker it is. Towards the edge of the diagram, colours appear somewhat brown and historically the term 'brown' has been synonymous with dark colouring.[326] Although browns have been considered by different authors to be reduced-lightness colours, there appears to be no consensus about which part of the spectrum reduced in lightness best represents the brown colours. For example, Paterson positions browns in the area of the long wavelengths, 585 nm to 620 nm, which is the red sector of the orange part of the spectrum.[327] For Le Grand, browns

[325] Balls, *Bright Earth*, p. 51.
[326] I. Paterson, *A Dictionary of Colour* (London, 2003), p. 70.
[327] Ibid., p. 70.

can be considered to be in the area of the spectrum between the orange and the green-yellow hues.[328] However, Malin and Murdin consider them to be purely dark yellows.[329]

In my initial classification of the colours of the Arbanassi decoration I followed the CIE concept for naming the hues that cannot be identified with any particular chromatic colour, but, for those that cannot be identified as achromatic either, I used the term 'brown'. Within this group of colours, I acknowledged only two sub-categories, light browns and browns. I will begin my examination of the brown colours of Arbanassi by analysing the spectral curves for the light browns.

4.2.5.1 Light Browns

The light browns that can be observed in the naves appear somewhat translucent and, if they can be likened to any of the chromatic colours, they can be identified as warm with yellow undertones (as suggested by Malin and Murdin) rather than with red undertones (as suggested by Paterson). The research that Nenov published in 1984 also placed the main colour agent of the browns within a range of yellow iron pigments such as sienna, umber and their burnt varieties.[330] Comparing the curves from the churches with the curves from the pigments, the absorption characteristics of the sienna curves appear to be closest to the curves from the churches.[331] Siennas are yellow iron oxides and their iron content is high, between 46% and 60%. The warmth of a brown colour produced from a sienna-type pigment is usually related to the small-sized particles of goethite (yellow iron oxide mineral).[332] The presence of manganese

---

[328] Y. Le Grand, *Light, Colour and Vision* (New York, 1957), p. 220.
[329] D. Malin and P. Murdin, *Colours of the Stars* (Cambridge, 1984), p. 137.
[330] Nenov, *Practikum po himichni problemi v konservatžiata*, pp. 115–117.
[331] Appendix I.
[332] Helwig, 'Iron oxide pigments' in Berrie, *Artists' Pigments*, Vol. 4, p. 53.

ions in the pigment also contributes to the much browner and warmer appearance of the sienna pigments.[333]

4.2.5.2 Other Browns

Brown colours with a lower lightness than the light browns discussed above have been used in all four churches. Analysis of the spectral data from the churches again indicates the presence of iron oxide as the main colour agent and the examined areas have hues which lie in the red-orange part of the spectrum.[334] Within this range the brown hues of the churches of the Nativity and of St Dimitr have perceptually manifest similarities, while these differ from those of the other two churches, of the Archangels and of St Atanass.[335]

One reason for this can be found in the use of different pigments. In this instance, the browns in the churches of the Nativity and St Dimitr show a resemblance to the spectral curves of burnt umber or burnt sienna.[336] However, the spectral characteristics from the churches of the Archangels and of St Atanass indicate the use of umber as the pigment in the preparation of the brown paints there.[337] Nevertheless, there are still perceptual differences in the appearance of the browns within each pair.[338] In the previous sections, which involved investigation into yellow iron pigments, I suggested some of the possible reasons for these differences. These include variations within the same pigment caused by variations in the amount and type of impurities incorporated in the crystal structure of the raw material. Another possible reason was variations in

---

333 Ibid., pp. 60–61. However, the best-quality sienna has an even higher iron oxide content, between 60 and 70%, and some 1–3% aluminium oxide, while at the same time the concentration of the clay is very low.
334 Appendix I.
335 Ibid.
336 Ibid.
337 Ibid.
338 Appendix II.

the degree of fineness of the grinding of the pigments. However, the variation in the nuances of the yellows can also be the result of the intentional or unintentional addition of other pigments. Mixing of pigments not only alters the appearance of the colour of the paint, but inevitably distorts the profile of the spectral curve representative of the colour mixture.

The spectral analysis of the browns in the Church of the Nativity does not make obvious the presence of iron oxides.[339] One possible reason could be the addition, whether intentional or not, of a green pigment to the brown mixture, as described by Thompson.[340] Furthermore, a complex mixture of pigments, some of them iron oxide-based, might produce the colour brown, but, because of the number of pigments involved, it would be very difficult to detect this in the spectral curve. For example, Sharenkov writes that, on some occasions in post-Byzantine art, browns were made by mixing red earth pigments with black and white, a technique known at least since the Middle Ages.[341] Cennini speaks of the preparation of brown, which he calls *verdaccio*, iron oxide pigments mixed with black and white.[342] To establish the nature and the amount of the ingredients of the mixture it would be necessary to carry out additional micro-chemical investigations. This would still be the recommended line of action, even if the mixture was the result of combining pigments of only one type, for example yellow earth pigments. It should also be remembered that the absorption minima for all the yellow pigments is in the ultraviolet part of the spectrum. This means that without measurements taken with the ultraviolet component of the

---

[339] Appendix I.

[340] Thompson, *The Practice of Tempera Painting*, p. 83.

[341] Sharenkov, 'Tehnologija na živopisnite materiali' in Prashkov, *Vuprosi na konservatžiata I restavratžiata*, Vol. 1, p. 74. For the medieval practice, see Hawthorne, J. G. and Smith, C. S. (trans.), *Theophilus, On Divers Arts* (New York, 1979, first edition 1963), p. 16.

[342] Cennino d'Andrea Cennini, *Il Libro dell'Arte: The Craftsman's Handbook*, in Thompson, D. V. (ed. and trans.), (New York, 1960, first edition 1933), pp. 45, 55, and also in Sharenkov, A., *Starinni Traktatti po Tehnologija i Tehnika na Živopista*, Vol. 2, . 2 (Sofia, 1994), pp. 206, 211.

inbuilt light source of the spectrophotometer it is not possible to discern the exact type of the yellow iron pigment.

To conclude, the investigation into the browns used in the four examined churches suggests that the most probable basic pigments used in the production of these colours were iron earth pigments. High-quality iron earth has been and still is readily available in Cyprus and was presumably relatively easy to obtain elsewhere within the Ottoman Empire. The brown iron pigments may also have been mined locally or relatively close to Arbanassi, although no likely sources are mentioned in current research on Arbanassi. Nevertheless, theoretically, the differences in the appearance of the browns in the different naves could be attributed to natural impurities associated with differences in the geographical origin of the pigments. Of course, they might have been deliberately introduced by the mixing of pigments. Next I will examine the achromatic colours, black and white.

4.2.6 Blacks

Analysis of the spectral characteristics of the blacks in the churches of St Atanass and of St Dimitr suggests a cool tint, while the spectral curves from the other two churches, of the Nativity and of the Archangels, suggest a red-brown or warm undertone.[343] What accounts for this difference? The nineteenth-century *erminia* of Christo Michailov from the town of Samokov described the method of preparation of black pigments from materials of vegetable or animal origin, as well as from carbon and lampblack.[344] However, Nenov found that, up to the end of the seventeenth century, black was prepared using charcoal

---

[343] Appendix I.

[344] P. Mitanov and L. Koinova, 'Tehnologija i tehnika na stenopisite ot Roženskata trapezaria', *Muzei I Pametnitži na Kulturata*, No. 2 (1973), pp. 58–66; V. Vassillev, *Epminii, Tehnologii i Ikonographija* (Sofia, 1976), p. 222.

from vegetable and animal bones, but makes no mention of any instance where lampblack was used.[345]

Research has proved that vegetable-derived blacks usually have cool undertones. Nenov writes about the use of vine twigs, peach, apricot, plum and cherry stones and almond shells.[346] Animal-derived blacks appear warmer, having brown undertones.[347] Because of the difference shown in the dominant wavelength, it seems that the blacks in the churches of Arbanassi are in all probability derived from both vegetable and animal carbon blacks. The differences in the total colour appearance of these blacks can most likely be attributed to the two different initial materials used in their preparation and to variations in chemical composition within the same general type of source. For example, differences in the soil in which the vegetable matter grew or in the diet of the animals may cause variations in the chemical composition of the residues left after the process of carbonisation. However, contamination by any of the other pigments used in the decoration cannot be excluded.

4.2.7 White

White is present in all the studied churches. Nenov reported that before the eighteenth century white pigments in church decoration were calcium carbonate-based.[348] It is therefore reasonable to assume that the whites in the Arbanassi naves might also be of that variety. Calcium carbonate comes in a variety of forms: calcite (ground marble and limestone), chalk, lime white (a suspension of slaked quicklime, the latter produced via calcification of marble and/or limestone at 800–900°C), egg and mollusc shells and bone. Such a variety

[345] Nenov, *Practikum po himichni problemi v konservatžiata*, pp. 118–119.
[346] Ibid., p. 119.
[347] J. Winter and E. W. Fitzhugh, 'Pigments based on carbon' in B. H. Berrie, *Artists' Pigments: A Handbook of Their History and Characteristics*, Vol. 4, p. 13.
[348] Nenov, *Practikum po himichni problemi v konservatžiata*, p. 96.

of sources also suggests the possibility of differences in the appearances of the whites. Several authors writing about the pigments and recipes from different historical periods – James (the Byzantine period), Thompson (the medieval period), and Sharenkov (post-Byzantine art in the territory of Bulgaria) – suggest that the most frequently used material is calcite. The most common form of calcite found in the wall paintings of the examined periods was lime white, followed by ground marble and limestone.[349] The same three types of material, lime white, marble and limestone, are also mentioned by Cennini (the Renaissance period), in his *Il libro dell'arte*.[350]

Nevertheless, my analysis of the Arbanassi whites indicated that the artists used not calcite-based, but lead-based white pigments.[351] Lead-white pigments are known to exhibit a high level of lightness (whiteness). However, Arbanassi whites are with reduced lightness. One likely explanation for the reduction might lie in the effects of gradual darkening over time, resulting from the chemical reaction between the paint surface and the sulphurous impurities in the air forming black lead sulphide (PbS). There is a lack of obvious blackening of the nave decorations, however. The relatively high altitude, between 300 and 499 metres above sea level, and the absence of any polluting industry in the immediate geographical area may explain this lack of darkening.[352] Therefore, it is reasonable to suggest that in the subsequent relatively recent cleaning of the interiors there has been minimal darkening of the lead-white-painted areas of the decoration.

---

[349] James, *Light and Colour*, p. 28; Thompson, *The Materials and Techniques of Medieval Painting*, pp. 92–97; and also in Sharenkov, *Starinni Traktatti po Tehnologija i Tehnika na Živopista*, Vol. 2, pp. 206, 211; Sharenkov, 'Tehnologija na živopisnite materiali' in Prashkov, *Vuprosi na konservatžiata*, Vol. 1, p. 70.

[350] Cennino d'Andrea Cennini, *Il Libro dell'Arte*, in Thompson, (ed. and trans.), pp. 45, 55.

[351] Appendix I.

[352] I. Vassilev, V. Andreev, N. Godev and T. Spassova, 'Synoptic statisticheski metod za predskazvane na zamursjavaneto na vazduha v gradove razpoloženi v planinski rajoni' in *Proceedings of XIV International Conference on Carpathian Meteorology*, Sofia (1989), pp. 374–378.

The spectral data collected from the Arbanassi whites also indicate warm, reddish overtones in the whites used in the naves. Even though white lead is known to be a warm white, the Arbanassi whites appear to be warmer than would be indicated by the spectral characteristics of a pure lead white.[353] Such a deviation from the pure white colouring might also have contributed to the reduction in lightness. Scholarship indicates that orange and reddish discolouration with an unknown composition of lead whites can occasionally be observed.[354] The mechanism responsible for the occurrence of that discolouration needs further examination.

Another likely contributory factor to the reddish overtone of the Arbanassi whites could be the presence of iron oxide. My examination of the characteristics of the spectral data led me to believe that it is most likely that the presence of iron oxide might be discerned in the whites from the churches of the Archangels Michael and Gabriel, St Atanass, and St Dimitr.[355] Such a presence might be a natural occurrence, but, on the other hand, it might be due to the introduction of some iron oxide by the artistic processes. If the oxide was introduced by the artists, this might have been a cross-contamination occurring in the processes of preparation and/or of paint application, or it could be the result of lead-white pigments being mixed with calcium carbonate-based ones. This possibility cannot be excluded.[356] Iron oxide impurities occur naturally in the raw materials of calcium carbonate, such as marble and chalk. Some explanation for the pinkish undertone of the calcites is offered by the work of Gettens, Fitzhugh and Feller.[357] They found that calcite varies not only in the amounts of its supporting structures, such as quartz, magnesite, dolomite and clay, but also in the amount

[353] Appendix I.
[354] C. Hoevel, 'A study of the discoloration products found in white lead paint', *The American Institute for Conservation: Book and Paper Group Annual*, Vol. 4 (1985), pp. 1–7.
[355] Appendix I.
[356] Harley, *Artists' Pigments c. 1660–1835*, pp. 165–166.
[357] R. J. Gettens, E. W. Fitzhugh, and R. L. Feller, 'Calcium carbonate whites' in Roy, *Artists' Pigments*, Vol. 2, pp. 203–224.

and content of its colouring agents. The most common colouring agents are found to be hematite and carbon, with hematite being the iron-rich mineral. It could also be argued that the darker appearance of the Arbanassi whites, in addition to the chemically induced darkening by the synthesis of lead sulphide, could have been helped by the introduction of carbon through the addition of calcium carbonate.

Still, even in view of the likely presence of calcium carbonate, the whites in Arbanassi can be considered to be lead white. All the white elements of the composition were applied on top of the already-frescoed wall (*fresco secco*), which complies with the technical restrictions imposed by the pigment. Apparently, when lead white is found in wall paintings, it is not applied in the *buon fresco* layer, but as an overpainted layer of *fresco secco*, because the pigment is considered not to be stable in *buon fresco* painting.[358]

However, there are no sources that can shed light on why the artist(s) used lead-dominated white paints, rather than the expected calcium carbonate ones. It can only be speculated that they might have been looking for paint with a particular quality. Since lead white has very high opacity, it has superior covering qualities to calcium carbonate-based whites. It might therefore be that lead white was employed intentionally at Arbanassi for the creation of certain visual effects. For example, a copious number of details with specific textural quality can be seen to suggest pearl-like adornments on the royal garments in the scenes of Constantine and Helena (Figures 28–31).

The high opacity of lead white and its generally high level of lightness mattered significantly when white was used for inducing a higher light contrast (Figure 30). Figure 29 also illustrates the main disadvantage of the application of lead

[358] E. Kotulanova, J. Schweigstillova, S. Švarcova, D. Hradil, T. Bezdička and T. Grygar, 'Wall painting damage by salt: Causes and mechanisms', *Acta Research Reports*, No. 18 (2009), pp. 27–31.

white through *fresco secco*; the layer of white has worn through in many places. It cannot be proved at what stage in the life of the frescoes that damage occurred; before cleaning took place, during the removal of the soot layer, bebetween the 1970s and the 1980s, or after cleaning was completed. One reason for the damage is the natural softness of the lead white paint-paste. The other is that it fails to establish a chemical bond with the surface to which it is applied.

White is the last in the list of the colours used in the palettes of the Arbanassi naves. Table 3 below consolidates the findings in this chapter about the most plausible main colour-inducing agents and the most likely pigments used in the production of the colours in Arbanassi.

It has five columns. In the first are the names of the colour hues; in the other four are stated the colours used in each church, one column for each church. The colours used in each church are marked with the nearest colour representation allowed by Microsoft Word. In each cell in the column for each church, I have entered the chemical formula of the most probable colour agent of the pigment used to produce that colour. Under each formula, I have entered the name of the raw material and the name of the pigment.

Table 3: Palettes of the churches of Arbanassi identified in the preliminary investigation and the most probable materials for colour used in the decoration.

Colour	Nativity	Archangels	St Atanass	St Dimitr
Bright Red	Fe_2O_3 Hematite /Red Ochre	Fe_2O_3 Hematite /Red Ochre	Fe_2O_3 Hematite /Red Ochre	HgS Cinnabar/Vermilion
Dark Red to Purple	Fe_2O_3 Hematite (Red Ochre)	Fe_2O_3 Hematite (Red Ochre)	N/A	HgS Cinnabar (Vermil-ion)
Green	Fe^{2+};Fe^{3+}; Si; Mg; etc. *Terre verte*	N/A	Fe^{2+};Fe^{3+}; Si; Mg; etc. *Terre verte*	N/A
Yellow	$Fe_2O_3.nH_2O$ etc. Goethite (Yellow earth):Yellow ochre, Sienna, Umber	$Fe_2O_3.nH_2O$ etc. Goethite (Yellow earth):Yellow ochre, Sienna, Umber	$Fe_2O_3.nH_2O$ etc. Goethite /Yellow earth: Yellow ochre, Sienna, Umber	$Fe_2O_3.nH_2O$ etc. Goethite (Yellow earth):Yellow ochre, Sienna, Umber
Blue	N/A	N/A	**$2CuCO_3.Cu(OH)2$** Azurite	N/A
Brown	Fe_2O_3 etc. Goethite (Yellow Earth)/Brown ochres: Sienna, Burnt Sienna, Umber Burnt Umber	Fe_2O_3 etc. Goethite (Yellow Earth)/Brown ochres: Sienna, Burnt Sienna, Umber Burnt Umber	**Fe2O3 etc.** Goethite(Yellow Earth)/Brown ochres: Sienna, Burnt Sienna, Umber Burnt Umber	Fe_2O_3 etc. Goethite(Yellow Earth)/Brown ochres: Sienna, Burnt Sienna, Umber Burnt Umber
White	**$2PbCO_3.Pb(OH)_2$** White Lead	**$2PbCO_3.Pb(OH)_2$** ± **$CaCO_3$** White Lead with possible addi-tion of Calcite: Limestone, Marble, etc.	**$2PbCO_3.Pb(OH)_2$** ± **$CaCO_3$** White Lead with possible addi-tion of Calcite: Limestone, Marble, etc.	**$2PbCO_3.Pb(OH)_2$** ± **$CaCO_3$** White Lead with possible addi-tion of Calcite: Limestone, Marble, etc.
Black	C Bone and Vegetable carbon	C Bone and Vegetable carbon	C Bone and Vegetable carbon	C Bone and Vegetable carbon

The table shows the chemical make-up of the pigments employed in Arbanassi and just how narrow their range is. Most of them are coloured earths, which are a large and important group of naturally occurring pigments that are all iron based. They are red, yellow and brown ochres, siennas, umbers and *terre verte*.

Other pigments are either metal ores, found as rock formations such as hematite and azurite, or salts, found as granular or crystal structures, such as cinnabar.

The mercury salt present in the cinnabar might have been manufactured by a deliberately-induced chemical process through which mercury and sulphur were combined into red mercury(II) sulphide (HgS). However, the two other pigments, carbon black and white lead, were in all probability produced by the painters themselves, respectively by thermal carbonisation or oxidation.

To evaluate the content of the Arbanassi palettes I will attempt to put the above list of pigments into their context. I will examine their historic use within the later Byzantine and early post-Byzantine eras. Moreover, as Arbanassi was within the Ottoman Empire, a consideration of the pigments available and used by Ottoman artists, as well as the cost of the pigments and the availability of funds, would further situate the Arbanassi palettes.

4.3 Contextualising the Pigments of Arbanassi

Table 3 indicated that the majority of the pigments are of a kind that have been in use since early times, such as coloured earths and carbon blacks. However, the main substance of the white in the naves is lead white, which is unusual in the context of early post-Byzantine church decoration elsewhere. [359] I was able to identify only a couple of cases within the Balkans where lead white, rather than carbon white, had been used. These are the seventeenth-century interior decorations of the Transylvanian Church of St Paraschiva in Maramures and in

[359] Nenov, *Practikum po himichni problemi v konservatžiata*, pp. 95-96.

the Church of St Stephan, Meteora, Greece.[360] Elsewhere in mainland Greece, as in Athos, calcium-based whites are used.[361]

It is possible that the use of lead white might have been part of an artistic experimentation in that period, even though there is no evidence as to when or where that use was initiated. It might be that the idea had gained momentum through the practice of open membership of established artistic groups. During their travels in pursuit of commissions, artistic groups often adopted new members or lost some of their initial members who joined another group. Such practices inevitably allowed for techniques to be disseminated, including perhaps that of replacing the usual calcium-based white with lead-based white. In the case of the other three churches, of the Nativity, the Archangels and St Dimitr, it can only be speculated where the Arbanassi artists might have adopted the idea of using lead white, but it cannot be because of any lack of alternative raw material, as calcite, in the form of limestone or marble, is easily obtainable. It is conceivable that instead, as white details were added impasto, the high opacity of lead white better suited the technical requirements of the artists.

Some of the inclusions in the table of the Arbanassi pigments indicate that two pigments had restricted use. These are cinnabar and azurite. Both pigments

---

[360] C. Marutoiu, I. Bratu, A. Trifa, M. Botis, V. C. Marutoiu, 'FTIR analysis of painting materials from the Church of Saint Paraschiva, Poienile Izei, Maramires, Romania' *International Journal of Conservation Science*, Vol. 2, No. 1 (2011), pp. 29-35; Sr. Daniilia, E. Monopoulou, K. S. Andronikopoulos, A. Tsakalof, K. Bairachtari, 'From Byzantine to post-Byzantine art: the painting technique of St Stephen's wall paintings at Meteora, Greece', *Journal of Archaeological Science* , No. 35 (2008), pp. 2474-2485.

[361] Daniilia, Monopoulou, Andronikopoulos, Tsakalof, Bairachtari, 'From Byzantine to post-Byzantine art: the painting technique of St Stephen's wall paintings at Meteora, Greece', pp. 2474-2485; Sr. Daniilia, A. Tsakalof, K. Bairachtari, Y. Chryssoulakis'The Byzantine wall paintings from the Protaton Church on Mount Athos, Greece: tradition and science', *Journal of Archaeological Science* , No. 34 (2007), pp. 1971-1984; Sr. Daniilia, E. Monopoulou, Fr. D. Demosthenous, G. Karagiannis, 'A comparative study of wall paintings at the Cypriot Monastery of Christ Antiphonitis; one artist or two', *Journal of Archaeological Science* , No. 35 (2008), pp. 1695-1707.

were used only within the Church of St Atanass. The reds in all the other churches are iron oxide based, while areas that were intended to be perceived as blue in the other three churches were treated using a technique where a thin layer of white paint was applied over a black coloured background, to produce a sensation of blue colour.

Moreover, neither the cinnabar nor the azurite were used in a pure form. For example, my investigation pointed towards the likely adulteration of the cinnabar paint with iron oxide as a bulking-up agent.[362] Such a practice was widely used in the early post-Byzantine era.[363] For example, it was found in the fifteenth-century church decoration of the Monastery of Christ Antiphonitis, Cyprus, and in the sixteenth century paintings of St Meodori, now in the present territory of Albania.[364] A mixture of cinnabar and iron oxide was also used in the preparation of red paints in the sixteenth century church decoration of Serbian churches and in sixteenth/seventeenth-century Athonite decoration.[365]

In all these examples, including in the nave of the Church of St Atanass, cinnabar was the main component of the mixture. However, in the case of azurite, in a number of instances, including the decoration of the Church of St Atanass, minimal amounts of the pigment were added to white in the preparation of a light blue paint. Even then, light blue paint was used sparingly and only in ornamentation. Although in the case of the adulteration of cinnabar, there is no readily discernible difference between the paint prepared with a pure pigment and that prepared from the mix of cinnabar and iron oxide, the use of azurite

---

[362] See Appendix I.
[363] Sharenkov, A., *Starinni tractate po Tehnologija I Tehnika na Živopista*, Vol. 1, kn. 2 (Sofia, 1994).
[364] Sr. Daniilia, E. Monopoulou, Fr. D. Demosthenous, G. Karagiannis, 'A comparative study of wall paintings at the Cypriot Monastery of Christ Antiphonitis; one artist or two', *Journal of Archaeological Science* , No. 35 (2008), pp. 1695-1707.
[365] V. Tanevska, Lj. Džidrova, B. Minčeva-Šukarova and O. Grupče, 'Micro-Raman pigment analysis of wall-paintings from a church in the Skopje Fortress', *Proceedings of the Balkan Symposium on Archaeometry*, pp. 83-84 (2008).

within a white mixture inevitably leads to a reduction in saturation in comparison with the pure pigment. To compensate for the loss of saturation, a well-exercised optical technique was used by the artists. This technique was common during both the late Byzantine and post-Byzantine period and consisted of applying the blue paint over a carbon black background. For example, it can be observed in the thirteenth century wall paintings in the Monastery of Mileseva (around 1230) and in Panselinos's work on Athos (1295). The application of the technique in the early post-Byzantine era can be seen, for example, in the work of Theophane the Cretan in the Meteora Monastery of St Nicolas Anapaphsas (1525) and in the paintings of his pupil, Tzortzis, in the katholikon of the Monastery of Dousiko, Trikala, Greece (1557), as well as in the nave of the Church of St Atanass, Arbanassi.

However, the use of azurite in Arbanassi, in church decoration across the Ottoman Empire and on Athos is significantly different to the use of this pigment in important monuments within the rest of the Orthodox world. In key sites in the Danubian principalities and in Russia, the use of azurite is abundant, mainly in the creation of a blue background in the top half of all the scenes, for example, in the sixteenth and seventeenth-century decoration of the Moldovan Church of St George in Suceava and in the north Moldovan monasteries of Voronet and Probota, as well as in Arbore and Balinestu in Sucevita.[366] Moreover, the azurite employed in Moldovan churches was used in both exterior and interior wall paintings.[367] Also the seventeenth-century interior decoration of the Wallachian Horezu Monastery, associated with the princely house of Bran-

[366] North Moldova is part of present day Romania.
[367] Some discolouration in the exterior paintings, caused by weathering, can be observed at present, mainly in the external scenes.

coveanu, displays a similarly lavish use of azurite in the backgrounds of the scenes.[368]

Plentiful use of azurite in the background can also be observed in the interior wall decoration in significant Russian sites, for example, in the katholikon of the Kirillo-Belozersky Monastery, Beloozero and in the Cathedral of St Elijah the Prophet, Yaroslavl. In all these Russian or Danubian sites, the lower part of the background, below the blue, is coloured green when not occupied by stylised architectural structures or groups of human figures. Such positional use of the colours blue and green has been associated with the background of the scenes in late Byzantine Athonite church decoration, primarily with wall paintings from the thirteenth century, but not in Arbanassi. This differs significantly from the post-Byzantine arrangement where there are always three distinct bands of background colours.[369] Within these bands the positional display of colours is fixed and the sequence, beginning from the top, is: black or a greyish colour, then usually green and finally brown. This pattern is observed in the Athonite tradition and appears to be characteristic of post-Byzantine churches within the Ottoman Empire, including all the Arbanassi churches.

There is also a significant difference, in the context of the chemical make-up of pigments used for achieving blue and green colouration, between the pigments used for the achievement of those colours within the Ottoman Empire and those used outside it in the autonomous or independent Orthodox Christian states. For instance, while the light blue band in the Danubian and Russian churches mentioned above is azurite, within the Ottoman Empire and on Athos, blue is usually a result of the application of a thin layer of white paint over a carbon-black background.

---

[368] Horezu Monastery is in the present territory of Romania.
[369] Prashkov, *Stenopisite na Tzurkvata Roždestvo*, p. 78.

At the same time the green pigment identified in the Danubian sites mentioned above, including the seventeenth-century wall paintings in the Transylvanian Church of St Paraschiva, Maramures and in the Russian churches, is malachite. In the Greek-speaking part of the Orthodox world, I was able to trace malachite in the seventeenth century decoration in the Church of St Demetrious of Thessalonica in Turnovo and in the sixteenth/seventeenth-century decoration of the Church of St Stephen, Meteora.[370] Even then malachite had been detected only in ornamentation and highlighting, while green earth was used as a basic green pigment. Elsewhere, including in the Athonite church decoration and Arbanassi, green earth was employed. This raises questions about the availability and the use of the pigments azurite and malachite within the Ottoman Empire. Consideration of the pigments used by the Ottoman artists in Istanbul and elsewhere at the time will situate the Arbanassi palettes, even though Islamic and Christian artists were part of different milieus, resulting in minimal interaction between them.

Research shows that Islamic artists in the early post-Byzantine era, especially those involved in the popular art of the Ottoman miniature, employed much larger palettes than those identified as having been used in wall decoration.[371] Some pigments, dyes and other materials are only found in miniature painting, such as carmine, cinnabar, haematite, minium, lac, realgar, indigo, azurite, lapis lazuli, malachite, verdigris, orpiment, lampblack, carbon black, tin white, lead white, plant dyes (turmeric and safflower), silver, gold and occasionally brass and copper filings and mica.[372] Most of these pigments are unstable when ex-

---

[370] Prashkov, L. (ed.) *Vuprosi na konservatžiata I restavratžiata*, Vol. 1 (Sofia, 1985); Daniilia, Monopoulou, Andronikopoulos, Tsakalof, Bairachtari, 'From Byzantine to post-Byzantine art: the painting technique of St Stephen's wall paintings at Meteora, Greece', pp. 2474-2485.

[371] Ottoman miniatures were the most popular form of art at the time, being favoured not just by the court, but also by the middle classes and foreign visitors to the Empire.

[372] L. Burgio, R. J. H. Clark, V. S. F. Muralha and T. Stanley, Pigment analysis by Raman microscopy of the non-figurative illuminations on 16th to 18th-century Islamic manuscripts', *Journal of Raman Spectroscopy*, No. 39 (2008) and also V. Muralha, L. Burgio, R. J. H. Clark, 'Raman spec-

posed to light or introduced to high levels of alkalinity or acidity, as they would have been if used in fresco paintings. For example, indigo and orpiment lose their colour when exposed to light for just a few months. Others change colour as the chemical structure changes; for instance realgar changes from orange to yellow, while the degradation of verdigris produces brown tones and tin white turns black. Carmine, known also as cochineal, and lac, together with plant dyes, are known to be unstable in the presence of high alkalinity or prolonged exposure to light. Nevertheless, because of their brilliant colours and restricted exposure to light, these pigments and dyes have been traditionally employed in miniatures in different cultures, including Christian manuscripts. The list of artists' materials employed by Ottoman miniaturists includes some pigments and other materials that have been identified in both Christian and Islamic seventeenth-century wall-paintings. These were cinnabar, haematite, minium, azurite, lapis lazuli, malachite, carbon black, lead white, lampblack for paint preparation, together with silver and gold for areas that were gilded.[373]

There are very few examples of painted wall decoration from the seventeenth century to be found in Ottoman Islamic religious architecture, as at the time ceramic tiles became popular as a decorative material for the interiors of mosques. Nevertheless, there is a minimal use of wall painting in the most important seventeenth-century mosque - the Blue Mosque in Istanbul, built between 1609 and 1616 by Sultan Ahmed I (1590-1617). Although the entire interior walls are covered with Iznik tiles decorated with blue and turquoise over a white background, here is also a delicate floral motif adorning the white of the inverted spheres of the domed areas. The painting is executed in blue, using the most expensive of the pigments that are suitable for wall painting, lapis lazuli.

---

troscopy analysis of pigments on 16th -17th c. Persian manuscripts', *Spectochimica Acta Part*Part A 92 (2012), 21-28.

373 L. Burgio, R. J. H. Clark, V. S. F. Muralha and T. Stanley, Pigment analysis by Raman microscopy of the non-figurative illuminations on 16th to 18th-century Islamic manuscripts', *Journal of Raman Spectroscopy*, No. 39 (2008).

As for civil architecture, there are no surviving seventeenth-century examples of wall paintings, either in Istanbul or in the Balkans. However, research into Ottoman houses suggests that, at the time, the residences of upper class Ottoman officials had painted interiors. However, in the wider Empire there are two partially preserved seventeenth-century Ottoman interiors that are considered representative of the fashion at the time. One is in the present territory of Egypt and the other in Syria.[374]

In the Egyptian Ottoman house, the artists used two colours, blue and green. The pigments used were respectively lapis lazuli and malachite.[375] In the Syrian interior, the same pigments were employed for the main body of the decoration while some details were added using cinnabar and gilding.[376] Therefore, it can be concluded that the chemical make-up of the palette used by Islamic Ottoman artists in wall painting included fewer pigments than those used in Arbanassi, but the Ottoman artists used only the most expensive pigments.

Contextualising the Arbanassi palettes within both traditions of wall painting, that of the Eastern Orthodox Church and of the Ottoman Muslims, raises a number of questions. For instance, how easy was it to obtain pigments within the Empire and from where? How much more expensive were the costly pigments in the seventeenth century, compared to the coloured earths which

---

[374] A. A. Brania, M. S. El-Rashidy, 'Characterisation, treatment and conservation of one Ottoman house wall paintings, Cairo, Egypt', in the *Procedings of 4th International Congress on Science and Technology for the Safeguarding of Cultural Heritage in the Mediterranean Basin,* Vol.2 (Cairo, 2009), pp. 84-94 and A. Scharrahs, Insight into a Sophisticated Painting Technique: three polychrome interiors from Ottoman Syria in German collections and field research in Damascus, at http://www.damaskuszimmer.de/PDFs/Publication_Anke%20Scharrahs.pdf?lang=de&objID=12&typeid=1 Alepo room [accessed, 2012].

[375] A. A. Brania, M. S. El-Rashidy, 'Characterisation, Treatment and conservation of one Ottoman house wall paintings, Cairo, Egypt', in the *Procedings of 4th International Congress on Science and Technology for the Safeguarding of Cultural Heritage in the Mediterranean Basin,* Vol.2 (Cairo, 2009), pp. 84-94.

[376] A. Scharrahs, Insight into a Sophisticated Painting Technique: three polychrome interiors from Ottoman Syria in German collections and field research in Damascus, at http://www.damaskuszimmer.de/PDFs/Publication_Anke%20Scharrahs.pdf?lang=de&objID=12&typeid=1 Alepo room [accessed, 2012].

dominated the chemical make-up of the Arbanassi decoration? Did availability of funds contribute in any way to this make-up? Brief answers to these questions will help further to situate the Arbanassi palettes within their historic context.

From the sixteenth century the Ottomans simultaneously exported and imported quantities of colour materials: pigments, dyes, and other raw materials. For example, azurite, cinnabar and high quality coloured earths were mined in abundance within the Empire.[377] At the same time records show that the Ottomans imported colour materials from Venice, the city that was at the time the European centre of such trade.[378] However, there is no systematic research on how these pigments and raw materials, were distributed within the Empire.

Nevertheless, from scholarship on both artisan life and on the miniature, it can be deduced that Ottoman craftsmen as well as various traders sold colour materials through their workshops or specialised shops, more often than not situated at one of the Ottoman bazaars.[379] The major bazaars were in Istanbul, Bursa, and Edirne. The Istanbul bazaar, in particular, was documented as a place where miniaturists to the Sultan's Court had their workshops and from which they also offered for sale all the colour materials they used in their paintings.[380] As bazaars were places of open trade it is conceivable that Christian painters ob-

---

[377] S. Faroqhi, *Artisans of Empire:Crafts and Craftspeople Under the Ottomans*, (New York, 2008), pp. 45-64.

[378] J. Kirby, S. Nash and J. Cannon (eds), *Trade in Artist's Materials:market and commerce in Europe to 1700*, (London, 2010).

[379] S. Faroqhi, *Artisans of Empire:Crafts and Craftspeople Under the Ottomans*, (New York, 2008), pp. 45-64

[380] Ibid, pp. 65-86.

tained pigments or any other artists' materials from Istanbul or from one of the other major bazaars, but there is no real evidence of such activity.[381]

Even within the context of the good range of pigments that was readily available to purchase within the Empire, it was earth pigments that dominated the palettes of Arbanassi. A variety of pigments suitable for wall painting techniques, such as lapis lazuli, malachite, azurite and cinnabar, has been linked to icon painting and manuscripts.[382] Although these pigments are generally regarded as expensive, there is no available information on the comparative cost of colour materials in the Ottoman Empire in the seventeenth century.

However, it may be assumed that the price of pigments within the Empire reflected general European prices, as the Ottomans were involved in the trading of artists' materials. I used the price of red earth pigments in the Italian market around the middle of the seventeenth century as the basis of this examination because they dominated the Arbanassi palettes.

In the case of the red pigments suitable for wall paintings, one ounce of cinnabar in the mid-1600s cost between five and ten Roman *baiocchi* per ounce, up to twenty times more than one ounce of the best quality red earth, which was about half of one *baiocchi* per ounce, hence the frequent adulteration of cinnabar with red earth.[383] Azurite was even more expensive, between eighty and one hundred and twenty times the average price asked for an earth pigment, at 40 to 60 *baiocchi* per ounce. This explains the care with which it was used in or,

---

[381] At the time the Ottoman authority followed a policy of fixed pricing for commodities throughout the Empire, so it follows that the actual location of the purchase would have been only a matter of convenience.

[382] Prashkov, L. (ed.) *Vuprosi na konservatžiata I restavratžiata*, Vol. 1-2 (Sofia, 1985) and Sharenkov, A., *Starinni tractate po Tehnologija I Tehnika na Živopista*, Vol. 1, kn. 2 (Sofia, 1994).

[383] R. Spear, 'A Century of Pigment Prices: Sevententh-Century Italy' in J. Kirby, S. Nash and J. Cannon (eds), *Trade in Artist's Materials: Market and commerce in Europe to 1700*, (London, 2010), pp. 275-293 and S. Kubersky-Piedda, ' The Market for Painters' Materials in Renaissance Florence', in J. Kirby, S. Nash and J. Cannon (eds), *Trade in Artist's Materials: Market and commerce in Europe to 1700*, (London, 2010), pp. 223-243.

more often, omitted from the palette both in Arbanassi and in other contemporary Christian sites within the Empire. The most costly pigment, lapis lazuli, was nearly a thousand times more expensive than the earth pigments at 5,000 *baiocchi* per ounce.

Of the green pigments, one ounce of malachite was at least ten times more expensive than the same amount of *terre verte*. Moreover, high quality *terre verte* was capable of producing hues that are close in appearance to the hues achieved by application of malachite-based paint, as is demonstrated by the greens in the nave of the Church of the Nativity, and was more cost effective than the semi-precious malachite.[384]

The comparative costs of the Arbanassi pigments suggests that, in all the churches, the budget allocated for pigments must have been low, despite the fact that the Christian community there was still considered to be very wealthy. The most likely explanation is that at the time there were significant inflationary powers at work.[385] For example, examination of the prices of artistic materials in Europe, centring on the Italian market, indicated that between the 1570s and the end of the seventeenth century the prices of pigments increased, sometimes dramatically. The price of best quality lapis lazuli blue increased from 1,100 *baiocchi* per ounce in 1584 to 5,000 *baiocchi* per ounce in 1631.[386] The price of azurite blue increased from 6.2 *baiocchi* per ounce in 1572 to 14.8 *baiocchi* per ounce in 1688. In the period between the 1570s and 1688 the price per ounce of cinnabar increased from 1.7 to 3.6 *baiocchi.* Even the red earth increased significantly in price per ounce; from 0.2 to 1.1 *baiocchi.*

---

[384] The Empire was a major exporter of *terre verte* to Venice. It is plausible that there was an even greater difference in price between *terre verte* and the imported malachite.
[385] The world's inflationary processes at the time were associated to a great extent with the influx of silver from the New World.
[386] R. Spear, 'A Century of Pigment Prices: Seventeenth-Century Italy' in J. Kirby, S. Nash and J. Cannon (eds), *Trade in Artist's Materials: Market and commerce in Europe to 1700*, (London, 2010), p. 278.

During the century after the reign of Suleiman the Magnificent (d.1583), the beginning of the Empire's decline was marked by massive inflation and debasement of the currency.[387] The internal inflationary force must have reduced the wealth of the Arbanassi patrons and consequently their buying power. The increase in the price of pigments on the international market must have curbed that power further. Moreover it needs to be remembered that the funds of the community needed to provide not only for the church decoration, but also for securing the building permission and the construction, not just for the four churches under examination, but also for the total of seven churches built within the seventeenth century. Furthermore, citizens supported the Athonite missionary work and fundraising as well as maintaining their investments and the expansion of their business interests. Therefore, it seems likely that the selection of the Arbanassi pigments was restricted by economic circumstances, rather than by availability.

To summarise, knowledge of the chemical basis of the palettes provides a ground for contextualising the use of colour in the naves, rather than just comparing the resultant hues identifiable at the initial sensory inspection of the wall paintings. Moreover, understanding the chemical foundation of the pigments will enable me next to consider what scope the palettes gave the artists, as the main chemical structures of the pigments confer particular advantages or restrictions in the context of the wall painting techniques used in the naves.

---

[387] There is historic evidence that in the period 1585 to 1588, the Ottoman silver currency, *akçe*, was officially devalued against the gold Venetian ducat and other foreign silver currencies by 100%. In addition, the Ottoman currency was debased by a 44% reduction in its silver content. Compared to the ducat, which was an internationally recognised monetary unit, the exchange rate was 120 *akçe* for one ducat. As the slow decline of the Empire continued and the inflationary forces grew, by the middle of the seventeenth century one ducat a reached trading price of 600 *akçe*. See H. Berument and A. Gunay, 'Inflation Dynamics and Its Sources in the Ottoman Empire: 1586-1913', *Islamic Economics*, Vol. 3 (1991), pp. 1-22.

The domination of the Arbanassi palettes by coloured earth pigments and the use of carbon black backgrounds bound the polychromatic appearance of the Arbanassi decoration to the colours that could be obtained from this group of pigments. For instance, the types of earth pigments included in the palettes are ochres, siennas, umbers, as well as their burnt variety (with the addition of *terres vertes* in the interiors of the churches of the Nativity and of St Atanass). This determined the gamut of the interiors within the yellow, red, beige, red-brown, purple and green colours, compared, for example, to the gamut of the Islamic interiors, with their predominantly blue and green and minimal use of red.

The employment of some cinnabar mixed with red ochre in the nave of the Church of St Dimitr did not depart from the general gamut of the Arbanassi palettes, nor did the limited employment of azurite, in any way alter the dominance of the colours of the earth pigments. Moreover, the use of a carbon black background to the compositions emphasised further this spectral range, compared to seventeenth-century Danubian and Russian church decoration, where the bluish-green background made the short wave part of the spectrum dominate the gamut of their decoration.

The inherent advantages of the Arbanassi palettes are associated with their appropriateness for the wall-painting techniques and the style of the decoration. In the first place, the dominance of earth pigments, which have been proved to be non-fading and highly resistant to the alkaline medium of the lime of the rendering, allowed for the creation of stable painted surfaces that are colour-fast and therefore durable, with the exception of cinnabar and white lead.[388] As the latter were not widely used, the changes in the appearance of the images

[388] This stability is demonstrated even if exposed to weather.

can be considered negligible, especially in the first decades of use, except for the deposit of soot.

In addition, the earth pigments are non-bleeding; therefore, when applied, they allowed the artists to obtain a clear distinction between the coloured areas, even in those cases where the edges of these areas were not defined by an additional outline. Moreover, it was possible to achieve the required good and even coverage of each well-defined part of the decorative compositions that is characteristic of the Byzantine style of painting, as the range of pigments, and especially the coloured earths, allowed for fine fractions, known for their high opacity, to be obtained by limited preparation. This preparation is expected to have included only simple processes such as grinding and levigation, both to separate out impurities where necessary and to obtain fine fractions of the pigments.[389]

Furthermore, the fine fractions, together with the stability of the earth pigments, gave scope for modifying the composition of the paints either for economic or for aesthetic reasons. For instance, in the Church of St Dimitr, mixing cinnabar with haematite must have been to reduce the cost, as is noted in the literature,.[390] In this case, the aim appears to have been to avoid visibly changing the colour of the main pigment - cinnabar - while in other cases the artists have purposefully sought to enlarge their palette, such as mixing white and black pigments to create grey, or adding black or white pigments to a chromatic colour pigment to create varying shading.

[389] Levigation is the process of grinding an insoluble substance to a fine powder, while wet. Further, any soluble impurities in the substance are dissolved, and the product thereby purified. The greatest advantage of this process is the subsequent separation of the product into various grades of fineness.

[390] It was stated that the mixing of malachite with green earth was often practised

The observed consistency of the spectral profiles collected from each of these composite colours leads to the conclusion that mixing of the pigments preceded the preparation of the paint.[391] Because of the fineness of the pigment particles at the time of mixing, this technique allowed the homogenous distribution of the pigments that had been added together and therefore the achievement of an even tone when the mixture was applied as a paint. Research shows that the technique had been practised since Byzantine times.[392]

The earth pigments gave the artists further scope for expansion of the palettes when a deliberate and controlled thermal modification was used. As during the heating a partial dehydration of the chemical structure takes place the colour of the pigment changes. When the heated pigment is the red ochre type of coloured earth, the end product is purple-coloured, as identified earlier in the paludamentum of St Constantine in the Church of the Archangels. When heating siennas or umbers, the resultant pigments are called respectively burnt siennas and burnt umbers. Although they do not change as drastically as do the red ochres, the partial dehydration modifies their saturation and brightness and the effect is to produce much deeper, darker colours.

However, an understanding of the chemical compositions of the paints with which the images have been constructed does not provide an understanding of the way in which the compositional use of colour had affected the perceived appearance of the colours and how that, in turn, had affected the images. These are questions I will seek to answer in the next chapter, for which I will need first to establish the perceptual value of the colours within the palette of each church by assessing the characteristics of the light reflected from the surface colour in conjunction with the chromatic response of the human eye.

---

391 Appendix I.
392 James, *Light and Colour* and N. N. Volkov, *Tžvet v Živopisi*, (Moscow, 1984), pp. 84-92.

CHAPTER FIVE

Colours in the Naves of Arbanassi

In the previous chapter, I advanced my understanding of how colour was used in the decoration of the naves of the Arbanassi churches by identifying the type of pigments used by the artists. The identification was done by examining the spectral characteristics of the light reflected from the initially selected coloured surfaces. I used a special tool to configure and record that information in each band of the spectrum. As each of those surfaces was painted in a single colour, using one dominant pigment in the preparation of the paint, it was possible to use the gathered spectral information to ascertain the specific chemical structure that determined the colour of that pigment. The totality of the spectral characteristics of each colour surface represents the chemical footprint of the dominant pigment. Understanding the chemical nature of the pigments allowed me to contextualise the colours used in the naves within the artistic and economic practices at the time. Moreover, I was able to comprehend better the scope that the range and nature of the Arbanassi pigments gave to artists in the context of their wall painting techniques.

In this chapter I will analyse how the compositional use of the Arbanassi colours impacts on the way the images look. To appreciate how the specific compositional arrangement of colours affected their appearance I need to be aware of the appearance of the individual colours out of their compositional context. Therefore, my initial aim will be to find a way to describe the individual colours comprehensively.

Earlier, I outlined only the general colour-hue categories: red, yellow, blue, green, brown, beige, white, grey and black. However, to be able to describe comprehensively the sensation evoked by the appearance of a colour it is not enough just to specify its hue, though hues are the main categories that help to distinguish one colour sensation from another. Within each of these categories there are numerous variations of appearance with regard to intensity and how relatively light or dark a colour might appear.

As already indicated, there are numerous reasons, both subjective and objective, that make it difficult to describe a colour's appearance. The subjective constraints are those imposed by the mechanisms of visual perception and memory, together with the limitations in the verbal communication of colour imposed by any linguistic representational system.[393] The objective constraints are associated mainly with the existing colour-reproduction systems in image-capturing devices, compounded by imperfections in printing and computer imaging.

There is a strong link between the kind of pigment used and the appearance of the resultant colour. For example, the green obtained from malachite is different from the green obtained from *terre verte*. Examination of the spectral profiles collected from the naves also gave some indication of the appearance of the coloured surfaces, especially those painted using different pigments. However, merely describing the colour, as an additive mixture of the portions of light reflected from the painted surface, is not in itself a description of the appearance of the colour of that surface.

---

393 Gage, *Colour and Meaning*, pp. 53, 56.

There are many different systems that offer the possibility of transcribing the visual sensation of individual colours. These systems order colours within a physical, logically constructed structure.[394] In this chapter I will use the Munsell Colour Ordering System to transcribe the appearance of the colours comprising the palette of each nave. The Munsell System presents both a numerical and a visual model of colour appearance, which allows for a fair degree of accuracy and at the same time provides a visual illustration of the appearance of each colour.

My investigation will progress initially by identification and comparative examination of the visual model of the palettes of the naves in the Munsell System. This will be followed by a discussion of the specific use of colour in the context of particular images, which will appraise the influence of the compositional use of colours and will assist in framing my study of the light in the naves. I will begin my investigation by explaining why I chose to use the Munsell System to describe the nave colours and elucidating the process of selection of the Munsell samples.

5.1 Describing the Colours of Arbanassi

Describing anything, including a colour, usually implies the act of marking it out, verbally or numerically, or visually representing its appearance.[395] Yet the description will need to be in a format that will permit the successful communication of that sensation. Such a format will necessarily avoid the optical distortion caused by juxtaposing colours (simultaneous contrast), the problems associated with colour memory deficiency and those associated with the reproduction of colour images. Only then will it be possible to explore to what degree

[394] Hunt, *Measuring Colour*, pp. 131–153.
[395] C. Sloans and A. Stevenson, *Oxford Dictionary of English* (Oxford, 2005).

the appearance of a particular hue differs in the various naves where the same basic pigment was used.

From all the available systems that could assist in providing a reasonably accurate description of the Arbanassi colours, I chose the Munsell Book of Colours or the Munsell Colour System. This is because the Munsell System has the capacity to describe the appearance of colours in conjunction with the response of the human visual system to a colour stimulus. Its classification is accepted as a universal means of providing a physical exemplification and numerical notation of the appearance of a colour for identification and reference. This will make the results of the present study readily available for further investigations at the site. Finally, the Munsell Colour System was perhaps the most broadly used standard of colour in the twentieth century.[396] The system is familiar and used extensively in research in the humanities generally.[397]

Physically, the Munsell System consists of a strictly defined collection of colour samples (chips), arranged around an axis.[398] The spacing of the chips is organised in perceptual steps, determined by testing the visual responses of real observers. In the Munsell System, each chip has three dimensions that are perceptual and correspond in general terms to the dimensions recorded

---

[396] Gage, *Colour and Meaning*.

[397] For the use of the Munsell System in archaeological investigations, refer, for example, to N. Herz and E. G. Garrison, *Geological Methods for Archaeology* (Oxford, 1998) or M. Giardino, R. Miller, R. Kuzio and D. Muirhead, 'Analysis of Ceramic Color by Spectral reflectance', *American Antiquity*, Vol. 63, No. 3 (1998), pp. 477–478. For an example of the use of the Munsell Colour System in linguistics, see Kay and Berlin in their investigation into basic colour terms; the method is still in use in this area of study. However, most importantly for the purposes of this thesis, the Munsell System is particularly favoured by art historians (see Gage, *Colour and Meaning*, p. 65). Notably, in the 1980s, Epstein used the Munsell notation in the field of Byzantine studies in a comparable context, namely the examination of the colours employed in the wall paintings in the tenth-century cave church of Tokali Kilitse (A. Epstein, *Tokali Kilitse: Tenth-Century Metropolitan Art in Byzantine Cappadocia*, DOS 22 (Washington, DC, 1986), pp. 58–59, cited in Gage, *Colour and Meaning*, p. 243/187, and in James, *Light and Colour*, p. 12).

[398] A. H. Munsell and R. B. Farnum (Introduction), *A Color Notation: An Illustrated System Defining All Colors and Their Relations 1941*, (Baltimore, ninth edition, 2004, first edition, 1941). See illustrations of the systems in Hunt, *Measuring Colour*, pp. 136-137.

numerically: hue, saturation and lightness.[399] Each specification is standardised and starts with the number and letter for the hue, followed by the number for the value and that of the chroma. The traditional method of identifying the Munsell chips that are representative of the appearance of the colours of interest involves visual comparison.[400] This means matching the colour of the investigated object, substance or surface with a chip from the Munsell Book of Colours or from one of the specialised charts.[401] It should, however, be noted that Herz warns that the traditional method of visual identification presents a number of problems. These include the individual observer's particular skill at colour discrimination, the lighting and viewing conditions and, not least, the effect of optical interaction with the adjacent colours.[402] It also needs to be borne in mind that the subsequent examination of the samples must be carried out under the controlled lighting conditions and with the background specified in the Munsell Book.

While the problem of optical interaction might be reduced by placing a grey mask over the adjacent areas, the other two elements, namely the individual's ability to detect colour differences and the viewing conditions, will still affect the accuracy of the assessment. Moreover, Westland argues that, when the Munsell chips are used directly during fieldwork, more often than not this leads to contamination of the surface of the chips, changing the appearance of their

---

[399] Observer – a human with normal colour vision who takes part in a perceptually based investigation.
[400] In Wyszecki and Stiles, *Color Science*, p. 507 *value* in the Munsell System represents the lightness of a colour on a scale delimited at one end by black and at the other by white. Again in the same work at p. 487 *chroma* is defined as 'the attribute of a visual sensation which permits a judgement to be made of the degree to which a chromatic stimulus differs from achromatic stimulus of the same brightness'.
[401] Official, calibrated books of the Munsell Colour System are now being offered by the MacBeth Division of Kollmorgen Corporation, New Windsor, New York.
[402] Herz and Garrison, *Geological Methods for Archaeology*, p. 43.

colour.[403] Taking account of all the above reservations associated with the direct visual estimation of the Munsell chips, it becomes clear that a more refined method of identification of the relevant chips is required. An accurate description of the colours in the palettes of Arbanassi is necessary to ensure the reliability of the record of those appearances. Subsequently such records should allow for the faithful representation of the colours used. A faithful representation of the appearance will promote a better understanding of the magnitude of the effects resulting from the optical interaction between colours found to be juxtaposed in any particular pictorial scene. Moreover, such a representation will inform the investigation of the extent to which the manipulation of the pigments beforehand assisted in the enhancement or otherwise of the perceived brilliance of the interiors. Finally, by creating a reliable record of the appearance of the colours used in the Arbanassi naves, it will be possible to utilise them in further, comparable research into the use of colour in post-Byzantine art. I will now present the governing concept behind the method I will use when selecting the Munsell chips that can be considered true colour matches for the colours of the naves.

The constancy of the appearance of the chips comprising the Munsell Book is a starting point. That constancy is guaranteed by the existence of a notation for every chip in the International Commission on Illumination (CIE) colour-ordering system. In principle, the CIE measurements form a representative numerical model of the relationship between light falling on the surface (incidental light) and the response of the visual system of the beholder to the part of the incidental light reflected from the coloured surface. These measurements are called colourimetric measurements, and the emphasis is on the response of the visual system of the beholder rather than on the degree of modi-

[403] S. Westland, 'Colour Science', in D. Roberts, (ed.), *Signals and Perception: The foundation of human perception* (New York, Milton Keynes, 2002), pp. 93–94. The appearance of every Munsell chip is strictly monitored at production stage.

fication of the incidental light by the microstructure of the surface. In order to provide a common starting platform, CIE introduced standardised mathematical models for the source of illumination and for the visual system of the beholder. In this way, the only variable determining the result of the measurements is the colour of the surface.

Westland suggests that, because of the existence of a CIE model for each colour chip, it is best to find the match between the CIE measurements of the examined colour surface and the nearest colour chip specification. In the past, a set of tables was used, but now special algorithms have been developed to provide quick and efficient ways of finding any match. Here I need to stress that the match has to be described as the nearest match, but not the *exact* match. This means that if there is a set of measurements they are compared with the set of measurements of the existing Munsell chips. The Munsell Colour Order System is based on perceptual steps and does not claim to represent the entire gamut of colour recognisable by the human eye; hence it is only to be expected that the match cannot be exact. Even then, according to Westland, the nearest match is of much greater accuracy than the match made using the traditional method.[404] Moreover, I would argue further that, in cases where an investigation requires a high level of accuracy, as is demanded by restoration projects for example, the collected CIE measurements can be used directly to match an already-existing colour appearance.

5.2 Examination, Procedure and Results

Historically it was in the 1930s that F. I. G. Rawlings, the first scientific advisor to the Trustees of the National Gallery in London, examined the surface colour of objects from the Gallery's collection by performing visual colourimetric

[404] Westland, 'Colour Science', pp. 93–94.

measurements using a tintometer. However, that data provided information only on the response of the cone photoreceptors in the retina, but not on the response of the rods, and therefore it was not capable of providing a full description of the surface colours.[405] The visual perception of colour is associated with the presence of two general types of photoreceptor in the retina of the eye of the beholder: cones and rods. These receptors are cells with visual photopigments that absorb light, and are collectively called ‘opsins’. Recently they have begun to be known as ‘rhodopsins’ (although, strictly speaking, rhodopsin is the opsin for the rods).[406] Cones are associated with colour vision and are most active in a bright environment, whereas rods are responsible for the registration of the levels of experienced brightness of a surface, and are most active in reduced lighting. Cones are of three different kinds, according to the chemical structure of the photopigments that they carry and which serve to differentiate colours. This differentiation is achieved through different pigments reacting to the varying spectral composition of light at a particular wavelength, with the impulses generated in the cones resulting in colour sensation.[407] Depending on the wavelength that excites them, these three kinds of cone are called respectively red (564 nm in the red–yellow zone), green (534 nm in the green–yellow zone) and blue (420 nm in the bluish-purple zone).[408] Therefore, to obtain a full description of the appearance of a surface colour, it is necessary to have information about the complete likely retinal reaction.

---

[405] Rawlings, F. I. G., ‘A Tintometric Comparison of Artists’ Pigments’, in *Technical Studies*, issue IX (London, 1940), pp. 3–10.
[406] J. Bowmaker, ‘The retina’ in D. Roberts, (ed.), *Signals and Perception: The foundation of human perception* (New York, Milton Keynes, 2002), pp. 121–122.
[407] Wyszecki and Stiles, *Color Science*, pp. 90–93.
[408] Hunt, *Measuring Colour*, pp. 20–23; F. Schmidt and G. Thews, (eds), *Human Physiology* (Berlin, Heidelberg and New York, 1989, first edition 1987), p. 241. These publications advocate R (580 nm) G (540 nm) and B (440 nm); however, later research accepted the different wavelengths shown in the text above; see H. Davison, *Physiology of the Eye* (London, 1990, 5th rev. edition, first edition, 1972).

For that reason, today a tristimulus colourimeter is generally employed to obtain a complete description of a surface colour. For example, the monitoring programme of the frescoes of the thirteenth-century church in the village of Bojana, near the capital, Sofia, conducted between 2000 and 2002 by the Institute of National Culture and Monuments, used tristimulus colourimetric equipment.[409] In principle, a colourimeter could be used to record the appearance of the colours of Arbanassi. However, according to Wyszecki and Stiles, a tristimulus colourimeter can measure the appearance of a colour with a fairly high level of precision, but they warn that colourimeters lack accuracy and that the results cannot be replicated exactly.[410] Such a lack of accuracy could be expected to compromise the precision needed in the later selection of the Munsell chips for describing each of the Arbanassi colours. This in turn would impair the ability to employ the recorded appearances in the comparative assessment of the use of colours in the Arbanassi churches and in any future examination of the colours of Arbanassi in the context of pictorial compositions. Where a reasonable level of accuracy is needed, both Hunt and Wyszecki and Stiles recommend the use of spectrophotometric apparatus, with the exact type being chosen in accordance with the requirements of the proposed investigation.[411]

Taking into account the above recommendation, I used a hand-held Konica Minolta CM-2600d spectrophotometer to collect the colourimetric data for defining the corresponding Munsell chips. This instrument has a high level of accuracy

[409] A report is linked to a document from the archives of the Institute, entered as P-63 from 27.07.2001, which authorised the monitoring of the church at Bojana as one of the sites in Bulgaria that has been listed as a UNESCO World Heritage site since 1979.
[410] Wyszecki and Stiles, *Color Science,* p. 243. Hunt also speaks about this briefly in Hunt, *Measuring Colour*, p. 112.
[411] Ibid., pp. 108–109; Wyszecki and Stiles *Color Science*, pp. 232–235.

and compatibility with other makes of spectrophotometer and has the capacity to collect and store colourimetric measurements in CIELAB colour space. [412]

After generating the nearest Munsell match for each of the colours identified in the Arbanassi naves, I compared the respective Munsell coordinates.[413] The overall trend was that the corresponding Munsell matches for each of the different naves displayed various degrees of dissimilarity between the hue, value and chroma.[414] Nevertheless for the matches associated with a generic colour that shared the same pigment the overall tendency was for those matches, more often than not, to share the same hue and chroma. These colours however always differed in their value, indicating that there were discrepancies between their lightness. At the same time, in the cases where the examined matches were associated with a particular generic colour, but linked to different pigments, the differences were across all the Munsell coordinates. The least dissimilarities were noted for the hue coordinate, while chroma and value were often found to be very different.

To gain some understanding of the overall appearance of the Arbanassi chromatic colours, I then compared the numerical value for their Munsell chroma and value to the numerical scale for these coordinates in the Munsell System. This comparison indicated that both chroma and value are low across the selected Munsell matches, suggesting that, if examined in isolation, the individual

---

[412] 1976 CIELAB is one of the colour systems that defines the appearance of colours mathematically, taking into account the sensitivity of the human eye. This means that comprehensive data, taken across the entire visible spectrum between 400 nm and 740 nm, was examined within the limits of the response of the three different types of cone in the retina: S (420–440 nm); M (534–545 nm); and L (564–580 nm), taking into account the response of the rods. Each measurement is defined and recorded as colourimetric coordinates L* (lightness), a* (red–green part of vision), and b* (blue–yellow part of vision). See Appendix II.
[413] The results for the appearance of the colours in the churches of Arbanassi are presented numerically in the form of colourimetric coordinates (L*a*b*), together with the results of the calculations for the Munsell chips (from now on I will call any Munsell chip identified in this way 'the Munsell match') and are displayed in a table in Appendix II.
[414] See Appendix II.

chromatic colours of the naves will appear faded. Such a result however is apparently contradictory to the noted earlier vibrancy and colourfulness of the Arbanassi interiors.

To ascertain the degree of visual disparity between the appearance of the individual colours and the way the colours look in the context of the pictorial compositions I used the individual CIE coordinates to generate representative samples of the nearest Munsell matches.[415] An illustration of these matches is presented in Figure 32. It confirms both the dull appearance of the palettes of the Arbanassi naves, but also the overall similarity, suggested earlier, by the use of identical pigments across the naves. As, theoretically, the perception of a colour is affected to a degree by the neighbouring colours, the way in which the images look needs to be assessed in the context of the compositional arrangement of their colours.

5.3 The Colours of Arbanassi in their Compositional Context

Earlier, I established that within the decoration of each nave there was a stylistic unity and that the scenes of the Archangel Michael and of SS Constantine and Helena were created using the entire palette employed in the particular interior. Thus it can be expected that the examination of these two scenes will allow an assessment of the ways in which colours were used compositionally within the seventeenth-century nave decoration of the churches.

From the initial examination of the naves, it became evident that there are clear stylistic and thematic parallels between the representational systems of all the

---

[415] E. S. Tantcheva, V. Cheung and S. Westland, 'Analysis of 17th-century church interiors using the Munsell system', *Proceedings of* AIC, Stockholm, (2008) and E. Tantcheva, V. Cheung, and S. Westland, 'Analysis of the use of yellow in seventeenth-century church interiors', *IJDNE,* Vol. 4, No. 3 (2009), p. 314. I am grateful to Dr Cheung for performing the selection of the nearest Munsell match and for generating the representations of the Munsell chips.

naves. My investigation of the images of the Archangel Michael and SS Constantine and Helena will concentrate on identifying any occurrence of common patterns that can be expected to have increased the perceived brightness and colourfulness of the images. In principle, the sharper the contrast between the characteristics of any two adjacent surfaces, the clearer and the brighter the perception of the scene. Moreover, perceptually, the level of brightness experienced has also been linked to the level of colourfulness experienced, and vice versa.[416]

Being guided by this conceptual frame, I will survey the scenes for instances of the juxtaposition of positively light and definitely dark colours. This pattern constitutes the phenomenon known as simultaneous light contrast and it emphasises the brightness of the lighter of the neighbouring colours. I will also enquire into the use of another relevant optical strategy, known as simultaneous colour contrast. This involves juxtaposing colours that are complementary pairs, namely: red/green, orange/blue, yellow/violet.[417] In the process of my examination, I will draw conclusions about how these patterns had an impact on the way that the images look.

Starting from the top of the scenes, the first common element of the compositions are the haloes of the saintly figures. In all the naves the haloes are composite shapes, consisting of discs, originally gilded, but now yellow, placed within two concentric circles. The inner circle is black while the outer one is white. The haloes are within the black part of the background, creating a rhythmic pattern of strong light contrast between the different elements. Moreover, the gilded part of the haloes must have provided a bright, plain setting for

---

[416] Hunt, *Measuring Colour*.

[417] M. E. Chevreul, *The Principles of Harmony and Contrast of Colours and their Applications to the Arts* (London, 1855). These are known as complementary pairs and the colours included in each pair can be found exactly opposite each other on Newton's colour wheel.

the head of each saint. Within the composition of the head the face is usually painted in a light colour and framed by dark brown hair. Here again, the original highly reflective surface of the gilded haloes would have appeared even brighter, being emphasised by the colour of the hair and, to an extent, its matt surface.[418]

The exceptions to this particular compositional arrangement are associated mainly with the images of St Helena in the churches of the Nativity, the Archangels, and St Dimitr. There the head of the saint is covered by a short white palla (a scarf wrapped around the shoulders), but the artists still managed to employ light contrast to a greater or lesser degree. For instance, In the churches of the Nativity and of the Archangels the pattern of alternating very light with very dark in this part of the image was maintained by outlining the overall shape of St Helena's palla, while within the shape of the palla, its folds were drawn in black. In the Church of St Dimitr there is no apparent light contrast between the colour of the halo and the saint's palla. Here definition between the palla and the face of the saint has been sought by the use of a highly contrasting delicate pattern, painted in red. This pattern determines the width of the white form of the palla around the face of St Helena and within the halo, but also distinguishes the garment over her shoulders from the pale yellow colour of her pallium and indicates the folds in the fabric.

The folds and details of the clothing within the figures of the Archangel and SS Constantine and Helena in all the churches are also always marked with dark lines. For instance, in the Church of the Nativity the folds in the clothing of the Archangel are indicated by black lines which, in places, are juxtaposed with

[418] The reflective surfaces are perceived to be lighter than the same colour matt surfaces. See Hunt, *Measuring Colour* and also Berns, *Billmewer and Saltzman's Principles of Color Technology*, p. 10.

white highlights. In the same church, St Constantine has a bright red paludamentum, the outline and folds of which are delineated in dark brown. In the Church of the Archangels, the folds of the red cloak of the Archangel Michael are in dark brown, while the folds of the darker, purple paludamentum of St Constantine are painted using black. This perhaps indicates that the painters had tried to maintain the highest level of light contrast in all parts of the image with the range of colours that they were using at the time.

The same pattern of use can also be observed in the other two churches, though the level of light contrast is much reduced in the Church of St Dimitr and in particular in the red painted cloak of the Archangel and paludamentum of St Constantine. Here the folds of the fabric are also painted in red, but in a shade that is only marginally darker than the main colour of each garment. The folds of the paludamentum are exceptionally difficult to distinguish. It could nevertheless be argued that the chemical changes in the cinnabar-based red paint and the subsequent darkening of the surfaces had promoted the perceptual evening-up of the degree of lightness of both the lighter and the darker colours. Therefore, it is plausible to suggest that the original level of light contrast in this part of the decoration might have been sharper and akin to the levels observed in the rest of these compositions, as well as in the other naves.

There is also a clear manifestation of the use of simultaneous light contrast in the armour of the Archangel Michael and the wings of his figure. For example, in the Church of the Nativity the details of the armour are outlined in alternating dark and light lines. Dark lines that are black can be found over the predominantly grey parts of the armour. Those lines that are dark brown outline the predominantly yellow parts. In the Church of the Archangels the bright white of the armour of the Archangel is juxtaposed mainly with black-edged brown ornamentation but in a few places also with the red of his cloak. In the

Church of St Atanass, every detail of the armour of the Archangel is painted in a dark colour and extensively highlighted. In the church of St Dimitr, the painter juxtaposed two pairs offering maximum light contrast: light grey and charcoal black or dark brown and yellow.

The same rhythm of alternating very dark and very light colours can be found in the rest of the images. For example, facial details and other small elements, including all the details and embellishments on the cross, pallia and the tunics of the saints, are always found painted in highly contrasting colours, namely dark brown or black detailing over a light background colour. The limbs of the saints are painted beige while details and contours are delineated in dark paint This treatment creates an emphasis on the brightness of the colours of the embellishments against the background on which they are painted. Similarly, even the silhouettes of the images are all outlined in a dark or light colour, depending on the colour that is adjacent.

Light contrast was also used on the wings of the archangels, where white detailing was added to the dark brown shapes, as in the churches of the Nativity and St Atanass. In the Church of St Dimitr, similar detailing was added over both the dark brown and the charcoal grey areas of the wings. The white detailing is very fine and closely follows the form. Because of the strong light contrast, despite the fineness of the white lines, their brightness has been underpinned by the deep background colour and the lines are readily recognisable. The frequency of the detailing is high, especially in the upper part of the composition, and the increased perceived brightness of the white assists more readily the identification of the shape of the wings within the composition.

The style of the Archangel's wings in the nave of the Church of the Archangels is completely different as the artist has dispensed with all detailing. Instead there are two white forms, suggestive of wings. Moreover, the wings do not extend over the lighter parts of the background, where the degree of light contrast would have been considerably less, but are confined within the black section of the background. As this compositional arrangement intensified the brightness of the white, the wings of the Archangel were made highly visible.

The pursuit of the strongest light contrast and visibility within the upper part of the composition has already been acknowledged in my analysis of the compositional use of colour in the halo and the head of all three saintly figures. It can also be observed in some other elements of the images of SS Constantine and Helena. For example, in the Church of the Nativity, in both images the embellished shoulder piece of St Constantine's pallium and the shoulders of St Helena's, covered by her white palla, are entirely within the black background. Especially in the image of St Helena, the bottom line of her palla is on exactly the same level as the border line between the black and the green sections of the background area. The images of SS Constantine and Helena are treated in a similar way in the naves of the churches of the Archangels and St Dimitr. In the former, her shoulders, covered by her white palla, and in the latter, her light-coloured shoulder piece, are exactly within the black section of the background, just above the next band of lighter colour. Even though the light shoulder piece from the image of St Constantine in the above two churches is not so sharply defined as in the images of St Helena, nevertheless the lightest part of the images is still within that black background area, increasing the perceived brightness of this part of the compositions, creating a focal point.

It is only in the scene of SS Constantine and Helena from the nave of the Church of St Atanass that this optical strategy has not been implemented even though simultaneous light contrast has been sought in the treatment of the heads of the saints. Here, analysis of the compositional arrangement of colours used in the construction of the images suggests the systematic employment of simultaneous colour contrast, a strategy that aims to intensify the chromatic qualities of the individual colour within a pair of juxtaposed complementary colours. For example, in the context of the scene, all the visible parts of the tunic of St Constantine (with a few exceptions such as the outer part of his left arm or the end of his right sleeve) are framed by the dark brown and red inner lining of his black paludamentum. The impression of the overall colour of the lining is of dark orange. The reddishness of the overall colour of the lining of the paludamentum on the left side of the image has been increased by the fact that its entire left side is juxtaposed with the green of the second band of the background of the composition. As the colour of his tunic is dominated by the light blue pattern, tightly applied over a basic black background, the dominant colour of the tunic and the colour of the lining of his paludamentum instigate a level of simultaneous colour contrast associated with the perceptual relationship between orange and blue. Although this indicates an increase in the colourfulness of both colours, it should be stressed that light blue optically benefits from the use of the simultaneous light contrast occurring between the black background of the tunic and its light coloured pattern, hence the perceived brilliance of the blue in the image.

Instances of simultaneous colour contrast are also evident in the context of the images of the Archangel and that St Helena. In both images, colour contrast occurs in those areas where red-painted compositional elements of the figures are juxtaposed with green coloured ones. For example, the left edge of the red cloak of the Archangel borders almost entirely on the green section of the background and so does the greater part of the right and bottom edges of his cloak. Similarly, in the case in the image of St Helena, three quarters of her red tunic is again surrounded by the green-coloured section of the background. Moreover, in the majority of the cases, where the red of the garments is not juxtaposed with green, it is juxtaposed with a dark or black colour. For instance, in the image of the Archangel, the red of his cloak is juxtaposed with the colours of his armour, his tunic and with the black of the background, while in the red section only part of the figure of St Helena is placed within the black background. Therefore, it can be concluded again that the perceived brilliance of the red colour within both scenes can be attributed to the optical enrichment induced by the combined use of both colour and light contrasts.

The use of simultaneous colour contrast can also be found in the scenes of the Archangel Michael and SS Constantine and Helena from the nave of the Church of the Nativity. It occurs again in the areas where red is juxtaposed with the green of the background. This is, for example, the case with the red of the cloak of the Archangel or the red-orange paludamentum of St Constantine and, to a degree, the deep red tunic of St Helena, enhancing the perceived colourfulness of these particular sections of the images.

Furthermore, if the assumption of Prashkov was correct, that the black tunic of St Constantine had originally been covered in a thin layer of either white or light blue pigment, so that it was then perceived as deep blue, it can be concluded that at that time a degree of colour contrast must have occurred between the blue tunic and the red-orange of the paludamentum.[419] It can be observed that the shape of the tunic had been carefully surrounded by the red of the paludamentum, even in the area of the yellow section of the background of the scene, where the black or otherwise dark blue of the tunic would have created an occurrence of light contrast.

It is plausible, therefore, to assert that by creating the compositional arrangement within the image of St Constantine, the painter sought to exploit either the

[419] Prashkov, *Stenopisite na Tzurkvata Roždestvo*.

colour contrast between the blue and red-orange, or the light contrast between black and red. In both cases the brightness of the colours involved has increased.

These scenes from the naves of the churches of St Atanass and of the Nativity display a significant frequency in the occurrence of simultaneous colour contrast, which works in synergy with the light contrast. In the naves of the churches of the Archangels and of St Dimitr, however, simultaneous colour contrast occurs neither in the scene of the Archangel nor in the scene of SS Constantine and Helena. Moreover, analysis of all the other scenes in these naves confirms that simultaneous colour contrast was not used at all. This raises a question about what may lie behind the different approaches to the compositional arrangement of colours within the two sets of churches: St Atanass and the Nativity on the one hand; and the Archangels and St Dimitr on the other.

Re-examination of the range of colours included in the palettes of each of the four churches in the first instance indicated that the palette of the Church of St Dimitr is the narrowest one.[420] It contains only two chromatic colours, red (bright and dark) and yellow, but these are not a pair of complementary colours. In the case of the Church of the Archangels, there are three chromatic colours, red, purple and yellow, but again none of these are complementary. Therefore, with these palettes it was not possible for the artists of the churches of the Archangels and St Dimitr to employ colour contrast as an optical strategy. Nevertheless, because of the extensive use of light contrast in these two naves, the perceived brightness of the images is high. Moreover, because of the correlation between the perceived brightness and perceived colourfulness, the scenes in these naves are perceived not just as vivid, but also as colourful, despite of the narrow range of chromatic colours in the palettes of both churches.

[420] See Table 1.

In summary, to comprehend the use of colours in the naves of Arbanassi, I ascertained the range and appearance of the Arbanassi colours. Their inherent limitations and the scope they offered to the painters in the context of their generic chemical composition and consequent appearance were explained. Moreover, my examination of the compositional use of the available colours led me to the conclusion that colours were used skilfully and purposefully to create interiors that looked vibrant and colourful despite the dull appearance of the individual colours in the palettes. Simultaneous light contrast was the main compositional strategy employed in the construction of the decoration, and it was the limited number of colours employed in Arbanassi that restricted the use of simultaneous colour contrast.

By elucidating the use of colour in the naves I outlined the specific frame within which the appearance of the decoration was staged. When I carried out that part of the investigation my aim was to establish the principles on which colour appeared to have been employed in the naves. In doing so I used illumination with characteristics as close as possible to those of noon daylight. This was to comply with the international acceptance of this light as the default light when the intention is to present and explain the characteristics of any coloured surfaces.[421] This raises the question, in the context of the phenomenon of colour constancy, whether it can be considered that the general understanding of the use of colour in the naves is sufficient to enable the appearance of their interiors at the time their painting was complete to be ascertained. In other words, will the characteristics of the seventeenth-century lighting conditions in the nave affect my conclusions about the appearance of the church decoration at the time?

[421] D. B. Judd, D. L. Macadam, G. Wyszecki, H.W. Budde, H. R. Condit, S.T. Henderson and J. L. Simonds, 'Spectral Distribution of Typical Daylight as a Function of Correlated Color Temperature', *JOSA*, Vol. 54, Issue 8, (1964), pp. 1031-1036.

Colour constancy is a term that indicates the capacity of human vision to allow for the appearance of a surface colour to be considered more or less stable within a reasonably wide range of changes in the brightness and colour of the illumination.[422] Initially, the scientific world had often accepted colour constancy as applicable in any situation.[423] Empirical investigations, however, concluded that the range within which colour constancy operates is relatively narrow, falling between the brightness of an overcast noon sky and that of a day with bright sunshine. [424]

My initial examination of the churches indicated that the architectural design of the buildings relied on a few comparatively small windows to provide natural illumination to the naves. Therefore, it can be concluded that even if the level of brightness outside the building was of the level required for the operation of colour constancy, the fenestration of the buildings could be expected to have reduced the influx of daylight, resulting in a considerable difference between the brightness outside and inside the naves. The brightness can be expected to have been reduced still further if the window openings were glazed, as the glass would have absorbed part of the incoming light energy.

Moreover, natural light in the range within which colour constancy operates is considered to be white or colourless, while any other light, natural or artificial, is considered to be coloured to a greater or lesser degree. If the windows were indeed glazed in the seventeenth century then, depending on the colour of the

---

[422] D. H. Foster, S. M. C. Nascimento, B. J. Craven, K. J. Linnell, F. W. Cornelissen, E. Brenner, 'Four issues concerning colour constancy and relational colour constancy', *VR*, Vol. 37, No. 10 (1997), p. 1341–1345.

[423] Fairchild, *Color Appearance Models,* p. 66.

[424] D. H. Foster, S. M. C. Nascimento, B. J. Craven, K. J. Linnell, F. W. Cornelissen, E. Brenner, 'Four issues concerning colour constancy and relational colour constancy', *VR*, Vol. 37, No. 10 (1997), p. 1341–1345; A. Gautier-Hion, 'The diet and dietary habits of forest guenons' , in A. Gautier-Hion, F. Bourlière and J.-P. Gautier, (eds.) *A primate radiation: Evolutionary biology of the African guenons* (1988), pp. 257–283.

glass, the glazing can be expected to have changed the colour of the interior light as well. If there were internal sources of artificial illumination these might also have altered the colour of the interior light. In principle, all Eastern church interiors are expected to employ incandescent sources, such as candles and oil lamps, which emit light with a colour in the long-wave part of the spectrum.

Research carried out since the 1950s indicates that if there is a difference in the colour of the ambient light, compared to the default light of midday, the perceived appearance of the surface colours examined under that ambient light will be found to have been altered significantly.[425] In fact, changes have been registered across all the colour-defining characteristics; hue, chromaticity and brightness.[426] Therefore, if the perceived appearance of the individual colours is changed, that will alter the dynamics of the complex system of optical relations between the colours, as explained in the context of the compositional arrangement of colours in the Arbanassi decoration. My investigation into the use of colour in the naves concluded that in principle, these optical relations determined the final appearance of the interiors. From this it follows that I next need to ascertain the seventeenth-century interior lighting and to comprehend how it might have changed the individual colours and their consequential optical interactions. Only then will I be able to propose how the interiors of Arbanassi

---

[425] L. M. Hurwich and D. Jameson,'Some quantitative aspects of an opponent-colors theory. IV: A psychological color specification system', *JOSA*, Vol. 46 (1956), pp. 416–421; M. Hårleman, 'Colour emotions in a full size room' in C*olour and Paints*, Proceedings of Interim Meeting of AIC, Porto Alegre (2004), pp. 223–226. Also E. S. Tantcheva, V. Cheung, S. Westland, 'Effect of Candlelight on Seventeenth Century Church Interiors using Munsell System' , Proceedings of 11th Congress of AIC, Sydney (2009). The last work compares the use of CIELAB and CIELAB97 in the selection of the nearest Munsell match. The conclusion is that the choice of illuminate is more important than the choice of colour space.

[426] E. S. Tantcheva, V. Cheung, S. Westland, 'Effect of Candlelight on Seventeenth Century Church Interiors using Munsell System' , Proceedings of 11th Congress of AIC, Sydney (2009. Work compares the use of CIELAB and CIELAB97 in the selection of the nearest Munsell match. The conclusion is that the choice of illuminate is more important than the choice of colour space.

would have appeared at the time, within the context of the described used of colour.

PART II

LIGHT

The aim of this part of the thesis is to evaluate the interior light in the naves of the four churches and to ascertain how those naves would have appeared in the seventeenth century in the context of both the elucidated use of colour in their decoration and the original interior illumination.

To evaluate the illumination I will analyse the level of brightness (that is, the experienced level of luminance) and the prevailing colour of the internal illumination. These variables will simultaneously bring an understanding of the quality of the interior light and allow consideration of the appearance of the naves in the seventeenth century. Because surface colour is a function of the spectral characteristics of the light falling on that surface and, to a lesser degree, of the intensity of that light, there is a correlation between the appearance of a coloured surface and the colour of the ambient light.[427]

Interior light is usually a composite of natural and artificial light and my understanding is that both components were present in the Arbanassi naves once the churches were completed and functioning. In principle, when the levels of luminance of one of the components is very low, the characteristics of the other dominate the interior illumination. For example, if an interior receives plenty of bright daylight, the contribution of the artificial illumination will be minimal.

---

[427] Berns, R. S., *Billmewer and Saltzman's Principles of Color Technology*, (New York, Toronto, 2000, first edition, 1981), pp. 13-14 and 26-27.

As the characteristics of the interior lighting will be close to bright daylight the appearance of that interior will be determined by the appearance of the colours and their optical interrelation as if examined under standard noon daylight. In the case of the natural lighting, I will estimate only the levels of brightness as daylight is usually considered colourless. In all other cases when the level of luminance of the natural illumination is low enough for the artificial illumination to dominate then its characteristics will be instrumental in determining the appearance of those interiors.

In the seventeenth-century Arbanassi churches, candles and oil lamps would have been sources of artificial illumination. The levels of luminance would have depended on the number and the position of the light sources, variables which I will explore when investigating the artificial lighting of the naves. Moreover, the colour of the light emitted by candlelight is in the region of the orange to yellow-orange part of the spectrum. Therefore, I will need to appraise the appearance of the individual colours and their optical relation in the naves where artificial light prevails, before being able to engage in analysis of the appearance of the seventeenth-century decoration.

The investigation in this part will be conducted over two chapters. In Chapter Six I will evaluate the natural illumination of the naves as it would have been in the seventeenth century by estimating the levels of luminance attributed to the incoming daylight. In Chapter Seven I will pursue the argument that, as artificial light dominated the interior illumination of the naves, this resulted in an increase in the colourfulness of the interiors and underpinned the meaning of the images. I will seek to contextualise the images within their Byzantine-Greek heritage, in particular biblical texts, as they provide the frame of reference for the meaning which the images were intended to convey.

CHAPTER SIX

Natural Illumination in the Seventeenth-Century Arbanassi Naves

The aim of this chapter is to evaluate the original natural lighting of the Arbanassi naves in the context of my investigation into their appearance under the probable seventeenth-century interior illumination. As discussed earlier, the lighting characteristics that can affect the appearance of the interiors are the colour and the brightness of the light. Because natural illumination is typically considered to be colourless, I will only estimate the luminance of the interior created by the incoming daylight. I will consider previous studies of interior luminance of church interiors, elucidate my methodological concerns associated with the fact that the majority of the Arbanassi nave windows are permanently closed with shutters for conservation purposes and develop a methodology to overcome the latter problem.

I centre my methodology on estimating the level of brightness created by the incoming daylight likely to have been experienced in the seventeenth century. My starting point is that the experienced brightness is a function of the fenestration, the availability of light and the volume of the nave chambers. For example, the greater the total illuminating surface provided by the fenestration and the better the availability of direct sunlight, the brighter the chamber. Conversely, the smaller the volume of the chamber in relation to the total illuminating surface, the higher the level of the experienced brightness.

Although the total illuminating surface for each nave depends on the size of the architectural openings, the availability of light is dependent on a number of variables relating to the overall architectural design of each church. In this context I will examine the existence of glazing in the seventeenth century, as glazing lowers the level of the interior luminance because of optical distortion through absorption and refraction of the incoming light. The relation between the apertures and any shading devices is also scrutinised, as these also influence the intensity of the incoming light.

However, before commencing my investigation into the likely seventeenth-century levels of brightness of the natural illumination of the naves, I need to evaluate the authenticity of the present form of the architectural structures and of their fenestration in particular. Any significant alteration of the original architectural design can be expected to alter the perception of the colours of the decoration and ultimately of the nave interiors.

6.1 Fenestration in the Seventeenth Century

When I considered the available research associated with the construction history of the Church of the Nativity, it became apparent that it is reasonable to accept that the space of the nave and its fenestration are now in the same form in which they were in the seventeenth century.

In the case of the Church of the Archangels, however, there are contradictory opinions among scholars about the shape and size of the church building in the seventeenth century. In the 1970s, Mardi-Babikova presented a case that the church existed and functioned as a one-nave church from the middle of the sixteenth century to the middle of the eighteenth century, and only then were the rest of the chambers added and painted.[428] Later, in the 2000s, Vatchev proposed that the entire church, with its various divisions, had been built as a single construction in the seventeenth century. His explanation for the stylistic difference between the frescoes in the outer narthex and those in the nave was that, initially, only the nave was painted, while the other chambers were painted later, in the middle of the eighteenth century.[429] However, the earlier opinion, that of Mardi-Babikova, is more plausible on the basis that the conclusion reached by Vatchev was based on false premises.[430]

The first premise in Vatchev's hypothesis was that there is no difference in the material used in the construction of the nave and the outer narthex. However, such a presupposition does not take account of the fact that all the churches included in this research were built of the same basic material: readily available local stone, with only occasional use of bricks and timber. Furthermore, in the various constructional stages of some of the churches the same kind of stone was used throughout, but no difference in the appearance of the various parts has been reported. For example, the Church of the Nativity is considered to have had three constructional stages, but nevertheless the material used for each of these is basically the same local stone. It was only when the difference in the thickness of the walls of the nave and the rest of the building was discovered during an examination of the treatment of the window sills around the church that the existence of more than one stage in the construction was suggested.

The next premise on which Vatchev based his argument was the lack of any clear indication of the chapel being joined to an earlier structure. It is however technically possible to add a wing to an existing structure and have no clear di-

[428] Mardi-Babikova, *Arbanashkite Tžurkvi*, p. 15. She based her conclusion on a stylistic analysis of the wallpaintings.
[429] H. Vatchev, *Tžurkovnijat ansamble v Arbanassi*, pp. 61–63.
[430] Ibid., pp. 61–63.

viding line between the new and the old structure if the same material is used in the second stage of the construction. Such a division cannot be avoided when a more primitive way of joining structures has been used. For example, in the case of the second building stage of the Church of the Nativity, the new structure immediately abuts the existing one. However, this method of construction is usually avoided as it can produce a mechanically vulnerable structure. This proved to be true for the Church of the Nativity, when a technical inspection of the building in the 1970s discovered problems with the walls moving apart in the places where two building stages met. It was decided that reinforcing buttresses needed to be added on the long sides of the structure to prevent the original and the new buildings from moving away from each other, which would have led to the roof collapsing (Figure 33).[431]

This problem is generally avoided with the use of the alternative technique: careful removal of the end stones or bricks on the part of the existing building to which the new is to be joined. This enables the new construction to be firmly anchored to the old one. This technique is preferable not only mechanically but also aesthetically and, if performed skilfully, it can be difficult to identify the junction between the old and the new structure. This provides a possible explanation for the lack of any obvious signs of joining of the earlier part to the newly erected one. Furthermore, while there may have been initial colour and textural differences between the freshly obtained stone used for the new and the weathered stone of the old part, it is reasonable to expect that, over the last two centuries of the building's existence, the processes of weathering would have evened out such initial differences.

Vatchev's final premise about the stylistic unity of the exterior decoration cannot be accepted as supporting his conclusion that there was only one

[431] Prashkov, *Stenopisite v Tžurkvata Roždestvo* pp. 41–43.

constructional stage. By stylistic unity, Vatchev meant the introduction of the same decorative elements on all the façades. These elements are in the form of very shallow niches constructed primarily of bricks and mortar, but well incorporated into the stone construction. However, it can be argued that the repetition of a distinctly characteristic element of exterior decoration might be expected in any later enlargement of a building and therefore cannot be used to prove the lack of different constructional stages. Furthermore, closer examination of the niches reveals that there is a difference between the niches on the south wall, which is supposed to be part of the first constructional stage, and those on the north façade (Figure 34).

As can be seen from Figure 34, the overall impression of the form was preserved, but the detailing and the proportions of the niches on the north wall are obviously different, the niches on the south wall showing more refinement in their detail and execution. Because of the lack of any written documents from the time, it cannot be proved beyond doubt that these apparent differences evidence two separate stages of construction. One possible conclusion is that the north side was erected by a different group of craftsmen and that they were less skilful than the group involved in the construction of the south wall. Equally, there is nothing to prove that two groups working separately on the different faces of the church erected the building in a single phase. Therefore, it is difficult to accept that the mere existence of niches on the two exterior walls, displaying only an overall similarity, is proof of the church building having been erected in its entirety in one constructional stage.

So far in my exposition, I have argued that the premises put forward by Vatchev in favour of the existence of only one stage in the construction of the present architectural shell of the church are questionable. I will now argue against his hypothesis using the existing elements of the interior design. These elements offer support to the hypothesis of Mardi-Babikova that there were at least two constructional stages. To clarify my argument, Figure 35 is an illustration of the floor plan of the church.

This plan shows one unusual feature; the alcove on the north wall of the church nave protrudes further into the nave of the chapel dedicated to St Paraskeva than is visually satisfactory. The apparent result is that the semi-cylindrical shape of the outside of the alcove occupies nearly a quarter of the interior space that the chapel would otherwise have had. This kind of arrangement can reasonably be expected to occur only if the body of the chapel was built around the outline of the existing main nave. If the church was designed and built in one stage, as claimed by Vatchev, it would be more plausible to expect that the chamber of the nave would have been planned and built with a straight north wall, rather than with an alcove.

Furthermore, there is a considerable difference between the levels of the floors in the nave and those in the inner narthex. Vatchev himself argued that the existence of a difference of 25 centimetres in the floor levels of the parallel spaces of the chapel of St George and the narthex and the nave of the Church of St Dimitr itself suggests that there were two stages in the constructional history of that church (Figure 36). Therefore, it is difficult to see why he interpreted a comparable difference in levels in the Church of the Archangels in the opposite way.[432]

In the case of the Church of the Archangels, the floor of the inner narthex is 26 centimetres higher than the floor of the nave. By analogy with the case of the Church of St Dimitr, it can be suggested that in all probability this indicates that

---

[432] Vatchev, *Tžurkovnijat ansamble v Arbanassi*, pp. 55–56.

the Church of the Archangels Michael and Gabriel was also constructed in two stages (Figure 37).

My conclusion is that the Church of the Archangels Michael and Gabriel existed initially as a single-nave structure and that all the present internal openings were in fact external at the time when the nave was decorated. Therefore, in order to ascertain the impact of the relationship between the architecture of the church and the sun, from this point on I will treat the window in the north apse of the nave as having been an external aperture in the seventeenth century.

Finally, I need to consider the original form of the churches of St Atanass and St Dimitr. The available research associated with the construction history of both churches suggests that it is reasonable to accept that the footprint of the buildings is unchanged since the seventeenth century as is the fenestration of the Church of St Atanass. The nave windows in the Church of St Dimitr, however, were fitted in the 1950s. The interruption of the pattern of the remaining original decoration in the apse, for example, suggests that at that time the existing openings were enlarged. There are no remains of the seventeenth century decorative layer on the south wall, where there are two of the modern window frames. Nevertheless, it is plausible, because of the overall similarities in the exterior form of the Arbanassi church architecture that originally the south wall of the nave contained fenestration in the area where the present windows are, but the original ones were much smaller, in keeping with the general architectural style. Subsequently, on the strength of this presumption, I will suggest the plausible level of brightness in the seventeenth-century nave of St Dimitr by association.

6.2 Methodological Concerns

The level of illumination of an interior can be assessed objectively by measuring the amount of light that reaches a unit area with the human brightness perception taken into account. Such a measurement is a quantitative representation of the illumination level of a surface (i.e. the quantity of light received by a unit area) and is known as illuminance.[433] The higher the value of the measured illuminance, the brighter and perceptually more colourful the environment, because the recognition of colours increases as the vision shifts towards being fully photopic.[434] To assess the luminous properties of the naves quantitatively it is necessary to measure the illuminance of each interior at different times of day, throughout the year, and then to evaluate and compare the results.

Two works in the field of Byzantine studies offer a plausible methodology for a detailed examination of the luminosity of natural light in the context of a church interior. These are by Illiadis and Schibille.[435] In fact, Illiadis developed a methodology in connection with his work on the distribution of natural light in the Rotunda in Thessalonica that Schibille later used to investigate the perceptual significance of light in the early Byzantine church of Hagia Sophia.

Both researchers used the measurement of illuminance as an indication of the level of luminance (brightness) of the respective interiors of the Rotunda and of Hagia Sophia. Each investigation involved the collection of direct light measurements throughout the day at a number of selected points in the building. Illiadis appears to have carefully located these points vertically and horizontally

---

433 In the metric system the accepted size of the unit area is one square metre.

434 As previously explained, photopic vision is the vision of the eye under strong illumination, which allows full colour vision.

435 Illiadis, 'The Natural lighting of the Mosaics in the Rotunda at Thessaloniki', pp. 13-24 and Schibille, 'Light in Early Byzantium: The Church of Hagia Sophia in Constantinople'.

on the surface of the mosaics according to the hierarchy of the liturgical space from the entrance to the altar.[436] The horizontal points were selected along the longitudinal axis of the building from west to east and around the wall at a height of one metre above the floor. The vertical points were selected along the walls and on imaginary lines connecting the floor and the vault at regular intervals of two metres. The instrument employed by Illiadis was a portable photographic illuminance meter (luxmeter), a Topcon IM-2D.[437] Schibille also gathered light measurements at various times of the day and at a number of points, although the location of these points is not as clearly specified and argued as in the work of Illiadis.[438] To perform the measurements, she employed a portable photographic illuminance meter, a Minolta Auto Meter III-F. According to the available technical data, both devices are capable of collecting accurate illuminance data.

Both Illiadis and Schibille based their conclusions on the results of measurements taken over a short period, no longer than two months, and in one season, autumn. Although Schibille noted that the gathered data was admittedly far from comprehensive and was only of an indicative nature, nevertheless she considered that it appeared to be sufficient to form an overall view of the level of the brightness of the interiors.[439] It needs to be stressed, however, that if a

---

[436] The vertical hierarchy is that from earthly to heavenly and the horizontal is from the entrance to the altar, which manifests the symbols of salvation, according to Christian teaching.

[437] Illiadis, 'The Natural lighting of the Mosaics in the Rotunda at Thessaloniki', pp.18-20. The Topcon IM-2D has a measurement range between 0.1lux and 19,900lux with an accuracy of ±5%. Lux (lx) is the International System of Units, SI (*Système international d'unités*), unit for measuring the illuminance. The imperial measure is a foot-candle (ft^2) where 1 ft^2 = 10.76 lx. One foot-candle is the quantity of light received on a surface with an area of one square foot when the latter is one foot away from a light source of the intensity of 1 candle or candela (cd). One candle was initially the standard source, but now there is an internationally accepted standardised light source, which represents the light emitted by one-sixteenth of a square centimetre of the surface of a blackbody radiator operated at 1774°C (2047°K), which is the freezing temperature of platinum, at a normal atmospheric pressure of 101325 Pascals (Pa).

[438] Schibille, 'Light in Early Byzantium: The Church of Hagia Sophia in Constantinople', p. 96.

[439] Ibid., pp. 96-97.

profile of the interior illumination is to be representative of the daily, seasonal, and climatic changes in the light, it is necessary for measurements to be taken over a long period of time and for the results to be assessed statistically.

There is, nonetheless, a methodological problem that prevented me from using such methods of direct measurement. This resulted from the current restriction or even exclusion of the entry of daylight into the naves of the Arbanassi churches. For example, although it was possible to open the 1970s shutter on one of the main windows in the nave of the Church of the Archangels, if measurements were taken from the area of the window whose shutter could be opened, the collected data would not be representative of the general level of illumination in that chamber. The same is valid also for the altar space, even though the small windows serving it are unobscured.

The Church of St Atanass has been and is still in use as a cemetery church and its shutters can either be closed or left open. However, as part of the conservation programme associated with the church, the windows openings are fitted additionally with single-glazed panels, securely fixed to the architectural frame. The glass of the panels is textured and intensely coloured in a yellow-green hue.[440] The quantity and the quality of the natural light reaching the interiors is highly modified by this glass and if light measurements were taken in the nave chamber, they would be affected. Changes in the light passing through the glass are effected by the reflection and diffusion of a portion of the rays by the glass before the light enters the chamber. The result is a loss of brightness in varying degrees. The incoming light is also changed by the other phenomena closely related to the microstructure of the glass, such as refraction and absorption,

[440] Examination of the glazing material shows that the usual tints are yellowish or greenish, depending on the raw materials used.

which also result in changes to the colour of the incoming light,.[441] Refraction is the change in the speed and direction of the light-waves when light passes from one medium to another.[442] However, because the glass used in the windows of the nave of the church of St Atanass is relatively thin, the effects of refraction can be considered negligible.

The most dramatic changes occurring in the incoming light are the result of absorption. The absorption of some wavelengths from incidental light, but not others, leads to the appearance of colour in substances. The window glass in the Church of St Atanass absorbs all the wavelengths except those in the yellow and green part of the spectrum, so acts as a colour filter which therefore colours the incoming light yellow and green. It can be concluded, therefore, that the presence of coloured window glass changes the colour (quality) of incoming light, compared with clear glass (and especially compared with a complete absence of glazing), and also reduces significantly the luminosity (quantity) of the natural illumination. As a result the use of a quantitative method to ascertain the illuminance of the nave interior in this church is not appropriate.

Therefore, it is necessary to seek either a complementary or even an alternative approach to the investigation that will allow an indirect assessment of the luminance of the interior. Because the main question about the natural lighting in the naves of Arbanassi is the general level of illumination of the interior as a whole (the experienced brightness), I will consider the internal relationship between the incoming light and the interior space. Any method for the

[441] In any case, the glass material acts as a colour filter, letting in only that part of the visible light which corresponds to the colour of the glass and absorbing the rest of the spectral variety. R. Tilley, *Colour and the Optical Properties of Materials*, (Chichester, 2000), pp. 18-19; 28-33.

[442] The angle of incidence is different from the angle at which the light leaves the medium – the angle of refraction.

assessment of the level of brightness in the naves must necessarily be based on general architectural principles.[443]

Theoretically, the linear relationship between the size of the apertures, the amount of light that passes through them and the size of the area they serve in relation to the size of the apertures, influences the magnitude of the experienced brightness within that space. Even though Illiadis and Schibille both measured the levels of illuminance, they found it necessary to investigate certain aspects of the association between the illuminating and the illuminated elements of the design. Their targeted approach was specific to the aim and scope of each individual research. Illiadis, being directly interested in the existing level of illumination of the Rotunda's mosaics, engaged in a detailed examination of the relationship between the illuminating window surfaces and the illuminated surface of the mosaics.[444] He indirectly explored this relationship by extrapolating the ratio between the total surface of the dome and the illuminated surface of the upper windows. He also checked the effect of this ratio by taking light measurements. What Schibille sought was a connection between the difference in the level of brightness in different areas and their significance in the theatre of the Divine Liturgy.[445] She compared the total surface area of the windows in the relevant part of the interior with the comparative height of those areas.

As I am interested in the total level of brightness, I have adopted a method that is used at the design stage of a building.[446] It is based on the proven correlation

---

[443] Mateev, *Arhitecturata kato Fenomen*; Lam, *Sunlight as Formgiver for Architecture*; J. Grosslight, *Light, Light, Light: effective Use of Daylight and Electric Lighting in Residential and Commercial Spaces* (Tallahassee, 1984); N. Ruck, O. Aschehoug, S. Aydinli, J. Christoffersen, *Daylight in Buildings - A source book on daylighting systems and components*, (Berkeley, 2000), M. Fontoynont, *Daylight Performance of Building* (London, 1999).
[444] Illiadis, 'The Natural lighting of the Mosaics in the Rotunda at Thessaloniki, pp.13-24.
[445] Schibille, 'Light in Early Byzantium: The Church of Hagia Sophia in Constantinople'.
[446] Mateev, *Arhitecturata kato Fenomen: Teotrija na Prostranstvoto*;Lam, *Sunlight as Formgiver for Architecture*; Grosslight, *Light, Light;* Fontoynont, *Daylight Performance of Building*.

between the levels of brightness and the ratio (as a percentage) between the total illuminating surface area and the surface area of the floor of a room. This ratio is called relative brightness and is associated with the level of detailed activities that can be carried out within an area that has a certain relative brightness. For instance, the minimum relative brightness required for the safe performance of very simple casual tasks is 10%. This is the accepted ratio for stairwells in an average architectural setting (domestic or public), where the accepted minimum illumination level is 100 lux.[447] This level of illumination is usually compared to the experience that a beholder has during a very dark overcast day. For the comfortable performance of daily tasks, however, the accepted minimum illuminance is 300 lux, represented by approximately 20% relative brightness.[448] This level of luminance is very similar to that of low-level office lighting.

The ratios of relative brightness offer acceptably accurate estimates in any contemporary domestic or office setting.[449] The estimates are usually considered for standard illumination conditions, which are taken to be a completely overcast sky. The question then is to what extent the concept of relative brightness is applicable in the context of historic ecclesiastical interiors. I suggest that it can be successfully used in the case of the Arbanassi interiors because the ecclesiastical architecture of Arbanassi is on an intimate scale. Therefore, the tectonics of light in these churches are more comparable to those in domestic or normal office architecture. In interiors such as those of the Rotunda and of the Church of Hagia Sophia, this approach would not be particularly viable because of the dif-

---

[447] Lux is the unit of illuminance indicating the luminous power per area and represents the intensity of illumination, as perceived by the human eye.
[448] Grosslight, *Light, Light,* p.140 and G. Baldgiev, 'Priložna Svetlinna Tehnika: Osvetlenie na Rabotni Pomeshtenija/ Prostranstva', *DS*, (2007), 5035:1-7. Baldgiev's work presents a standard for indoor illumination derived from visual tests carried out with the participation of average middle-aged observers.
[449] Ibid., 5035:1-7.

ferent dynamics introduced by the great height of the ceilings and the rather complicated system of daylight illumination in both those buildings.

Establishing the ratio of the relative brightness in the seventeenth-century naves will both ascertain the level of natural illumination and give some idea of the level of detail recognition that could be achieved. Moreover, this will indicate how easy it might have been to distinguish the compositional details and will also help to deduce how that might have affected the appearance of the decorated space of the nave, because of the relation between the brightness of the environment and the ability of the human eyes to recognise colour. To find the value of the ratio of the relative brightness for each nave, I will calculate the total illuminating surface area, which is the total surface of the apertures that contribute to the illumination of a particular nave, and the surface area of its floor.

6.3 Computation of the Illuminating Surface Areas

In each church there are two or three main nave windows, predominantly rectangular in shape, though the main windows of the Church of the Archangels Michael and Gabriel are arched. In every altar area, two small windows are situated above each other in the apse. The upper of these two windows is circular or square. The lower are all rectangular. When there are internal openings between the nave and some other chamber, as in the case of the window-like opening between the nave of the Church of the Nativity and the chapel of St John the Forerunner, or the doorway between the nave and the chapel of St Harallampii in the Church of St Atanass, there will be a certain amount of light exchange between those chambers through the internal openings, which can be termed ‘borrowed light’. When considering the sources contributing to the brightness of a chamber the role of such internal openings needs to be estimated, as their exact contribution can only be proved by the use of direct light measurement, which it is not possible to carry out. I will now examine the apertures into the naves of three churches only - the churches of the Nativity, the Archangels and St Atanass - and will calculate the relevant illuminating areas. As I have already mentioned, the window openings of the Church of St Dimitr were modified after 1913.[450]

6.3.1 Church of the Nativity of Christ

The Church of the Nativity of Christ has two south-facing windows of differing outside dimensions. Working from east to west, the surface area of the first window is 0.60 square metres and of the second is 0.49 square metres.[451] In the apse, the surface of the lower window is 0.14 square metres and the surface area of the upper window is 0.12 square metres. The total exterior window surface area in the building is therefore 1.35 square metres. The nave has a further two internal apertures that existed in 1668 when the frescoes were executed. On the west wall, there is a door from the inner narthex with a surface area of 1.44 square metres. On the north, there is a window-like aperture, opening into the inner narthex of the Chapel of St John the Forerunner, which has an area of 0.50 square metres. Therefore I need to consider the contribution of these two internal openings.

In my research I have not been able to find an established method for estimating the contribution towards the general level of brightness of 'borrowed light' through interior apertures. I will therefore consider an estimation of the possible 'borrowed' contribution in the context of the level of illumination present in the adjacent chambers into which the interior apertures open. In the inner nar-

---

[450] Vatchev, ' Enoriiskiat hram v Turnovskata Mitropolia'.
[451] The dimensions of the windows are: W_1 height 0.75 m and width 0.80 m, and W_2 height 0.75 m and width 0.65 m.

thex of the Church of the Nativity the illuminating surface of the north-facing windows of the chapel is 0.80 square metres. The illumination they will provide will be diffused and comparatively low at all times. Although the inner narthex has two south-facing apertures, the illuminated volume is nearly three quarters of the volume of the nave chamber. Therefore it is difficult to imagine that they would have altered the total brightness to any significant degree. It can be argued that the minimal impact of that borrowed light could be accounted for by increasing the total outside window surface area by 1% or 0.01 square metres.[452] When the correction proposed above is taken in consideration, the proposed total illuminating area in the nave of the Church of the Nativity can be considered equal to 1.36 square metres.

6.3.2 Church of the Archangels Michael and Gabriel

The nave of the Church of the Archangels Michael and Gabriel has three south-facing windows, each having different outside dimensions. Counting from east to west, the surface area of the first window is 0.38 square metres, that of the second is 0.23 square metres and that of the third is 0.22 square metres. In the apse the surface area of the lower window is 0.30 square metres and that of the upper window is 0.07 square metres. The total external window surface area in the nave is therefore 1.20 square metres. The nave has a further two internal apertures. On the west wall there is a door from the inner narthex with a surface area of 1.83 square metres. On the north wall, in the alcove, there is a window-like aperture, opening into the nave of the chapel of St Paraskeva, which has an area of 0.24 square metres. As the Church of the Archangels was a single-nave church and the internal opening was in fact external in the seventeenth century the total illuminating area is brought to 3.27 square metres.

[452] This area is equal to 5% of the area of the inside apertures.

6.3.3 Church of St Atanass

In this church there are two south-facing windows of approximately equal size and both are situated on the north wall of the chamber. The surface area of each window is 0.57 square metres. In the apse the surface of the lower window is 0.12 square metres and that of the upper window is 0.20 square metres. The total external window surface area is therefore 1.46 square metres. The nave has a further two internal apertures. In the west wall there is a door from the church narthex with a surface area of 1.33 square metres and in the south wall there is a door from the Chapel of St Harallampii with a surface area of 1.56 square metres.

While the door from the narthex cannot be expected to contribute to the light in the nave, as there are no windows in the narthex itself, the door on the south wall makes a significant contribution. This was apparent from the observations I made during fieldwork in August/September 2005. At the time, there was no electrical power in the building and the north windows did not give much light. It was necessary to keep the south door open most of the time in order to provide a twilight level of general illumination. The light was sufficient for the performance of simple tasks and to navigate safely around the place. However, when the door had to be closed, in order to avoid glare while taking photographs of the wall paintings in the area immediately around the door, the chamber became very dark. In fact, the state of darkness was such that it was almost impossible to distinguish between objects. This observation illustrates the importance of establishing whether the south door was in situ in the seventeenth century or whether it was added later.

Moreover, if that door was initially an external opening, an even greater contribution from this aperture to the increase of the experienced brightness of the interior is to be expected. The total illuminating area will be brought up to 3.02 square metres. This creates a significant discrepancy between this estimate and the earlier estimate for the illuminating area of 1.46 square metres. Such a difference between the illuminating areas for spaces with the same volume and configuration can be expected to predispose significantly different levels of colour sensitivity and recognition, even after taking the phenomenon of colour constancy into account. Therefore I need to investigate which of these two scenarios is most likely to have been employed in the seventeenth-century.

My examination of traditionally-built structures in the Turnovo area showed that there are churches in existence that have external doors additional to those on the main longitudinal axis. These doors, with a few exceptions, are positioned on the south wall of the nave, as in the Church of St Atanass. For example, the Cathedral Church of St Nikola the Wonder-Worker of Kapinovo Monastery (initially built in 1272) and the Church of St Iliya of Plakovo Monastery (initially built in 1450) each have a south-facing door giving access directly into the nave, in addition to the west-facing door into the narthex of those churches.[453] However, it is still difficult to establish decisively whether these side doors into the naves were installed initially or at the time of later renovations in the nineteenth century. Therefore it is not possible to provide clarification by way of comparison as to whether the south door in the Church of St Atanass was part of the original construction, representing an existing tradition, or was installed later as a matter of convenience.

In 1997, Rutzeva concentrated only on the stylistic examination of the wall paintings, devoting little attention to the architectural fabric of the church building, but arguing for the stylistic unity of the interior. Such argument could be

[453] Kapinovo is around 12 km and Plakovo is around 40 km from Arbanassi. I. Božilov, N. Touleshkov and L. Prasliov, '*Bulgarski Monastiri*' (Sofia, 1997), pp. 111-120; 147-152.

taken indirectly to suggest that there had not been any alterations to the chamber.[454] In 2006, Vatchev extended Rutzeva's argument about stylistic unity specifically to the area of the south door of the nave.[455] According to him, the south door was already in existence at the time of the painting of the nave.[456] He argued from this that the decorative programme of the nave presents a general stylistic unity, as proved by Rutzeva, and most importantly, the image of the Venerable St Sisoes the Great (usually depicted as weeping over the grave of Alexander the Great, in horror at the relentless passing of time and the vanity of this transient world) that occupies almost the entire space of the first register above and to the left of the south door, can be stylistically considered to be an integral part of the decoration(Figure 38).[457]

The image of the saint seems to have been a popular choice for the space above the entrance door; it can be seen, for example, above the door leading from the nave of the katholikon of the Meteora monastery. There the image is carefully spaced above the frame of the door, in contrast to the offset positioning in the nave of the church of St Atanass (Figure 39).

Vatchev argued that the Arbanassi image was conceived and executed when the entire nave was painted in 1667. His argument is that the image is well-positioned above the door and the text included in the composition is well-presented. However, on closer examination, this claim raises some doubts. It may be that the opening was there before the painting began and the interruption of the image to the left is a result of decisions taken by the artists at the time of execution of that register. Vatchev's insistence that the fact that the text is well-positioned within the frame of the scene cannot be taken in support of this

[454] See the introduction to this thesis.
[455] Vatchev, *Tžurkovnijat ansamble v Arbanassi*.
[456] Vatchev, *Tžurkovnijat ansamble v Arbanassi*, pp. 65, 68.
[457] "Alexander died, Alexander was buried, Alexander returneth into dust; the dust is earth; of earth we make loam …."

second scenario. This is because, in any event, the text was one of the last elements added to the composition. It would have been, therefore, possible to plan its arrangement within the well-defined compositional space.

Moreover, another problem demonstrates itself when comparing the two illustrations of scenes of St Sisoes's lament, one from the nave of the Church of St Atanass, the other from the Meteora monastery (Figures 38 and 39). During such comparison it becomes apparent that the scene from the Church of St Atanass does not occupy the entire width of the door, unlike the image from the decoration of the katholikon of the Meteora monastery. The right side of the frame of the image of St Sisoes in the Church of St Atanass arrives part way along the lintel to allow more space around the upper part of the body of the saint in the adjoining scene. Moreover, that neighbouring image itself does not fit comfortably within the space allotted to it. The problem is manifested in the elbow and the left part of the cloak of the saint being cut off (Figure 38). Also, the part of the image that is immediately next to the doorway finishes suddenly, leaving the outline of the bottom half of the figure running into the frame of the door, making the composition appear unbalanced within the frame.

It can be argued that such an arrangement came about as a result of the doorway being opened after the saints of the first register had been painted, interrupting the rhythm of that register. There is a point that can be put tentatively in support of this scenario and that is that stylistically there are some dissimilarities between the image of St Sisoes and the other two images surrounding it. The image of St Sisoes is painted in a much more expressive style than the other two saints and the detailing, such as the treatment of the hair or the hands of the saint, is executed with greater care. In contrast, the image from the katholikon of the Meteora Monastery stylistically resembles the surrounding images, even though the posture of St Sisoes is understandably more dramatic than that of the neighbouring ones. For that reason, it is more likely than not that the south door into the nave of St Atanass was created after the decoration of the nave was initially completed. Nevertheless, because the existing stylistic difference between the scene with St Sisoes and the rest of the decoration are not sharp, in all probability the painter was from the same group of painters that worked on the rest of the decoration.

To establish with certainty, however, whether the scene of St Sisoes was an afterthought or carefully planned from the beginning, it would be necessary to probe into the painted surface below, in order to establish whether there was an earlier layer of wall paintings directly under the image. Regrettably, this was not possible at the time of my fieldwork. In view of this, as the original arrangement on the south wall of the nave cannot be proved beyond doubt, I will extrapolate the lightness of the interior, taking into account different illuminating surface areas resulting from these two possible alternative scenarios discussed above. At the beginning of the section investigating the original openings of the church of St Atanass, the initial number at which I arrived was 1.46 square metres of surface area the first scenario, where the illuminating area is a sum of the surface areas of the nave windows only. The second scenario is with the illuminating area equal to the sum of the above and two thirds of the surface area of the south doorway. This is assuming that the doorway had originally been an internal opening.

Earlier I deduced that the windows of the chapel facing south receive direct sunlight for a good part of the day, securing bright natural illumination. Furthermore, in the specific schematic examination of the relationship between the altitude of the sun and the window openings of the chapel, it became apparent that when the sun is low enough, some direct sunlight might be able to reach the nave. This is possible because the chapel area is narrow at 1.4 metres and the side door into the nave and the third window of the chapel lie on the same axis, opposite each other. Calculations indicated that the chamber of the nave, being almost twice the size of the chapel, has only about half the illuminating area of the chapel.[458] This particular door opening contributes noticeably to the natural illumination of the nave and especially the western half. The brightness of the incoming daylight diminishes as the distance from the window increases. It can therefore be suggested that the surface area of the existing doorway contributes nearly as much as an external opening would, but with a surface area no greater than two-thirds of that doorway.[459] Numerically such an approximation amounts to about 1.04 square metres, as the surface area of the south doorway is 1.56 square metres. When the total illuminating surface area in the Church of St Atanass is amended with the figure above, it brings it to 2.50 square metres.

The third scenario produces an illuminating area consisting of the surface areas of the nave windows and the surface area of the doorway assuming that the south-facing door was an external opening, and is 3.02 square metres. The illuminating areas in the other two churches are respectively 1.36 square metres for the nave of the Church of the Nativity and 3.27 square metres for the nave of the Church of the Archangels.

To estimate the levels of brightness that the illuminating surfaces in each nave were likely to create, I must take into account the availability of daylight and in particular how readily the interiors were illuminated by direct sunlight, as this kind of illumination will best contribute to the level of brightness of the naves. This will necessarily involve appraisal of the architectural design and its setting.

---

458 The calculated volume of the chapel is 23.32 cubic metres and the illuminating area is 2.24 square metres, compared to the 40.30 cubic metres volume of the nave and only 1.46 square metres of illuminating area.

459 Lam, *Sunlight as Formgiver for Architecture*, p.33.

The setting will affect the illuminance of the indirect daylight that enters the interiors, while elements like the roof overhang and the position of the windows in relation to the sun and in relation to the overhang will determine what kind of daylight enters the fenestration, direct or indirect. Hence, next I will examine the elements of the architectural design of the churches that might have influenced the availability of light.

6.4 Architectural Design and Natural Illumination

The elements of the Arbanassi church buildings that can be expected to have modified the direct incoming light, and which I will examine in this section, are the presence of glazing in the seventeenth century and the position of the window openings in relation to the annual trajectory of the sun. For the cases where the interiors received only indirect natural illumination I need to consider the ability of the materials of the immediate surroundings of the churches and their interiors to reflect light.

Archaeological and art historical research on the site shows no material evidence that any of the churches originally had glazed window openings. Instead, the apertures had horizontal bars, installed for security purposes.[460] The availability of glass was good at the time, although it was expensive, and the larger seventeenth-century houses of Arbanassi were originally partially glazed.[461] It is therefore difficult to argue that economic reasons accounted for the lack of glazing; the donors of the churches did not lack resources.[462] The question then is what might the reason have been for this design decision. Was

[460] The window frames, containing coloured glass for the reduction of UV radiation, were fitted much later, in connection with the conservation project for Arbanassi.
[461] Kostov, *Arbanassi*, p. 25.
[462] Haritonov, Chohsdsžieva, Rutževa, *Arbanassi*, pp. 45-46.

the case of Arbanassi an exception to usual building practices or was it part of a tradition in which glazing of ecclesiastical buildings was not expected?

Inconsistent glazing practices can be observed in the Byzantine era. Schibille wrote that primary literary sources led her to believe that originally the windows of Hagia Sophia had been glazed and attributes the fact to the lavish, almost extravagant, use of materials in the construction of the church.[463] Illiadis, however, does not mention the existence of any glazed window panes, at any time either past or present, in the Rotunda in Thessalonica.[464] His research investigates incoming light with a meticulous attention to detail; he scrutinises all the elements of architectural design that might have influenced the incoming light. Therefore, it is difficult to assume that such a significant element would have been omitted from his investigation.

In his conceptual work on the role of natural lighting in an architectural environment, Lam briefly discuses the glazing practices in both Byzantine and post-Byzantine churches, speaking of the existence of both unglazed and of glazed sites.[465] Lam gives as an example Greece, where he discovered that the churches that had been glazed used clear, rather than coloured glass.[466] From his research, Lam concluded that the unglazed windows are usually small, placed relatively low and protected by overhanging roofs and/or deep window reveals. This positioning was observed even in cases where the ceiling heights were considerable. Lam concluded that the omission of glazing was a common practice in sunny climates.

---

463 Schibille, ' Light in Early Byzantium: The Church of Hagia Sophia', pp. 89-93.

464 Illiadis, 'The Natural lighting of the Mosaics in the Rotunda at Thessaloniki', pp.13-24.

465 Lam, *Sunlight as Formgiver for Architecture*.

466 Ibid., pp.73-72. There is a photograph of an unidentified post-Byzantine church that shows the window arrangement.

The deduction made by Lam about the correlation between glazing, climate and size of windows can be disputed in general terms, because although the summers in Greece, and for that matter in Bulgaria, are hot, the winters, on the contrary can be very cold. However, I would argue that because of the small size of the windows and the traditionally extensively overhanging roof, the interiors of the church buildings of Arbanassi are usually sheltered from weather. The degree of protection provided by this arrangement was sufficient for the way an Eastern congregation uses the liturgical space of a church. The nave would have been crowded during liturgical times, with the congregation habitually standing in their overcoats rather than sitting. The church interior was illuminated by incandescent lighting, with a number of the worshippers holding candles in a sheltered space. In these circumstances, the comparatively small volume of the nave chambers could be expected to have led to an appreciable increase in the interior temperature. Therefore, the lack of glazing would not have presented a significant problem during the Arbanassi winter. Conversely, it is self-evident that in summer, because of the small size of the windows and the large overhang of the roofs of all of the churches, the interiors would have been shielded from prolonged exposure to direct sunlight.

Lam also suggests that another factor, apart from economic considerations and climate, that played a significant role in decisions about the treatment of the window openings was the predominant local tradition in church architecture. My own observation of rural parish church architecture in the region of Turnovo and in the southern parts of Bulgaria suggests that unglazed windows were commonplace, even in the period after the liberation from Ottoman rule. Window openings were usually protected only by shutters and fitted with iron bars. This approach seems to have continued as late as the first half of the twentieth century.

From this it can be concluded that, although there is inconsistency in the glazing of Byzantine as well as post-Byzantine churches in the Balkans generally, the local building tradition in the Turnovo area in particular indicates a tendency to omit glazing, specifically in the earlier post-Byzantine period. It can be assumed, therefore, that the Arbanassi churches were not glazed at the time of their construction. The consequence is that all the available daylight entered the church buildings undistorted, producing the highest level of illumination in any particular circumstances.

Theoretically, the overhangs will affect the intensity of the incoming light, as they manipulate the availability of direct sunlight by shielding the window apertures and allowing only indirect light to enter. The deeper the overhang and the closer the window openings are to the soffits of a building, the better the roof will shield the façade from direct sunlight, allowing only indirect light reflected from the surrounding ground to enter the interior, thus reducing the level of natural illumination. I therefore have to consider where in relation to the roofs the apertures of the naves are in the context of each of the four buildings.

Although only the roof of the Church of the Nativity is considered to be the original seventeenth century one, the roofs of the other three churches, the Archangels, St Atanass and St Dimitr, do not greatly vary in their overall profile. For example, the simple pitched configuration of the apex of the east elevation of the roofs is a common design feature of the four Arbanassi churches. As is apparent from Figures 40-43, it is likely that the overhangs, although deep, will not affect the illumination of the apse windows of the churches as they are positioned high above these apertures. In addition, the apses protrude beyond the canopy provided by the roof. This particular combination of design elements secures the best capture of the available light, direct or indirect, by the windows of all the apses.

The main nave windows of all the churches are situated closer to the ground than to the soffits, as can be ascertained at least from Figures 42, 43 and 44. The distance between the top of the windows and the soffits of the roof varies. For example, it is approximately three metres in the case of the Church of the Nativity, approximately five to six for the Church of the Archangels, and slightly less than two metres for the Church of St Atanass. The original windows of the Church of St Dimitr have been replaced. It is, nevertheless, plausible to assume that those windows were as close to the ground as they are in the other three churches because of the seemingly locally accepted style.

Because the majority of the windows in each church are permanently closed with shutters, for the assessment of the principal relationship between the roof of the churches, the position of the windows and the altitude of the sun, I have devised a colour-coded schematic presentation based on the geocentric model of the relationship between the sun and the earth. At the heart of my method is the cyclical nature of the yearly and daily patterns of the earth's movements around the sun and on its axis, both of which have a length of 360°. The cyclical nature of these movements allows both prediction and extrapolation of the position of the sun at any point in time, given the geographical location.[467] It is necessary to know the sunrise and sunset coordinates on the days of the solstices, as these produce the two extreme patterns in the path of the sun. The coordinates of all the other sunsets and sunrises during the year are included between those for the two solstices.

[467] Any location can be determined by its geographical coordinates, its latitude and longitude. Arbanassi is at a latitude of 43º 6' (43.1º) (N) north of the Equator, and is 25º 40' (25.7º) (E) east of the meridian.

The schematic presentation incorporates the trajectories of the sun at the summer solstice (SS) and at the winter solstice (WS) (Figures 45-48). The positions of the sun at the summer solstice are indicated on the diagrams by warm-coloured dots; the positions of the sun at the winter solstice are marked by cold-coloured dots. The three chosen positions during the day are: one seasonal hour after sunrise or before sunset (yellow at SS or purple at WS); the third or ninth seasonal hour, equal to mid-morning at the third seasonal hour or mid-afternoon at the ninth seasonal hour (orange at SS and/or blue at WS); and the sixth seasonal hour at noon (red at SS and/or green at WS), as they are associated with the respective canonical hours of the daily liturgical rites.[468] The nave windows of the Arbanassi churches are situated mainly on the south walls (but occasionally on the north wall, as in the case of the Church of St Atanass). Within the schematic presentation of the trajectories I have placed the north–south lateral cross-section of the nave of each church in order to examine the way the light enters through the windows during the year.

The angular values for the altitudes at the chosen daily positions of the sun during the summer and winter solstices are: the SS altitudes 12°/ 39°/70° and the WS altitudes 7°/ 17°/ 23°.[469] The south wall is the one on which the nave windows of the Churches of the Nativity, the Archangels, and St Dimitr are positioned. Even though the Church of St Atanass has its main windows on the

---

[468] The canonical hours, according to the Eastern Church tradition, are: Matins (before dawn and at the rising of the sun), the First hour (the first hour after the rising of the sun), the Third hour (the time of the Divine Liturgy), the Sixth hour, the Ninth hour, Vespers (at sunset), Compline (at bedtime) and the Midnight Office (normally only celebrated in monasteries, and known also as Mesonyktikon).

[469] The exact angular values for the altitudes at the chosen daily positions of the sun during the summer and winter solstice are: for the summer solstice sunrise and sunrise at 12°7′; for the third/ninth hour at 38°42′; for the sixth hour (noon) at 70°12′. The altitudes for the winter solstice are: sunrise and sunrise at 6°33′; third/ninth hour at 17°7′; sixth hour (noon) at 23°26′. For practical reasons, when used in the drawings, the above figures are rounded to the nearest degree.

north elevation, it is also necessary to examine its south elevation. This is because the south-facing windows of the chapel of St Haralampii are expected to contribute indirectly to the natural illumination of the nave interior of St Atanass. During the discussion of the schematic presentations I will take into account the relative position of the fenestration, compared with the ground level around the part of the church building that houses the nave.

The above schematic presentations of the correlation between the roofs of the four buildings, their fenestration and the altitude of the sun reveal that, at the time of the winter solstice, when the sun is low, direct sunlight is available to the south façade throughout the day. Only a short section of all the façades, immediately below the soffits, can be expected to stay in shadow. At the summer solstice, when there is a much greater difference between the minimum and the maximum altitudes of the sun in the course of a day, the availability of direct sunlight for the south façade is limited. Direct sunlight can be available only between sunrise (at the time of Matins) and the third seasonal hour (at the beginning of the Divine Liturgy) and between the ninth seasonal hour and sunset (at the time of Compline). For the rest of the time, between the third and the ninth seasonal hours, only the horizontal or near-horizontal surfaces, such as the roofs of the church buildings, will be receiving direct illumination.

Two sets of factors cause the shadow of the overhang to cover the height of the south walls of the naves and therefore to shield the south windows from direct sun. The first is the specific exterior design of the buildings: single-storey, low-height structures, with extensively overhanging roofs. The second is the angle at which the sunlight meets the surface of the earth between the third and the ninth seasonal hours at the summer solstice.

To conclude, examination of how the light would have penetrated the interiors of the naves of the churches throughout the day between the winter and summer solstices, reveals that at the time of the winter solstice, direct sunlight can completely penetrate the interior of all the naves. Throughout the day at this time of year the incoming light will increase in brightness, but only very gradually, because there is less difference between the altitudes at the beginning of the day and at noon than there is in summer. One can therefore expect the natural interior lighting during the winter to be relatively even throughout the day, though it the incoming light can be expected to be of much less intense than on a bright summer day.

The specific exterior design of the buildings - single-storey, low-height structures, with extensively overhanging roofs - would have shielded the south-facing windows from bright sunlight in summer. For example, at the summer solstice, because of the angle at which the sunlight meets the surface of the earth between the third and the ninth seasonal hours, the interiors would have been illuminated mainly with indirect light.[470] The naves of the churches of the Archangels and of St Atanass have north-facing windows, and those will always be illuminated by indirect daylight.

The indirect daylight is the part of the sunlight that is reflected off the ground surrounding the building while the other part of the incoming flux is absorbed by the ground surface. Consequently, the characteristics of the indirect light depend on the characteristics of the sunlight at the time and on the capacity of the ground surface to absorb light energy. The higher the brightness of the sunlight, the brighter the resultant indirect illumination. Indirect daylight is less bright than direct sunlight and will result in lower illumination of the interiors,

[470] See Appendix III for an explanation of this term and the length in astronomical hours for the geographic location of Arbanassi.

altering the viewing conditions compared to those when direct sunlight enters the nave.

The degree of absorption of the incident flux depends mainly on the texture and colour of the ground surface.[471] The texture of the ground depends on the macroscopic and microscopic irregularities of the surface and is associated with the level of coherency of the reflected light.[472] Those irregularities are responsible for the diffused nature of the indirect illumination. Because of the lack of direction, indirect illumination is soft and even. At the same time, the absorption of light energy is also associated with the molecular structure of the surfaces on which the light falls and from which part of that incident light is reflected back. The microstructure (molecular or molecular mixtures) of a surface predetermines the colour of the light reflected from that surface.[473] The general rule is that the darker the colour of a surface, the less the amount of light energy reflected from that surface. The microstructures that produce dark-coloured material will affect to a greater extent the brightness of the indirect lighting of an interior, making it appear darker.[474]

The ground around the church buildings of Arbanassi is predominantly covered by low vegetation, but the area immediately adjacent to the windows is paved with slabs made from the same light-coloured yellowish local stone of which the walls are constructed. Nearly all the buildings in the town, ecclesias-

---

[471] Lam, *Sunlight as Formgiver for Architecture*, pp. 48–50; J. E. Flynn and A. Segil, *Architectural Interior Systems:Lighting, Air conditioning, Acoustics* (New York, 1991, first edition 1970), pp. 126, 160-164.

[472] When light strikes a surface some of the light energy is absorbed by the matter, partly because of its colour, and the remaining portion of the total energy of the incoming flux bounces off. When reflected off mirror or polished surfaces the latter has a particular direction (the angle of reflected light is equal to the light of incident light), but when the receiving surfaces are rough, or at least matt, the reflected energy is sent in all directions.

[473] Nassau, *The Physics and Chemistry of Color*.

[474] Flynn and Segil, *Architectural Interior Systems*, pp. 126.

tical or domestic, have the area immediately next to the structure paved and paving completely surrounds the Church of St Dimitr.[475]

Although it cannot be proved beyond doubt that the paving was there in the seventeenth century, it is plausible that it was installed originally and maintained at every constructional stage. Having a pavement around the church buildings is a functional arrangement because of the closeness of the windows to the ground. Such an arrangement keeps the undergrowth and dirt away from the windows and as a design feature it is also a functional arrangement in another capacity. Some Orthodox Church rituals involve the congregation walking around the building after dark, for example at the time of the Easter vigil, when a pavement would have been useful.

In the seventeenth century the town of Arbanassi was at its economic peak. It is difficult to imagine that the pavements were laid at the time of stagnation, as archaeologists have proved that no work was done at such times on and around the churches.[476] Photographs from the first half of the twentieth century reveal the existence of the paving.[477] There is no indication that any such work was carried out between the 1970s and the 1980s, when the conservation programme of the churches was in operation. Hence, it is reasonable to conclude that in the seventeenth century it is more likely than not that the area immediately around all four church buildings was paved. I therefore need to consider the reflectivity of these two kinds of surroundings, vegetation undergrowth and local stone.

The physical reflectivity of a surface is the ratio of the energy of the incident light flux reflected from a surface compared to the energy possessed by the in-

---

475 Vatchev, ' Enoriiskiat hram v Turnovskata Mitropolia', p. 105. The text does not indicate why on his drawings Vatchev marked the surround as being compacted earth.
476 Vatchev, 'Enoriiskiat hram v Turnovskata Mitropolia', p. 34-38.
477 Kostov, Arbanass, p. 45; Popgeorgiev, 'Selo Arbanassi', pp. 1-38.

cident light flux striking that surface. Being a ratio, reflectivity is customarily expressed in percentages. Reflectivity correlates to absorption as reflectivity is the measured radiant energy that was not absorbed by the material of the surface. Therefore, the colour and the texture of the material will be crucial for re-reflectivity. Because for green grass the average reflectivity is 25% I suggest that the overgrown surroundings of the churches can reasonably be accepted as having a general reflectivity of about 25%.[478] The reflectivity of the local stone was estimated to be on average 53% of the incident flux.[479]

Consequently, the indirect illumination will be less bright than that on the south side of the building where the sunlight meets the pavement. This is because the grassy area has low reflectivity and a lesser portion of the direct sunlight will be reflected back. In addition, the reflected light is dispersed further as the north-facing apertures are set further back beneath the line of the roof. Therefore, the indirect light coming from the north windows will be diffused and soft, but with lower brightness than the indirect light coming through the south-facing windows of the naves. Because of this it can be expected that the north windows will contribute to the background illumination, counterbalancing to a certain extent the flux coming from the south and assisting in the even distribution of the illumination. This scenario concerns only the original building of the Church of the Archangels and the nave of the Church of St Atanass.

When considering the position of the windows in relation to the floor level, in all the churches the nave windows on the south wall are high, over 1.6 metres

[478] Lam, *Sunlight as Formgiver for Architecture*), p. 49. In principle, vegetation is estimated to have a reflectance of 25%.
[479] The reflectivity was measured by the Bulgarian Institute of Geology as part of the National Geofund. I am grateful to the geologist, the late Isaac Isaacov, for providing the data. The relationship between the colour of the stone and that of the reflected light is a complex one, as the daylight is not monochromatic, added to which its spectral composition changes throughout the day.

above the floor level. Because of that positioning, at sunrise and sunset direct sunlight can penetrate the entire space not only during the winter solstice, but throughout the year. Moreover, between the third and the ninth seasonal hours direct sunlight will still enter the south-facing windows. However, because of the increase in the angle at which sunlight meets a surface, associated with the sun moving towards its maximum altitude at midday, the natural interior illumination of the naves relies partly on the light being reflected from the floors. Inevitably, this will diffuse the incoming sunlight and the brightness of that indirect illumination of the naves will dominate, but be reduced by nearly 50%, compared with the intensity of the incoming flux. The percentage reduction in brightness is defined by the reflectivity of the local stone of which the floors of all the naves are made. At the sixth seasonal hour, when the sun is at its highest and the sunlight at its brightest, because of the architectural design of the fenestration of the churches, indirect natural illumination was dominant. Such illumination would be much softer than would have been provided by direct natural illumination. Therefore it can be concluded that, throughout the year, the increase at the sixth seasonal hour may not have been as dramatic as the increase seen at the beginning of the day.

To summarise, because of the distinctive features of the architectural design of the churches, at the winter solstice the interior illumination relies on direct sunlight, whereas at the summer solstice, the interior relies on indirect illumination. It could be argued, therefore, that the natural illumination of the naves at the summer solstice will be somewhat comparable to that at the time of the winter solstice, that is to say, even and subdued lighting. To estimate the levels of brightness that might have been experienced in the seventeenth-century in each of the above three naves, I will extrapolate and compare the relative brightness in those chambers.

6.5 Computation of the Relative Brightness of the Naves

Relative brightness is a conceptual parameter, which provides an approximation of the level of brightness in a room and is numerically represented by the ratio between the illuminating area and the geometric dimensions of the illuminated chambers in standard lighting conditions: that of a midday overcast sky. This assessment will allow me to consider to what degree the artificial lighting determined the characteristics of the interior illumination and therefore influenced the appearance of the decorative space.

To assist the calculation and the comparative analysis of the relative brightness in the naves of the three Arbanassi churches, in Table 4 I have arranged the estimated values of the illuminating areas and the surface area of the floor alongside the linear measurements of the height of the ceilings in the naves and the volume of the nave spaces. From left to right the columns contain: the name of the church; the total illuminating surface area; the height of the ceiling at its highest point; the surface area of the floor; the volume of each nave space; and the ratio between the total illuminating surface area and the floor surface area (Table 4).

Table 4: The dimensions of the Arbanassi naves and the computed value of the ratio of their relative brightness

Church	**Illuminating area** (m^2)	**Height** (m)	**Floor area** (m^2)	**Volume** (m^3)	**Ratio** (%)
Nativity	1.36	3.80	45.27	172.03	3
Archangels	3.27	8.20	73.26	600.73	4.5
St Atanass	1.46 / 2.50/ 3.02	7.60	66.65	493.21	2.3 / 3.8/ 4.5

When considering only the first four columns separately from the ratio column, it is not difficult to assume that the levels of brightness in the naves of the churches of the Archangels and the Nativity are very similar. This is because the church nave with the greatest volume, the Archangels, also has the largest illuminating area, while for the Nativity the architectural space is the least, but so is the illuminating surface area. For St Atanass it is difficult to judge as, depending on the scenario, the size of the illuminating area will be similar either to that of the church of the Nativity or to that of the Archangels. The volume of the nave, however, lies between the volumes of the naves of these two churches.

When comparing the ratios in the last column, nonetheless, the interior of the nave of the Church of the Archangels and the last scenario for the nave of the Church of St Atanass display a much greater value for relative brightness than the nave of the Church of the Nativity. The values of the ratios for the first two naves is 4.5%, compared with the 3% for the Church of the Nativity.

In any event, the naves of the churches of the Archangels and of St Atanass have less than half of the recommended ratio for simple visual daily tasks, which should be at least 10%. Should the south door in the Church of St Atanass not be open, the value of the relative brightness goes down as far as a ratio of 2.3%, in line with my observations on the level of darkness when the door was closed. This makes the calculated ratios decline to a quarter of the minimum value. The ratio of the Church of the Nativity is not much greater.

It can be concluded, therefore, that the overall daylight performance of all the naves is poor in the atmospheric condition accepted as the standard when examining natural light, the midday overcast sky. Because standard natural lighting conditions were presumed when the above percentages were calculated, I will call these percentage values 'standard ratios'. It is reasonable, however to expect that on a sunny day those ratios will increase, because of the high luminance of the light entering the interiors, increasing the perceived brightness of the interiors. Consequently, this will indicate the impact on the apparent recognition of pictorial details and colours.

During the two months in which I conducted my field work, August 2005 and September 2006, I recorded only five overcast or rainy days during my entire time in Arbanassi. The result of my observations is in line with the statistics for the weather patterns in Bulgaria, which show that over the entire year, the country has an average of 289 sunny days a year or 81% of the annual total.[480] Bearing in mind the local climate and the high number of sunny days in the year I need to reassess the difference that will occur in the relative brightness estimated earlier for the standard overcast conditions.

Illiades observed the extent to which the level of the experienced brightness in the Rotunda is influenced by the level of brightness of the outside environment, in the context of the local climate. Because of the geographic proximity of Thessalonica and Arbanassi, the similarities in climate, the comparable number of sunny days, and the similarity in the geometry of the light (the angle at which the sun's rays meet the surface of the Earth), I again consulted Illiades' research into the natural lighting of the Rotunda. There, he measured the levels of illuminance inside the nave on a sunny day and reported a sharp increase in the control values (that is to say, values collected in standard conditions), of be-

[480] Second National Communication in connection to the UN Framework Conventions on Climate Change submitted in 1999 by then Bulgarian Minister of Environment and Waters, Evdokia Mineva, http://unfccc.int/resource/doc/nats/bulnc2.pdf [accessed, 2009] The document presents that there are on average 259 sunny days in the far north of the country (in the town of Lom) and 319 in the far south (in the town of Sandansky). As Arbanassi is in the middle part of the Bulgarian territory I am adopting the average of these two extreme positions.

tween five and ten times.[481] Illiadis found that, on average, when indirect sunlight enters the interior on a sunny day, the levels of illuminance in the interior are five times greater than when indirect daylight is received on an overcast day. When direct sunlight is received on a sunny day, the recorded levels of illuminance are ten times greater than under the standard condition.

It can be suggested that even if the intensity of the incoming light is the same as that experienced by Illiadis, the brightness of the naves, away from the window openings, will be less than that experienced by Illiadis in the interior of the Rotunda. His observations were made in an environment that is covered with mosaics, the surfaces of which reflect a substantial part of the incoming light. In Arbanassi, although decoration is applied over smooth plaster, the walls cannot reflect as much as would a surface composed of tesserae made of glass or polished marble or stone. This is because of the link between texture and the capacity of a surface to reflect light. The smoother the surface, the higher the reflectivity, with mirror surfaces having the highest. The surface of the wall paintings is matt and therefore has a low capacity for reflection of light compared with the surface of tesserae.

The capability of a surface to reflect some of the light that falls on it depends not just on the texture, but also on the colour of the surface.[482] For example, light surfaces, such as white and yellow ones, have high reflectance, while red, blue and green have low reflectance.[483] In my earlier investigation into the appearance of the Arbanassi colours, the numerical values of the collected data suggested that the lightness of most of the colours used in the decoration of the naves can be described as medium or dark. Moreover, the backgrounds in all

---

481 Illiadis, 'The Natural Lighting of the Mosaics in the Rotunda at Thessalonica', pp. 13-24.
482 Lam, *Sunlight as Formgiver for Architecture*, p. 33.
483 Ibid., p.33.

the pictorial compositions are painted black. Because the entire naves are covered in decoration the colours of the wall paintings will act to reduce the intensity of the natural illumination of the interiors through absorption by half of the brightness of the incoming light on a sunny day. As Illiadis observed in his studies of the Rotunda, which is subject to similar climatic conditions to Arbanassi, full sun results in an increase in the level of brightness by as much as ten times the level experienced under the standard condition of an overcast sky. However, that tessellated interior has much higher levels of reflectivity than the painted interiors of the Arbanassi naves. Taking into account the colour and the texture of the nave interiors I suggest that the increase in the level of brightness on a sunny day would be no more than five times the level experienced under standard conditions.

Another factor to consider when assessing the level of brightness in the naves is the effect which the windows have both in general and in particular in the context of their height and size in relation to the interior floor. In all three naves, those of the churches of the Nativity, the Archangels and St Atanass, the individual windows are small. They are positioned high in relation to the floor, on average at about 1.6 metres, allowing the light always to enter the interiors at an angle less than ninety degrees. The particular positioning of the windows will allow the areas immediately in front of those windows to be well illuminated when direct sunlight can enter. The rest of the interior will rely on indirect interior illumination from the light reflected from the floors of the naves. Again, the intensity of reflected light will be equivalent to one half of the increase in the level of brightness on a sunny day, or approximately two and a half times the increase in the level of brightness compared with that experienced under standard conditions.

Considering all of this, I have recalculated the standard ratios for the naves of the different churches and presented them in the table below (Table 5). Starting from the left: the first column of the table gives the name of the church; the second contains the standard ratios (ratios at the reference condition of a totally overcast sky, abbreviated as 'StR'); the third column indicates the relative level of brightness when indirect daylight enters the interior and the fourth column shows the increase on a sunny day, when the interiors are lit by indirect daylight, taking in consideration the texture and colour of the interiors. The values in the third column represent the relative brightness of the interiors.

Table 5: Comparison between the ratios for each church on a sunny day and when the average reflectivity of the colour of the painted interiors is taken into consideration.

Church	**StR** (%)	**StR x 5** (%)	**StR x 2.5** (%)
Nativity	3	15	7.5
St Atanass	2.3 / 3.8/ 4.5	8.6 / 14.25/ 17.25	5.7 / 9.5/ 11.5
Archangels	4.5	22.5	11.25

Examination of the table leads to the conclusion that the brightness of the naves must have been low, even on a sunny day. For the periods when only indirect daylight can enter the interiors, the indicative value for the brightness in the naves of the churches of the Archangels and of St Atanass varies between 11.5% and 9.5%, according to the position in relation to the doorways. For the situation of having no south opening at all into the nave of St Atanass, the relevant ratio of 5.7% indicates illuminance levels below 100 lux. Therefore, the rod-mediated vision is expected to be dominant and hence the chromatic qualities of the colours will appear to be low, if not non-existent.

Even when direct sunlight can enter the three naves, the relative brightness does not increase above 17.25% for the nave of the Church of St Atanass when the doorway is considered in its present form. For the nave of the Church of the Nativity this value is 15%, if the doorway was an outside opening. It is plausible that the levels of brightness in the St Dimitr must have been similar to those in the Nativity, but nevertheless it can be expected that the levels were slightly lower.

For the third scenario for the Church of St Atanass, when there are no south-facing openings, the relative brightness shown in the table is as low as 8.6%. It is only in the nave of the Church of the Archangels that the relative brightness displays a value of 22.5%, that is slightly higher than the value accepted to indicate a level of illuminance of up to 300 lux. At that level of illumination the cone-mediated vision can be expected to be fully operational. Even in this case, the rod-mediated vision is expected to reduce the colourfulness of the appearance of the interiors as the recommended illuminance of an environment where assessment of colour is best performed is 1000 lux.[484].

To conclude, because of the low levels of natural illumination in the naves it seems inevitable that the characteristics of the interior illumination must have been determined by the artificial lighting. Any attempt to assess what the appearance of the nave decoration might have been in the seventeenth century will be assisted by an enquiry into the effect the original artificial lighting and the resultant interior illumination had on the perception of the colours used in the decoration of the Arbanassi naves.

[484] Baldgiev, 'Priložna Svetlinna Tehnika', pp. 5035:1-7.

CHAPTER SEVEN

Seventeenth-Century Interior Illumination in the Arbanassi Naves and the Appearance of their Decoration

The aim of this chapter is to ascertain and evaluate the likely effect of the original nave illumination on the appearance of the nave decoration. Interior illumination usually has both natural and artificial ingredients. In conducting a detailed enquiry into how the architecture fashioned the natural illumination of the interiors, I showed how the deployment of natural light in all the naves was achieved within the restrictions of the architectural practices employed at the time: low buildings with extensive overhangs and small window openings. My conclusion was that because of those restrictions, the level of natural illumination would have been so low that any significant artificial lighting in the naves would have served as the dominant source of lighting. Thus I will need to ascertain the characteristics of the artificial lighting before discussing the probable effect it had on the appearance of the nave decoration.

Most certainly, at the time the naves were decorated, their artificial interior illumination was provided by a combination of candles and lamps (flame-light) the use of which has always been part of the Eastern Orthodox tradition of worship.[485] The colour of this light can readily be suggested, as light from incandescent sources is known to be in the orange to yellow-orange part of the spectrum. The intensity, however, depends on several factors, some relating to

---

[485] The term flame-light has been used by Chalmers to describe the light emitted from such sources as candles and oil lamps. See Delvin, K., Chalmers, A., 'Realistic Visualisation of Pompeii Frescoes' at http://www.cs.bris.ac.uk/Publications/Papers/1000595.pdf

the interior architecture, such as the wall finishes and the position of the lighting devices, others relating to the devices themselves: their type, number, luminance, and the geometry of the emitted light.

In this chapter I will first consider the likely seventeenth-century use of artificial light in the naves. I also will seek to define a methodology in the context of the attempts by Delvin and Chalmers to achieve a virtual recreation of the original appearance of historic sites under flame-light.[486] My methodology will involve simulating the main characteristics of flame-light within a real environment. For this purpose I will use low wattage incandescent modern lighting, as both the colour and the intensity of such lighting are reminiscent of those of flame-light.[487] This will approximate to the viewing conditions in the interiors as they would have been under the original artificial lighting and thus will provide an illustration of the probable overall effect of that artificial lighting on the appearance of the naves. However, to elucidate the likely way in which colour and light worked together in the Arbanassi naves, I will also examine the effects of the relationship between the lighting and the overall organisation of their decoration and discuss the distribution of the light within the interiors in the context of several individual images, notably those of the Archangel Michael and SS Constantine and Helena from the naves of the four churches of the Nativity, the Archangels, St Atanass and St Dimitr.

---

486 Delvin, K., Chalmers, A., 'Realistic Visualisation of Pompeii Frescoes' at http://www.cs.bris.ac.uk/Publications/Papers/1000595.pdf

487 G. Baldgiev, 'Priložna Svetlinna Tehnika: Osvetlenie na Rabotni Pomeshtenija/ Prostranstva', DS (2007), 5035:1-7. In the introduction to the standards in the interior illumination in different architectural environments and occasions, Baldgiev included a table with the characteristics of different types of electric bulbs, including the colour and the luminous output of the equipment. There the colour temperature of incandescent bulbs varies between 2000K for a 15W to 2900K for a 100W bulb. The luminous efficacy of the bulb, which is represented by the ratio between the luminous flux to power, varies between 0.2 for 15 W bulbs to 2.8 for average 100W. For a candle flame these values are respectively 1850K for the colour temperature and 0.04 for the luminous efficacy. Therefore the light from such low wattage bulbs can be considered close to that emitted by a flame light.

It is plausible that the iconography of the Arbanassi naves reflects the preferences and the choices of their patrons and painters. There is however no information about the dynamics between patrons and painters at Arbanassi. We have no evidence for the identity of either, nor can their identities be deduced by analogy with the tradition of such relationships in Byzantine times as the evidence here is very scarce and patchy.[488] Although there is some literary evidence of the status of Arbanassi as an ecclesiastical, economic and cultural centre, no information is available about any of the individual patrons, which might have shed light on the meaning, in a personal sense, of the scenes in the decoration of the naves.[489] Without this knowledge it is not possible to elucidate the specific significance of an image to a specific patron. Nevertheless, it is possible to assess the meaning of those images in a broad cultural sense. Although there is no evidence about the painters, either who they were or where they came from, Bulgarian scholars have associated the Arbanassi decoration and painters with Mount Athos and Athonite visual traditions. This provides a background for understanding the iconography of the scenes in the churches within the Eastern Orthodox visual tradition and its Byzantine-Greek heritage in particular. It is within this framework that well-established iconographic scenes such as the Nativity of Christ can be understood in a general context. In view of this, in my enquiry into the meaning of the images I will seek to ascertain the likely relationship of the images to biblical texts, establishing the general frame of reference.

Finally, in my detailed study of the way colour and the original lighting would work together in particular scenes, I place the emphasis on the compositional

---

[488] A. Stylianou and J. Stylianou, *Painted Churches of Cyprus* (Cyprus, 1997). http://images.icon-art.info/public/Byzantium/Stylianou%201997%20%20The%20Painted%20Churches%20of%20Cyprus.pdf [accessed May 2013]

[489] See the historic introduction to seventeenth-century Arbanassi in the introduction to the thesis.

application of colours. Although I recognise the possibility, if not the likelihood, of the patron having a say in this matter, the underlying assumption in this chapter is that it seems more plausible that in the actual application of paint, it was the painter(s) who made the decisions rather than the patrons.

7.1. Seventeenth-Century Artificial Lighting

Earlier, while reviewing the Bulgarian scholarship on Arbanassi, I briefly outlined the work of Gergova on the type of ceiling-suspended lighting devices probably used in the Church of the Nativity. I noted that there is no direct or indirect literary or material evidence to prove the specific design of those devices, but that scholarship indicated that their general type, used in both the Byzantine and post-Byzantine eras, was the polycandelon[490] fitted with candles or oil lamps.[491]

In the context of the Arbanassi naves, it is accepted that the locations of the polycandela in each of the naves are marked by the ceiling hooks, presumed by researchers to have been attached to the structures when the churches were built. These can still be identified.[492] In the naves of the churches of the Nativity and of St Atanass there are two hooks visible, one near the iconostasis at the east end and the other towards the west. The hooks are spaced relatively uniformly along the length of the naves, suggesting that the ceilings of the chambers would have been illuminated more or less evenly. The nave of the Church of St Dimitr has a vaulted ceiling at present and it is possible that this

[490] Lethaby, W. R. and Swainson, H., *The Church of Sancta Sophia*, (London and New York,1894), pp.115-116. Theis, L., 'Lampen, Leuchten, Licht' in Stiegemann (ed.), *Byzanz*, (Paderborn, 2001), p. 59. Bouras, L., 'Byzantine Lighting Devices' in JÖB 32 (1982), pp. 480-481.
[491] For Byzantine era: Schibille, 'Light in Early Byzantium'. For the tradition in the Bulgarian Province of the Ottoman Empire: Vatchev, 'Enoriiskiat hram v Turnovskata Mitropolia'; Gergova, 'Tzurkvata na Arbanashkijat Manastir Uspenie Bogorodichno', pp. 9-10, Prashkov, *Stenopisi vTzurkvata Rozdestvo*.
[492] Prashkov, *Stenopisi vTzurkvata Rozdestvo*; Vatchev, 'Enoriiskiat hram v Turnovskata Mitropolia'.

was the original arrangement. This is suggested by the partly preserved seventeenth-century scene of the *Dormition of the Mother of God* on the west wall that has an arched painted frame which, presumably, followed the profile of the original ceiling. Thus the arrangement of the polycandela in this church might have been similar to that in the other two churches. In the Church of the Archangels there is only one hook, in the centre of the false dome.

It is not possible to prove the original height at which the polycandela were suspended, but it can be suggested that in the vaulted churches they would have been relatively close to the ceilings because of the comparatively low height of the vaulted interiors - especially in the Church of the Nativity (3.80 m). In the Church of the Archangels it would have been possible for the polycandelon to be suspended further from the false dome, as the height of the interior at this point is significant (8.20 m). Nevertheless, it can also be expected that the false dome would have been well lit, because of its relatively small volume and its form of an inverted hemisphere, which would have intensified the perceived brightness of the illumination it received.

Although it is impossible to specify the precise type of ceiling-suspended device that was used, nevertheless there is evidence that a horos (χορος) type of lighting device was used in church interiors of the Eastern tradition in the Balkans through both the Byzantine and post-Byzantine periods.[493] Bouras wrote that horoi (χοροι) represent 'the most sophisticated lighting device of the middle Byzantine period' and they were used continuously throughout the Eastern

[493] In Greek χοροί (horoi) is the plural form of the noun χορός (horos). The name χορός seems to have been applied to a type of chandelier mentioned in the sixth century ekphrasis of Paul the Silentary. While recounting the marvels of Hagia Sophia, he identifies a lighting device as a choir of lamps - χορός. See Mango, C., *The art of the Byzantine Empire 312-1453: Sources and Documents*, (Toronto, 1986), pp. 89-90.

tradition including medieval Russia.[494] For instance, similar devices, dated as from the late Byzantine period, are still employed on Mount Athos and in the Markov Monastery in Serbia.[495] The preserved horoi from the Byzantine period are of metal, although Hadjimihali indicated that from the seventeenth century until at least the end of the nineteenth century wooden horoi were in vogue within the Ottoman Empire.[496] His findings suggest that it is plausible that wooden horoi might also have been used in the naves of the Arbanassi churches, so the next questions are what was their general design and how did they function?

The main body of any horos, metal or wooden, simply acted as a frame that supported a multitude of light sources, usually oil lamps or candles. The lamps either formed part of the main body of the horos or were suspended from it by metal chains attached to the sides of the horos.[497] There are textual evidences, at least in Byzantine times, that there were up to two lamps at a time attached to each side of the frame of the horos.[498] In the collection of the Protaton church on Mount Athos there is a metal lamp that was used in the seventeenth century.[499] It is made of open-textured silverwork in the shape of a truncated cone. It is

---

[494] Bouras, L., 'Byzantine Lighting Devices' in JÖB 32 (1982), p. 480. Haritonov elaborates on the links which Arbanassi had with the Moscow Patriarchate, through the Russophile Turnovo Metropolitan at the beginning of the seventeenth century. H. Haritonov, G. Chohadsžieva, S. Rutževa, *Arbanassi*, p. 65. Also instead of horos, the plural form of the word is used - horoi.

[495] Gergova, *Durvorezbeni Polilei* Todorovič, D., 'Polijelej u Markovom Manastiry' in *Zograph*, 9 (1979)

[496] Hadjimihali, A., *La Sculpture sur Bois*, (Athénes, 1950), p. 41. Cited in Gergova. The best surviving example of a seventeenth-century wooden horos is in the Recklinghausen Museum in Germany.

B. Y. Olcay , 'Lighting Methods in the Byzantine Period and Findings of Glass lamps in Anatolia', *JGS*, 43 (2001), pp. 80, 84-86

[498] B. Y. Olcay , 'Lighting Methods in the Byzantine Period and Findings of Glass lamps in Anatolia', *JGS*, 43 (2001), p. 79 writes that in the Typicon of the Pantocrator Monastery in Constantinople, dated 1136,there is a reference to a southern church having octagonal horoy, with sixteen lamps .

[499] Karakatsanis, A. A.(ed.), *Treasures of Mount Athos* (Thessaloniki, 1997), p. 420. For more details see also Ikonomaki-Papadopoulos, Y., 'Post-Byzantine Silverwork' in Karakatsanis, A. A.(ed.), *Treasures of Mount Athos* (Thessaloniki, 1997), pp. 365-367.

completely open at the top and is suspended on four chains, which are gathered together at the hook from which the lamp was suspended (Figure 49). The bottom of the actual lamp-holder is again in open-textured silverwork, with a small pendant cross underneath. The metalwork acts as a holder in which a cup-shaped vessel with oil was inserted.

The design of this lamp-holder can be considered to be illustrative of the type that might have been used in Arbanassi, as it is considered to be representative of a 'widespread and long-lived' design that was widely used across the Orthodox world from the sixteenth to the nineteenth centuries.[500] For example lamp-holders from that historic period, with designs very similar to that found in Protaton, can be seen in the monasteries and museums of Serbia, in the Monastery of St Catherine on Mount Sinai, the Church of St Stephen, Meteora Monastery and even in the Armoury in the Moscow Kremlin.[501]

Archaeological research shows that the most likely materials for the cup-shaped vessel, including in the Byzantine period, would have been glass or terracotta.[502] In Islamic cultures there is a long-standing tradition of the production and use of glass cup-shaped vessels for the horoi type of polycandela used in mosques.[503] Thus it can be suggested that within the Ottoman Empire it would

---

500 Karakatsanis, A. A.(ed.), *Treasures of Mount Athos* (Thessaloniki, 1997), p. 420. For more details see also Ikonomaki-Papadopoulos, Y., 'Post-Byzantine Silverwork' in Karakatsanis, A. A.(ed.), *Treasures of Mount Athos* (Thessaloniki, 1997), pp. 365-367.
501 Ibid, p. 420.
502 B. Y. Olcay , 'Lighting Methods in the Byzantine Period and Findings of Glass lamps in Anatolia', *JGS*, 43 (2001) p.80
503J. T. Kider Jr, R. Fletcher, N. Yu, R. Holod, A. Chalmers, 'Recreating Early Islamic Glass Lamp Lighting' (January, 2009)
http://repository.upenn.edu/cgi/viewcontent.cgi?article=1629&context=cis_papers&sei-reir=1&referer=http%3A%2F%2Fwww.google.co.uk%2Furl%3Fsa%3Dt%26rct%3Dj%26q%3Dchal-mers%2520%252B%2520early%2520islamic%2520lamps%26source%3Dweb%26cd%3D1%26ved%3D0CDEQFjAA%26url%3Dhttp%253A%252F%252Frepository.upenn.edu%252Fcgi%252Fviewcon-

have been reasonably easy to obtain glass vessels for the church horoi. Bearing in mind that in the seventeenth century Arbanassi was an ecclesiastical place of significance, with its monasteries and metropolitan residency, it is likely that glass vessels were used for the Arbanassi horoi.

It could be expected that, in Arbanassi, the vessels were filled with vegetable (probably olive) oil.[504] The oil might have been used on its own or with the addition of salt.[505] Another popular practice was to fill half of the vessel with water before adding the oil which, according to Chalmers, allowed more of the light to be conducted downwards.[506] However, the particular design of the likely lamp-holder used at the time would have allowed very little of the light to be conducted downwards.

Lamps of the kind described above can be expected to have been used in Arbanassi not only with the horoi that were suspended from the ceiling, but also as part of a number of mobile lighting devices that would have acted to highlight the significance of particular scenes as, theologically, light has always been viewed as a primary condition of spiritual life.[507] It is reasonable to expect that lamps were suspended or placed in front of key icons within the iconostasis - at the very least those dedicated to Christ, the Mother of God and the patron saint(s) of the church. They would have been with single, double, or even triple lamps. There would also have been floor standing candleholders that would

---

tent.cgi%253Farticle%253D1629%2526context%253Dcis_papers%26ei%3D1rObUfeFIoq_0QW3q4D4DA%26usg%3DAFQjCNG3GJmyhTlAIpsrUG6wzoHQVNhDiA%26bvm%3Dbv.46865395%2Cd.d2k#search=%22chalmers%20%2B%20early%20islamic%20lamps%22 [accessed, February 2013].

504 Archimandrite Avksenii, *Liturgika* (Plovdiv, 2003), pp. 22-23.

505 Schibille, N., 'Light in Early Byzantium Church of Hagia Sophia in Constantinople' (unpublished doctoral thesis, University of Sussex, 2003), pp 94-102.

506 Kider Jr, Fletcher,Yu, Holod, Chalmers, 'Recreating Early Islamic Glass Lamp Lighting'.

507 A. Kashdan, *The Oxford Dictionary of Byzantium*, (Oxford, 1991) p. 1227

have accommodated varying numbers of candles.[508] These candleholders are usually placed around the area of the iconostasis and some can be expected to have been found ranged down the east-west axis of the nave, often in combination with analoys on which icons would have been displayed for veneration.[509]

To summarise, in the context of existing research on Byzantine and post-Byzantine traditions in artificial church illumination, it can be concluded that in the seventeenth century, in the Arbanassi naves, there were a number of horoi type of polycandela which were suspended from the ceilings. The exact number and location of such horoi can be identified in each nave. Considering the position and the likely height at which the polycandela might have been suspended it can be concluded that the ceiling areas in those churches with simple vaults would have been well and evenly illuminated. By contrast, the ceiling illumination in the nave of the Church of the Archangels – which has a dome in addition to vaulting – would have been focused, as there would only have been a single polycandelon in the dome. There were also mobile lighting devices, but even if their location and number cannot be determined, they would still have produced the same type of light as the horoi, namely flame-light.[510]

The design of the chandeliers now to be found in the churches of the Nativity and St Atanass is reminiscent of that of a horos type of polycandelon. They are fitted with candle-like bulb-holders and, at the time of my fieldwork, both were equipped with 25-watt incandescent bulbs. The nineteenth-century chandelier

---

[508] So far there has been only one example identified as a seventeenth-century candleholder and it is exhibited at present in the crypt of the Cathedral Alexander Nevski, Sofia. It is a free-standing, pentagonal wooden candleholder. All around the crown of the pentagon are individual metal candleholders, providing places for about twenty candles. Although the exhibit has not been associated with any particular church, it is an illustration of one of the types of light sources that might originally have been used in the Arbanassi naves.

[509] Archimandrite Avksenii, *Liturgika* (Plovdiv, 2003), p. 56.

[510] Delvin, K., Chalmers, A., 'Realistic Visualisation of Pompeii Frescoes' at http://www.cs.bris.ac.uk/Publications/Papers/1000595.pdf.

in the nave of the Church of the Archangels also has multiple electric incandescent lights, but each bulb was of 40 watts.[511] All these electric light-sources are in accordance with the conservationists' specification, so their emission in the UV part of the spectrum is practically non-existent. Considering the present use of incandescent electric lighting, the immediate question is: are there any significant differences between the characteristics of the historic and the present artificial lighting, as both are incandescent, but of different types?

7.2 Differences between Present and Historic Artificial Lighting and the Likely Transformation of the Arbanassi Colours

The brightness and the colour of ambient light has a significant influence on the perceived appearance of the coloured surfaces illuminated by it.[512] Hence in this section I will explore the differences between the seventeenth-century flame-light and the modern electric light in these two respects. Compared to the present electric illumination, the presumed seventeenth-century flame-based illumination can be expected to have been of much lower brightness. For example, by analogy with the preserved examples of horoi, it was accepted that the Arbanassi ceiling lighting devices would have been eight- or twelve-sided constructions, carrying one or two oil lamps per facet. To give some indication of the brightness of a horos the luminous intensity of its output can be contrasted with the average luminous intensity of a standard incandescent electric light bulb, which is accepted to be a single tungsten 40 watt bulb.[513] Estimates suggest that the probable luminous intensity of a horos with twenty-four flame lamps would be about one twentieth of a single 40 watt bulb, because each

511 The dating of the chandelier is as noted in Haritonov, Chohadsžieva, Rutževa, *Arbanassi*, p. 57.
512 L. M. Hurvich, *Colour Vision* (Sunderland, Mass: Sinauer, 1981), p. 195.
513 Luminous intensity takes account of the sensitivity of the human eye and is the visible light emitted by a source in a particular direction.

flame provides only one unit of luminous intensity, compared to nearly 500 units of luminous intensity for a 40-watt bulb.[514] Moreover, the output of the individual lamps would not have been focused, as they were distributed over the frame of the horos, so reducing the total impact. By contrast, there are 17 light bulbs on each horos-like device in the naves of the churches of the Nativity and St Atanass of 25 watts each.

In the context of the colour of the emitted light, flame-light predominantly occupies that part of the spectrum which ranges from orange, through orange-yellow to yellow.[515] In comparison, the spectrum of a 'standard' 40-watt incandescent bulb appears to occupy the medium wavelengths and can be described as being in the orange to yellow-orange part of the spectrum, its exact position on that spectrum depending on the manufacturer's specification. Thus it can be concluded that, because of the significant differences in both intensity and colour between the historic and the present lighting, the present appearance of the naves cannot be assumed to be particularly representative of the appearance of the nave colours under the presumed original lighting. Hence, I will next consider how the flame lighting might have impacted on the appearance of colours compared to their appearance under standard noon daylight, which is the internationally recognised basis of comparison.[516]

---

[514] I have proposed the comparative brightness in the context of the research that showed that a device holding sixteen lamps would produce only one thirtieth of the luminance of a single 40-watt tungsten electric light bulb. See Schibille, N., 'Light in Early Byzantium Church of Hagia Sophia in Constantinople' (unpublished doctoral thesis, University of Sussex, 2003).

[515] Different vegetable oils were used sometimes, while candles, especially for everyday use, were not always made of beeswax, but also from animal fat. When comparing the colour of the light sources in the seventeenth century with the incandescent ones used now, in terms of colour temperature, a measurement that indicates the hue of a specific type of light source, the difference on average is 850K as flame-light is 1850K while a standard incandescent bulb is 2500K. I am grateful to Dr Saunders form the British Museum for providing the colour temperature of flame light.

[516] Hunt, R. W. G., *Measuring Colour (*Kingston-upon-Thames, 1998, first edition 1987).

To estimate the appearance of the Arbanassi colours under the presumed seventeenth-century artificial illumination, I will use the results of both quantitative and qualitative research carried out since the 1950s on the significance of the colour of the illumination to the perceived appearance of surface colours.[517] The results of these investigations can be summarised as showing substantial shifts in all dimensions of colour appearance - hue, brightness, and saturation – when they are examined under lighting conditions different in character from the accepted standard noon daylight.[518] For example, the shifts in the hues of the chromatic colours showed that under incandescent light those colours that are classified as warm, such as yellows, reds and their associated colours like beiges and browns, become even warmer and appear more saturated. The changes are a consequence of these hues shifting towards the red part of the spectrum, i.e. yellows turn orange-yellow to orange; reds become perceptually redder; beiges and browns, deriving from iron oxide-based yellow or yellow-red types of pigment, are transformed in a way comparable to the yellows, but gaining orange-yellow to orange undertones.

The appearance of those colours that can be described as cool, such as blues and greens, generally became perceptibly cooler, but the degree to which this happened depended on the particular hue, while saturation was not increased equally across the green spectrum. For instance, while colours described as

---

[517] L. M. Hurvich and D. Jameson, 'Some quantitative aspects of an opponent-colors theory', pp. 416-421. L. M. Hurwich and D. Jameson,'Some quantitative aspects of an opponent-colors theory. IV: A psychological color specification system', *JOSA*, Vol. 46 (1956), pp. 416–421; M. Hårleman, 'Colour emotions in a full size room' in C*olour and Paints*, Proceedings of Interim Meeting of AIC, Porto Alegre (2004), pp. 223–226. Also E. S. Tantcheva, V. Cheung, S. Westland, 'Effect of Candlelight on Seventeenth Century Church Interiors using Munsell System' , Proceedings of 11th Congress of AIC, Sydney (2009). The last work compares the use of CIELAB and CIELAB97 in the selection of the nearest Munsell match. The conclusion is that the choice of illuminate is more important than the choice of colour space.

[518] Results indicated the level of transformation in the perceptual appearance of colours under low level incandescent light compared to the accepted as standard midday daylight, colour temperatures between 5500K and 6500K.

green to green-blues increased in saturation, green-yellows perceptually decreased in saturation. Blue colours shifted optically down the spectrum, but increased in saturation. By association, it is probable that the same rule would also apply to the optical blues obtained not from a blue paint, but by the application of a thin layer of white over a black area, as in the majority of Arbanassi wall paintings. However, it must be stressed that even if an increase in saturation of the cool colours is indicated, the level of increase can be expected to have been lower than that of the warm colours. In other words, under flame light, the increase of the saturation of certain greens and the blues would have been noticeably less than that of warm colours, especially reds and yellows.

Moreover, all the grey achromatic colours showed considerable changes, which can be summed up as gaining in chromaticity.[519] For example, the light greys moved in the direction of the colour of the illumination, towards the warmer, long wavelength part of the spectrum, by gaining orange-yellows to yellow-orange undertones. On the contrary, the darker greys obtained undertones in colours that were complementary to that of the illumination, i.e. towards the short wavelength part of the spectrum, namely blue to blue-violet undertones. Therefore, it can be concluded that, because achromatic colours optically mutate under flame light to chromatic ones, the gamut of any of the Arbanassi images using greys is likely to have been enlarged, with these images becoming more colourful.

However, the achromatic colours that can be described as blacks or white did not seem to be affected by the colour of the ambient light, but rather by the intensity of illumination alone. An interesting phenomenon was observed in the wider context of dark and light colours, in that these categories of colours re-

---

[519] Arnheim, R., *Art and Visual Perception. A Psychology of the Creative Eye,* (Berkley, Los Angeles, London, 1974, first edition 1954), pp.302-329.

sponded differently to the same level of illumination.[520] Dark colours were perceived as being darker than initially expected when they were examined under flame light, with the perception of blacks and charcoals shifting so that they appeared almost pure black.[521] This can be explained by the fact that dark colours absorb more light than they scatter, which makes them more responsive to ambient light of low luminous intensity, with black being particularly responsive. On the contrary, as light colours scatter more than they absorb, they were still perceived to be as light as they were considered to be under noon illumination, with white being considered to be nearly pure white. It can therefore be concluded that illumination with low luminous intensity will not impair, but will rather optically enhance the brightness of light colours.

To summarise, the changes outlined here indicate that the appearance of the individual Arbanassi colours can be expected to have been different under the original illumination. However, it is difficult to envisage how the naves in the seventeenth century might have appeared merely by the application of abstract knowledge about the likely optical mutation of the individual colours of Arbanassi. Therefore, in order to be able to discuss the original appearance of the interiors, I will need to consider the possibility of recreating the seventeenth-century lighting in situ.

7.3 Choice of methodology

Since the end of the twentieth century computer science, providing means by which natural-looking virtual realities can be created, has offered the possibility of three-dimensional visualisation of both imaginary and existing spaces. A computer-based methodology was developed by Delvin and Chalmers to visu-

---

[520] Arnheim, *Art and Visual Perception*, pp. 302-329.

[521] Luminous intensity takes account of the sensitivity of the human eye and is the visible light emitted by a source in a particular direction.

alise historic environments that were originally illuminated by flame-light. I have chosen their work because of some parallels between the overall aims of their investigation into the frescoes in the House of the Vettii in Pompeii and my work.[522] For example, their ultimate goal was to determine the effect of flame-light on the interior Roman wall paintings, compared to the effect of modern lighting. My aim is similarly to ascertain the effect of the presumed seventeenth-century lighting on the appearance of the colours in the Arbanassi nave decoration, while at present modern lighting illuminates the interiors. Moreover, there are some direct similarities between the sites at a presentational level and in the appearance of colours used. For instance, as in the case of the naves, the *oecus,* or the reception room, which was the main object of the Delvin and Chalmers investigation, has been carefully conserved and the appearance of the original frescoes is dominated by reds and yellows. The other similarity with the Arbanassi interiors is that artificial light emitted by flame sources has been considered as the dominating interior illumination.

The three-dimensional computer reconstruction of the *oecus* by Delvin and Chalmers in 2001 offered a realistic visualisation of an historic, richly frescoed interior under its original lighting conditions and highlighted the difference this made to the perception of the colour and interior space. Delvin and Chalmers claimed that their method is not site-specific, but universal, as the virtual reality they created by that method is treated by them as indistinguishable from the real physical environment. This cannot be claimed by the often-used photo-realistic computer reconstructions. Consequently, imagery generated using their method provides a safe and controlled environment in which the perception and purpose of colour in decoration can be tested.

---

[522] Delvin, K., Chalmers, A., 'Realistic Visualisation of Pompeii Frescoes' at http://www.cs.bris.ac.uk/Publications/Papers/1000595.pdf.

To achieve true visualisation of the *oecus* when it was in use, before the eruption of Vesuvius, Delvin and Chalmers sought to create not just a physically correct depiction but also one that was perceptually equivalent to the actual multi-dimensional scene. They argued that, because the commonly-used software packages for generating reality-simulating scenes base the lighting conditions on daylight or contemporary electric lighting and not on the characteristics of the light emitted from lamps or candles, the visual appearance of the generated images is not perceptually close enough to the authentic historic appearance. They explained the perceptual mismatch of the real and the created scenes in the cases of coloured or even multicoloured interiors as a consequence of the way our perception of colour is affected by the amount, colour and nature of light reaching the eye. Thus, they argued that only by simulating the appropriate type of interior lighting will it be possible to illustrate how a particular environment may have looked in the past.

In their case-study Delvin and Chalmers recorded the frescoes of the room photographically, incorporating at either side of each image a GretagMacbeth ColourChecker colour rendition chart to permit colour calibration, identification of existing illumination levels and computation of any existing gradient in the light to be performed where necessary. They also collected detailed spectral data from flames produced by olive oil lamps, the visible part of the spectrum at 5nm interval, using a spectroradiometer. They examined the flames of lamps filled respectively with olive oil alone, with olive oil and salt and with olive oil and water. Ten readings were taken in an otherwise completely dark room, using a board coated with 99% optically pure Eastman Kodak Standard white powder. However, the readings did not indicate any substantial perceptual dissimilarities between the light emitted by the differently-filled oil lamps.

The data was used to create a colour model and the flickering nature of the flame for use in the rendering of the computer-generated scenes. To provide an efficient method of incorporating the characteristics of a real flame into the synthetic image a set of programs was written. The simulation was validated with real tests of scenes including a GretagMacbeth ColourChecker colour rendition chart illuminated in the first instance with a 55 watt electric bulb and in the second by an olive oil-fuelled lamp.

The conclusion of Delvin and Chalmers was that, even with the computer-generated approximation of the real flame, significant differences in the perceived appearance of the room were noted between the computer-generated images of the *oecus* using the characteristics of modern lighting and of flame lighting. They reported that the main difference was that the flame-lit environment emphasised those areas of the decoration that were painted using yellow and red pigments, more than was the case when these same areas were seen under modern lighting.

However, while this examination might seem to offer a useful methodology for studying the appearance of the naves of Arbanassi under the seventeenth-century lighting conditions, there were a number of technical problems that prevented me from generating a comparable three-dimensional computer reconstruction of the naves. For example, the first fundamental requirement for a high-fidelity computer reconstruction, as used by Delvin and Chalmers, is the existence of a very accurate record of the geometry of the naves. Although accurate floor plans of the Arbanassi churches and cross sections of their east ends are available, they provide only basic details of the interior spaces, such as the width, length and height of the chambers. To create a highly detailed geometric model of the complex interiors of the naves, with their vaulted ceilings and the inverted semi-spheres of the apses (and, in the case of the Church of the Archangels, the hemisphere of the false dome), it would be necessary to undertake three-dimensional laser scans of each nave. Although, in theory, this would have been feasible because of the existence of portable scanners, it was not possible in practice, because the use of laser instrumentation in the interiors of the churches is prohibited by the Regional Museum Authority.

Delvin and Chalmers stressed in their work that account should be taken of the reflectance curve of the material under examination, for the final synthetic image to be fully perceptually correct, but this is another problematic area. My difficulty arose from the combination of the complex geometry of the architecture and the inclusion in the decoration of highly specular surfaces, such as gilded areas, when the rest of the decoration uses light-diffusing materials (i.e. paint).[523] This was not an area of concern for Delvin and Chalmers, as the *oecus* has a simple architectural shape, a parallelepiped, and the decoration is executed in light-diffusing materials with similar characteristics. A possible solution to the problem was offered by Chalmers, in collaboration with other scholars (some from the University of Warwick Digital Laboratory and some from Cultural Heritage Imaging in San Francisco). They described the way in which a map of the reflectance of materials within a complex geometrical form can be achieved and the possibilities it offers for the exploration of perceptually correct imaging in high fidelity computer reconstructions.[524] However, it was not feasi-

[523] V. Sunstedt, A. Chalmers, Martinez, Ph., 'High Fidelity Reconstruction of Ancient Egypt – The Temple of Kalabsha' http://www.cs.bris.ac.uk/Publications/pub_master.jsp?id=2000076 [accessed, 2012]

[524] They used the apse mosaic at the Angeloktisti Church at Kiti, Cyprus as a case-study in order to create a Polynominal Texture Map from a highly specular surface and investigated how the position of lighting affected the appearance. See Zanyi, E., Schroer, C., Mudge, M. and

ble to perform such an investigation, as it again would have required the use of laser equipment. Even if such use had been permitted, the data would still be incomplete, unless the gilding (mainly of the haloes, but also of the edging of the clothing of the saints and the cross in the nave of the Church of the Archangels), had been restored before the measurements were taken. Therefore, if only for these reasons, it was not possible to realise a high fidelity computer reconstruction of the naves.

Instead, I had to devise a methodology that would enable me to ascertain the appearance of the naves under the illumination as it was likely to have been in the seventeenth century, despite the imposed restrictions. My methodology uses a similar framework to that used by Delvin and Chalmers. As in their study I examined the appearance of the interiors under different types of illumination in order to provide the data necessary to conduct the evaluation. However, while they operated in the context of virtual reality, where to achieve a change of illumination required the inputting of the desired lighting characteristics, I considered lighting conditions within the actual environment of the naves.

Delvin and Chalmers evaluated the magnitude of the changes in the appearance of the interior when viewed under flame light against the appearance of the *oecus* under contemporary illumination. In my investigation into the Arbanassi naves, my starting point was the appearance of the individual colours, as assessed under the standard, noon daylight. Hence standard light will be one of my points of reference against which to evaluate the changes in the appearance of the naves under another set of lighting conditions, approximating to flame

Chalmers, A. G., 'Lighting and Byzantine Glass Tesserae' in *Proceedings of EVA 2007: Electronic Information, the Visual Arts and Beyond*, London, 2007.

light. In cases where it is not possible to create lighting conditions that in colour and intensity closely resemble standard light, I will use the appearance of the naves under the existing contemporary lighting, as in the Delvin and Chalmers investigation. Like Delvin and Chalmers I will comment on the results of my experiments in the context of photographic illustrations of each setting.

7.4 The Likely Transformation of the Naves under the Original Illumination and Evaluation of their Appearance in the Context of the Nave Decoration

I identified only two churches where I could physically perform the experimentation; the naves of the churches of the Nativity and of the Archangels. In neither of the other two churches, St Atanass and St Dimitr, was there any artificial lighting. Because of the overall similarities of the architecture, decoration and lighting of the vaulted Arbanassi churches I will conduct a parallel examination of the likely effect of the original lighting in the framework of the decoration in the two churches of this type, the churches of the Nativity and of St Atanass. Building on this, the way in which colour and light work together in the context of the decoration needs to be considered. In the context of the discussion about the overall effects of the approximated seventeenth-century lighting conditions on the appearance of the naves and within the framework of the understanding how the Arbanassi colours would change under flame light I will now conduct a theoretically-based examination of the scenes in the ceiling decoration and the images. I will pursue the argument that, because of the compositional use of colours, the optical changes emphasised primarily the theologically implied meaning of the images.

The effects in the best-lit and worst-lit registers will be demonstrated most clearly if there is found to be a consistency in the way light and colour work together throughout the naves. For that purpose I will examine the ceiling decoration and the images of the Archangel and SS Constantine and Helena from the first register. In the case of the Church of St Dimitr, however, I will only be able to discuss the way in which the presumed original lighting and the colours in the scene of the Archangel and SS Constantine and Helena work together, as the rest of the decoration is badly damaged. In the nave of the Church of St Atanass in addition to these two scenes I will also examine the scene of St Sisoes, because of its slightly unusual composition and size. However, initially I will explain how the approximation of the original lighting in each of the two naves of the churches of the Nativity and of the Archangels was achieved.

7.4.1 Experimental settings

To simulate the likely effect of the seventeenth-century lighting on the appearance of the nave of the Church of the Nativity, I examined the appearance of the nave exclusively under modified electric lighting. To modify the electric light I fitted both chandeliers in the nave with bulbs of 15 watts each (Figure 51). In the seventeenth century natural light would have been present, but although I was not able to provide any, it can be argued that its absence would not create any significant disparity between the original and the achieved lighting conditions. The calculations which I conducted to estimate the brightness of the naves, if they had been illuminated only by natural light, indicated that, even if bright sunlight was entering the naves, the interiors of both churches would be comparatively dark, with illuminance below 100 lx. Moreover, the schematic examination of the way the incoming daylight would be distributed indicated that for the naves of the churches of the Nativity and of St Atanass, the natural light would contribute mainly to the illumination of the lower section of the interior. Such lighting could be expected to have benefited mostly the lower registers, but because of its low luminance it could not be expected to have introduced any significant changes. Therefore it can be concluded that the use of artificial lighting alone will not invalidate the results of this examination of the way in which the original lighting affected the appearance of the nave interior of the churches of the Nativity or of St Atanass.

To evaluate the effect of this modified electric lighting on the appearance of the decoration of the nave of the Church of the Nativity, I compared it to the appearance of a test scene (Figure 50).[525] The test scene was created by illuminating the interior with a photographic floodlight.[526] The distribution of illumination across the nave is more or less even, because of the luminous efficacy of the floodlight and the rounded shape of the vaulted ceiling. Consequently the appearance of the nave of the Church of the Nativity in this scene is affected neither by the colour of the ambient light nor by any significant variation in the intensity of illumination across the interior. This makes the appearance of the test scene as close to the ideal as possible as the basis against which to evaluate how the colour of the illumination and the distribution of the modified electric lighting affect the appearance of the nave.

In the nave of the Church of the Archangels the experimental settings were different. Because of the specific design of the bulb-holders in the chandelier in this church, the dimmest bulb I could use was of 25 watts (Figure 52). The luminous output of the modern polycandela fitted with bulbs of this wattage will undoubtedly be greater than the output of an original horos fitted with oil lamps, however the lower wattage bulbs still brought the level of brightness of

---

[525] This is the type of artificial light closest in characteristics to noon daylight.
[526] The luminous efficacy of which is high enough for its characteristics to dominate the appearance of the interior illumination, although the chandeliers were also lit at the time.

the interior illumination that much closer to the original. Moreover, the colour of the light emitted by the lower wattage bulbs was noticeably more in the orange than in the yellow part of the spectrum, thus bringing the colour of the modified illumination more in line with the colour of flame-light, compared to the colour of the higher wattage bulbs used at present.[527]

It was also possible to introduce natural lighting by opening the shutters in the domed area in the nave of the Archangels. This allowed the opportunity to examine how the daylight might have impacted on the appearance of the complex interior while the modified electric light was on. I photographed this setting in the Church of the Archangels between 3:00 pm and 3:30 pm, as this is the time when the daylight is at its most intense (Figures 53).[528] Though the record was created in August, the intensity of the daylight would then have been around its highest for the year because of the overhang of the soffits.[529] Therefore this represents the highest level of impact of the natural lighting on the appearance of the interior.

I did not use the same test scene in the nave of the Church of the Archangels as in the nave of the Church of the Nativity. On the one hand it was not possible to use a photographic floodlight and on the other hand even if I could, because of the complex geometry of the interior I would have not been able to achieve the same even illumination as in the Church of the Nativity. Consequently, I used,

---

[527] The light of a candle flame is approximately 1850 K (I am grateful to David Saunders, from British Museum, for providing this information). The light from an incandescent light-bulb is within the interval between 2200K to 3200 K. Most frequently, the temperature is specified as 2500 K or 2700K. For a concise reference chart see also http://www.gelighting.com/na/business_lighting/education_resources/learn_about_light/color_specifying.htm [accessed, 2011].

[528] All the photographic records of the naves in the churches of the Nativity and of the Archangels for the purpose of this experiment were made without the use of the camera's flash in order to avoid interference.

[529] For a schematic illustration of the way sunlight interacts with the building and when and how successfully the natural light penetrates the interior, see Figure 45.

as in the Pompeii investigation of Delvin and Chalmers, the appearance of the nave under the usual modern lighting, where the chandelier is fitted with 40-watt bulbs.

7.4.2 Church of the Nativity of Christ and the other vaulted Arbanassi churches

Figure 50 shows the appearance of the test scene, where the whole interior of the Church of the Nativity is illuminated by the simulated standard light of a photographic floodlight. In it, the individual coloured areas appear dull. This is in keeping with the earlier discussion about the Arbanassi palettes, where under standard illumination the appearance of the individual chromatic colours was considered to be dull because of their comparable relatively low lightness and saturation.[530] Consequently, all the elements of the compositions appear in the same plane under the standard type of illumination resulting in the decoration appearing not only dull, but fragmented and two-dimensional.

By contrast, the appearance of the nave of the Church of the Nativity under the modified electric illumination appears much warmer and more colourful, as may be seen in Figure 51. The red and bright yellow coloured elements of the decorative compositions appear to have increased in saturation. However, the saturation of the green areas is perceived as significantly reduced, compared to the appearance of those colours in the test scene.[531] The susceptibility of the green colours to change under flame-light can be observed more clearly in the transformation of the colour of the canopy of the Metropolitan's throne, on the right side of the picture. The white coloured elements have become manifestly brighter compared to the rest of the composition, while in fact the actual brightness across the scene is less under the modified electric light than under

---

[530] Here I continue to follow Munsell's terminology for dimensions of colour. See Appendix II.

[531] As explained earlier the saturation of the cool colours can be expected to increase under flame light, but to a much lesser extent than that of the warm colours.

the standard (floodlit) illumination. The black areas of the background have changed from a dull charcoal colour to a highly saturated, almost pure black. Consequently, the optically acquired variation in brightness and saturation of all of the colours under the modified artificial lighting is manifested as an apparent degree of three-dimensionality compared to the flat appearance of the decoration under the standard illumination.

The other apparent difference between the two figures is the uneven distribution of the intensity of the illumination. For example, the centre section of the ceiling appears to be the best-lit part of the interior. From the central section down the sides of the vault, the intensity of the illumination shows a gradual decline, causing all sections at a particular level to receive an equal amount of illumination. Following the overall Byzantine model, the decoration of the Arbanassi churches is divided into registers, with the scenes and the images arranged in an order of theological significance, which declines from the upper to the lower register. Thus, it can be argued that the gradation of the intensity of the artificial illumination created by the ceiling lights similarly reflects the theological gradation of the decoration at every level.

The ceiling decoration in the two churches of the Nativity and St Atanass consists of three representations of God: *Christ the Child* (Emmanuel), *Christ Pantocrator* and the *New Testament Holy Trinity* (the Father, the Son and the Holy Spirit). The scenes are arranged as an additional register that is defined from east to west by the ceiling beams and from north to south by the third registers. The scenes in the ceiling are larger than any other scene or image in the registers with the representation of God within each composition dominating the compositional space. However, the order in which the images appear from east to west in the churches of the Nativity and St Atanass differs. In the nave of the Church of the Nativity, they appear in the above order, while in the nave of the church of St Atanass the sequence is *Christ Pantocrator*, the *Holy Trinity* and *Christ the Child* (Figures 54-59). A probable explanation for the variation in the position of the images is that as they are representations of the different manifestations of God they are in fact of equal theological significance and therefore the exact placement does not matter. This general type of ceiling decoration was typical not just of the Arbanassi churches, but of church decoration generally in the post-Byzantine Balkans from the fifteenth to the seventeenth centuries where the dominant style of architecture was without a dome.[532] Therefore, it is probable that originally the ceiling decoration of the nave of the Church of St Dimitr also displayed these images.

The scene of *Christ the Child*, according to Prashkov and Rutzeva, was developed in the early post–Byzantine period in conjunction with the vaulted ceiling interior. It can be suggested that the composition had derived from the traditional Byzantine composition of *Christ-Pantocrator* as revealed in close parallel. This iconographic type was established in the early Byzantine era.[533] Christ is always represented either as a full figure enthroned or a half figure in a medallion, with his right hand raised in the sign of benediction and a book or a scroll in his left hand.[534] In Byzantine times the half-figure version was typically depicted within a medallion in the cupola, shown surrounded by heavenly powers - saintly and/or angelic figures - who were displayed on the next level down, in the drum of the dome, as for example in the Monastery of Daphni (twelfth century), Athens or in the Church of St Mary Pammakaristos (after 1304), Constantinople (now Fethiye Camii). The composition may well have

---

532 Rutževa, Sv., *Ikonografia I stil na stenopisite v tzurkvata Sv. Atanassii, Prashkov, Stenopisity v Rozdestvo Hristovo*.

533 Rutževa, Sv., *Ikonografia I stil na stenopisite v tzurkvata Sv. Atanassii,* p.48.

534This composition is associated with the God being 'the Ruler of the Universe' or 'the Judge of All', as in the Last Judgement. The book, when shown opened, is the Books of the Gospels, but when shown closed, as in the case of the images in the Arbanassi churches, is the Book of Life which will be opened on the Day of Judgement.

been intended to represent Heaven (Daniel, e.g. chapter 7; Revelation, e.g. chapter 21). The images or the symbols of the four evangelists were characteristically displayed on the next level, immediately below the drum, on all four sides.[535]

The compositions of the two scenes, *Christ the Child* and *Christ Pantocrator*, in the nave of the Church of the Nativity display particular compositional cross references to each other (54-55). For instance, although traditionally the scenes of the Pantocrator are linked with representations of the evangelists, in the nave of the Nativity it is the scene of *Christ the Child* rather than the composition of *Christ Pantocrator* that includes their symbols. To an extent this also supports the supposition expressed earlier that the images of God in the ceiling decoration of the vaulted naves are interchangeable, as they were assumed to be of equal significance. There are further similarities between the two compositions in the nave of the Church of the Nativity. Here both medallions are situated within a light-coloured rectangle which appears superimposed upon a red rhomboid, thus forming an octagonal star-like shape, which symbolises the eighth day and ultimately eternity.[536] This octagonal shape has been used since Byzantine times.[537] It probably derives from early Christians treating the eighth day assembly as marking both the Resurrection of Christ and the new creation, with its idea of the gift of eternal life for the followers of Christ.

The third image in the ceiling register in the two churches of the Nativity and St Atanass is a representation of the Holy Trinity. In the nave of the Church of the Nativity God the Father is on the throne, the cross with Christ crucified before

---

[535] According to Christian teaching, the evangelists set forth both the words of God and the Word of God - Christ - to the world as a result of inspiration by the Holy Spirit, making it possible for the knowledge of God to be spread widely, to the four corners of the earth.
[536]Ouspensky, L. and Lossky, V., *The Meaning of Icons* (Crestwood, New York, 1999, first edition 1952 in German), pp. 73-76.
[537] Ouspensky, L. and Lossky, V., *The Meaning of Icons* (Crestwood, New York, 1999, first edition 1952 in German), pp. 73-76.

him and the dove representing the Holy Spirit placed above the head of Christ (Figure 56). Research indicates that this particular type of composition, known as *Fatherhood*, developed in Russia in the second half of the fourteenth century and the beginning of the fifteenth century from the Byzantine tradition of anthropomorphic representation of God as a reaction against the teaching of the sects of *strigolniks* and *židovstvashtih.*[538] This is the only example within the Arbanassi decoration where an association with a Russian model can be established. The association may lie in the close connections which Metropolitan Dionisious had at the time with the Russian Church. Dionisious was very proactive in the preparation of the 1689 uprising and was an open Russophile who sought support for the cause through the Russian church. Considering that the composition was painted in 1681, when Dionisious was the Metropolitan and this particular Church was his place of worship, the suggestion that the choice of a Russian model, especially for such an important image as the *Holy Trinity*, was his personal preference cannot be ruled out.

By contrast, in the nave of the Church of St Atanass the composition on the same theme accords with the earliest anthropomorphic Byzantine model of representation of God the Father that is believed to have developed around the eleventh century (Figure 59).[539] Archive material from the Dionysious Monastery on Mount Athos associates the anthropomorphic representations particularly of God the Father with the struggle of the official Church with some of the numerous contemporary heresies, but mainly those of the *bogomils* and *pavlikjans*.[540] In the nave of St Atanass both the Father and the Son are seated on a throne, a likely allusion to New Testament texts (Matthew 16:19 and Acts 7:55-56), with the Holy Spirit above them. The enthroned images of God

[538] A. Klibanov, *Revolutzionije Dvizenia v Russii v XIV-XVbek*, (Moskva, 1960), p. 205
[539] M. Kisjova, 'Za edno mnogo rjadko izobrazenie na Svetijat Duh', *PI*, 1998, p. 39-52.
[540] Ibid. p.48.

are associated with his role as a ruler who at the Last Judgement will 'judge both the living and the dead'.[541] In the thirteenth and the fourteenth centuries this composition diminished in popularity, but was still occasionally employed. Similar examples from the Byzantine era can be seen in the thirteenth-century wall paintings of the Church of the Mother of God Kubelidiki, Kostur, Macedonia and in the Chilandandar Monastery on Mount Athos, dated as either from the thirteenth or the fourteenth centuries.[542]

The way in which the scenes of Christ Pantocrator from the naves of the churches of the Nativity and of St Atanass interact with the original nave lighting is different, but it could be argued that the overall effect of that interaction is comparable, especially the effect it has on the appearance of the central element of the composition, the medallion with the image of Christ. In the Church of the Nativity the medallion, with its bright red background and white and bright red circumference, would increase in saturation and warmth under flame light, compared to its appearance under standard noon illumination. Compositionally the medallion is centred on the green-coloured rectangle that appears superimposed on a red rhomboid. The heavenly realm around the medallion is represented by flying angelic figures with some red and black elements in their clothing. Under flame light, green would look much less saturated than red despite the fact that the lightness of the bright red and the green colours in this nave have been proved to be comparable.[543] However, under flame light the darker red of the second rhomboid would look slightly less bright than the green, while the black of the background would be a deeper shade than the estimated appearance under standard illumination. Therefore in can be suggested that the compositional use of colours in the scene of the Pantocrator from the

[541] The Creed

[542] M. Kisjova, 'Za edno mnogo rjadko izobrazenie na Svetijat Duh', *PI*, 1998, p. 39-52.

[543] See Appendix II

Church of the Nativity, in combination with the optical mutation of those colours, would optically induce a gradual reduction in lightness from the centre of the scene towards the periphery of the composition. Consequently, the optically induced sense of three-dimensionality would emphasise the medallion and especially the image of Christ. This is because of the high specular reflectance of the relatively large gilded areas, which would create the impression of emitted rather than reflected light, especially in the low relative brightness of the interior.

By contrast, in the composition of *Christ Pantocrator* in the nave of the Church of St Atanass, the palette of the image includes only a limited range of warm and bright colours. The palette is used throughout the entire composition, for the medallion with the image of Christ and for the concentric compositional space with the heavenly assembly surrounding it. Because of the uniformity of the colour scheme there would be no variation in the way the light and colour interacted together under the original flame light, unlike that observed in the context of the same composition in the Church of the Nativity. Nevertheless, the increase in the saturation of the warm chromatic colours under the original flame illumination of the nave would increase the strong simultaneous contrast within the medallion composition. This would accentuate the entire chromatic composition of the heavenly realm within the compositional space. Still, the figure of Christ, with its large areas of gilding and monumental form, would perceptually predominate over the slightly fragmented part of the composition surrounding him.

Because of the stylistic and compositional similarities between the scenes of *Christ the Child*, and the scenes of *Christ-Pantocrator* in each of the naves, the combined effect of the original lighting and the use of colour in the scenes of *Christ the Child* would be comparable to that of the Pantocrator. In the Church of the Nativity, the overall appearance of the band outlining the medallion is bright red and the colour scheme of the rest of the composition within which it is set is predominantly green (Figure 54). For instance again the red medallion shape is centred within an octagonal star-like shape that was again composed using green and red. Similar flying figures surround the medallion, but amongst them are four six-winged seraphim in the darker brown-red colour used also for the symbols of the evangelists, situated at the four corners of the composition of *Christ the Child*. Therefore the brightness of the elements here would again diminish gradually, with the symbols of the evangelists and finally the black background being the darkest, thus modelling the depth of the compositional space. Moreover, because the inside of the medallion is green, which would decrease in saturation, this would not only underpin the prominence of the red medallion, but would also emphasise the brightness of the image of Christ the Child. Here he is dressed in a white tunic and a light brownish himation. Considering the transformation of the colours under flame light, the brightness and warmth of his himation would increase, but even more would the brightness of his tunic. Consequently this would increase the luminous quality of the entire image, even though the use of gold here is not as extensive as in the image of the corresponding scene of Christ Pantocrator. The compositional use of colour in the scene of *Christ the Child* from the nave of the Church of St Atanass is almost identical to that of *Christ-Pantocrator* from the same nave, except for his white tunic, which again would increase the perceived overall high brightness of this particular image (Figure 57).

In both naves, the full figure of God the Father is in a bright white tunic and himation, with reds and white being used in the immediate backgrounds and the heavenly powers predominantly red. Because of the extensive use of bright reds the compositions would become much warmer and brighter under the seventeenth-century illumination. In the context of the composition in the nave of the Nativity, the dark shape of the Cross does not allow for the same gradation of brightness to occur as in the other two ceiling compositions (Figure 56). Nevertheless, because of the size of the figure of God the Father, white dominates the scene. Under the original lighting, perceptually, the brightness of the white would increase significantly, thus creating more direct reference to the luminary nature of God than would be generated under any other lighting. In the nave of the Church of St Atanass again the way colours are used in the construction of the image produces a radically different compositional effect, with gradation of brightness within the background of the scene (Figure 59). The direction of the gradation emulates that in the scenes of Christ in the nave of the Church of the Nativity, with the lightest shades in the middle of the composition, within the area where the Holy Trinity is depicted. Under the original lighting the colour of the background would seem even brighter and more saturated and the dominant colours in the image of Christ, black and red, would also appear increased in saturation, because of the colour of the ambient lighting. The image of the Father, being predominantly white, would look much brighter. Because of the overall brightness of the group of the Holy Trinity against the varied background and the direction of its gradation it can be suggested that flame light would create not so much a sensation of three dimensionality, as of light emitted from the group.

To summarise, in the naves of the churches of the Nativity and of St Atanass the overall effect of the seventeenth-century flame light on the appearance of the ceiling compositions would create a direct reference to one of the fundamental theological points about God, his luminary nature (1 John 1:5). This is despite the different compositional arrangements and use of colour in the ceiling decorations. The effect was achieved by the brightest area of each scene being associated with the image of God or by a greater or lesser gradation of brightness within the ceiling compositions. Such a gradation is often associated with light modelling of a painted image, where the lightest parts appear perceptually closer and the darker seem more distant, creating a sense of three dimensionality, as was demonstrated in the case of the ceiling decoration in the nave of the Church of the Nativity. At the same time such a gradation identifies God as the source of the light that shines on the faithful (Psalm 118:27). Following this argument it can be suggested that as the ceiling–suspended lighting devices were most likely close to the ceiling and because the presumed design of the candleholders would not have allowed much light to be directed downwards, the interaction of the original light with the decoration would have created the impression that it was in fact the images that emitted the light. Moreover, it became evident from the examination of the photograph of the nave of the Church of the Nativity taken under the modified electric illumination that the first register of the decoration was apparently the least illuminated section of the interior. Such an effect would underpin further the theological significance of the gradation down the registers. The question is then, if the first register is the least important, would colour and light be expected to work together in emphasizing the meaning of the images to a comparable extent?

In the context of the image of the Archangel Michael in the naves of the three churches of the Nativity, of St Atanass and St Dimitr there are a number of references to different angelic duties of the Archangel as recorded in the biblical texts. For example, the Archangel's attire and sword confirm him as a warrior-angel. The general compositional stereotype found in the Arbanassi naves has a direct parallel with the description of the Archangel in the Old Testament, at Joshua (5:13-15), where he appeared to Joshua with 'sword drawn in his hand'. The object which the saint holds in his left hand provides an additional reference, but it varies from image to image. For example, in the nave of Church of the Nativity, the Archangel holds what appears to be a black-grey orb with a white cross, where almost certainly the cross symbolises Christ. It is likely to be an allusion to the biblical description of the saint's role as 'the captain of the host of the Lord' who fights evil and defends God's people (Joshua 5:13).

In the naves of the churches of St Dimitr and of St Atanass, however, the object in the left hand of the Archangel Michael is different and is one that associates the saint with the Last Judgement. In the nave of the Church of St Dimitr he holds the scroll on which the names of the saved are written, while in the nave of the Church of St Atanass the object in his left hand resembles either a cup, from which the wrath of God is poured (Revelation 15:7) or a horn, as in the last trumpet sounded by the leading angel, Michael, (Revelation 8:7). The oldest example of such an association is from the middle Byzantine period and can be seen in the Church of the Archangels, Iprari, Georgia, where it is on the north wall and is dated as from 1096. There the Archangel also is holding a cup. This association of the Archangel with the Last Judgement is less common in wall paintings during the seventeenth century, but is more widely encountered in icon compositions. The only parallels with Arbanassi can be found in paintings on the exterior of the Chapel of St John in the Monastery of Panagia Mavriotiža in Kostur, Macedonia (1552) and in the refectory of the Hilandar Monastery on Mount Athos (1662).[544] It is probable that the image in Hilandar was an inspiration for the compositional arrangements within the scene of the Archangel Michael in the nave of St Atanass church, in view of the likelihood of the artists who painted the nave of the church of St Atanass in 1667 having been associated with Athos.

Although different stylistically, the images of the Archangel Michael in all three naves (in the churches of the Nativity, of St Atanass and of St Dimitr) share a comparable palette. It is dominated by warm chromatic colours, mainly reds, beiges, browns and yellows (Figures 20, 22, 24, 26). The other characteristic col-

[544] Rutževa, Sv., *Ikonografia I stil na stenopisite v tzurkvata Sv. Atanassii, selo Arbanassi*, pp.56-58.

our used extensively is the achromatic grey, employed in the armour of the saint. All the greys are either light or much darker shades, with the light greys dominating the images. Under the seventeenth-century flame-light dominated illumination, the dark shades would appear blue-violet while the lighter grey areas would acquire an orange-yellow undertone. No other mutation in hue would be expected for any of the other colours used in this nave. The increase in the saturation of red, brown and beige, together with the transformation of the light greys, would make the image gain in warmth of appearance, as its colours are based in the red-orange part of the spectrum. Moreover, the colour contrast between the red of the cloak and the green of the background would emphasise further the increase in saturation of the red colour, making the entire figure seem much brighter under flame light than it would appear under standard illumination. Consequently, it can be argued that while the compositional details of the image gave reference to the angel's responsibilities in the heavenly realm, under flame light and because of the specific use of colour, as in the scenes of God in the ceiling registers, the overall appearance of each image of the Archangel Michael would refer to his angelic nature. For example, in the Old Testament, Exodus 3:2, refers to the angel of the Lord appearing 'in flames of fire' while, in the New Testament, Hebrews 1:7 describes angels as 'winds' and 'flames of fire'.

This trend in the use of compositional colours allowing for more comprehensive representation seems to apply not only in the depiction of biblical characters, but can also be observed in the portrayal of historic ones. For example, it can be seen in all the images of SS Constantine and Helena (Figures 21, 23, 25, 27). In the nave of the churches of the Nativity, of the Archangels and of St Atanass the general compositional use of colour in these images is in accordance with the established Byzantine tradition, in which St Constantine usually wears a blue tunic. However in the Church of St Dimitr St Constantine wears a black tunic with yellow ornamentation and a red palludamentum. St Helena is again in a red stola and her pallia are very light - almost white - beige. Nevertheless in all three churches the dominant colours are warm; reds, beiges, browns and yellows. Thus, under the original illumination, all the scenes would appear much warmer and more saturated, therefore looking brighter and more colourful than they would under standard illumination. In the churches where the colour blue, obtained either optically or by the use of blue pigment, is used, it would also increase its saturation and thereby support the more colourful appearance.

In the scenes in the nave of the churches of the Nativity and of St Atanass the balanced distribution of the main chromatic colours - dark and bright reds, yellow, optical blue, together with the green of the background - and the ornate pallia and cross, would further support the likelihood of a multi-coloured appearance, increasing the overall sense of the brightness of the scenes. However the converse applies in the nave of the church of St Dimitr, where the colourfulness of the images would increase indirectly because of the increased brightness of the scene resulting from heightened simultaneous light contrast under the seventeenth-century flame light. Such increase of colourfulness is observed because of the direct correlation between brightness and colourfulness.[545] It can be suggested that these qualities of brightness and colourfulness might have been sought traditionally in the appearance of the scene of SS Constantine and Helena, as they convey a sense of opulence, a quality that is usually associated with royalty and high status.

On the contrary, in the scene of St Sisoes in the nave of the Church of St Atanass the only colours used are light brown, beige, white, black and optical blue, so the composition conveys simplicity as it appears almost monochrome, appro-

[545] Hunt, R. W. G., *Measuring Colour (*Kingston-upon-Thames, 1998, first edition 1987).

priately where the image is of a venerated monk (Figure 38). The image is the same distance from the suspended lighting device as the other images on the south wall, but also on the west and north wall, because of the suspending hook being central to the scene of *Christ the Child*. By occupying the upper half of the full height of the first register, the scene with St Sisoes is in its best-lit part and therefore clearly visible, suggesting the importance placed on it, as evidenced by its particular popularity in the Athonian monasteries in the sixteenth and seventeenth centuries. On Athos it can be found in the decoration of the monasteries of the Great Lavra (1535), Stavronikita (1546), Xcenophon (1567), Docheiariou (1568) and Dionisiou (1615). The composition of the scene with St Sisoes and the text are the same as in the Athonian monasteries and also in the Meteora, in the Varlaam Monastery (1566). In the present territory of Bulgaria, elsewhere than in Arbanassi, it can be seen in the sixteenth-century wall paintings in the Kurilo Monastery (1596). In Arbanassi it is present in the narthex of the churches of the monasteries of the Dormition of the Mother of God and St Nikola, as well as in the outer narthex of the Church of the Nativity.

Research indicates that in Byzantine times, probably up to 1484, the text alone would be placed above a door. Only later was the image portraying St Sisoes added, with the overall composition from then on being maintained.[546] The significance of the eschatological message which the scene conveys (about the vanity of worldly success and the equality of all in death) is relatively easy to read. As was earlier observed, in the nave of the Church of St Atanass it is not only the colours used in the image, but also its spatial position and its relation to the fixed lighting devices that assured its high visibility in the context of the decoration in the first register. With the optical transformation of the colours under the dominant flame light the strong light contrast between the black

[546] Rutževa, Sv., 'Ikonografska I stilova harachteristika na stenopisnia ansamble ot tzurkvata Sv. Atanassii in Arbanassi ot 1667 godina' in *PI*, special edition (1998), pp. 38-43.

background and the white text would increase, the light-coloured areas appearing brighter and, in the case of the text, easier to read. The overall bright appearance of the composition in the scene of St Sisoes and its high legibility are underlined by the much darker overall appearance of the saints on either side of the doorway; St Vakhous to the right and St Nestor to the left.

To conclude, having examined a number of different scenes, it can be suggested that in the decoration of the naves of the three churches of the Nativity, of St Atanass and most likely of St Dimitr, the interaction between the compositional colours and flame light reveals to a greater or lesser extent the didactic purpose of the image. The question now is how and to what extent this trend manifests itself in the context of the very different architectural setting and lighting conditions in the nave of the Church of the Archangels.

7.4.3 Church of the Archangels Michael and Gabriel

The interior arrangement of this church, with its domed and part-vaulted nave, results in an uneven distribution of light, especially as there is only one ceiling-suspended device, beneath the dome (Figure 53). Nevertheless this pattern of distribution emulates that which would be found in a Byzantine domed structure. Because artificial illumination is focused there, initially I will centre my evaluation of the effect of the approximated original lighting on the domed part of the interior. In the context of the distribution of the available light, the brightest illumination of the test scene is focused within the dome and the immediate supporting spandrels. Consequently these areas themselves appear bright. The next best-lit areas are within the alcoves, one to the north and the other to the south. Within the alcoves a vertical gradation of the intensity of the illumination can be observed, where the upper section is best-lit and almost as bright as the domed area. Because of the brightness of the light emitted by the chandelier fitted with 40-watt bulbs and its comparative colourlessness, the overall appearance of the decoration is bright, but somewhat dull. The intensity of the illumination, however, rapidly diminishes towards the first register, as does the brightness and eventually the clarity of the images. When considering that the decoration in the brighter section of the alcove is in the second of the three registers in this church, it become apparent that the overall pattern of the distribution of the intensity of the illumination once again corresponds to the theological significance of the decoration in each register.

The immediately noticeable difference between the test scene and the scene under the modified lighting is that the domed area has acquired a much warmer, more colourful and more intense appearance. Moreover, the illumination in the scene with the modified lighting is closer to the original as it combines the effect of the natural and the approximated artificial lighting. As can be seen from the illustration, here the domed area is almost exclusively viewed under the characteristics of the modified electric illumination, even in the conditions illustrated in Figure 52, where the intensity of the natural lighting is at its strongest. Therefore, within the immediate domed area, the observed effect of the simulated original lighting can be attributed mainly to the colour of the modified electric lighting. This lighting would have increased the saturation of the predominately warm colours used in the execution of the decoration: reds, yellows, beiges and browns. Moreover, because the luminous intensity of the modified electric lighting is much lower than the modern lighting, all the other expected effects of the optical transformation of the appearance of the colours can be identified. For example, under the modified illumination, the black areas of the background have become highly saturated and consequently the lighter coloured areas have become more prominent. Furthermore, earlier, when the appearance of the individual colours in this nave was assessed, it was concluded that there were no significant variations in the brightness and saturation of the chromatic colours. However, a degree of three-dimensionality can be observed under the modified artificial lighting, compared to the more flat appearance of the decoration under the much stronger present electric illumination. This can be explained by the expected greater perceptual increase in the brightness of the lighter colours than in the slightly darker ones.

The most significant difference between the appearance of the test scene and the scene under the simulated original illumination that can be attributed to the difference in the luminous intensity of their illumination is in the observed levels of illuminance in the various parts of the interior. In the test scene the distribution of the intensity of the illumination follows the Byzantine pattern, where the domed area is the brightest, while in the other it deviates from that pattern. Here the highest intensity of the illumination is in the southern alcove, because of the high luminous intensity of the natural lighting. This causes the spandrels and the dome to be only the next best-lit section. The distribution of the intensity of the lighting within the south alcove is also different from that of the test scene as it does not show any great variation, because of the pattern of the distribution followed by natural light from the south window. Moreover, although in the illustration the observed brightness of the north alcove is much lower than that of the south alcove, it could be argued that in the seventeenth century the natural illumination in both areas would have been comparable, but somewhat lower. This is because the opening in the north alcove would at that time have been an external one but, unlike the south alcove, because of its orientation would have not been capable of receiving direct sunlight. In extreme lighting conditions, as in Figure 53, when direct and strong sunlight can be expected to enter the south window, the levels of illuminance in the alcoves would then have been very different.

Despite the observed discrepancies between the pattern of distribution of the intensity of the illumination in the Byzantine model of illumination and the pattern observed under the simulated original lighting conditions, where the alcoves are more brightly lit than the dome area, the visible section of the domed area is still more prominent than the visible parts of the alcoves. This result can again be attributed to the effect the colour of the illumination has on the appearance of the decoration, making it appear more intensely warm and colourful. In the illustrations under both lighting conditions the complex architecture prevents a full view being obtained of the dome and of the alcove areas. Hence, to gain a better understanding of the effect on the decoration of the distribution of the colour and intensity of the original illumination, it is necessary to consider the way colour and light work together in the context of the images contained in these areas.

In the dome, set in a bright red medallion, is an anthropomorphic representation of the Holy Trinity (Figure 60). The Father and the Son are enthroned and the dove of the Holy Spirit is above them. The left hand of the Father rests on a sceptre, while Christ holds the Book of Life. There is some deviation from the Byzantine model. For example, both figures are dressed in dark attire untypical for that model and, instead of being placed on a plain background, the group is painted on a black background, surrounded by clouds, within which reside numerous flying heavenly powers. In the 1980s Prashkov reported that the composition in the dome is very unusual and that he was not able to find parallels elsewhere.[547] Around the medallion is a dense figurative composition representing the multitude of the heavenly powers again alluding to descrip-

[547] I believe that a detailed examination needs to be carried out on the chemical composition of the paint, to determine whether the present appearance is caused by deterioration of the pigments used originally.

tions of Heaven in both the Old and New Testaments.[548] The four evangelists are depicted in the spandrels.

In the upper section of each of the alcoves there is a single composition that follows Byzantine iconographic tradition. In the north alcove is the scene of the *Nativity of Christ*, referred to in the New Testament Gospels of Matthew and Luke. Research indicates that the type of composition was widely used from the late Byzantine era in the fifteenth century to the end of the seventeenth century (Figure 61).[549] It can certainly be found in scenes of the Nativity in all the Arbanassi churches. Here the Mother of God is reclining with the baby next to her. Within the compositional space two other scenes are incorporated providing further references to the main theme. One depicts the bathing of the infant after the birth. The other portrays Joseph in the company of an old man with a crooked stick. The scholarship does not agree on the identity of the other man. In the 1920s Millet, in the context of the post-Byzantine church decoration on Athos, considered the man to be a shepherd, while Božkov in the 1960s, in the same context, supposed him to be a monk.[550] In the 1990s Bobrov associated the image with the apocryphal book of Jacob, where a character, called Anen, a learned man, went to discuss with Joseph the impossibility of the immaculate conception and virgin birth.[551]

In the south alcove is the scene of the *Descent into Hell*. It has also been associated with one of the books in the Apocrypha, that of Nicodemus (2:1-11).[552] The composition used here is associated with one of two Byzantine iconographic

---

548 Ezekiel 1 and 10; Isaiah 6:2; Revelation of St John 4.
549 A. Božkov, 'Bitovite elementi v stenopisite ot Arbanashkite tžurkvi (XVII–XVIII)', *Sbornik na BAN*, Vol. VI (Sofia, 1963), pp. 99-132.
550 G. Millet, *Monuments de l'Athos*, (Paris, 1927), p. 66; A. Božkov, 'Bitovite elementi v stenopisite ot Arbanashkite tžurkvi (XVII–XVIII)', *Sbornik na BAN*, Vol. VI (Sofia, 1963), pp. 99-132.
551 J. G. Bobrov, *Osnovui Ikonografii Drevne Ruskva Iskustva*, (St. Petersburg, 1999), pp. 76-78.
552 J. Radovanovich, *L'emperieur dans l'art byzantine*, (London, 1971), p 246.

models that were developed in the Paleologian period and which were followed closely within the Orthodox world. One of the models represents Christ pulling Adam out of the grave first, while Eve waits behind him. In the other model, which is employed in the nave of the Church of the Archangels, Christ brings both Adam and Eve to life simultaneously (Figure 62). In both models the event is witnessed by saints and prophets. Representing his victory over death, in the scene from the south alcove Christ is depicted in a pointed mandorla, standing on the broken doors of Sheol (Hell). The mandorla images are considered to have become popular in wall paintings after the middle of the eleventh century.[553]

To assess the effect of the seventeenth-century lighting on the appearance of this part of the decoration, account also needs to be taken of the fact that the original lighting device would have been of the polycandelon variety. In this context it could be argued that, because the original device was probably wider than the present chandelier and the individual light sources (in this case lamps) were more evenly distributed around the circumference of the polycandelon, the incandescent illumination would be distributed more evenly across the dome. Even though the luminous intensity provided by the original type of device would still be low, the colour of its light would be more saturated than the modified electric light. Moreover, because of the likely design used for the actual lamps-holders, the intensity of the light distributed downward and sideways to the spandrels would be much lower, compared to the intensity of the light distributed upwards. Consequently, this would leave the dome alone as the brightest-lit part within the domed area. which is dominated almost exclusively by flame light.

---

[553] T. Velmans, V.Korač, M. Suput, *Bizancio: el esplendor del arte monumental*, Barcelona, (1999).

The specific use of colour in the dome distinguishes further the two compositional areas in the decoration, separated by the various bright red and black bands that outline the medallion shape. The composition of the heavenly powers is predominantly in warm colours, mainly red, purple and reddish brown with the addition of white and some black. Consequently the colour of the seventeenth-century flame light would impact strongly on the composition of the heavenly host and the medallion shape, which would appear much warmer and thus more colourful than under the modified electric lighting of the chandelier.

The colour scheme of the medallion is much simpler, almost monochrome, with the black of the background and the darkly-clothed group of the Father and the Son contrasting with the white of the clouds and the gilded area, which is the most extensive in the decoration of the dome and in the nave as a whole. The other such area is the gold band at the rim of the hemisphere of the dome. The haloes of the multitude of the heavenly powers and the hems of their garments are gilded and, within the medallion, the haloes of the Father and the Son are also gilded. It can be suggested that the decoration of the dome alludes to the New Jerusalem in the book of Revelation, where the Holy City is described as shining with the glory of God and with brilliance 'like that of a very precious jewel' (Revelation 21:11) with its wall as pure gold (Revelation 21:18) and the place where the God resides.

The lower level of the original artificial illumination would impact most of all on the medallion area, with its monochrome composition amplified by the strong light contrast, the black perceptually increasing in saturation while the white-painted areas would appear much brighter. The impression of brightness of the medallion would be heightened most of all by the high specular reflectance of the polished gilded surface. Having the gilded area on the inside, nearer the seated group, and the white section of the clouds further away, creates the same pattern that was found in the composition of the Holy Spirit in the Church of St Atanass. As there, the brightness diminishes the further away the decoration is from the group. Consequently, the size of the gilded area and the sharpness of the glare would allude more effectively to the luminary nature of God and Him being the ultimate source of Light in the New Jerusalem (Rev 21:23).[554]

Considering the compositional use of colours and gilding in the domed area as just described, it can be suggested that, under the original lighting, the dome and the medallion in particular would become the brightest part of the interior, despite the brightness of the natural illumination of the alcoves, suggested by the experiment approximating to the original lighting. Moreover, this proposition takes account of the compositional use of colours in the upper section of their decoration, where the use of light colours, especially in the north alcove, is significant. However, it could be argued that as the alcoves are dominated by natural lighting this would result in an overall reduction in the perceived brightness of the scene. This is because the colourless natural lighting would bring the appearance of the individual colours more into line with their recorded appearance under the standard illumination, under which the estimated lightness is about or below the medium range.[555]

When juxtaposing the two scenes, the *Nativity of Christ* and the *Descent into Hell*, it can be observed that the use of compositional colours allows for compositional, perceptual and consequently conceptual parallels to be made between them. For example, in the north alcove the image of the *Nativity of Christ* is made a fo-

---

[554] The city does not need the sun or the moon to shine on it, for the glory of God gives it light, and the Lamb is its lamp. NIV

[555] This is in the context of the results from the estimated nearest Munsell chip value. See Appendix II.

cus of the scene by the placing of the reclining figure of Mary on a brightly-coloured bed and its positioning centrally over a black background. In the opposite alcove the mandorla image of bright red with an even brighter image of Christ is again positioned centrally within a dark area, thus being the focus of this particular scene.

The pattern in the gradation of lightness in the image of Christ, where he is perceived as much lighter than the mandorla because of his bright white tunic and gilding, confirms Christ as a source of light within the mandorla. Equally, in the scene of the Nativity of Christ, the image of the reclining Mother of God is accentuated by the black background, representing the dark cave, but her depiction against the massive bright landscape creates the impression that the landscape is illuminated by the event of the Nativity itself. The rocky background in the two scenes has an almost identical profile, confirming further the compositional parallels between the images. It can be suggested that both the compositions and the use of colour allude to the theology of the two comings of Christ. His first coming is understood in theological terms to have brought light to the world (John 1), while at his second coming it is believed that Christ will bring to life and ultimately to light the faithful dead. The proximity of the images to the nearby sources of natural light further reinforces the implied meaning of the images.

The natural light would also dominate the vaulted part of the nave, but to a different effect. Following the results of the investigation into the relative brightness of the natural illumination, it can be anticipated that the intensity of the illumination in this part of the nave would be much lower than in the domed area. This would emphasise the theological significance of the images in the dome and the alcoves. The vaulted ceiling is occupied by a typical, but simplified, version of the Byzantine model of the scene of *Christ Pantocrator*. This image is presented within a bright medallion composed of several bright red and black bands, with Christ holding the closed Book of Life in his left hand and his right hand raised in blessing. He is in the traditional red and gold tunic and dark, optical blue himation. Significantly the image is situated within a white background which could be suggested to be indicative of his luminous nature. At the four corners of the composition there are the symbols of the evangelists in white and brown colours, and on the four sides there are pale images of seraphim.

The impression of the luminous qualities of the medallion would be emphasised by the strong light contrast between the image of Christ with its dark himation and the light background. The brightness of the image would also rely on the high specular reflection of the gilded areas, which were relatively extensive compared to the rest of the decoration in this section of the interior. Bearing in mind the low intensity of the illumination in this part of the nave such extensive use of gilding, together with the bright background of the medallion would emphasise the scene of Christ Pantocrator in the context of the decoration of this section. Also, because of the low visibility in the vaulted part of the interior, particularly at the west end, the compositional use of colours is of even greater significance in this area. It would be difficult to envisage any additional mobile lighting devices being used here because of the seating system that encompasses the interior. It can be argued that the effect of the interaction of the original illumination and the colours used in the scenes of the Archangel Michael and of SS Constantine and Helena would serve to emphasis their attributes in a way that would be comparable to the appearance of these compositions in the vaulted churches of the Nativity, of St Atanass and of St Dimitr.

The initial examination of the images indicated that the use of both colour and gilding is different to that in the same scenes in the other three churches (of the

Nativity, of St Dimitr and of St Atanass), where grey was used extensively. For example, in the nave of the Church of the Archangels, the dominant colours in the scene of the Archangel Michael are red and white. Red would not be as prominent as in the interiors dominated by flame light, nor even as in the naturally well-lit interior, as photopic vision would not operate fully in that part of the interior because of its low illuminance. Still the white would appear bright, especially in the context of the expected darkening of the rest of the colours in the scene. The sensation of the brightness of the image would also be increased by the strong colour contrast between the luminous white of the attire and the dark ornamentation of the armour. Thus it can be suggested that the brightness of the image even under low illumination would allude to his angelic nature. In the context of the scene of SS Constantine and Helena their appearance would be defined primarily by the extensive use of gilding. It can be anticipated that such an effect would not only suggest a degree of overall brightness in the images of these saints compared to the rest of the register (where, even in the scene of the Archangel, gilding has not been used to the same extent), but would also underpin their royal status.

To conclude, in all the different sections of the interior of the Church of the Archangels, despite the complex architecture and the variety of illumination, the way the compositional use of colours and the original lighting would work together would reinforce the didactic quality of the images just as in the much simpler interiors of the vaulted churches. Therefore it can be argued that the colours in the palette of the churches had been skilfully applied in the creation of the images, by taking account of the available light in every area. The apparent aim of the artists at a particular perceptual quality in the finished images suggests that the compositional use of colour pertained to the specific meaning of the image, rather than to a random use of colours or to an uninformed mechanical copying of existing models.

A consideration of the results from the investigation into the effect of the original lighting on the appearance of the seventeenth-century nave decoration leads to the conclusion that the way in which colour and light would work together was considered by the original artists in the context of the entire decorative programme and was used appropriately. Here the intention is to bring the multitude of images into one conceptual frame of the Christian message, where God was shown as the ultimate source of light and supreme commander of the universe. The result of my investigation indicates that that the simple architecture and the content and organisation of the decoration of the vaulted churches of the Nativity and of St Atanass and perhaps of St Dimitr would convey just this theological concept under the original illumination. However, the complex architecture, the content of the decoration and the type of original lighting in the nave of the Church of the Archangels would be permit the optical presentation of the doctrine of the two comings of Christ. Here they are highlighted through the use of natural light and the particular use of colour, with the dome remaining the focal point of the interior, emphasising the idea that the incarnation of Christ and his second coming are the signs of the kingdom of God being brought to earth. It can be concluded that the way in which the compositional use of colour in the seventeenth century decoration under flame illumination would transform the interiors into a coherent embodiment of the Christian message.

CONCLUSION

The aim of my thesis was to elucidate the effect the specific use of colour in the decoration and the original lighting of the interiors had on the appearance of the seventeenth-century naves in four Arbanassi churches - the churches of the Nativity, of the Archangels, of St Atanass and of St Dimitr. The underlying hypothesis was that the architecture and the decoration of these churches are representative of the architectural and artistic practices employed by the Eastern Christian community in the seventeenth century Bulgarian province of the Ottoman Empire. Selecting several church interiors from the same historical period rather than just one provided a wider base for the investigation. To achieve my aim I used both existing methods and developed new ones to create a scientifically-based methodology that can also be used in the context of research where an historic monument is itself the only surviving evidence of past visual practices.

Bulgarian historical, art historical and archaeological research into the four churches has confirmed the dating of the interiors of the naves as seventeenth century, whilst the other chambers were built and decorated in a variety of different periods. My findings proved that the appearance of the colours of the decoration is authentic, not having changed significantly since the interiors were painted, as the basic pigments are stable chemical mixtures. By contextualising the decoration of the Arbanassi naves in the Eastern Orthodox visual tradition I established that the style and the organisation of their decoration is consistent with the overall Byzantine model, the Athonite visual tradition having played a decisive role in confirming that model as the standard in the seventeenth-century Orthodox world, including Arbanassi.

I also demonstrated that the range and the appearance of the colours were constant throughout each nave. Thus just two scenes were sufficient for the detailed investigation of the colours used in each nave. These were the scenes from the first register on the west wall, the images of the Archangel Michael and of SS Constantine and Helena. Using these images throughout the investigation provided a uniform basis for comparing the use of colour in the different naves.

In my initial visual enquiry into the use of colour I found that the artists used only a very limited number of colours in each church – nine in all. The gamut of the seventeenth-century artists' palettes is relatively constant and there are seven colours that are present in all the churches: red, yellow, beige, brown, white, grey and black. Greens are restricted to two of the churches, the churches of the Nativity of Christ and of St Atanass, while blue is used only in the Church of St Atanass.

The colours were then examined by spectrophotometry. This allowed me to determine the main pigments used to produce each of them. My investigation revealed that most are coloured earths, such as red, yellow and brown ochres and *terre verte*, but some are either metal ores, found as rock formations, such as hematite and azurite, or salts, found as granular or crystalline structures, such as cinnabar.

Awareness of the chemical basis of the Arbanassi colours provided a frame within which I was able historically to contextualise the use of colour in the naves, both within the Ottoman Empire and within Western Europe, mainly Italy, and to enquire into the availability and affordability of the pigments at the time the naves were painted. I established that the availability of a variety of pigments was good, but that the use of a limited range, of inexpensive pigments within the Arbanassi palettes was likely to be a consequence of the economic circumstances, including strong inflationary forces both within the Empire, and in Europe. Moreover, knowledge of the chemical composition of the pigments allowed me to consider the advantages and the disadvantages that the palettes of Arbanassi offered the artists.

Among the main advantages were the suitability of the pigments for wall painting techniques, their durability, their non-bleeding qualities and the opportunity to expand the palette through simple thermal or grinding operations. The limited preparation of the raw materials, such as grinding and levigation, required before use, meant that the pigments were easy to use. The main disadvantage was that the dominance of the earth pigments in the palettes of Arbanassi restricted the gamut, and thus the appearance of the decoration, to mainly warm colours; yellows, reds and browns.

While my analysis of the pigments revealed what the wall paintings of the Arbanassi naves were made of, it could not provide an understanding of why they looked the way they did. I sought the answer to that question in the study of the compositional use of colours in the context of the perceived appearance of the individual colours in the palettes. To ascertain the perceptual value of each colour identified in my visual examination of the naves I performed psychophysical measurements of the characteristics of the light reflected off surfaces painted, taking into account the chromatic response of the human eye.

To describe the appearance of the colours I used the Munsell Colour Ordering System. It has a fair degree of accuracy, provides a standardised numerical notation of colours that can be communicated easily, but most importantly offers a visual illustration of the appearance of the colours and is generally favoured in the humanities. The nearest equivalents in the Munsell System to the perceived appearance of the individual colours used in the naves showed those colours to be of low chroma and value, meaning that, in isolation, they are perceived as dull. However my initial visual examination noted the colourfulness of the church interiors. In the context of the scenes of the Archangel Michael and SS Constantine and Helena I comprehended that the artists constantly juxtaposed colours in a way that resulted in strong simultaneous light and colour contrasts. My conclusion was that this skilful use overcame the subdued appearance of the natural pigments and created a bright and colourful impression. By elucidating the use of colour in the naves I set the frame within which the decoration of the naves interacted with the original interior lighting.

In principle, the appearance of surface colours is a function of the spectral characteristics of the light falling on that surface and, to a lesser degree, of the intensity of that light. The interior lighting is usually a combination of natural and artificial lighting. Initially I scrutinised the contribution of the natural and the artificial light to the lighting conditions of the naves. As natural light is considered to be colourless I did not enquire into that aspect, but only into its intensity. To ascertain this I enquired how the natural light was deployed in the church interiors and what effects various aspects of their original seventeenth-century interior design would have had on the distribution of the light in each nave. I then explored the relationship between the fenestration, the volume of the chambers and the nature of the incoming natural lighting, direct and indirect. I was able to demonstrate that the level of luminance was low and that, as a result, artificial lighting dominated the upper half of the interiors.

Most certainly, at the time the naves were decorated, their artificial interior illumination was provided by flame light, as the use of oil lamps and candles has always been part of the Eastern Orthodox tradition of worship. I examined the likely design and spatial arrangement of the sources of the seventeenth-century artificial lighting in the naves and established that the main sources of light were polycandela suspended from fixed points in the ceilings, with oil lamps providing the illumination. With the acquired knowledge about the content of the palettes of Arbanassi and in the context of empirical scientific research into the perceptual changes occurring under such light I examined the direction in which the colours would have changed under the original lighting.

However, to envisage how the naves in the seventeenth century might have appeared, I devised a methodology in the context of Chalmers' virtual reconstruction of the appearance of historic interiors under their presumed original lighting. As various obstacles prevented me from constructing an approximation of the seventeenth-century lighting conditions as a virtual reality, I conducted an actual approximation in the real setting of the naves of the churches of the Nativity and of the Archangels. Analysis of the resultant scenes established that in the Church of the Nativity and, by implication, in the other vaulted interiors, the illumination would be at its brightest in the ceiling area of the vaults and would gradually diminish, in accordance with the diminishing theological significance of the scenes depicted in the lower registers in the naves. In the nave of the Archangels the experiment demonstrated that the dome area was the part of the interior best lit by artificial light, while the alcoves and the vaulted part of the interior were illuminated almost exclusively by natural light.

To elucidate the likely way in which colour and light worked together in the Arbanassi naves, I examined the effects of the relationship between the lighting and the overall organisation of the decoration in the best-lit and worst-lit registers, demonstrating that there was a consistency in the way light and colour work together throughout the naves. The compositional application of colour was a particular focus of my study and my underlying assumption was that the painter(s) rather than the patrons chose the colours during the execution of the images. Because of the compositional use of colours, the optical changes emphasised primarily the implied theological meaning of the images. I demonstrated that the painters used colour skilfully and sensitively in the context of the available illumination to underline the didactic nature of the images.

My examination into the effect the original lighting had on the seventeenth-century nave decoration of the four Arbanassi churches is a new departure for research into these churches. The methodology and innovative methods of examination pioneered in this thesis allowed me to depart from conventional art-historical assessments. Not merely accumulating technical data, the present research challenges previously accepted presumptions and offers a means of revealing the optical complexity of the original interiors. This provides an increased knowledge and understanding of the visual practices employed in the Arbanassi interiors. The wider significance of this thesis lies in the way that it bridges the existing division between science and the humanities. It has developed new, universally applicable methods of examination, which provide research tools that are of potential use in all similarly constrained circumstances.

Appendix I

Spectral characteristics of the Arbanassi pigments

1. Bright Reds

Figure 63 shows the spectral curves for the bright reds used in the four churches. That for the Church of the Nativity is shown by a blue line, that for the Church of the Archangels by a magenta line, that for the Church of St Atanass by a yellow line, and that for the Church of St Dimitr as a cyan line. The spectral curves of the main colour-inducing components of the three pigments mentioned above are also shown. Red oxide for the red ochres is represented by a deep purple line, mercury sulphide for vermilion red is represented by a brown line and lead oxide for the orange-red is represented by a green line.

From these curves, it is clear that the bright reds in all four churches peak distinctly in the red–orange area of the spectrum, as their dominant wavelengths are in the interval between 590 nm and 700 nm. Further scrutiny of Figure 63 reveals a similarity between some of the spectral curves in the areas of maximum absorption, despite the levels of absorption being identical. In principle, where there are similarities between the curves in the areas of maximum absorption, this is an indication that there is a high probability that the underlying colour agent will also be similar.[556] When the spectral curves for the churches are compared with the spectral curves for the individual pigments, the bright reds in the churches of the Nativity, the Archangels and St Atanass suggest that they all have iron oxide as the main colour agent. The spectral curves for these churches display the typical upward tendency of red iron oxides in the area of

---

[556] Berns, *Principles of Color Technology*, p. 94.

the long wavelengths and maximum absorption in the areas of the short wavelengths.

2. Dark Reds

For the reds that can be classified as dark reds, there is data for only three of the four churches studied in this thesis. The spectral curves from these churches are presented in Figure 64. The curve for the dark reds in the nave of the Church of the Nativity is shown as a blue line, that for the Church of the Archangels as a magenta line, and that for the Church of St Dimitr as a yellow line. The other two spectral curves included in the figure are again those of red iron oxide, shown as a purple line, and cinnabar, shown as a cyan line. I will compare the dark reds in the three churches with each other, and also with the spectral curves of these two pigments.

A comparative examination of Figure 64 reveals similarities in the absorption characteristics of the spectral curves associated with the two churches of the Nativity and of the Archangels. Both spectral curves have their maximum absorption in the blue band of the spectrum and the rising long wavelength tail is indicative of the presence of iron oxides. Thus it may be assumed that in both churches the artists employed iron ochres for the preparation of dark red-coloured paints. In the previous section, dealing with the bright reds, the maximum scattering of the iron reds was notably in the red to red-orange bands. Here the dark reds, even though these are again iron reds, show their maximum scattering in the purple band of the spectrum.

3. Yellows

In Figure 65, the spectral curves of the pigments are presented alongside the spectral reflectance curves of the yellows from all four churches. The spectral curve for the Church of the Nativity is shown as a blue line, that for the Church of the Archangels as a magenta line, that for the Church of St Atanass as a yellow line, and that for the Church of St Dimitr as a cyan line. The spectral curve for yellow ochre is shown as a purple line, that for sienna as a green line, and that for raw umber as a brown line. The data collected from the yellow colours in the naves of the four churches and from the three standard yellow pigments, using a Konica Minolta spectrophotometer CM 2600-d, is over the visible part of the spectrum, between 400 nm and 740 nm.

Examination of the spectral curves of the yellows shows their maximum scattering in the yellow-green area of the spectrum, but also that they all differ in lightness. The lightest yellows are in the Church of St Dimitr and the darkest are in the Church of the Nativity, while all have similar saturation. All the curves, both those for the standard pigments and those for the churches themselves, display an upward tendency, characteristic of any iron oxide, in the long wavelength area of the spectrum, and the characteristic dip for the yellow iron pigments in the area about 470 nm. From Figure 65 it is not possible to define the exact type of yellow pigment because the absorption fingerprint of the particular yellow iron pigments is in the ultraviolet area, with the spectral curve starting to rise sharply at the short wavelengths (the violet part of the spectrum). Although the Konica Minolta spectrophotometer offers the possibility of collecting data in the ultraviolet part of the spectrum, between 10 nm and 400 nm, I did not collect any because of the prohibition issued by the Museum authority on the use of any light source that emits in the UV part of the spectrum.

4. Blue

The spectral curve of the only blue is shown in Figure 66 as a navy blue line. Two more curves are included in the figure, for azurite in magenta and for smalt in yellow.[557]

[557] Smalt is a powdered deep blue glass. The colour is cobalt oxide based.

According to Nenov the two pigments that were used in the production of blue up to the end of the seventeenth century were azurite and lapis lazuli. As can be seen from Figure 66 I included only a standard sample of azurite. The choice was made on the strength of the evidence that, in the visual part of the spectrum, both azurite and lapis lazuli have almost identical spectral curves. The difference is noticeable in the NIR examination.[558] Instead of lapis lazuli I included a smalt standard sample, as I was advised during my fieldwork.[559]

Comparative examination of the curves in Figure 66 reveals that the spectral curve collected from the ornamentation of St Constantine's tunic is very different from the curves of the standard samples. However, the curve from the paint has its maximum absorption in the area in the red band of the spectrum, approximately between 635 and 655 nm, similarly to the spectral curve of azurite. The area of maximum scattering is in the region between 470 nm and 480 nm. The dominant wavelength for azurite is published by Barnes at 475.6 nm and for lapis lazuli he shows it as 474.4 nm.

5. Greens

In Figure 67, together with the spectral curves for the churches, where that for the Nativity is shown by a navy-blue line and that for St Atanass by a magenta

[558] J. K. Delaney, E. Walmsley, B. H. Berrie, and C. F. Fletcher, 'Multi-Spectral Imaging of Paintings in the Infrared to Detect and Map Blue Pigments' in *Scientific Examination of Art: Modern Techniques in Conservation and Analysis (Sackler NAS Colloquium)*, (Washington, 2005), pp.120-136. Prashkov, in his writings on conservation and restoration of post-Byzantine art, mentioned only the use of azurite and no other pigment. L. Prashkov, 'Razvitie i razprostranenie na ikonata' in *Bulgarsko Vuzroždensko Izobrazitelno i Priložno Izkustvo* (Sofia, 1985), p. 9.

[559] The suggestion was made in 2006 by Petrova, then conservator in the Institute of the National Culture and Monuments, in private communications. Although smalt seems to be a slightly unusual choice, nevertheless the use of this pigment had been known as early as the fourteenth century in Italy. See Ball, *Bright Earth*, pp. 133-134. Because of the connection of the Arbanassi merchants with Italy, the possibility of importation cannot be excluded. Haritonov, Chohadsžieva, Rutževa, *Arbanassi (*Sofia, 2003), p. 7; J.Thissen, 'Smalt' in Roy, *Artists' Pigments*, Vol. 2, pp. 113-130.

line, the spectral curves obtained from specimens of *terre verte* and malachite are presented. The spectral curve of *terre verte* is shown as a yellow line and the curve of malachite as a cyan line.

On average, the maximum wavelength of scattering for *terre verte* and malachite is within a similar range. For *terre verte,* it is between 497 nm and 540 nm.[560] However, the maximum scattering for the particular *terre verte* sample presented in Figure 24 is very much into the yellow part of the spectrum, between 550 nm and 570 nm. This shift was explained by Grissom.[561] He writes that variations in colour identified with yellow can be associated with burnt *terre verte*. The particular spectral curve presented by Grissom has the dominant wavelength shifted to 572 nm.[562] Moreover, he also speaks of a possible shift in the maximum area of scattering of *terre verte* towards yellow, rather than blue, when the pigment is mixed with white.[563]

On average, the maximum scattering for malachite is between 505 and 525.[564] The most characteristic difference between the spectral curves is in the area of the spectrum in the range of about 440–450 nm, where the spectral curve of the malachite displays a characteristic dip.

6. Light Browns

The spectral curves of the two light-brown colours identified in the four churches of Arbanassi are displayed in Figure 68, together with the spectral curves of the standard pigments listed by Nenov.[565] The spectral curve of the light browns from the Church of the Nativity is shown as a navy blue line and that from the Church of the Archangels as a magenta line. These are compared

---

[560] Grissom, 'Green Earth' in Feller, , *Artists' Pigments*, pp. 144–146.
[561] Ibid., pp. 141–149.
[562] Ibid., pp. 144–145.
[563] Ibid., p. 145.
[564] Getten and Fitzhugh 'Malachite and Green Verditer' in Roy, *Artists' Pigments,* Vol. 2, p. 190.
[565] Ibid.

with the spectral curves of sienna, shown as a yellow line, burnt sienna as a cyan line, umber as a purple line and burnt umber as a brown line.

7. Other Browns

Brown colours with a lower lightness than the light browns discussed above have been used in all four churches. In Figure 69, the spectral curve of the browns from the Church of the Nativity is shown as a navy-blue line, that of the browns in the Church of the Archangels as a magenta line, that of the browns in the Church of St Atanass as a yellow line, and that of the browns in the Church of St Dimitr as a cyan line. Spectral curves collected from the wall paintings in these churches are compared in Figure 69 with the spectral curves from the four yellow iron oxide pigments enumerated by Nenov in 1984.[566] The spectral curve of sienna is displayed as a mauve line, that of burnt sienna as a brown line, that of umber as a green line, and that of burnt umber as a blue line.

8. Black

In Figure 70 I compare the spectral curves from the churches with the spectral curves from samples of pigments of vegetable origin (shown as a purple line) and of animal origin (shown as a brown line). The spectral curves of the churches are as follows: for the Nativity a navy-blue line, for the Archangels a magenta line, for St Atanass a yellow line and for St Dimitr a turquoise line.

The ideal black absorbs 100% of the incident flux.[567] However, the shapes of the curves from the churches of St Atanass and of St Dimitr show maximum absorption in the long wavelengths, while the dominant wavelength is in the short wavelength band.

---

[566] Nenov, *Practikum po himichni problemi v konservatžiata*, pp. 115–117.

[567] A technical term, indicating the light that falls onto the surface of an object or on the examined part of the surface area.

9. Whites

In Figure 71 I compare the spectral curves from the church whites with the spectral curves collected from two different samples of calcium carbonate, to give a broader basis for comparison. In that figure I code the spectral curve from the white in the Church of the Nativity as a navy-blue line, that of the Church of the Archangels as a magenta line, that of the Church of St Atanass as a yellow line, and that of the Church of St Dimitr as a cyan line. The spectral curves of the two calcium carbonate specimens are shown as purple and brown lines respectively.

In Figure 71, the spectral curves from all the churches appear to display enough similarities to give grounds for the presumption that they share an identical colour agent. The result of the comparison fulfils the expectations of the use of a single type of pigment. There is, however, little resemblance between the spectral curves of the whites from the naves and the spectral curves of the two samples of calcium carbonate. One of the areas of dissimilarity is the difference in the dominant wavelengths. As can be traced in Figure 71, the dominant wavelength for all the Arbanassi spectral curves is in the long wavelength band. The curves of the samples either have no recognisable dominant wavelength or have one in the short wavelength band. This specific configuration of the Arbanassi curves implies that the type of white has a pink undertone. The configuration of the first sample indicates a bluish undertone, but it can be expected that the second sample would be perceptually colourless (there are irregularities in the curve's profile, but they cannot be expected to have any significant impact on the colour of the calcium carbonate-based second sample).

There is some dissimilarity in the absorption maximum between the two sets of spectral curves, from the churches and from the samples. In one of the graphs (number fourteen) in Barnes' article, four of the spectral curves are taken from four white pigments, three with different microstructures, and one of them appears to be a chemical mixture (Figure 73).[568] These are: titanium white (spectral curve A), a mixture of titanium white and barium sulphate (spectral curve B), zinc white (spectral curve C) and lead white (spectral curve D). When the profiles of the Arbanassi spectral curves (Figure 72) are compared with the spectral data found in Barnes, there is a closer resemblance of the profiles of the churches with that of the lead white (spectral curve D), rather than with those of the calcium carbonate samples.

[568] Barnes, ‘Spectrophotometric Studies of Artists Pigments’, pp. 120–138.

Appendix II

Colourimetric coordinates and Munsell matches of the Arbanassi colours

The results for the appearance of the colours in the churches of Arbanassi are presented numerically in the form of colourimetric coordinates (L*a*b*), together with the results of the calculations for the Munsell chips. I will refer to any Munsell chip identified in this way as 'the Munsell match'. These two sets of results are displayed on either side of the central vertical axis of the table below (Table 6).

Even though for most of the generic colours the main pigments are the same, analysis of the table indicates that in all cases the Munsell match for each entry is different. For example, the results for the yellow Munsell matches are remarkably close, but not identical. These are noted as chip 275 for the Church of the Nativity, followed by chip 274 for the Church of the Archangels, and finally the yellow in the Church of St Atanass is identified as chip 273. These three successive chip numbers are from the same page of the general Munsell Book of Colours. Technically, each page is dedicated to a particular hue. In this instance the page is designated as 2.5Y. The selected matches have the same chroma but differ in value, which is an indication for the lightness of colours. However, because the difference between any two successive Munsell chips is only one perceptual step, it can be concluded that the yellows in these three churches are very close in appearance, as well as sharing the same basic yellow iron oxide-based pigment.

Table 6: Colours of Arbanassi in CIELAB and Munsell notation.

	L*(D65)	a*(D65)	b*(D65)		Munsell number	Munsell notation
Brt REDS						
Nativity	45.51	24.99	18.87		**131**	10 R 6/8
Archangels	46.22	17.08	17.23		**56**	5 R 4/6
St Atanass	46.22	24.33	19.02		**93**	7.5 R 5/8
St Dimitr	38.16	14.06	9.97		**215**	7.5 R 4/4
Drk REDS						
Nativity	40.47	12.96	13.67		**1108**	10 RP 4/8
Archangels	44.63	14.51	15.38		**1264**	10 P 4/2
St Dimitr	32.27	1.71	3.61		**84**	7.5 R 3/1
BLUE						
St Atanass	56.36	10.23	-42.26		**1006**	2.5 P 5/2
GREENS						
Nativity	47.58	-7.77	4.45		**536**	2.5 G 5/2
St Atanass	53.7	-2.19	-0.12		**499**	2.5 GY 7/4
YELLOWS						
Nativity	58.26	9.92	32.52		**275**	2.5 Y 4/4
Archangels	65.40	9.15	28.66		**274**	2.5 Y 6/4
St Atanass	62.61	7.71	25.91		**273**	2.5 Y 7/4
St Dimitr	72.26	5.47	21.99		**265**	2.5 Y 7/2
BEIGE						
Nativity	69.50	3.28	19.17		**242**	10 YR 4/2
Archangels	69.90	1.92	9.29		**188**	5 YR 5/4
St Atanass	64.51	5.36	14.24		**239**	10 YR 7/2
St Dimitr	68.52	2.68	11.93		**247**	10 YR 6/4
Lt BRWNS						
Archangels	38.52	14.53	18.84		**151**	2.5YR 5/4
BROWNS						
Nativity	39.03	12.06	5.20		**209**	4.5YR 3/1
Archangels	33.22	5.03	1.70		**371**	10 Y 4/1
St Atanass	34.09	14.65	8.25		**306**	5 Y 5/2
St Dimitr	39.91	8.02	9.81		**108**	5 RP 2.5/1
WHITES						
Nativity	89.99	1.43	10.70		**263**	2.5Y 8.5/1
Archangels	68.61	3.11	15.21		**238**	10 YR 8/2
St Atanass	72.87	3.52	14.49		**237**	10 YR 9/2
St Dimitr	81.96	2.13	12.10		**263**	5 Y 8.5/1
GREYS						
Nativity	35.88	0.47	2.10		**298**	2.5GY 5/1
Archangels	36.73	0.62	3.48		**434**	2.5RP 6/2
St Atanass	37.29	0.14	3.28		**625**	10 PB 4/1
St Dimitr	37.55	1.25	3.75		**560**	2.5P 5/2
BLACKS						
Nativity	27.79	0.36	1.07		**505**	10 GY 2.5/1
Archangels	32.96	0.54	1.48		**442**	5 GY 2.5/1
St Atanass	34.42	-0.22	0.34		**564**	10 G 3/1
St Dimitr	27.63	0.86	0.5		**1171**	5 RP 2.5/1

The same degree of similarity can be observed in the whites of the churches of the Archangels and of St Atanass that share the same basic white lead pigment. In all other cases, the Munsell matches for the different churches differ significantly in their respective numbers, even though most of them share the same basic colour-inducing agent. However, in the case of the bright reds in the churches of St Atanass and of St Dimitr, although the Munsell matches appear to be from the same page of the Munsell Book, 7.5R, it has to be remembered that the colour agents for these two churches differs. Moreover, I have already indicated that, because the main colour agent in the Church of St Dimitr is cinnabar, the appearance of the reds in the nave decoration is significantly different from how it was in the seventeenth century, as mercury sulphide is a photosensitive chemical. In order to ascertain the near-original look of the bright red in this church, it would be necessary to carry out further investigations. This might involve micro-chemical analysis, for example, and the preparation and monitoring of fresh samples.

As has already been explained the various degrees of dissimilarity can be the result of a combination of factors, such as the geographical origin of the pigment, cross-contamination of colours during their preparation and application and the personal preferences of the artists. It is, however very difficult to prove which of these factors lie behind the variations in the actual appearances of any of the colours recorded here. The Munsell notations also reveal that the value, or the numerical representation, of the experienced lightness of any of the recorded chromatic colours (red, yellow, blue, green) indicates a low to medium value. For example, the bright reds vary numerically in value between six and four, when the maximum is ten. These results make them appear to be only of moderate lightness. Dark reds and purples vary between three and four. None of the Arbanassi colours, even those usually perceived as vivid, are entered as having a value higher than seven. Theoretically, the sensation of the lightness of a surface colour can be low because of deliberate mixing. Earlier, in the investigation of the pigments of Arbanassi, I showed that mixing was practised on some occasions. Accidental contamination and/or naturally occurring impurities were not ruled out as likely causes either. Therefore, it is not surprising to find the parameter of chroma – the element that indicates the purity of colour – to be low throughout the records. One typical example is the bright reds of the churches of the Nativity or of St Atanass.

My records for the magnitude of the chroma go up to number eight on a scale which can range from zero to infinity. This low value for the chroma is found in Munsell's notation for the bright reds used in the four naves. Considering that number eight is the highest chroma associated with any of the chromatic colours identified in the Arbanassi decoration, it can be concluded that the purity of the chromatic colours used is low indeed. One can argue that both the value and chroma of the nave colours were limited by the materials of colour. In this particular example, the examination in chapter four of the spectral curves from the bright reds suggested that in both the churches of the Nativity and St Atanass, the likely pigments were red iron oxide earths. At the same time, good-quality, vivid soil colours are also known to have chroma at a numerical value of up to eight. Taking into consideration that a pigment needed only to be mixed with water, and water is not expected to alter the chroma of the pigment, it can be concluded that the bright reds in the churches of the Nativity and of St Atanass were obtained by using high-iron-content red earths.

Appendix III

Seasonal Hours

The methods of measuring time in the Ottoman Empire during the sixteenth and the seventeenth centuries were associated with the actual movement of the sun.[569] The reason why the seasonal hour was the norm in measuring time was that the life of the Empire revolved around the discipline of the Islamic prayer times.[570] These were and still are defined by sunrise and sunset.[571] Therefore, the third hour would have been defined within the context of the apparent solar timekeeping system, which measures time in relation to the time of sunrise, rather than in the solar mean time used today. In the apparent solar system, there are always twelve hours between the time of sunrise and the time of sunset and twelve hours between sunset and sunrise. These are called seasonal hours. The seasonal hours vary in length, because the interval between the two reference points varies with the seasons, and they are a function of two variables, the sun's position on the ecliptic (time of year) and the latitude and the longitude of a place.

---

[569] The solar mean time is a mathematical construction and cannot be observed. It divides the length of time necessary for one twenty-four hour revolution of the earth into equal intervals of the astronomical or equinoctial hour, and is measured by clock. The apparent solar time is measured in variable intervals of time, seasonal hours, the length of which can be represented through the use of sundials. Ecclesiastical historians consider that time was measured by seasonal hours up until the eighteenth century. See Arch. Avksenii, *Liturgica* (Plovdiv, 2003), p. 290; T. Koev, *Sbornik po Bogoslovie* (Sofia, 1999), pp. 235.

[570] E. Hesterovskii, Metropolitan Makarii, *Liturgika ili Nauka za Bogoslužénieto an Pravoslavnata Tžurkva* (Sofia, 1931), pp. 196–198; D. A. King, *World-maps for Finding the Direction and the Distance to Mecca: Innovation and Tradition in the Islamic Science* (Leiden; Boston; Köln, 1999), pp. 10–11.

[571] Astrolabes were used to define the sunset and sunrise time. A seventeenth-century astrolabe is currently in the collection of the Museum of the History of Science, Oxford. http://www.mhs.ox.ac.uk/astrolabe/exhibition/53307.htm [accessed 2007].

The length of the apparent solar day throughout the year was defined by early Greek astronomy by means of a series of algorithms that simplified the results obtained from observations of the length of the daylight at a particular location.[572] Using the findings of early Greek astronomy, which divided the Graeco-Roman world into latitudinal strips (klimata), and his own observations, Ptolemy created a division of unequally spaced parallels based on the length of the longest apparent solar day (at the summer solstice), starting from the Equator where the day is equal to twelve equinoctial hours.[573] Because the Ptolemaic system is concerned with the apparent solar rather than equinoctial hours it makes it more relevant to my investigation, having been the timekeeping system in seventeenth century Arbanassi. Ptolemy's parallels are indicated by time rather than by degrees as is now the case with the modern equally spaced parallels (usually spaced at 5°).[574] The time between the parallels is considered constant and the next parallel indicates half-hourly increases in the length of the longest day.

For example, Arbanassi (latitude 43° 06′) is in the area between the parallel for the Hellespont, which is considered to be latitude 40° 56′, and the parallel for Mid-Pontus, passing through the middle of the Black Sea (latitude 45° 01′).[575] According to Ptolemy's geography, at the summer solstice the length of the day at Hellespont will be fifteen hours and at Mid-Pontus fifteen hours and thirty

[572] J. Berggren and A. Jones (tr.), *Ptolemy's 'Geography'. An annotated Translation of the Theoretical Chapters* (Princeton, 2001, first edition 1997).
[573] Ptolemy (83–161 AD), mathematician, geographer and astronomer, lived and worked in Alexandria. 'Klimata' is the plural version of the Greek word 'klima' and its meaning refers to the inclination of the axis of the celestial sphere in relation to the horizon.
[574] Berggren and Jones, *Ptolemy's 'Geography'*, p. 10.
[575] For the early Greeks' astronomical method of estimating the length of the daylight section of the day, see O. E. Neugerbauer, 'Some Fundamental Concepts in Ancient Astronomy', in O. E. Neugerbauer (ed.), *Astronomy and History: Selected Essays* (New York, 1983, first edition 1941), pp. 243–251.

minutes. Because the parallel referenced with the position of the Hellespont is the one closer to the Equator, within the logical construction of Ptolemy's geography it can be concluded that the length of the day in Arbanassi will also be fifteen hours. Ptolemy argued that it can be accepted that, within the Hellespont klima, there is a fixed one-hour difference in the duration of the daylight in every two consecutive months. The shortest day (winter solstice) was considered by Ptolemy to be nine seasonal hours and the longest day (summer solstice) to be fifteen hours. Below is a table based on the Ptolemaic understanding of the duration of daylight throughout the year at the parallel for the Hellespont. The table presents the results of the estimate of the third hour after sunrise. The results for the third hour in particular will assist in the discussion of the interior illumination of each nave at the time of the Divine Liturgy, as the most liturgically significant part of the day. (Table 7).[576]

Table 7: Length of daylight and the modern equivalent of the third hour, calculated based on the lengths of the seasonal hours through the year.

Month	**Modern hours of daylight per day**	**Modern hours and minutes in a seasonal hour**	**3rd hour of the day after sunrise in h/min**
December	9	45 min	2h 15 min
January/November	10	50 min	2h 30 min
February/October	11	55 min	2h 45 min
March/September	12	1h	3h
April/August	13	1h 5min	3h 15 min
May/July	14	1h 10 min	3h 30 min
June	15	1h 15 min	3h 45 min

[576] Whittemore, 'Notes on Light in Hagia Sophia, Istanbul', pp. 7–12, Archimandrite. Avksenii, *Liturgica*, pp. 28-31.

In the first column are the names of the months with the months between January and December paired, as the trajectories of the sun between the summer and winter solstices mirror the trajectories of the sun between the winter and summer solstices. The second column shows the corresponding duration of the daylight for the day during each month(s). In the third column is the length of a seasonal hour in modern timekeeping units (hours and minutes). The fourth column contains the chronological distance of the third seasonal hour during each month from the time of sunrise, represented in modern timekeeping units. The third seasonal hour (which was then also the third liturgical hour) is considered to be most significant in the daily life of the Church as it coincides with the beginning of the Divine Liturgy.[577]

The lengths of these solar hours are calculated by dividing the number of the estimated equinoctial hours during a chosen month on the fixed number of seasonal hours during the time of daylight. The number of the seasonal hours, namely twelve, is constant through the year, but the length of these hours varies from month to month as the length of the daylight period varies. For example, the two reference points, the winter solstice and the summer solstice, experience seasonal hours respectively 45 min [(9/12)x60 min] long and 75 min [(15/12)x60 min] long. Therefore, the length of the third seasonal hour will be 135 min or 2 h 15 min at winter solstice and 225 min or 3 h 45 min at the summer solstice.

When considered against the angular distance of 15° which the sun travels in one hour, the largest difference will be represented by the negligible fraction of 0.0075°.[578] At the third hour on a summer solstice day, the difference between

[577] Arch. Avksenii, *Liturgica*; J. Meyerndorff, *Orthodox Church: Its Past and Its Role in the World Today* (New York, 1981, first edition in French, 1960).

[578] The concept of the spherical form of the earth is at the basis of Ptolemy's notional division of the surface of the earth into seven klimata. The relative size of the diameter of the earth makes

the Ptolemaic and the actual lengths of daylight at Arbanassi will account for a tiny fraction of the angular distance travelled by the sun - 0.0225°in one hour. Because the differences between the Ptolemaic estimates and the actual lengths of the daylight are practically insignificant they can hardly be expected to account for any dramatic changes of the viewing conditions.[579] Therefore, the estimated lengths of the seasonal hours in the Ptolemaic system, shown in the table above, are acceptable for calculation of the third liturgical hour in seventeenth century Arbanassi.

---

the increase or decrease of the actual and of the observed changes in the intensity of the received light negligible. Because of this the length of the seasonal hour for each month is constant within each klimata.

[579] Ptolemaic simplifications meant that the lengths of daylight have departed to a degree from the actual length of the daylight at Arbanassi. For example, four points of reference on the trajectory of the sun for the lengths of the daylight at Arbanassi are: winter solstice 44.9 min; spring equinox 60.7 min; autumn equinox 61.4 min; and summer solstice 76.8 min. When the Ptolemaic estimates are compared to the actual lengths of the daylight the respective differences are: 0.1 min (0.006 h); 0.7 min (0.011 h); 1.4 min (0.023 h); and 1.8 min (0.03 h). The largest difference, as expected, is at the summer solstice, but even then it is insignificant in the course of a day and especially in terms of changes in the characteristics of the sunlight and consequently there will not be any noticeable change in the viewing conditions. Therefore it can be concluded that the use of Ptolemaic estimates instead of the actual Arbanassi lengths of daylight will not affect the veracity of the conclusions made in this investigation.

BIBLIOGRAPHY

Agoston, G. A., *Color Theory and Its Application in Art and Design* (1987).

Alli, J. R. and Cunich, P., 'The Orientation of Churches: some new evidence', *The Antiquaries Journal*, Vol. 81 (2001), pp. 155-193.

Andreev, J., 'Gorna Orjahovitza prez epohata na Turskoto vladichestvo' in *Rjahovetž*, Vol. I (V. Turnovo, 1994), pp. 102-110.

Archimandrite Avksenii, *Liturgika* (Plovdiv, 2003).

Arnheim, R., *Art and Visual Perception. A Psychology of the Creative Eye* (Berkeley, Los Angeles, London, 1974, first edition 1954).

Baldgiev, G., 'Priložna Svetlinna Tehnika: Osvetlenie na Rabotni Pomeshtenija/ Prostranstva', *DS* (2007), 5035:1-7.

Ball, Ph., *Bright Earth: The Invention of Colour* (London, 2002, first edition 2001).

Barnes, N. F., 'Spectrophotometric studies of artists pigments' in *Technical Studies in the Field of the Fine Arts,* Vol. 7 (1938), pp. 120-135.

Benson, H., 'Church orientation and patronal festivals', *The Antiquaries Journal*, Vol. 36 (1956), pp. 205-213.

Berggren, J. L. and Jones, Al. (tr.), *Ptolemy's 'Geography'. An Annotated Translation of the Theoretical Chapters* (Princeton, 2001, first edition, 1997).

Berlin, Br. and Kay, P., *Basic Color Terms: Their Universality and Evolution* (Stanford, 1999).

Berns, R. S., *Billmewer and Saltzman's Principles of Color Technology*, (New York, Toronto, 2000, first edition, 1981).

Berrie, B. H., *Artists' Pigments; A Handbook of Their History and Characteristics*, Vol. 4 (London (1985).

Berument H. and Gunay, A. 'Inflation Dynamics and Its Sources in teh Ottoman Empire: 1586-1913', *Islamic Economics*, Vol. 3 (1991), pp. 1-22.

Blum, P., 'Reflectance spectrophotometry and colorimetry', *PPH*, November 1997, pp. 5-7.

Bobrov, J. G., *Osnovui Ikonografii Drevne Ruskva Iskustva*, (St. Petersburg, 1999).

Bojadjiev, S., *Bulgarskata Arhitectura pres Vekovete* (Sofia, 1982).

Bowmaker, J., 'The retina', in Roberts, D. (ed.) *Signals and Perception: The Foundation of Human Perception* (New York, Milton Keynes, 2002), pp. 115-132.

Božkov, A., *Bulgarskijat Prinos v Svetovnata Kultura (*Sofia, 1999).

Božkov, A., *Turnovska Srednovekovna Hudozestvena Shkola (*Sofia, 1978).

Božkov, A., 'Bitovite elementi v stenopisite ot Arbanashkite tžurkvi (XVII–XVIII)', *Sbornik na BAN*, Vol. VI (Sofia, 1963), pp. 99-132.

Božkov, A., *Trevnenska Zivopisna Scholla* (Sofia, 1967).

Božilov, Iv., Touleshkov, N., and Prasliov, L., '*Bulgarski Monastiri*' (Sofia, 1997).

Brania, A. A., El-Rashidy, M. S., 'Characterisation, Treatment and conservation of one Ottoman house wall paintings, Cairo, Egypt', in the *Procedings of 4th International Congress on Science and Technology for the Safeguard of Cultural Heratage in the Mediteranian Basin,* Vol.2 (Cairo, 2009), pp. 84-94

Brjusova, V., *Freski Jaroslavlja XVII-nač. XVIII veka*, (Moscow, 1982).

Burgio, L., Clark, R. J. H., Muralha V. S. F. and Stanley, T., Pigment analysis by Raman microscopy of the non-figurative illuminations on 16-to 18th-centuyr Islamic manuscripts', *Journal of Raman Spectroscopy*, No. 39 (2008)

Buxbaum, G. (ed.), *Industrial Inorganic Pigments* (Weinheim, 2005, first edition 1993).

Cave, C. J., 'The Orientation of Churches', *The Antiquaries Journal*, Vol. 30 (1950), pp. 47-51.

Chevreul, M. E., *The Principles of Harmony and Contrast of Colours and their Applications in Arts (*London, 1855).

Chifljanov, B., *Liturgica* (Sofia, 1996).

Cormack, R., *Byzantine Art*, (Oxford, 2000).

Cormack, R., 'Painter's Guide, Model-Books and Craftsmen: or Memory and the Artist?' in M. Bacci (ed.), *L'artista a Bisanzio e nel mondoChristiano-orientale*, (Pisa, 2007), pp. 11-29.

Cornell, R. H. and Schwertmann, U., *Iron Oxides: Structures, Properties, Reactions, Occurrences, and Uses* (Weinheim, 2003, first edition 1996).

Cupitt, J., Saunders, D. and Martinez, K., 'Digital imaging in European Museums' in *Proceedings of SPIE* (1997), pp. 144-151.

Cursio, A. C., Allen, K. A., Sloan, K. R., Lerea, C. L., Hurley, J. B., Klock, I. B. and Milam, A. H., 'Distribution and morphology of human cone photoreceptors stained with anti-blue opsin', *JCN*, Vol. 312 (1991).

Daniilia, Sr., Tsakalof, A., Bairachtari, K., Chryssoulakis Y., 'The Byzantine wall paintings from the Protaton Church on Mount Athos, Geece: tradition and scuence', *Journal of Archaeological Science* , No. 34 (2007), pp. 1971-1984.

Daniilia, Sr., Monopoulou, E., Fr. Demosthenous, D., Karagiannis, G., 'Acomparative study of wall paintings at the Cypriot Monatery of Christ Antiphonitis; one artist or two', *Journal of Archaeological Science* , No. 35 (2008), pp. 1695-1707.

Daniilia, Sr., Monopoulou, E., Andronikopoulos, K. S., Tsakalof, A., Bairachtari, K., 'From Byzantine to post-Byzantine art: the painting technique of St stephen's wall paintings at Meteora, Greece', *Journal of Archaeological Science* , No. 35 (2008), pp. 2474-2485.

Davison, H., *Physiology of the Eye* (London, 1990, 5th rev. edition, first edition 1972).

Delaney, J. K., Walmsley, E., Berrie, B. H. and Fletcher, C. F., 'Multi-Spectral Imaging of Paintings in the Infrared to Detect and Map Blue Pigments' in *Scientific Examination of Art: Modern Techniques in Conservation and Analysis (Sackler NAS Colloquium)*, (Washington, 2005), pp. 120-136.

Delvin, K., Chalmers, A., 'Realistic Visualisation of Pompeii Frescoes' at http://www.cs.bris.ac.uk/Publications/Papers/1000595.pdf

Demus, O., *Byzantine Mosaic Decoration: Aspects of Monumental Art in Byzantium* (London, 1948).

Dimitrov, B. *Peter Bogdan – Bulgarski Istoric i Politic ot XVII bek (*Sofia, 1984).

Dimitrov, St., Danova, N., Pletnyov, G., Markova, Z., Draganova, T., Dimitrov, I., Stojanov, Iv., Todorov, P., Goranov, P., Bonev, N., Spasov, L., Panajotova, K., *Istoria na Veliko Turnovo: praistoria, antichnost, srednovekovie*, Vol. I (Sofia, 1986).

Dinkov, K., *Istoria na Bulgarskata Tžurkva* (Vratža, 1953).

Dinsmore, W. B., 'Archaeology and Astronomy', *Proceedings of the APS*, Vol. 8 (1939), pp. 95-173.

Düzdağ, M. E., *Şeiyhülislâm Ebussuud Efendi Fetvalari Işiğinda 16. Asir Tütk Hayati* (Istambul: Enderum Kitabevi, 1972), No. 463–464.

Epstein, A., *Tokali Kilitse: Tenth-Century Metropolitan Art in Byzantine Cappadocia*, DOS 22 (Washington, DC, 1986).

Fairchild, M. D., *Color Appearance Models* (Chichester, 2005, first edition 1997).

Faroqhi, S., *Artisans of Empire:Crafts and Craftspeople Under the Ottomans*, (New York, 2008).

Feller, R. L. (ed.), *Artist's Pigments. A Handbook of their History and Characteristics*, Vol. 1 (Cambridge, 1986).

Feller, R. L., 'Studies on the darkening of vermilion by light' in *Report and Studies on the History of Art (*Washington, 1967), pp. 99-111.

Fitzhugh, E. W., *Artist's Pigments. A Handbook of their History and Characteristics*, Vol. 3 (New York, Oxford, 1997, first edition 1986).

Flynn, J. E. and Segil, Arthur., *Architectural Interior Systems: Lighting, Air Conditioning, Acoustics* (New York, 1991, first edition 1970).

Foster, D. H., Nascimento, S. M. C., Craven, B. J., Linnell, K. J., Cornelissen, F. W., and Brenner, E., 'Four issues concerning colour constancy and relational colour constancy', *VR*, Vol. 37, No. 10 (1997), pp. 1341–1345.

Fontoynont, M., *Daylight Performance of Buildings* (London, 1999).

Gage, J., *Colour and Meaning: Art, Science and Symbolism* (London, 1999).

Galavaris, G., 'Some aspects of the symbolic use of lights in the Eastern Church', *BMGS*, Vol. 4 (1978), pp. 69-78.

Gandev, Ch., *Istoria na Bulgaria*, Vol. IV (Sofia, 1983).

Gandev, Ch., Tzvetkova, B., Georgieva, Tžv., 'Izmenenia vuv voenno-feodalnata sistema' in Gandev, Ch. (ed.) *Istoria na Bulgaria*, Vol. IV (Sofia, 1983), pp. 125-131.

Gandev, Ch., Tzvetkova, B., Grozdanova, 'Polozenieto na bulgarskoto selsko naselenie' in Gandev, Ch. (ed.) *Istoria na Bulgaria*, Vol. IV (Sofia, 1983), pp. 62-82.

Gautier-Hion, A., 'The diet and dietary habits of forest guenons', in Gautier-Hion, A., Bourliere, F., and Gautier, J.-P. (eds) *A Primate Radiation: Evolutionary Biology of the African Guenons* (Cambridge, 1988), pp. 257–283.

Genova, Z., Vatchev, H., 'Sondažni prouchvania v Arbanassi, Velikoturnovsko' in *AOP* (Lovetch, 1991), pp. 179-181.

Gerasimova-Tomova, V., 'Nadpisite kum tzurkvata Rozdestvo Hristovo v Arbanassi' in Praskov, L. S*tenopisite na tzurkvata Rozdestvo Hristovo v Arbanassi (*Sofia, 1979).

Gergova I., 'Horosut v Tžurkavata Roždestvo Hristovo', *PI*, No. 4 (1996), pp. 14-20.

Gergova, I., 'Tzurkvata na Arbanashkijat Manastir Uspenie Bogorodichno', *PI*, Vol. 1 (1999), pp. 9-10.

Gergova, I., *Ranniat Bulgarski iconostas 16–18 vek* (Sofia, 1993).

Gerlah, St., *Dnevnik na edno putuvane do Osmanskata Porta v Tžarigrad* (Sofia, 1976).

Gerov, G., *An Iconographical Theme from Mount Athos and its Spread in the Bulgarian Lands: The Miracle of the Archangels at Docheiario* (Thessalonica, 1987).

Gerov, G. 'Vreme' I 'Istoria' v Stenopisite ot Galeriata na Arbanashkata Tzurkva 'Rozdestvo Hristovo', *PI*, No. 4 (1996), pp. 3-13.

Gerov, G., Vodata kato granitža, *PI*, No. 2 (2002), pp. 31-57.

Gettens, R. J. and Fitzhugh E. W., 'Azurite and Blue Verditer' in Roy, A. (ed.) *Artists' Pigments: A Handbook of their History and Characteristics*, Vol. 2 (New York, Oxford, 1986), pp. 23-35.

Gettens, R. J. and Fitzhugh E. W., 'Malachite and Green Verditer' in Roy, A. (ed.) *Artists' Pigments: A Handbook of their History and Characteristics*, Vol. 2 (New York, Oxford, 1986), pp. 183-202.

Gettens, R. J., Feller, R. L., Chase, W. T., 'Vermilion and Cinnabar' in Roy, A. (ed.) *Artists' Pigments: A Handbook of Their History and Characteristics* (New York, Oxford, 1986), pp. 159-182.

Gettens, R. J., Fitzhugh, E. W. and Feller, R. L., 'Calcium carbonate whites' in Roy, A. (ed.) *Artists' Pigments: A Handbook of their History and Characteristics*, Vol. 2 (New York, Oxford, 1986), pp. 203-224.

Gettens, R. J., Kühn, H., and Chase, W. T., 'Lead white' in Roy, A. (ed.), *Artists' Pigments: A Handbook of their History and Characteristics* (Oxford, 1986), pp. 67-81.

Giardino, M., Miller, R., Kuzio, R., and Muirhead, D., 'Analysis of ceramic color by spectral reflectance', *AA*, Vol. 63, No. 3 (1998), pp. 477-483.

Gradeva, R., 'Ottomanskata Politika po Otnoshenie na Hristianskite Tžurkovni Sgradi', *Etudes Balkaniques*, No. 2 (1994), pp. 98-120.

Gregory, R., *Eye and Brain: The Psychology of Vision* (Oxford and Tokyo, 1998).

Grissom, C. A., 'Green Earth' in Feller, R. L. (ed.) *Artists' Pigments: A Handbook of their History and Characteristics*, Vol. 1 (Cambridge, 1985), pp. 141-167.

Grigorov, G., 'Materiali, izpolzuvani v tehnikite na kavaletnata živopis ot kraja na XIX v do nashi dni' in Prashkov, L., *Vuprosi na konservatžiata I restavratžiata*, Vol. 1 (Sofia, 1985), pp. 25-35.

Grosslight, J., *Light, Light, Light: Effective Use of Daylight and Electric Lighting in Residential and Commercial Spaces* (Tallahassee, 1984).

Grozdanova, E., Andreev, S., *Bulgarite prez XVII vek* (Sofia, 1986).

Gjuzelev, V., (ed), *Venetzianski dokumenti za istoriata na Bulgaria i Bulgarite ot XII–XV v* (Sofia, 2001).

Hagström, S. A., Neitz, J. and Neitz, M., 'Variations in cone populations for red–green colour vision examined by analysis of mRNA', *Neuroreport*, No. 9 (1998).

Harbova, M., 'Nauchna hipotheza za Arbanassi (starinnoto Zagorie) kato element v staroprestolnia Turnovgrad', *Akti na II[ija] Meždunaroden kongres po Bulgaristika, Izobrazitelno Izkustvo I Arhitektura* (Sofia, 1988), pp. 137-156.

Haritonov, H., Chohadsžieva, G., Rutževa, S., *Arbanassi (*Sofia, 2003).

Harley, R. D., *Artists' Pigments c. 1660–1835. A Study in English Documentary Sources* (London, 1982, first edition 1970).

Hawthorne, J. G. and Smith, C. S. (trans.), *Theophilus*, *On Divers Arts* (New York, 1979, first edition 1963).

Helwig, K., 'Iron oxide pigments: Natural and synthetic' in Berrie, B. H., *Artists' Pigments: A Handbook of Their History and Characteristics*, Vol. 4 (London, 1985), pp. 39-109.

Hesterovskii, E., Metropolitan Makarii, *Liturgika ili Nauka za Bogosluženieto an Pravoslavnata Tžurkva* (Sofia, 1931).

Herz, N. and Garrison, E. G., *Geological Methods for Archaeology* (Oxford, 1998).

Hieromonk Cassian, 'A Scientific Examination of the Orthodox Church Calendar' in Ach. Chrysostomos and Hieromonk Gregory (eds) *A Scientific Examination of the Orthodox Church Calendar or Old Calendar and Science* (Etna, 1998).

Hinton, I., 'Do chancels weep?', *CA*, Vol. 5–6 (2004), pp. 45-51.

Hoare, P. G. and Sweet, C. S., 'Orientation of early medieval churches in England', *JAH,* Vol. 26, No. 6 (2000).

Hoevel, C., 'A study of the discoloration products found in white lead paint', *The American Institute for Conservation: Book and Paper Group Annual*, Vol. 4 (1985), pp. 1-7.

Hradil, D., Grygar, Th., Hradilova, J., Bezdička, P., 'Clay and iron oxide pigments in the history of painting', *ACS*, No. 22 (2003), pp. 223-236.

http://www.cs.bris.ac.uk/Publications/Papers/1000595.pdf [accessed, 2012]

http://www.cs.bris.ac.uk/Publications/pub_master.jsp?id=2000076[accessed, 2012].

http://www.damaskuszimmer.de/PDFs/Publication_Anke%20Scharrahs.pdf?lang=de&objID=12&typeid=1 Alepo room [accessed, 2012] http://www.gelighting.com/na/business_lighting/education_resources/learn_about_light/color_specifying.htm. [accessed, 2011].

http://images.icon-art.info/public/Byzantium/Stylianou%201997%20-%20The%20Painted%20Churches%20of%20Cyprus.pdf [accessed May 2013].

http://repository.upenn.edu/cgi/viewcontent.cgi?article=1629&context=cis_papers&sei-reir=1&referer=http%3A%2F%2Fwww.google.co.uk%2Furl%3Fsa%3Dt%26rct%3Dj%26q%3Dchalmers%2520%252B%2520early%2520islamic%2520lamps%26sour-ce%3Dweb%26cd%3D1%26ved%3D0CDEQFjAA%26url%3Dhttp%253A%252F%252Frepository.upenn.edu%252Fcgi%252Fviewcontent.cgi%253Farticle%253D1629%2526context%253Dcis_papers%26ei%3D1rObUfeFIoq_0QW3q4D4DA%26usg%3DAFQjCNG3GJmyhTlAIpsrUG6wzoHQVNhDiA%26bvm%3Dbv.46865395%2Cd.d2k#search=%22chalmers%20%2B%20early%20islamic%20lamps%22 [accessed, 2013].

http://rruff.geo.arizona.edu/doclib/hom/cinnabar.pdf, [accessed, 2009].

http://www.loem.org/templates/cusloem/details.asp?id=30482&PID=535420, [accessed, 2011].

http://www.mhs.ox.ac.uk/astrolabe/exhibition/53307.htm [accessed 2007]

http://www.reisenett.no/map_collection/historical/shepherd/Ottoman_Empire_1481–1683.jpg, [accessed, 2008].

http://unfccc.int/resource/doc/nats/bulnc2.pdf [accessed, 2009].

Hunt, R. W. G., *Measuring Colour* (Kingston-upon-Thames, 1998, first edition 1987).

Hurwich, L. M. and Jameson, D., ‘Some quantitative aspects of an opponent-colors theory. IV A psychological color specification system’, *JOPSA*, Vol. 46 (1956), pp. 416–421.

Hurwich, L. M, *Colour Vision*,

Hårleman, M., ‘Colour emotions in a full-size room’ in *Colour and Paints,* Proceedings of the Interim Meeting of AIC, Porto Alegre (2004), pp. 223-226.

Ikonomaki-Papadopoulos, Y., ‘Post-Byzantine Silverwork’ in Karakatsanis, A. A.(ed.), *Treasures of Mount Athos* (Thessaloniki, 1997), pp. 365-367.

Illiades, Y., ‘The orientation of Byzantine churches in eastern Macedonia and Trace’, *MAA,* special issue, Vol. 6, No. 3 (2006), pp. 20-26.

Illiadis, I. G., ‘The natural lighting of the mosaics in the Rotunda at Thessaloniki’, *Lighting Research Technology*, 33 (2001), pp. 13-24.

Ishirkov, A., ‘Oblastnoto ime Zagora ili Zgorie v Minaloto i Sega’ in *INEM,* Vol. V (Sofia, 1925), pp. 80-89.

ISO/CIE10526–1991, *CIE standard colorimetric illuminants* (1991).

Jacob Christoph Le Blon, *Coloritto, or the Harmony of Coloring in Painting: Reduced to Mechanical Practice Under Easy Precepts and Infallible Rules, Together with Some Colour'd Figures in Order to Render the Said Precepts and Rules Intelligible Not Only to Painters But Even to All Lovers of Painting* (London, 1725).

James, L., *Light and Colour in Byzantine* Art (Oxford, 1996).

Jenssen V. and Majewski, L., Appendix to S. Boyd, 'The Church of the Panagia Amasgou, Monagri, Cyprus and its wall paintings', *DOP* 28 (1974), pp. 329-345.

Jonov, M., *Nemski i Avstriiski putepisi za Balkanite (XV–XVI v.)* (Sofia, 1979).

Judd, D.B., Macadam, D. L., Wyszecki, G., Budde, H.W., Condit, H. R., Henderson, S. T., and Simonds, J. L., 'Spectral Distribution of Typical Daylight as a Function of Correlated Color Temperature', *JOSA*, Vol. 54, Issue 8 (1964), pp. 1031-1036.

Kampf, G., 'Korngrößenverteilung und optische Eigenschaften von Pigmenten' in *Farbe und Lack*, No. 71 (1965), cited in Helwig, K., 'Iron oxide pigments: Natural and synthetic' in Berrie, B. H., *Artists' Pigments: A Handbook of Their History and* Characteristics, Vol. 4 (London, 1985).

Karakatsanis, A. A.(ed.), *Treasures of Mount Athos* (Thessaloniki, 1997)

Kashdan, A., *The Oxford Dictionary of Byzantium*, (Oxford, 1991)

King, D. A., *World-maps for Finding the Direction and the Distance to Mecca: Innovation and Tradition in Islamic Science* (Leiden; Boston; Köln, 1999), pp. 10–11.

Kider Jr, J. T., Fletcher, R., Yu, N., Holod, R., Chalmers, A., Recreating Early Islamic Glass Lamp Lighting (Jan, 2009) http://repository.upenn.edu/cgi/viewcontent.cgi?article=1629&context=cis_papers&sei-reir=1&referer=http%3A%2F%2Fwww.google.co.uk%2Furl%3Fsa%3Dt%26rct%3Dj%26q%3Dchalmers%2520%252B%2520early%2520islamic%2520lamps%26sour-ce%3Dweb%26cd%3D1%26ved%3D0CDEQFjAA%26url%3Dhttp%253A%252F%252Frepository.upenn.edu%252Fcgi%252Fviewcontent.cgi%253Farticle%253D1629%2526context%253Dcis_papers%26ei%3D1rObUfeFIoq_0QW3q4D4DA%26usg%3DAFQjCNG3GJmyhTlAIpsrUG6wzoHQVNhDiA%26bvm%3Dbv.46865395%2Cd.d2k#search=%22chalmers%20%2B%20early%20islamic%20lamps%22 [accessed, February 2013].

Kiriakoudis, E., 'The original founders – inscriptions and frescoes in the Church of the Nativity of Christ at Arbanassi in Bulgaria', *Cyrillo-Methodium*, Vol. VIII–IX (1984–1985), pp. 319-331.

Kirby, J., Nash S. and Cannon J. (eds), *Trade in Artist's Materials:market and commerce in Europe to 1700*, (London, 2010).

Kisjova, 'Za edno mnogo rjadko izobrazenie na Svetijat Duh', PI, 1998, p. 39-52.

Klibanov, A., *Revolutzionije Dvizenia v Russii v XIV-XVbek*, (Moskva, 1960)

Klimukova, N., 'Psalmite v Konteksta na Starozavetnite Stzeni ot Tzurkvata 'Rozdestvo Hristovo v Arbanassi', *PI*, No. 1 (Sofia, 1999), pp. 19-29.

Koev, T., *Sbornik po Bogoslovie* (Sofia, 2000).

Koeva, M., *Pametnitzi na Kulturata pres Bulgarskoto Vuzraždane* (Sofia, 1977).

Koeva, M., Jokimov, P., Stoilova, L., *Pravoslavni Hramove po Bulgarskite Zemi (XV–XX v.)* (Sofia, 2002).

Kostov, D., *Arbanassi* (Sofia, 1959).

Kotulanova, E., Schweigstillova, J., Švarcova, S., Hradil, D.,Bezdička and Grygar, T., 'Wall painting damage by salt: Causes and mechanisms', *Acta Research Reports*, No. 18 (2009), pp. 27-31.

Kubersky-Piedda, S., ' The Market for Painters' Materials in Renaissance Florence', in J. Kirby, S. Nash and J. Cannon (eds), *Trade in Artist's Materials:market and commerce in Europe to 1700*, (London, 2010), pp. 223-243.

Kujumdjieva, M., 'Dulgia Zivot na Edin Mit', *PI,* No. 1 (Sofia, 2002), pp. 7-16.

Kujumdjieva, M., 'Tzikulut po istoriata na prorok Moisei v galleriata na tzurkvata 'Rozdestvo Hristovo' v Arbanassi', *PI,* No. 4 (Sofia, 2003), pp. 33-42.

Kuzev, Al. and Gjuzelev, V., *Bulgarski Srednovekovni Gradove i Kreposti*, Vol. 1 (Varna, 1981).

Kühn, H., 'Zinc white' in Feller, R. A., *Artists' Pigments: A Handbook of their History and Characteristics* (Cambridge, 1986).

Lam, W. M. C., *Sunlight as Formgiver for Architecture* (New York, 1986).

Laurie, A. P., *The Painter's Methods and Materials (*New York, 1967).

Le Grand, Y., *Light, Colour and Vision* (New York, 1957).

Liritzis, I. and Vassiliou, H., 'Further solar alignments of Greek Byzantine churches', *MAA*, special issue Vol. 6, No. 3 (2006), 7-16.

Malin, D. and Murdin, P., *Colours of the Stars* (Cambridge, 1984).

Manova, E., *Bulgarska Stenopis XVI –XVII vek (*Sofia, 1985).

Mardi-Babikova, V., *Arbanashkite Tžurkvi* (Sofia, 1978).

Marutoiu, C., Bratu, I., Trifa, A., Botis, M., Marutoiu, V. C., 'FTIR analysis of painting materials from the Church of Saint Paraschiva, Poienile Izei, Maramires, Romania' *International Journal of Conservation Science*, Vol. 2, No. 1 (2011), pp. 29-35.

Martinez, K., Cupitt, J., and Saunders, D., 'High resolution colorimetric imaging of paintings' in *Proceedings of SPIE* (1993), pp. 144-151.

Maslev, St., *Targovijata meždu Bulgarskite zemi i Transivanija prez XVI-XVII bek* (Sofia, 1991).

Mateev, M., *Arhitecturata kato Fenomen: Teotrija na Prostranstvoto* (Plovdiv, 1996).

Mavrodinov, *Ednokorabnata i Krestovidna Tžurkva po Bulgarskite Zemi (*Sofia, 1931).

Meyer, R., *The Artist's Handbook of Materials and Techniques* (Chatham, 1991, first edition 1951).

Meyerndorff, J., *Orthodox Church: Its Past and Its Role in the World Today* (New York, 1981, first edition in French, 1960).

Millet, G., *Monuments de l'Athos*, (Paris, 1927).

Minev, D., *Grad Liaskovetz – minalo, segashno sustojanie I deitzi. Istoricheski I stopanski prinos* (Sofia, 1944).

Mineva, E., *Second National Communication in connection to the UN Framework Conventions on Climate Change* (submitted in 1999) http://unfccc.int/resource/doc/nats/bulnc2.pdf [accessed, 2009]

Mitanov, P. and Koinova, L., 'Tehnologija i tehnika na stenopisite ot Roženskata trapezaria', *Muzei I Pametnitži na Kulturata*, No. 2 (1973), pp. 58-66.

Mitjaev, Kr., *Sbornik v chest na Bulgarskoto Vuzraždane* (Sofia, 1938).

Mijatev, Kr., *Arhitekturata v Srednovekovna Bulgaria* (Sofia, 1965

Mitjaev, Kr., 'Dekorativnata sistema na Bulgarskite stenopisi', *Sbornik v Chest na V. Zlatarov*, No. 49 (1973), pp. 135-149.

Mouriki, D., *The Mosaics of Nea Moni on Chios*, Vol. I (Athens, 1985).

Munsell, A. H. and Farnum, R. B. (Introduction), *A Color Notation: An Illustrated System Defining All Colours and Their Relations 1941*, (Baltimore, ninth edition, 2004, first edition, 1941).

Muralha, V., Burgio, L., Clark, R. J. H., 'Raman spectroscopy analysis of pigments on 16-17th c. Persian manuscripts', Spectochimica Acta PartPart A 92 (2012), 21-28.

Murdin, P. (ed.), *Encyclopedia of Astronomy and Astrophysics,* Vol. 1–4 (London, New York and Tokyo, 2001).

Mutafov, 'Živopista na Aton prez prizmata na novite nauchni izsledvania. Razmisli', *PI*, No. 1 (2012), pp. 3-10.

Mutafov, V., 'Za etnicheskia, sotžialnia I stopanski oblik na selo Arbanassi prez XVII vek', *GMSB*, No. 5 (1979), pp. 83-93.

Nassau, K., *The Physics and Chemistry of Color: The Fifteen Causes of* Color (New York and Toronto, second edition, 2001, first edition 1983).

Nenov, N., *Practikum po himichni problemi v konservatžiata* (Sofia, 1984).

Neugebauer, O. E., 'Some fundamental concepts in ancient astronomy', in Neugebauer, O. E. (ed.) *Astronomy and History: Selected Essays* (New York, 1983, first edition 1941), pp. 243-251.

Newton, Is., *Optics: or a Treatise of the Reflections, Refractions, Inflections and Colours of Light*. *Also Two Treatises of the Species and Magnitude of the Curvilinear Figures* (London, 1704).

Nikolova, Ja., 'Gradoustroistvo I arhitektura' in *Istoria na Veliko Turnovo* (Sofia, 1986), pp. 231-282.

Olcay, B. Y. , 'Lighting Methods in the Byzantine Period and Findings of Glass lamps in Anatolia', *JGS*, 43 (2001), pp. 77-87.

Ouspensky, L., 'Our Lady of the Sign' in Ouspensky, L. and Lossky, V., *The Meaning of Icons* (Crestwood, New York, 1999, first edition 1952 in German).

Pantazis, G., Korakitis, E., Lambrou, E., Sinachopoulos, D., 'Researching the orientation of monuments the Church of the Great Meteoro Monastery'
<http://cipa.icomos.org/text%20files/antalya/174.pdf> [accessed 3 October 2007].

Papazov, D., 'Selo Arbanassi. Lichni spomeni i subrani Danni' in *SpBAN*, klon IF, Vol. 17 (XXXI) (Sofia, 1937), pp. 62-94.

Parry, K., Melling, D. J., Brady, D., Griffith, S. H., and Healy, J. F., (ed.), *The Blackwell Dictionary of Eastern Christianity*, (Oxford, Malden, 2002, first edition 1999).

Pastoureau, M., *Blue: History of a Colour* (Oxford, 2001, first edition 2000).

Paterson, I., *A Dictionary of Colour* (London, 2003).

Penkova, B., 'Za Njakoi Osobenosti na Postvizantiiskoto Izkustvo v Bulgaria', *PI,* No 1 (1999), 3-8.

Petrov, P., *Sudbonosni Vekove za Bulgarskata Narodnost* (Sofia, 1975) Philov, B., ' Znachenie na Atonskite manastiri za Bulgarskata tžurkovna živopis', *Otetž Paisii: obshtestveno-kulturno-politichesko spisanie*, No. 9 (1930).

Philov, B., 'Arbanassi', *IBAD*, No. 4 (1915), pp. 220-229.

Philov, B., 'Znachenie na Atonskite manastiri za Bulgarskata tžurkovna živopis', *Otetž Paisii: onshtestveno-kulturno-politichesko spisanie*, No. 9, (1930), pp. 123-128.

Philov, B., *Starobulgarsko Izkustvo* (Sofia, 1993).

Plesters J., 'The materials of the wall paintings' in Talbot-Rice, D. (ed.) *The Church of Hagia Sophia at Trebizond* (Edinburgh, 1968), pp. 225-234.

Popgeorgiev, J., 'Selo Arbanassi. Istoriko-arheologicheski belezki' in *PSBKD*, No 64, pp. 1-38.

Postnikova-Loseva, M., 'Srebrjanye izdelija juvelirov Serbii i Dubrovnuka XV-XVII vv', *Muzej Primenjene Umetnosti* Zbornik, No. 15 (1971), pp. 67-109.

Potamianos, I., 'Light into Architecture: Evocative Aspects of Natural Light as Related to Liturgy and Byzantine Churches' (unpublished doctoral thesis, University of Michigan, 1996).

Prashkov, L., *Stenopisi vTzurkvata Rozdestvo Hristovo* (Sofia, 1979).

Prashkov, L. (ed.) *Vuprosi na konservatžiata I restavratžiata*, Vol. 1-2 (Sofia, 1985)

Prashkov, L., Razkrivane, konservirane i restravrirane na ikonata Archangel Mihail ot 1663 ot Manastira Sv Troitža krai Turnovo' in Prashkov, L. (ed.) *Vuprosi na konservatžiata I restavratžiata*, Vol. 2 (Sofia, 1985), pp. 7-16.

Prashkov, L., 'Razvitie i razprostranenie na ikonata v Bulgaria' in *Bulgarsko Vuzroždensko Izobrazitelno i Priložno Izkustvo* (Sofia, 1985), pp. 69-118.

Prindle, Paul W., 'The 1752 Calendar Change', *The American Genealogist,* No 40 (1964), pp. 246-248.

Prindle, Paul W., 'The 1752 Calendar Change', *The American Genealogist,* No 41 (1965), p. 98.

Protich, A., 'Sushtnost and Razvitie na Bulgarskata Tžurkovna Arhitektura', *IBAI* (Sofia, 1921–1922), pp. 86-205.

Radovanovič, J., *L'emperieur dans l'art byzantine*, (London, 1971).

Radovanovič, J.,'Jedno čudo arhandjela Mihaila u Lesnovu', *Zbornik za likovne umetnosti*, No. 10 (1974), pp. 47-68.

Rawlings, F. I. G., 'A Tintometric Comparison of Artists' Pigments', in *Technical Studies*, issue IX (London, 1940), pp. 3-10.

Richards, E. G., *Mapping Time: Calendar and its History* (Oxford, 1999).

Roy, A. (ed.), *Artists' Pigment. A Handbook of Their History and Characteristics,* Vol. 2 (New York Oxford, 1997, first edition, 1993).

Roberts, D. (ed.) *Signals and Perception: The Foundation of Human Perception* (New York, Milton Keynes , 2002).

Ruck, N., Aschehoug, O., Aydinli, S., Christoffersen, J., *Daylight in Buildings – A Source Book on Daylighting Systems and Components* (Berkeley, 2000).

Rutževa, Sv., 'Ikonografska I stilova harachteristika na stenopisnia ansamble ot tzurkvata Sv. Atanassii in Arbanassi ot 1667 godina' in *PI*, special edition (1998), pp. 38-43.

Rutževa, Sv., *Ikonografia I stil na stenopisite v tzurkvata Sv. Atanassii, selo Arbanassi*, (unpublished doctoral thesis, University of Veliko Turnovo, 1997).

Saunders, D., Cupitt, J., 'Image processing at the National Gallery: The VASARI project' in *National Gallery Technical Bulletin*, No. 14 (1993), pp. 72-86.

Scharrahs, A. 'Insight into a Sophisticated Painting Technique: three polychrome interiorsfrom Ottoman Syria in German Collections and field research in Damascus', at http://www.damaskuszimmer.de/PDFs/Publication_Anke%20Scharrahs.pdf?lang=de&objID=12&typeid=1 Alepo room [accessed, 2012].

Schibille, N., 'Light in Early Byzantium Church of Hagia Sophia in Constantinople' (unpublished doctoral thesis, University of Sussex, 2003).

Schmidt, F. and Thews, G. (eds), *Human Physiology* (Berlin, Heidelberg and New York, 1989, first edition 1987).

Sendler, E., *The Icon: Image of the Invisible. Elements of Theology, Aesthetics and Technique* (Redondo Beach, 1999, first edition in French, 1981).

Sharenkov, A., 'Tehnologija na živopisnite materiali na Vuzroždenskata ikonopis' in Prashkov, L. (ed.) *Vuprosi na konservatžiata I restavratžiata*, Vol. 1 (Sofia, 1984), pp. 65-75.

Sharenkov, A., *Starinni tractate po Tehnologija I Tehnika na Živopista*, Vol. 1, kn. 2 (Sofia, 1994).

Shin, J. Ch., Yaguchi, H., Shioiri, S., 'Changes in color in appearance in photopic, mesopic and scotopic vision', *OR*, Vol. 11, No. 4 (2004).

Shurkova, L., 'Hristovata tžurkva v Arbanassi', *IIGA*, Vol. XII (1959), pp. 331-350.

Slaveikov, P. R., 'Bulgaria pod Tursko Gospodaruvane I nai veche v XV–XVII' in *Chitalishte No. 5* (Sofia, 1873), pp. 388-410.

Slaveikov, P. R., 'Bulgaria pod Tursko Gospodaruvane I nai veche v XV–XVII' in *Chitalishte*, No. 6 (1873), pp. 483-503.

Sloanes, C. and Stevenson, A., *Oxford Dictionary of English* (Oxford, 2005).

Snegarov, Iv., 'Istoricheski vesti za Turnovskata Metropolia' in *GSU, Bogoslovski facultet*, No. 20 (1943), pp. 3-136.

Snegarov, Iv., *Turskoto vladichestvo – prechka za kulturnoto razvitie na Bulgarskijat narod i drugite Balkanski narodi* (Sofia, 1958).

Snowden, R., Thompson, P., Troscianko, T., *Basics of Colour Vision* (Oxford 1999).

Spear, R., 'A Century of Pigment Prices: Sevententh-Century Italy' in J. Kirby, S. Nash and J. Cannon (eds), *Trade in Artist's Materials:market and commerce in Europe to 1700*, (London, 2010), pp. 275-293.

St Germanus of Constantinople, Meyendorff, P. (transl.), *On the Divine Liturgy*, (Chestwood, New York, 1984), pp.104-105.

Standard E 284, *Annual Book of ASTM Standards* (Philadelphia, 1997).

Standard ISO/CIE10526-1991, *CIE standard colorimetric illuminants (*1991).

Stephanov, P., 'Gerasim II Kakavelas –Turnovski Metropolit i Tžarigradski Patriarch pres XVII vek' in *300 Godini Chiprovsko Vustanie*, (Sofia, 1988).

Stephanov, P., *300 Godini Chiprovsko Vustanie*, (Sofia, 1988).

Stylianou, A. and Stylianou, J Painted Churches of Cyprus (Cyprus, 1997). http://images.icon-art.info/public/Byzantium/Stylianou%201997%20-%20The%20Painted%20Churches%20of%20Cyprus.pdf [accessed May 2013]

V. Sunstedt, A. Chalmers, Martinez, Ph., 'High Fidelity Reconstruction of Ancient Egypt – The Temple of Kalabsha'

http://www.cs.bris.ac.uk/Publications/pub_master.jsp?id=2000076

Tachiaos, A. E. M., 'Die Aufhebung des Bulgarischen Patriarchats von Turnovo', *BS*, Vol. 4, No. 1 (1963), pp. 72-85.

Tanevska, V., Džidrova, Lj., Minčeva-Šukarova B. and Grupče, O. 'Micro-Raman pigment analysis of wall-paintings from a church in the Skopje Fortress, Proceedings of the Balkan Symposium on Archaeometry, pp. 83-84 (2008).

Tantcheva, E., 'At the Crossroads of East and West: Donor Portraits in the Church of the Nativity of Christ in Arbanassi', *Ikonotheka*, No. 22 (Warsaw, 2010).

Tantcheva, E., Cheung, V. and Westland, S., 'Spectroscopic analysis of the interiors of seventeenth-century churches in Arbanassi', in *Colour Science for Industry*, Proceedings of Midterm Meeting of the AIC, Hangzou (2007), pp. 363-366.

Tantcheva, E., Cheung, V. and Westland, S., 'Analysis of 17th-century church interiors using the Munsell system' in *Colour – Effects and Affects*, Proceedings of the Midterm Meeting of the AIC, Stockholm (2008), pp. .

Tantcheva, E., Cheung, V. and Westland, S., 'Analysis of the use of yellow in seventeenth-century church interiors', *IJDNE*, Vol. 4, No. 3 (2009), p. 314.

Tantcheva, E., Cheung, V., Westland, S., 'Effect of Candlelight on the Seventeenth Century Church Interiors using Munsell System' , Proceedings of 11th Congress of AIC, Sydney (2009).

Theis, L., 'Lampen, Leuchten, Licht' in Stiegemann (ed.), Byzanz (Paderborn, 2000). Pp. 53-64.

Theopholov, T., 'Arhitecturno isledvane na cherkvata Sv. Gyorgy v selo Arbanassi' in MPK, Vol. XVII, No. 3 (Sofia, 1977), pp. 18-27.

Thews, G. (eds), *Human Physiology* (Berlin, Heidelberg and New York, 1989, first edition 1987)

Thissen, J., 'Smalt' in Roy, *Artists' Pigments A Handbook of Their History and Characteristics*, Vol. 2, (New York Oxford, 1997, first edition, 1993), pp. 113-130.

Thompson, D. V., *The Practice of Tempera Painting: Materials and Methods* (New York, 1936).

Thompson, D. V., *The Materials and Techniques of Mediaeval Painting (*New York, 1956).

Thompson, D. V. (ed. and trans.), Cennino d'Andrea Cennini, *Il Librodell'Arte: The Craftsman's Handbook* (New York, 1960, first edition 1933).

Tilley, R., *Colour and the Optical Properties of Materials* (Chichester, 2000).

Tjaželov, V. and Sopolitzin, O., *Malaja Istorija Iskustv*, (Moskva, 1975).

Todorovič, D., 'Polijelej u Markovom Manastiry', *Zograph*, No. 9 (1979).

Tuleshkov, H., *Bulgarski Stroitelni Tžentrove (XV–XIX)* (V. Turnovo, 1987).

Tutundjiev, Iv., *Turnovskata Metropolia prez 17 vek i purvata polovina na 18 vek* (Veliko Turnovo, 1996).

Tutundjiev, Iv., 'Ekzarhii na Tžarigradskata Patriarshia v Bulgarskite zemi prez XIV-XIX vek' in *Turnovska Knisžovna Shkola*, Vol. 7 (V. Turnovo, 2002), pp. 111-123.

Tžamblak, G., 'Pohvalno slovo za Euthymi' in Grasheva, L. (ed.) *Stara Bulgarska Literatura,* Vol. 2 (Sofia, 1982), pp. 228-245.

Tžonev, Zv., *Istoria na grad Gorna Orjahovitza I okolnostite mu – Liaskovetz I Arbanassi* (Veliko Turnovo, 1932).

Tžonev, Zv., *Manastirite I Starinnite Tžurkvi v Arbanassi* (Veliko Turnovo, 1934).

Tžvetkova, B. A. (ed.), *Frenski Putepisi za Balkanite (XV–XVIII v.)* (Sofia, 1975).

Tžvetkova, B., *Pametna Bitka na Narodite* (Varna, 1979).

Underwood, P.A., *Kariye Djamii*, Vol. 1 (1966).

Uspensky B. '*The Semiotics of the Russian Icon*' (Lisse, 1976, first edition in Russian, 1971).

Vassilev, A., *Erminii, Tehnologii i Ikonographija* (Sofia, 1976).

Vassilev, I., Andreev, V., Godev, N., and Spassova, T., 'Synoptic statisticheski metod za predskazvane na zamursjavaneto na vazduha v gradove razpoloženi v planinski rajoni' in *Proceedings of XIV^th^ International Conference on Carpathian Meteriology,* Sofia (1989), pp. 374-378.

Vatchev, H., *Enoriiskiat hram v Turnovskata Mitropolia prez XV – nachaloto na XVIII vek,* (unpublished doctoral thesis, Archaeological Institute and Museum of BAN, 1998).

Vatchev, H., 'Kum vuprosa za padaneto na stolichnia Turnovgrad pod Turska vlast' in *Akti na mezdunarodna konferentzia po sluchai na 600 godini ot prevzemaneto na Turnovgrad*, ((Veliko Turnovo, 1993), pp. 249-254.

Vatchev, H.,'Prouchvania v dvora na tzurkvata Sv. Arhangeli Mihail i Gavrail v Arbanassi', *IIMVT*, Vol. XX (Veliko Turnovo, 2004), pp. 199-208.

Vatchev, H., *Tžurkovnijat ansamble v Arbanassi* (Varna, 2006).

Velmans, T., Korač V., Suput M., *Bizancio: el esplendor del arte monumental*, (Barcelona, 1999).

Volkov, N. N., *Tžvet v Živopisi*, (Moscow, 1984).

Westland, S., 'Colour science', in Roberts, D. (ed.) *Signals and Perception: The Foundation of Human Perception* (New York, Milton Keynes , 2002), pp. 91-102.

Whittemore, Th., 'Notes on Light in Haghia Sophia, Istanbul', 26 January 1945, *Dumbarton Oaks*, pp. 7-12.

Winter, J. and West FitzHugh, E., 'Pigments based on carbon' in Berrie, B. H., *Artists' Pigments: A Handbook of Their History and Characteristics*, Vol. 4. (London 1985), pp. 1-37.

Wyszecki, G. and Stiles, W. S., *Color Science: Concept and Methods, Quantitative Data and Formulae* (New York, Chichester, Weinheim, Brisbane, Singapore, Toronto, 2000, first edition 1982).

Zanyi, E., Schroer, C., Mudge, M. and Chalmers, A. G. , 'Lighting and Byzantine Glass Tesserae' in *Proceedings of EVA 2007: Electronic Information, the Visual Arts and Beyond*, London, 2007.

Fig. 1: Map of the present territory of Bulgaria**.** The location of Arbanassi is marked with a red square point. http://www.loem.org/templates/cusloem/details.asp?id=30482&PID=535420, [accessed 2011]

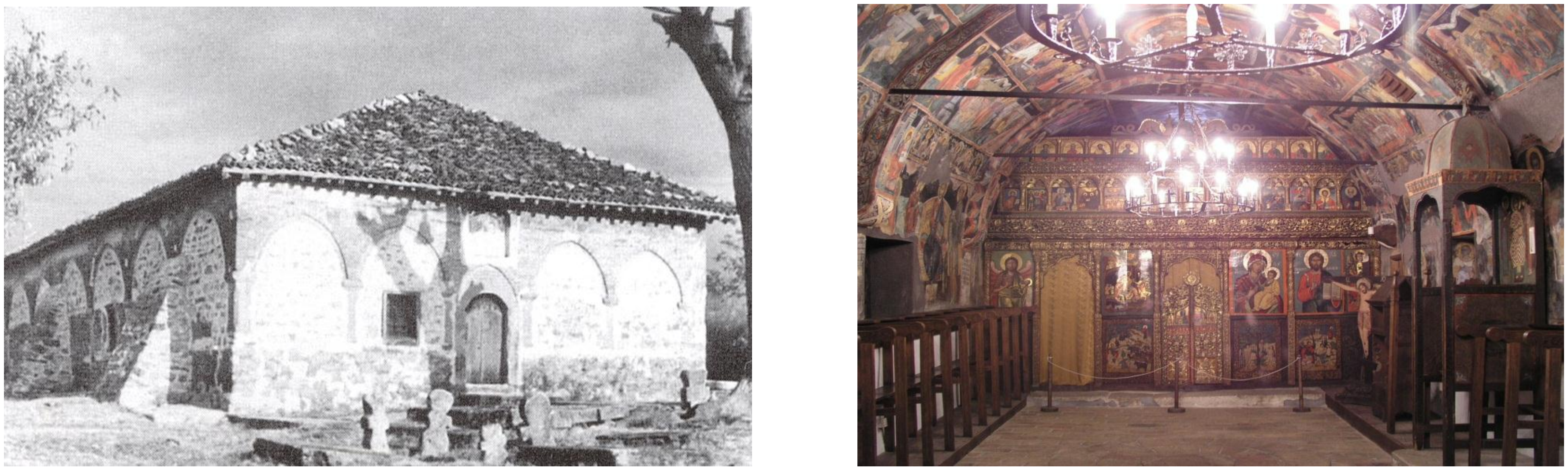

Fig. 2: The Church of the Nativity of Christ. Views of the exterior (Papazov, *Selo Arbanassi. Lichni spomeni i subrani danni*, 1937) and the interior.

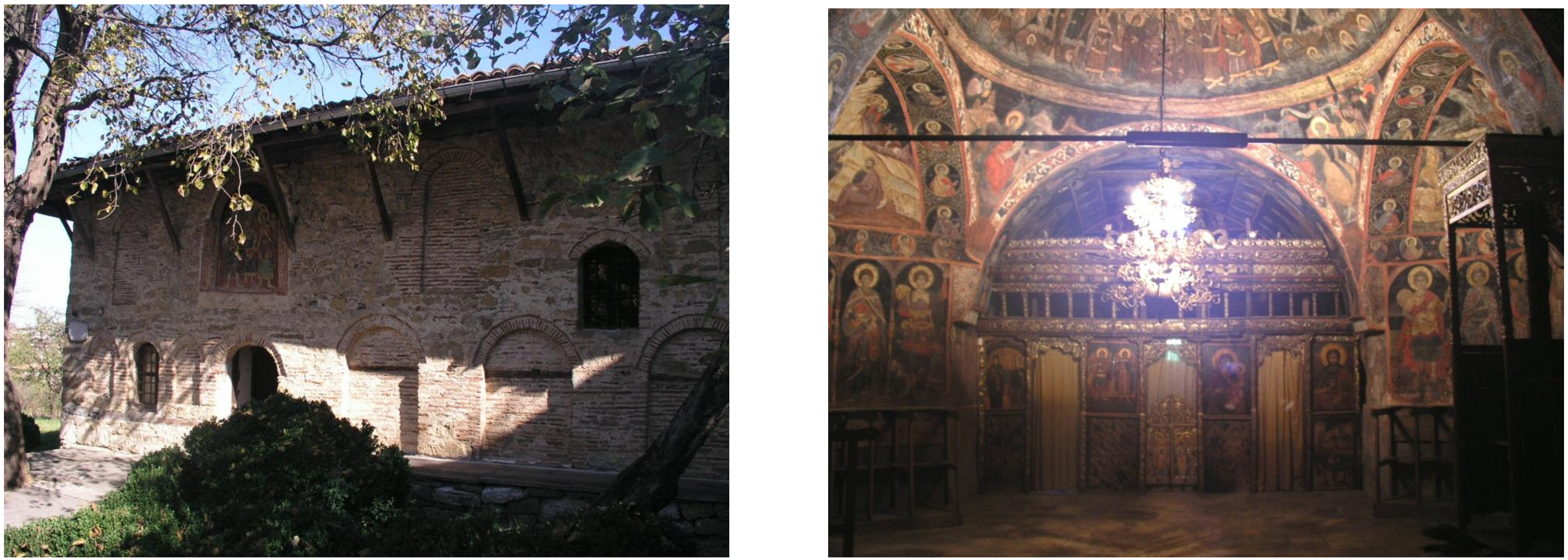

Fig. 3: The Church of the Archangels Michael and Gabriel. Views of the exterior and the interior .

Fig. 4: The Church of St Atanass. Views of the exterior and the interior.

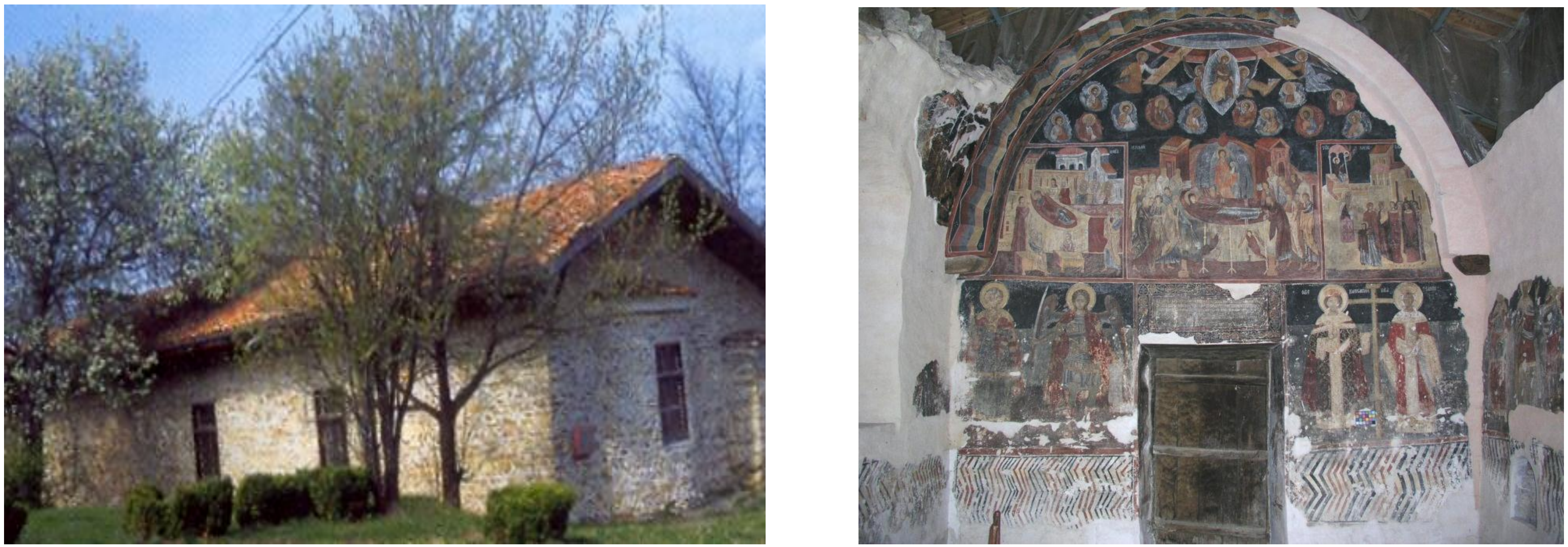

Fig. 5: The Church of St Dimitr. Views of the exterior and the interior.

Fig. 6: The Bulgarian Tzardom after 1371.
http://upload.wikimedia.org/wikipedia/commons/f/f0/Second_Bulgarian_Empire_after_1371.png,[accessed 2011].

Fig. 7: The Bulgarian Tzardom in the second half of the XIV century, representing the generally accepted version of Bulgarian historical research into the situation on the Balkans at the end of the fourteenth century. (Gandev, Ch. *(ed.)*, *Istoria na Bulgaria*, Vol. III, (Sofia, 1983), p. 350).

Fig. 8: Map of Arbanassi. The continuous outer line marks the boundaries of the settlement. Number 15 indicates the situation of the Church of the Nativity, number 35 the Church of St Atanass, number 81 the Church of St Dimitr and number 95 the Church of the Archangels Michael and Gabriel. (Haritonov, H., Chohadsžieva, G., Rutževa, S., *Arbanassi (*Sofia, 2003), pp. 94-95)

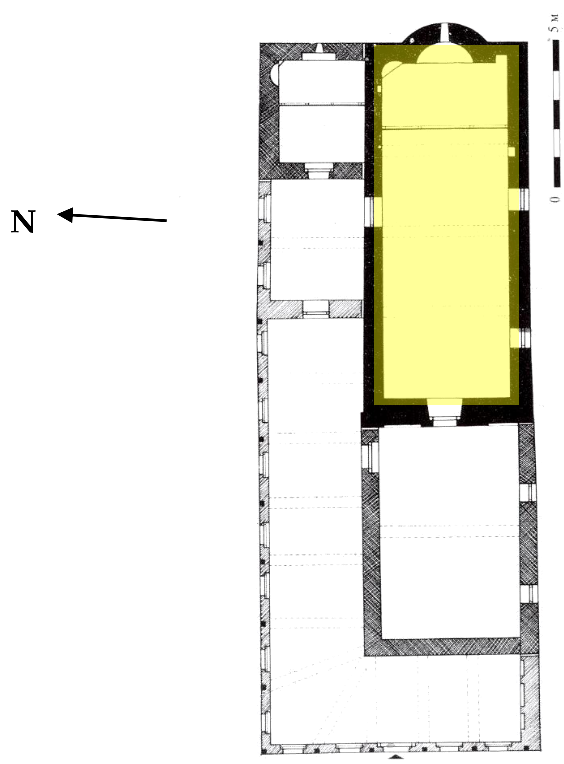

Fig. 9: Ground plan of the Church of the Nativity of Christ by Theophilov. It represents the building in its present form and is taken from Prashkov, L., *Stenopisi v Tzurkvata Rozdestvo Hristovo*, 1979. The nave is coloured yellow.

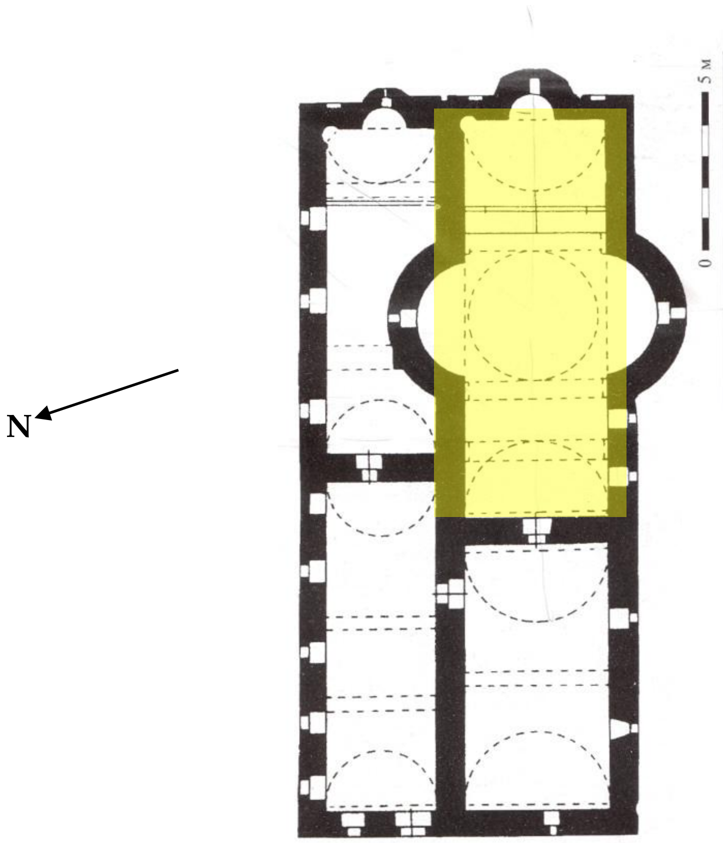

Fig. 10: Ground plan of the Church of the Archangels Michael and Gabriel by Zimmermann. It represents the building in its present form and is taken from Koeva, Jokimov, Stoilova, *Pravoslavni Hramove po Bulgarskite Zemi (XV–XX v)*, 2002. The nave is coloured yellow.

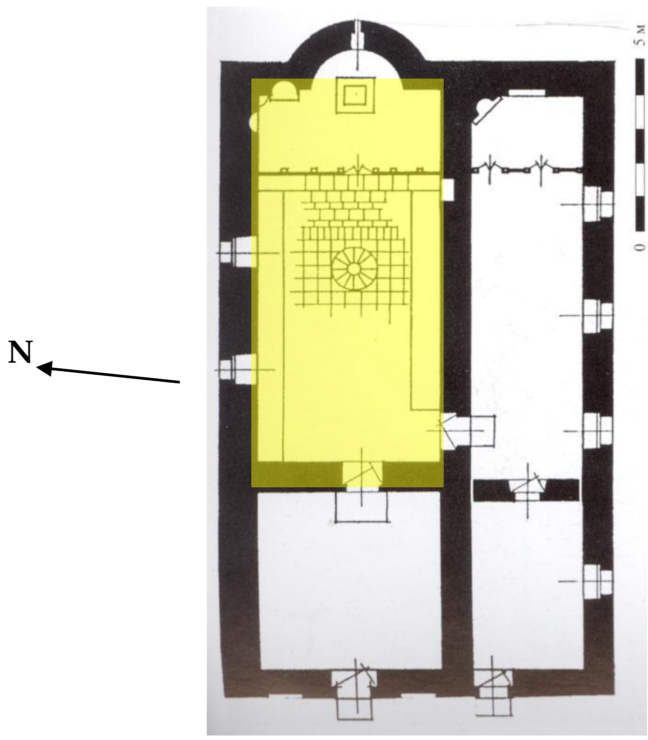

Fig. 11: Ground plan of the Church of St Atanass. This was drawn by the archaeologist Vatchev and is a modification of an earlier plan drawn by Theophilov (Vatchev, *Enoriiskiat hram v Turnovskata Mitropolia prez XV – nachaloto na XVIII vek,* 1998). It represents the building in its present form. The nave is coloured yellow.

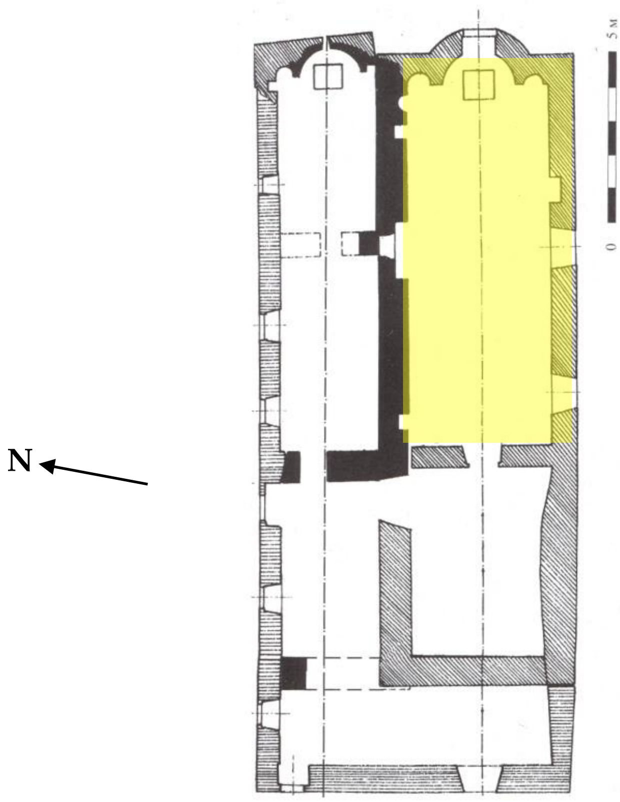

Fig. 12: Ground plan of the Church of St Dimitr. It represents the building in its present form and is taken from Vatchev, *Enoriiskiat hram v Turnovskata Mitropolia prez XV – nachaloto na XVIII vek*, 1998. The nave is coloured yellow.

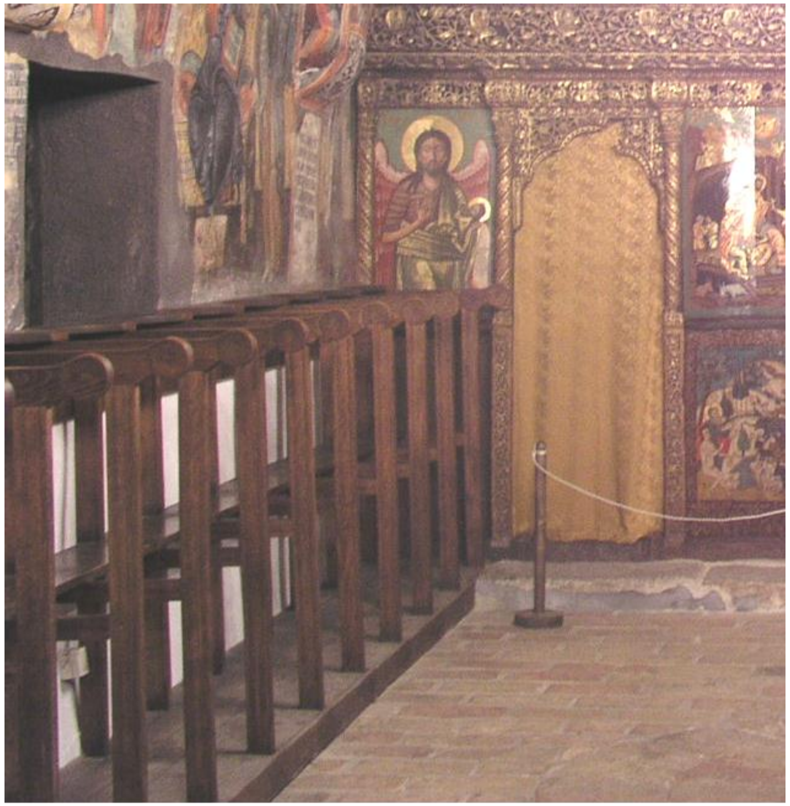

Fig. 13: Congregational seats in the nave of the Church of the Nativity of Christ.

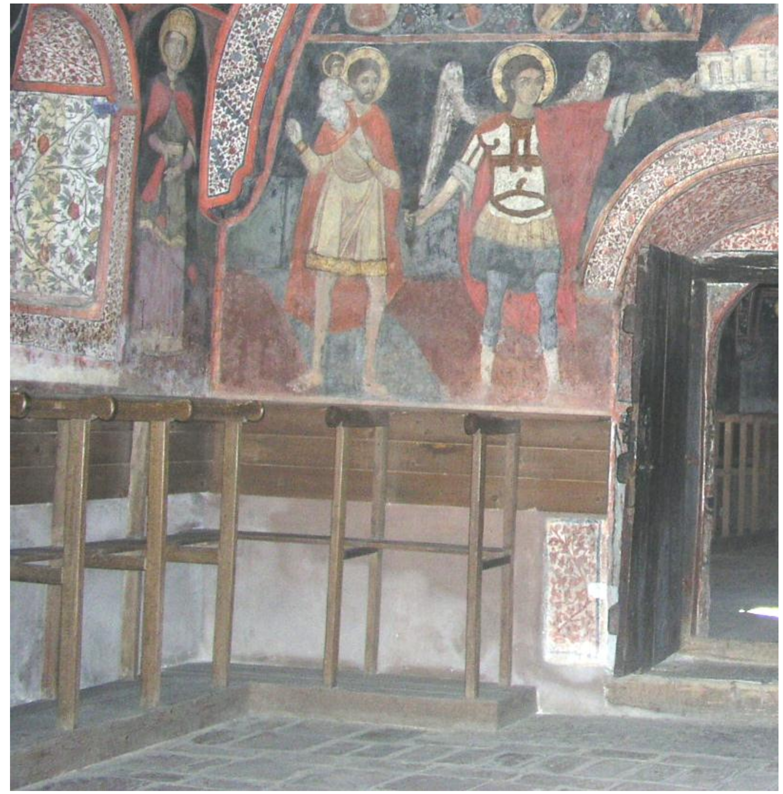

Fig. 14: Congregational seats in the nave of the Church of the Archangels.

Fig. 15: Congregational seats in the nave of the Church of St Atanass.

Fig. 16: Geometric patterns in the area under the first register in the nave of the Church of St Dimitr.

Fig. 17: Donor portrait (Hajji Gjorgy) from the west end of the outer narthex of the Church of the Nativity (between 1643 and 1649). (*Bosilkoff Publishers Arbanassi Collection*, (Veliko Turnovo, 2004), p. 5.

Fig. 18: Donor portrait (Kyr Tzonko) from the east end of the outer narthex of the Church of the Nativity (1632). (*Bosilkoff Publishers Arbanassi Collection*, (Veliko Turnovo, 2004), p. 3.

Fig. 19: Donor portrait from the katholikon of Bachkovo Monastery (1643). (Božilov, Touleshkov and Prasliov, *Bulgarski Monastiri*, (Sofia, 1997), p. 71.

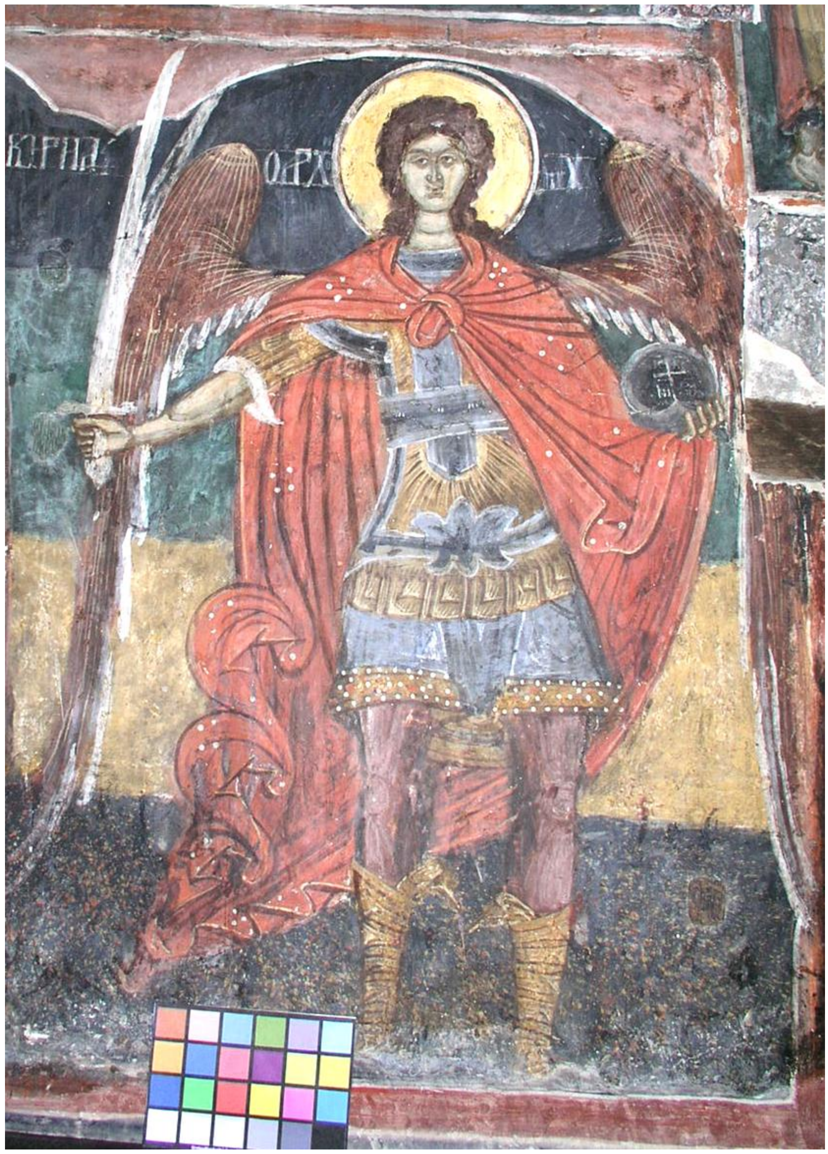

Fig. 20: Image of the Archangel Michael from the west wall of the nave of the church of the Nativity of Christ.

Fig. 21: Image of SS Constantine and Helena from the west wall of the nave of the Church of the Nativity of Christ.

Fig. 22: Image of the Archangel Michael from the west wall of the nave of the Church of the Archangels Michael and Gabriel.

Fig. 23: Image of SS Constantine and Helena from the west wall of the nave of the church of the Archangels Michael and Gabriel.

Fig. 24: Image of the Archangel Michael from the west wall of the nave of the Church of St Atanass.

Fig. 25: Image of SS Constantine and Helena from the west wall of the nave of the Church of St Atanass.

Fig. 26: Image of the Archangel Michael from the west wall of the nave of the Church of St Dimitr.

Fig. 27: Image of SS Constantine and Helena from the west wall of the nave of the Church of St Dimitr.

Fig. 28: Detail of the scene of SS Constantine and Helena in the nave of the Church of The Nativity. The pearl-like decoration of the pallia of St Helena is added as a thick second layer as is the pattern of the fabric of the stola.

Fig. 29: Detail of the scene of SS Constantine and Helena in the nave of the Church of St Atanass. In places the pearl decoration of the pallia of St Helena has disappeared, as the white *impasto* details have worn out owing to the lack of a bond between the base coat and the paint.

Fig. 30: Detail from the scene of SS Constantine and Helena in the nave of the Church of St Atanass. The image shows the thick application (*impasto*) of white, aimed at simulating pearl decoration on the pallia of St Constantine.

Fig. 31: Detail from the scene of SS Constantine and Helena in the nave of the Church of St Dimitr. The image shows the *impasto* application of white, simulating pearl decoration on the pallia of St Constantine.

Fig. 32: Representation of the appearance of the closest colour match for the colours in the churches of Arbanassi. The match is between the CIELAB colourimetric notations for the churches and for the Munsell chips, and is intended to illustrate the colour schemes in the naves of the churches.

Fig.33: Supporting system of concrete buttresses on the south façade of the Church of the Nativity of Christ.

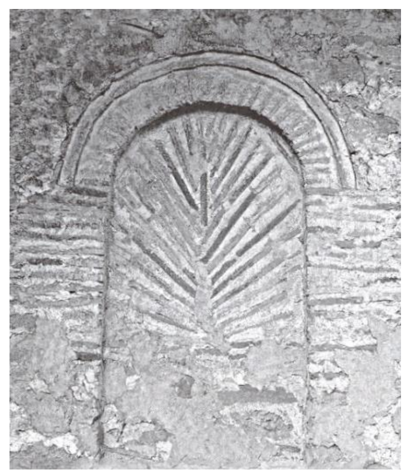

Fig. 34: Details of the south and the north façades of the Church of the Archangels Michael and Gabriel. The photograph on the left shows the style of the niches on the south façade and that on the right shows the style of the niches on the north façade (H. Vatchev, *Tžurkovnijat ansamble v Arbanassi*, 2006).

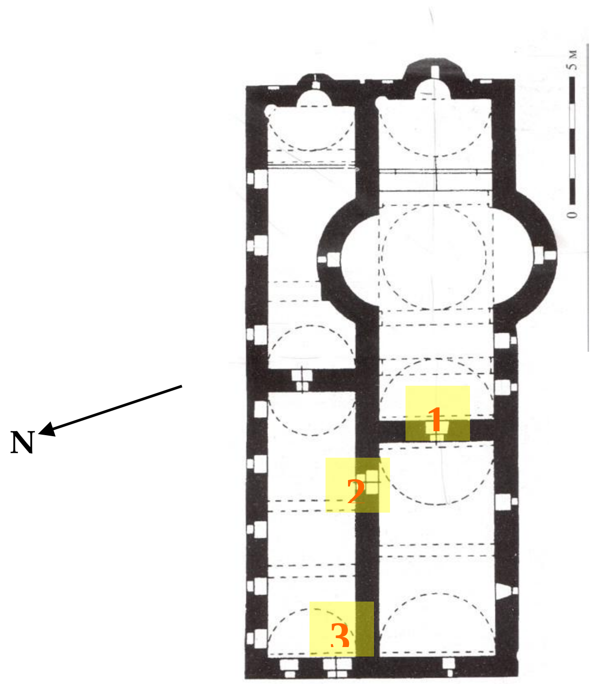

Figure 35: Floor plan of the Church of the Archangels Michael and Gabriel. There is one entrance into the church, in the west wall. The entrance into the nave (No 1) is separated from the main entrance (No 3) by the spaces of the outer and inner narthexes. The connection between the two narthexes is by a doorway (No 2). (H. Vatchev, *Enoriiskiat hram v Turnovskata Mitropolia prez XV – nachaloto na XVIII vek*, 1998).

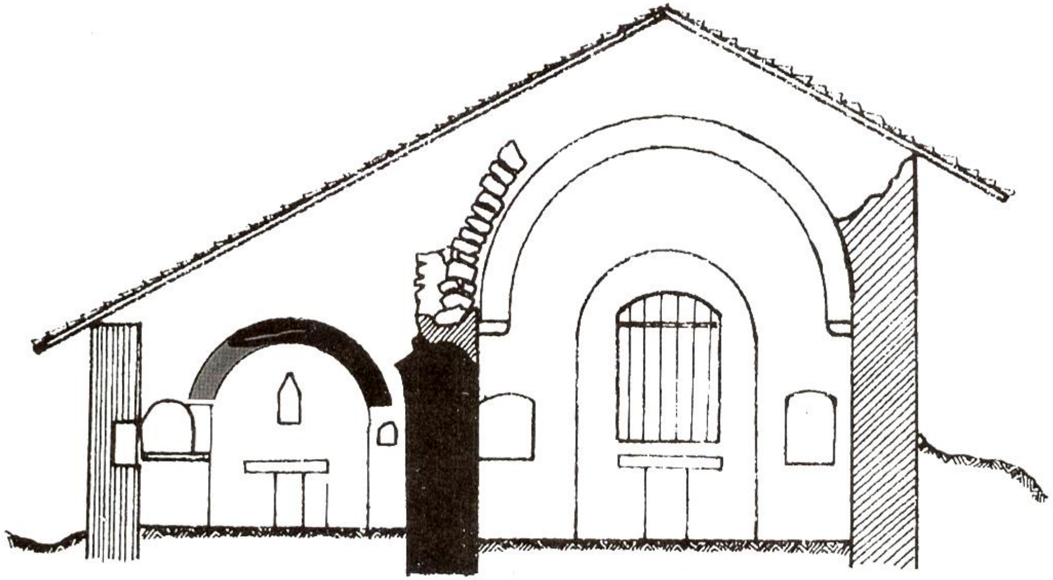

Fig. 36: Lateral cross section of the Church of St Dimitr. The partition wall dividing the interior space into chapel and church proper is in black, which signifies parts of the old construction. The same marking is used for the reused part of the apse in the chapel of St George (H. Vatchev, *Tžurkovnijat ansamble v Arbanassi*, 2006).

Fig. 37: Entrance door into the nave of the Church of the Archangels Michael and Gabriel. The door is situated at the west end of the chamber and connects the nave with the inner narthex. It is possible to identify on the picture the noticeable difference in the floor level between the two chambers, compensated for by a step.

Figure 38: Image of St Sisoes the Great above the door leading from the nave of the Church of St Atanass.

Figure 39: Image of St Sisoes the Great above the door leading from the nave of the catholicon of the Meteora monastery.

Fig. 40: The Church of the Nativity of Christ: Eastern end of the north elevation, showing the depth of the roof on the eastern elevation.

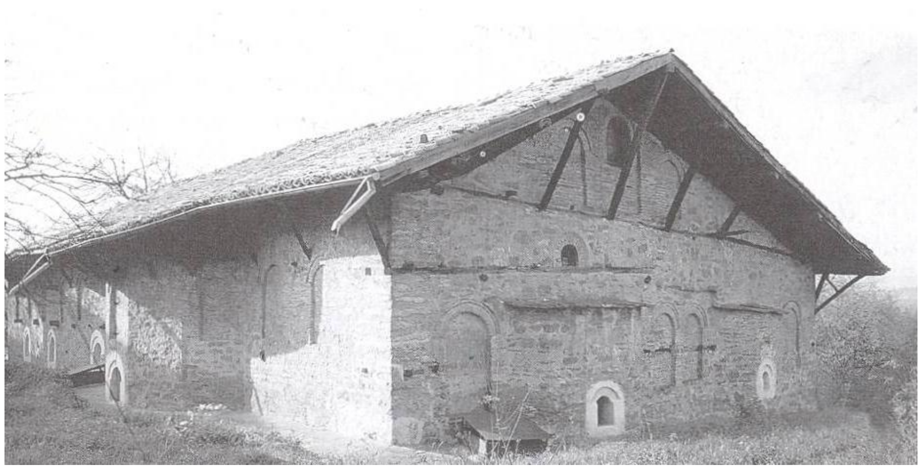

Fig. 41: The Church of the Archangels Michael and Gabriel: South-east view, (Vatchev, *Tžurkovnijat ansamble v Arbanassi*, 2006).

Fig. 42: The Church of St Atanass: East façade.

Fig. 43: The Church of St Dimitr: East façade.

Fig. 44: The Church of the Archangels of Michael and Gabriel: South-east view, showing the continuous depth of the roof around the building (Vatchev, *Tžurkovnijat ansamble v Arbanassi*, 2006).

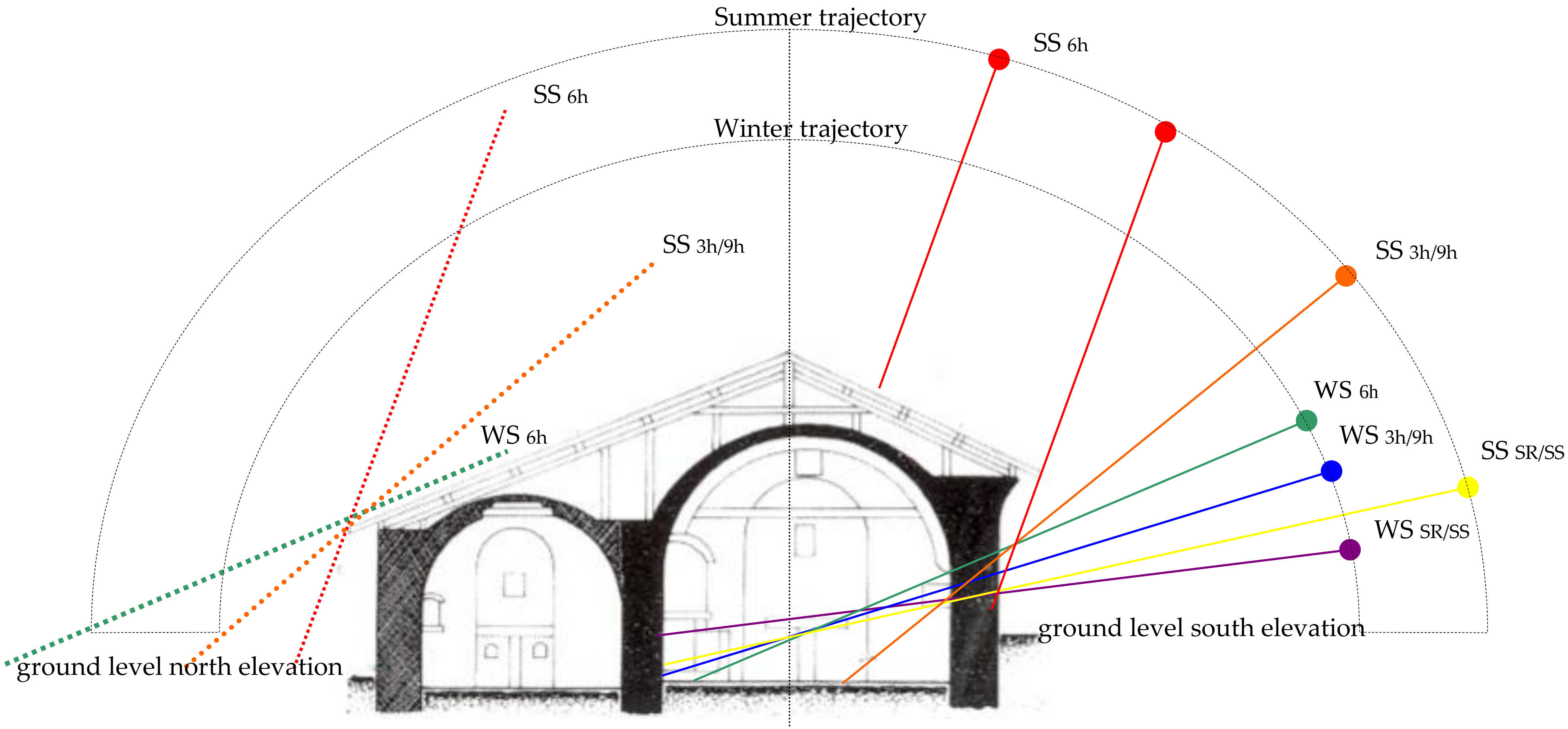

Fig. 45: Schematic presentation of the interaction of the sunlight with the south and north façades of the Church of the Nativity of Christ during the year

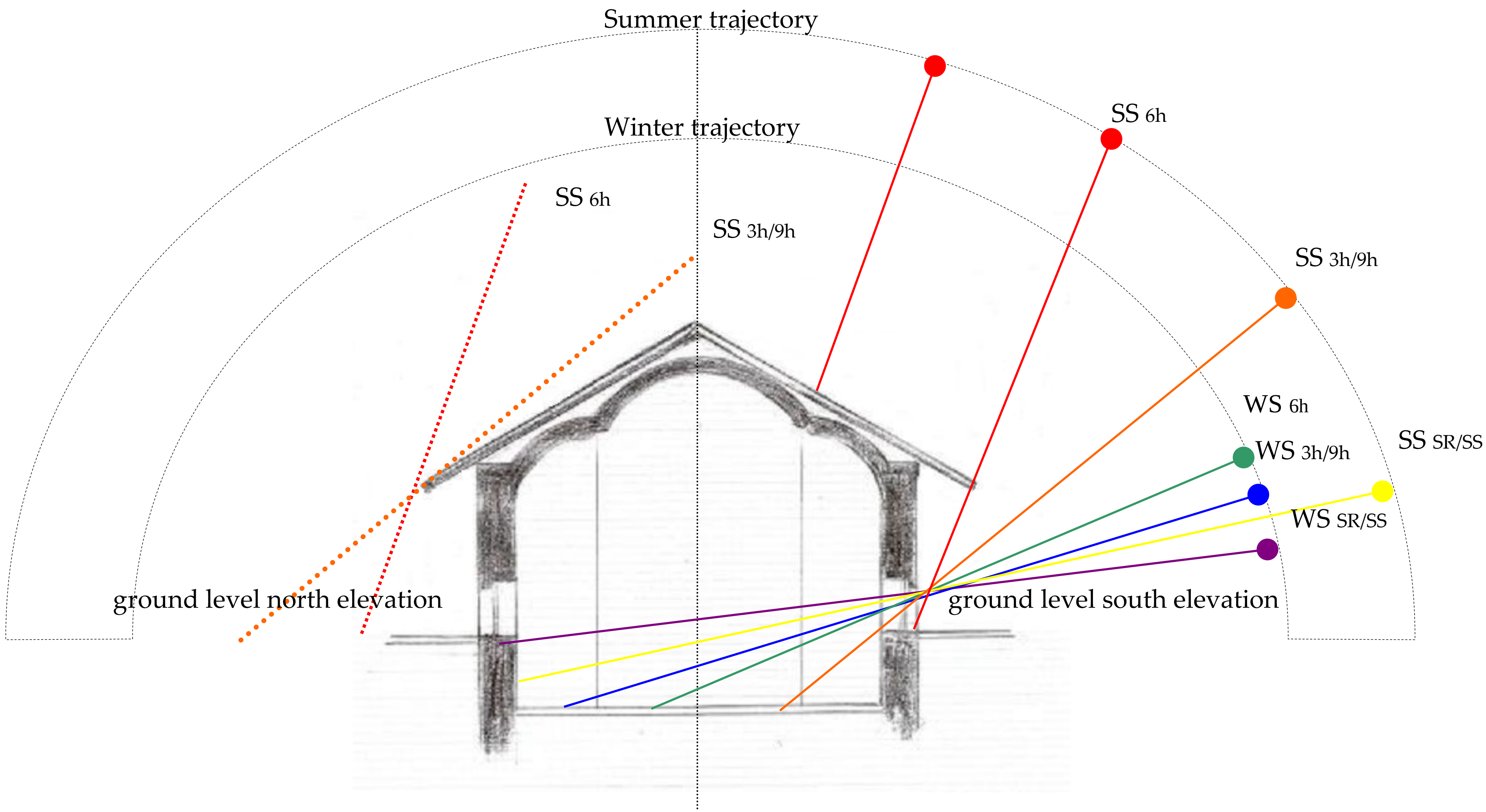

Fig. 46: Schematic presentation of the interaction of the sunlight with the south and north façades of the Church of the Archangel Michael and Gabriel during the year

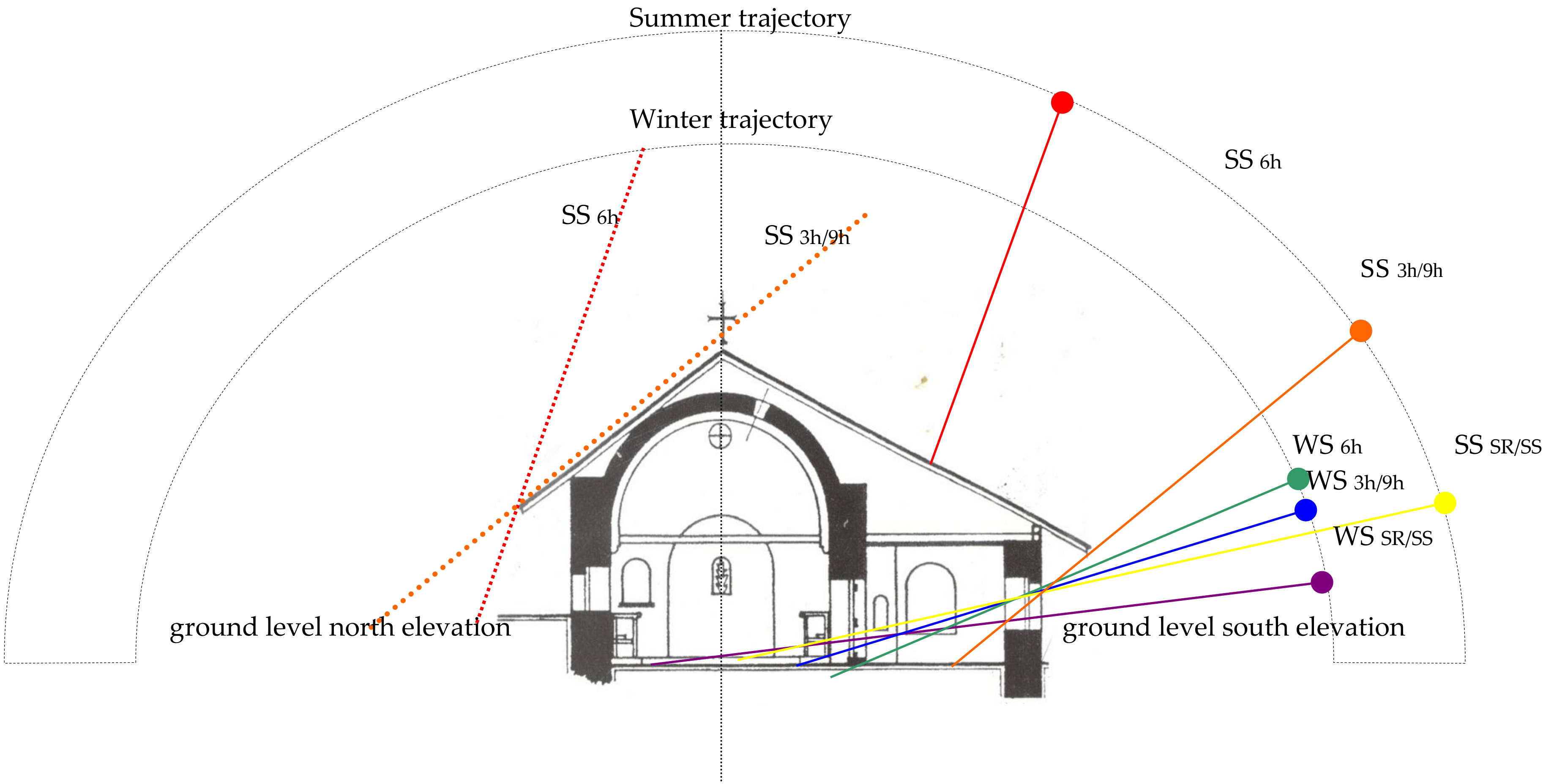

Fig. 47: Schematic presentation of the interaction of the sunlight with the Church of St Atanass during the year.

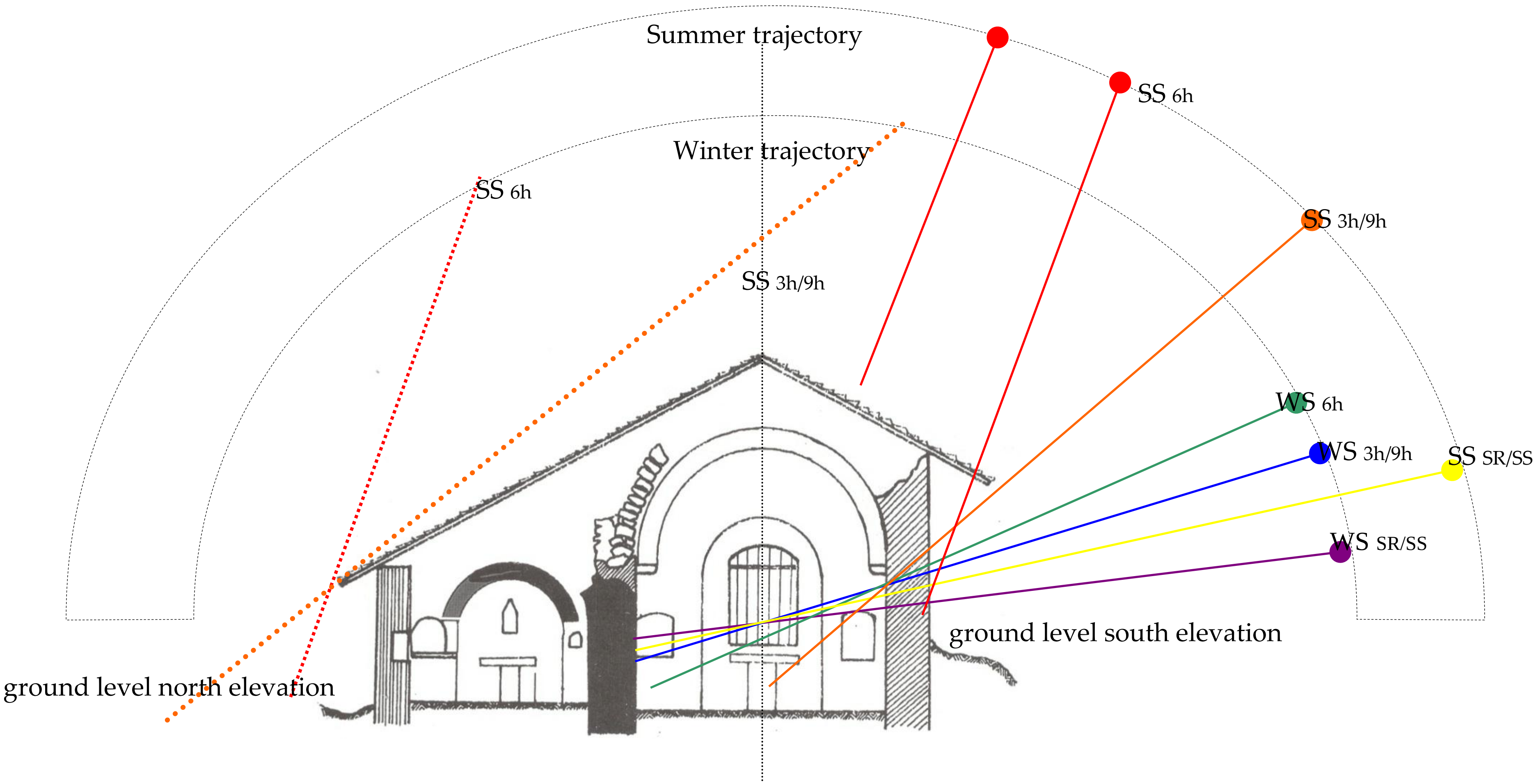

Fig. 48: Schematic presentation of the interaction of the sunlight with the Church of St Dimitr during the year

Fig. 49: Hanging Lamp, Protaton Monastery, Mount Athos (late seventeenth century). (Karakatsanis (ed.), *Treasures of Mount Athos*), p. 420

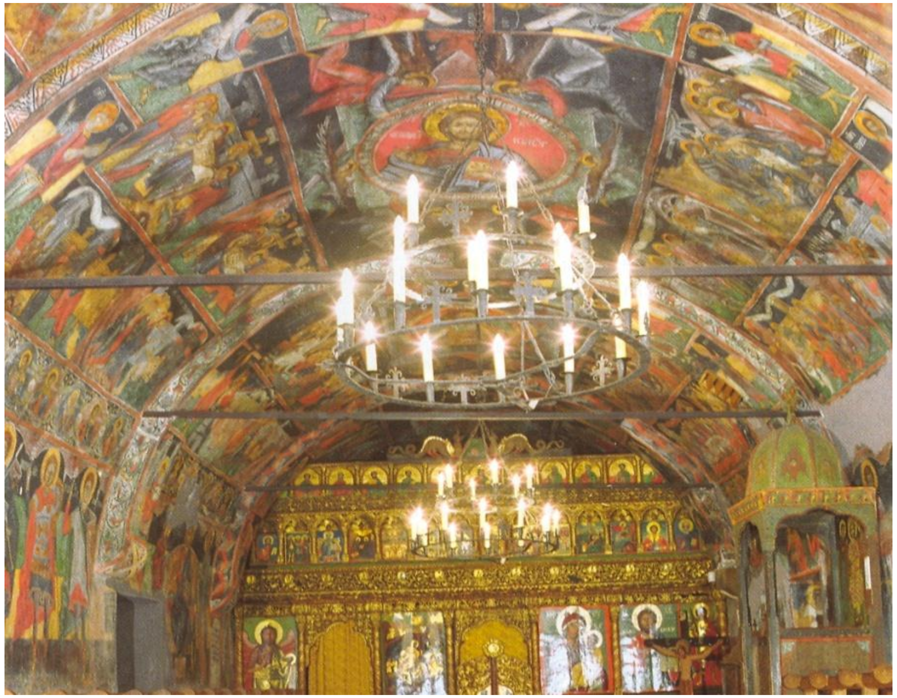

Fig. 50: Nave of the Church of the Nativity of Christ. The photograph was taken using a photographic flood-light together with the electric chandeliers which, at the time, were fitted with 25 watt bulbs.

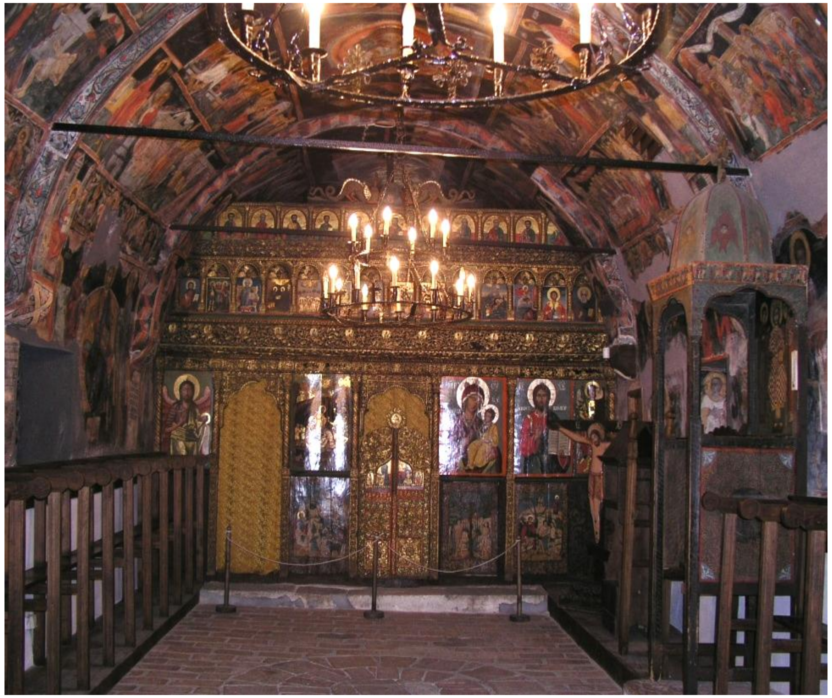

Fig. 51: Nave of the Church of the Nativity of Christ. The photograph was taken using only the light of the electric chandeliers of the nave which, at the time, were fitted with 15 watt bulbs.

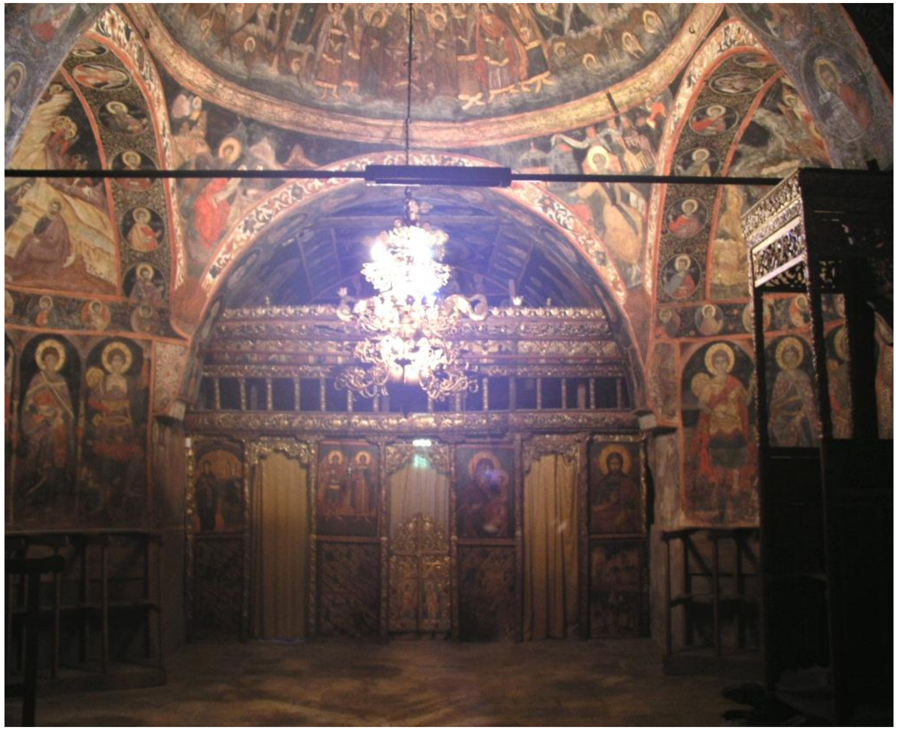

Fig. 52: Central part of the nave of the Church of the Archangels Michael and Gabriel. The photograph was taken without flash or any other additional illumination.

Fig. 53: Central part of the nave of the Church of the Archangels Michael and Gabriel. This photograph was taken between 3:00 p.m. and 3:30 p.m., with the shutters of the first two windows partially opened.

Fig. 54: Image of Christ the Child from the east end of the ceiling in the nave of the Church of the Nativity

Fig. 55: Image of Christ Pantocrator from the centre of the ceiling in the nave of the Church of the Nativity.

Fig. 56: Image of the Holy Trinity (Fatherhood) from the west end of the ceiling in the nave of the Church of the Nativity. (Haritonov, H., Chohadsžieva, G., Rutževa, S., *Arbanassi (*Sofia, 2003), p. 54.

Fig. 57: Image of Christ Pantocrator from the east end of the ceiling in the nave of the Church of St Atanass. (Haritonov, H., Chohadsžieva, G., Rutževa, S., *Arbanassi (*Sofia, 2003), p. 54.

Fig. 58: Image of the Holy Trinity from the centre of the ceiling in the nave of the Church of St Atanass.(Rutževa, Sv., *Ikonografia I stil na stenopisite v tzurkvata Sv. Atanassii, selo Arbanassi*, (unpublished doctoral thesis, University of Veliko Turnovo, 1997).

Fig. 59: Image of Christ the Child from the west end of the ceiling in the nave of the Church of St Atanass.(Rutževa, Sv., *Ikonografia I stil na stenopisite v tzurkvata Sv. Atanassii, selo Arbanassi*, (unpublished doctoral thesis, University of Veliko Turnovo, 1997).

Fig. 60: Image of the Holy Trinity – scene in the dome of the Church of the Archangels Michael and Gabriel. (Haritonov, H., Chohadsžieva, G., Rutževa, S., *Arbanassi (*Sofia, 2003), p. 56.

Fig. 61: Image of the Nativity of Christ from the north alcove in the Church of the Archangels Michael and Gabriel. (Haritonov, H., Chohadsžieva, G., Rutževa, S., *Arbanassi (*Sofia, 2003), p. 63.

Fig. 62: Image of the Descent into Hell from the south alcove in the Church of the Archangels Michael and Gabriel. (Haritonov, H., Chohadsžieva, G., Rutževa, S., *Arbanassi (*Sofia, 2003), p. 63

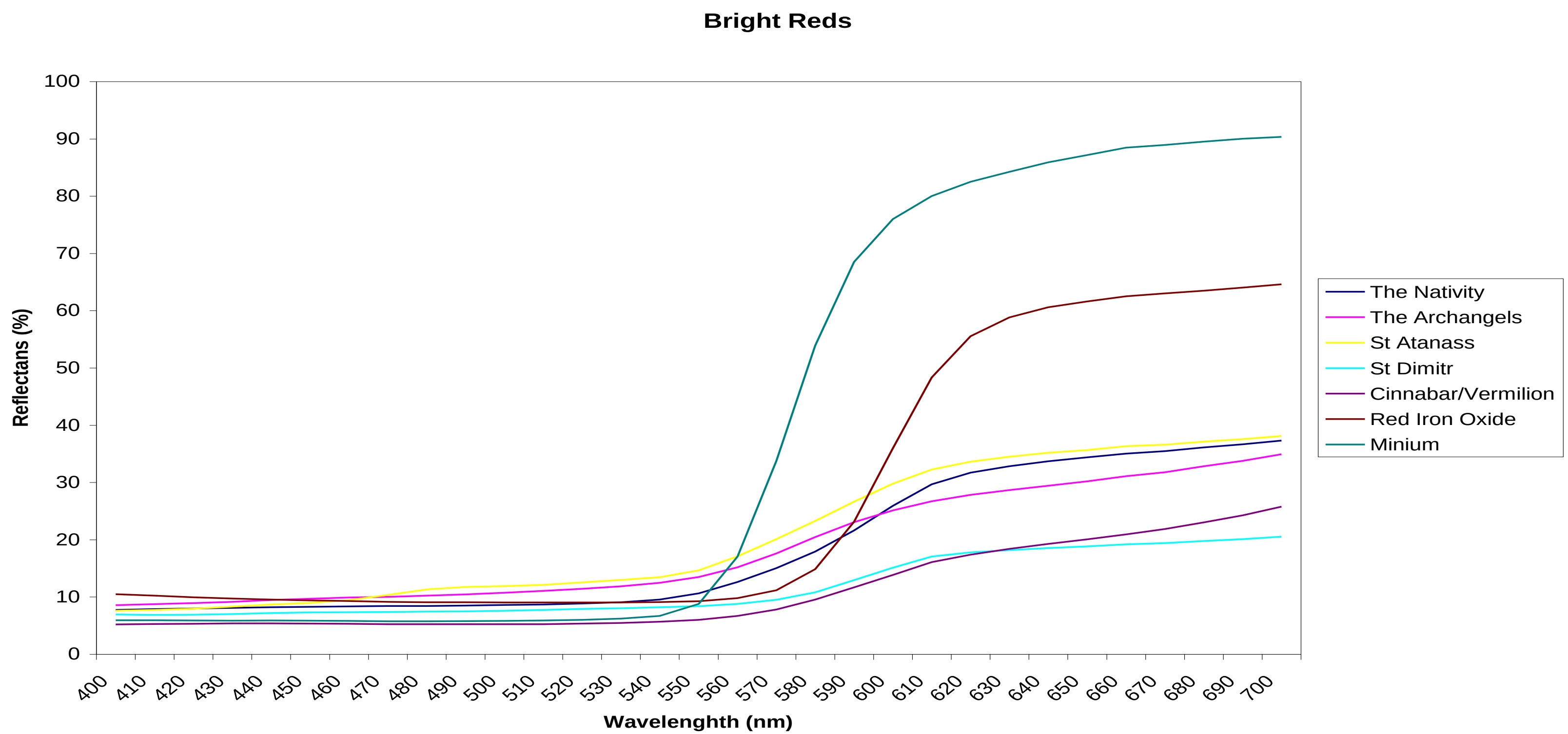

Fig. 63: Representative reflectance curves of the bright reds in the four churches showing the three colour substances suggested by Nenov.[580] All the curves peak in the red–orange area of the spectrum.

[580] Nenov, N., *Practikum po himichni problemi v konservatžiata*, (Sofia, 1984), pp.112–113.

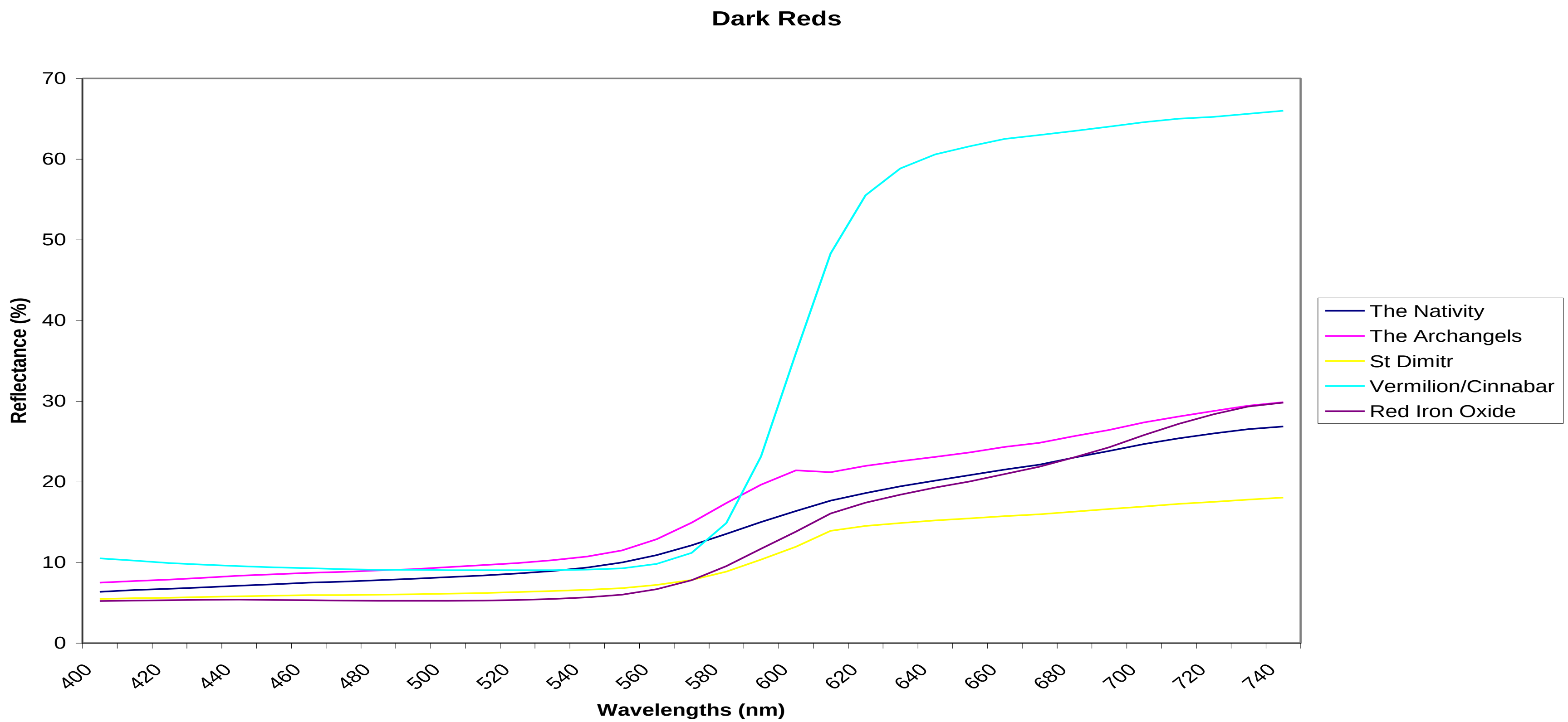

Fig. 64: Representative reflectance curves of the dark reds in the churches of the Nativity, the Archangels and St Dimitr and two of the colour agents, red iron oxide and cinnabar.

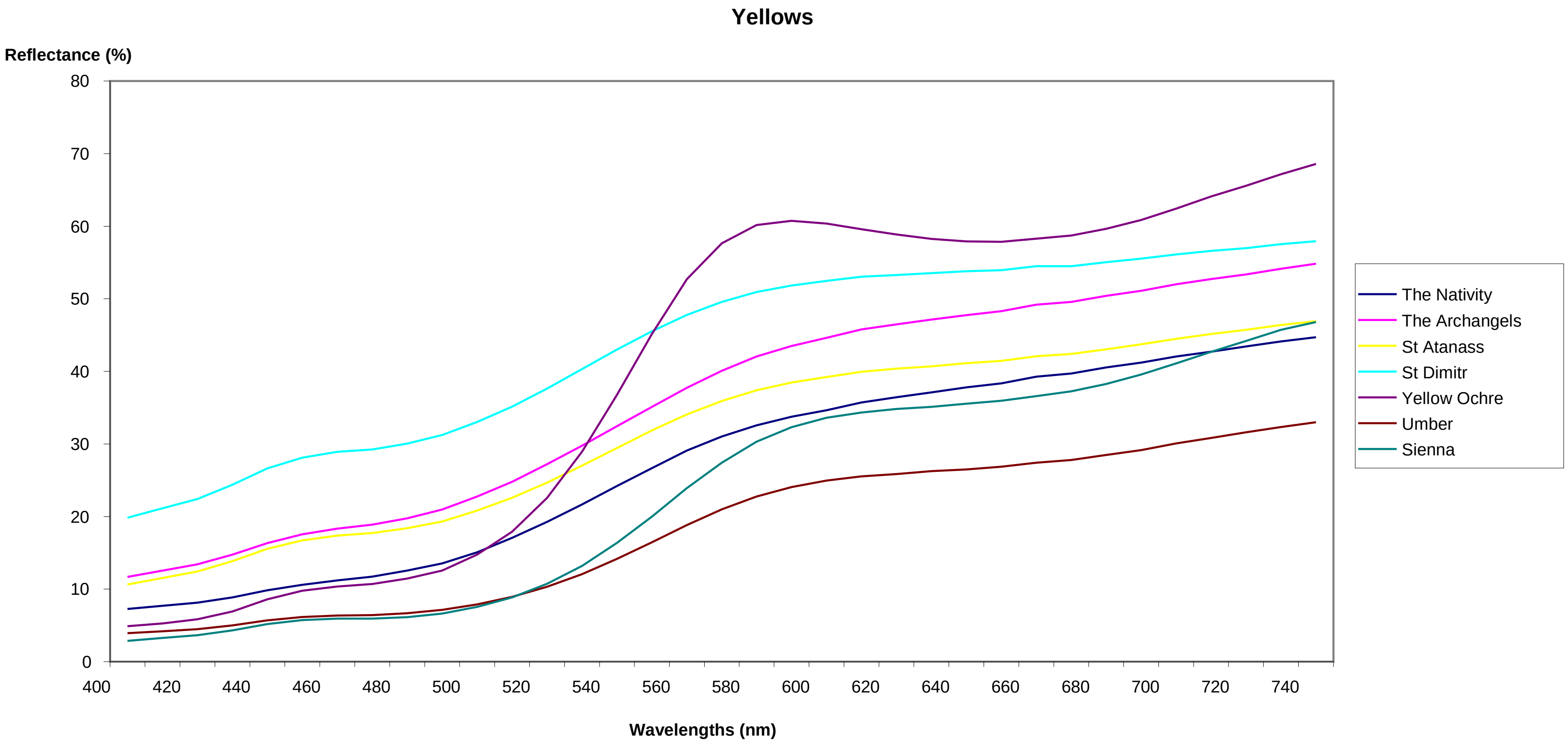

Fig. 65: Representative reflectance curves of the yellows in the naves of all four churches and selected standard pigment samples.

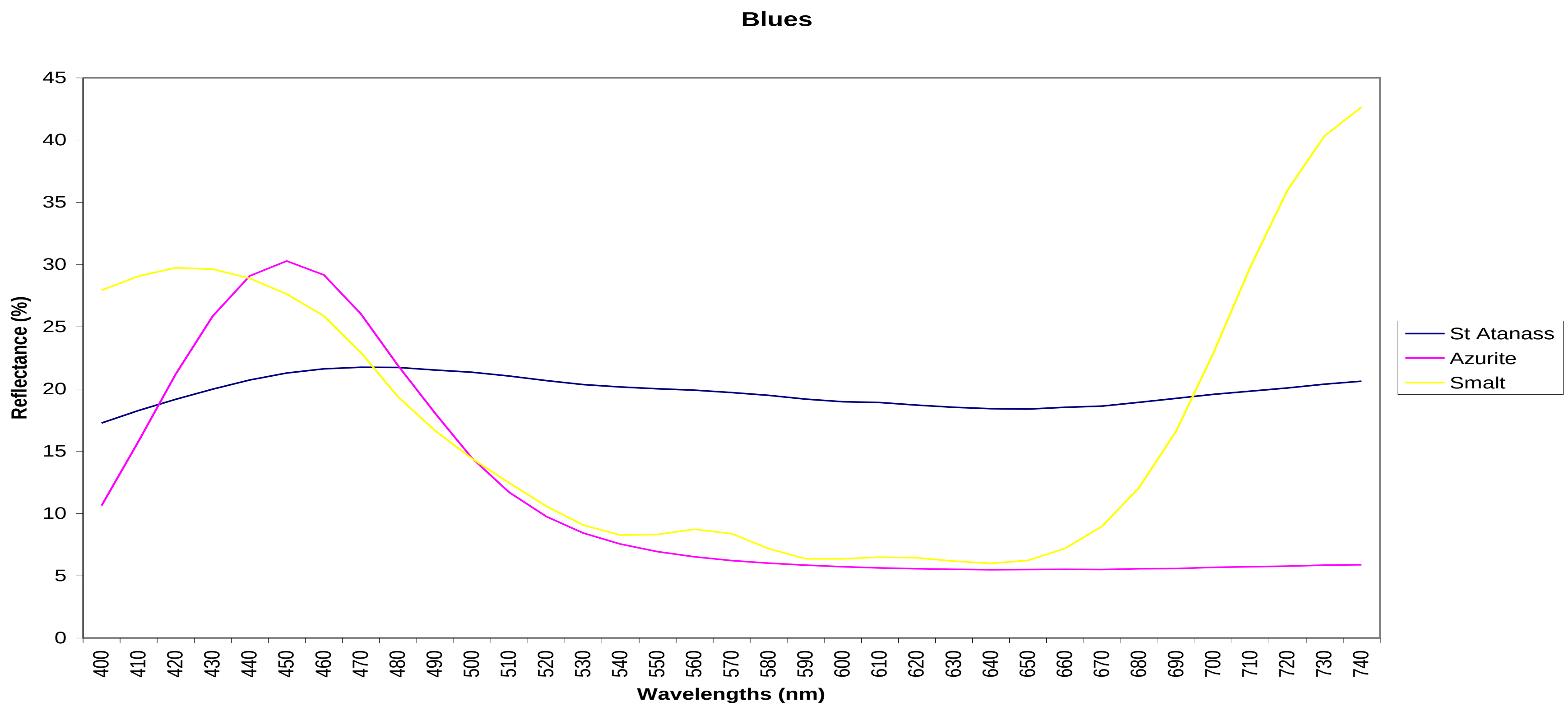

Fig. 66: Representative reflectance curves of the blue in the nave of St Atanass and selected standard pigment samples.

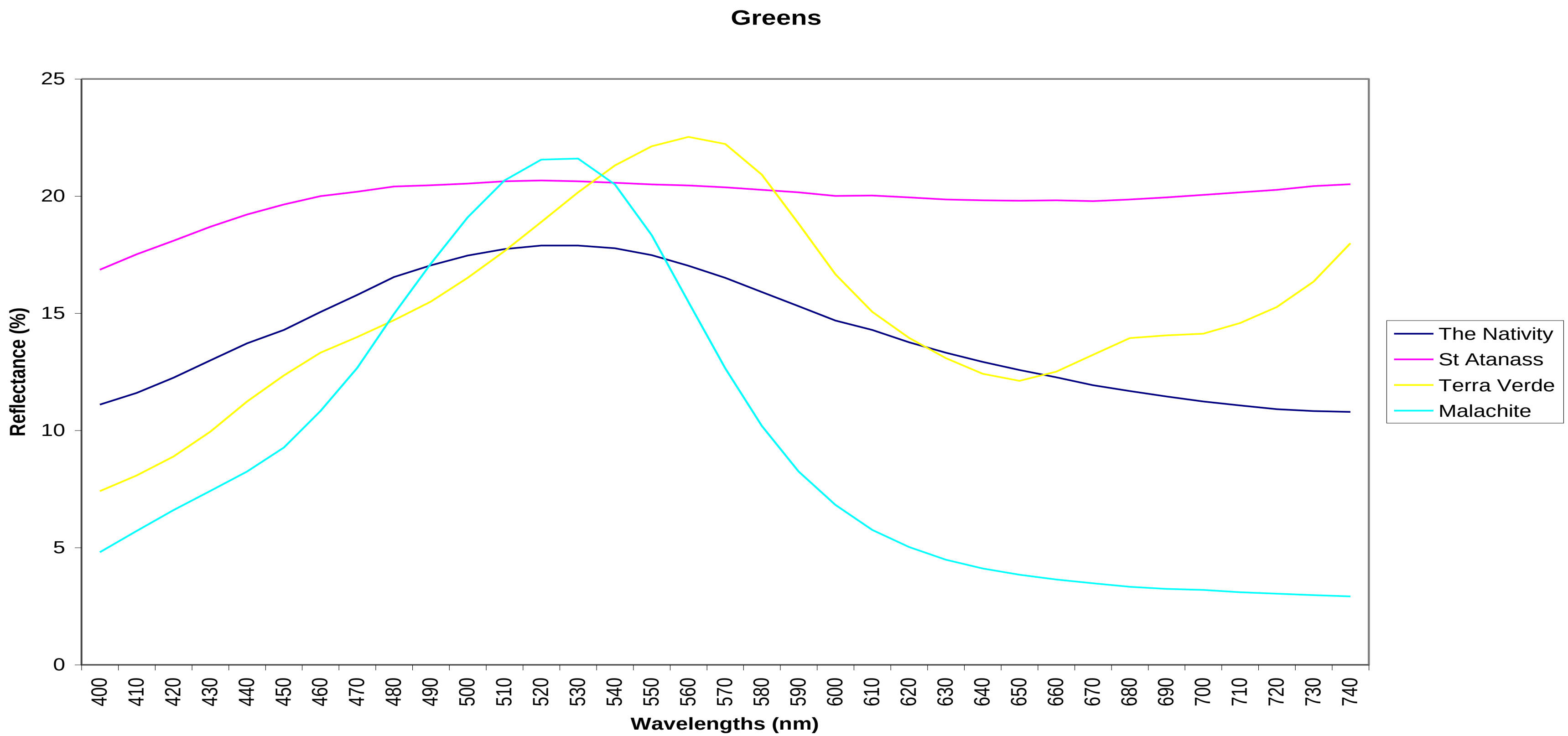

Fig. 67: Representative reflectance curves of the greens in the Church of the Nativity and the Church of St Atanass, together with those of *terre verte* and malachite.

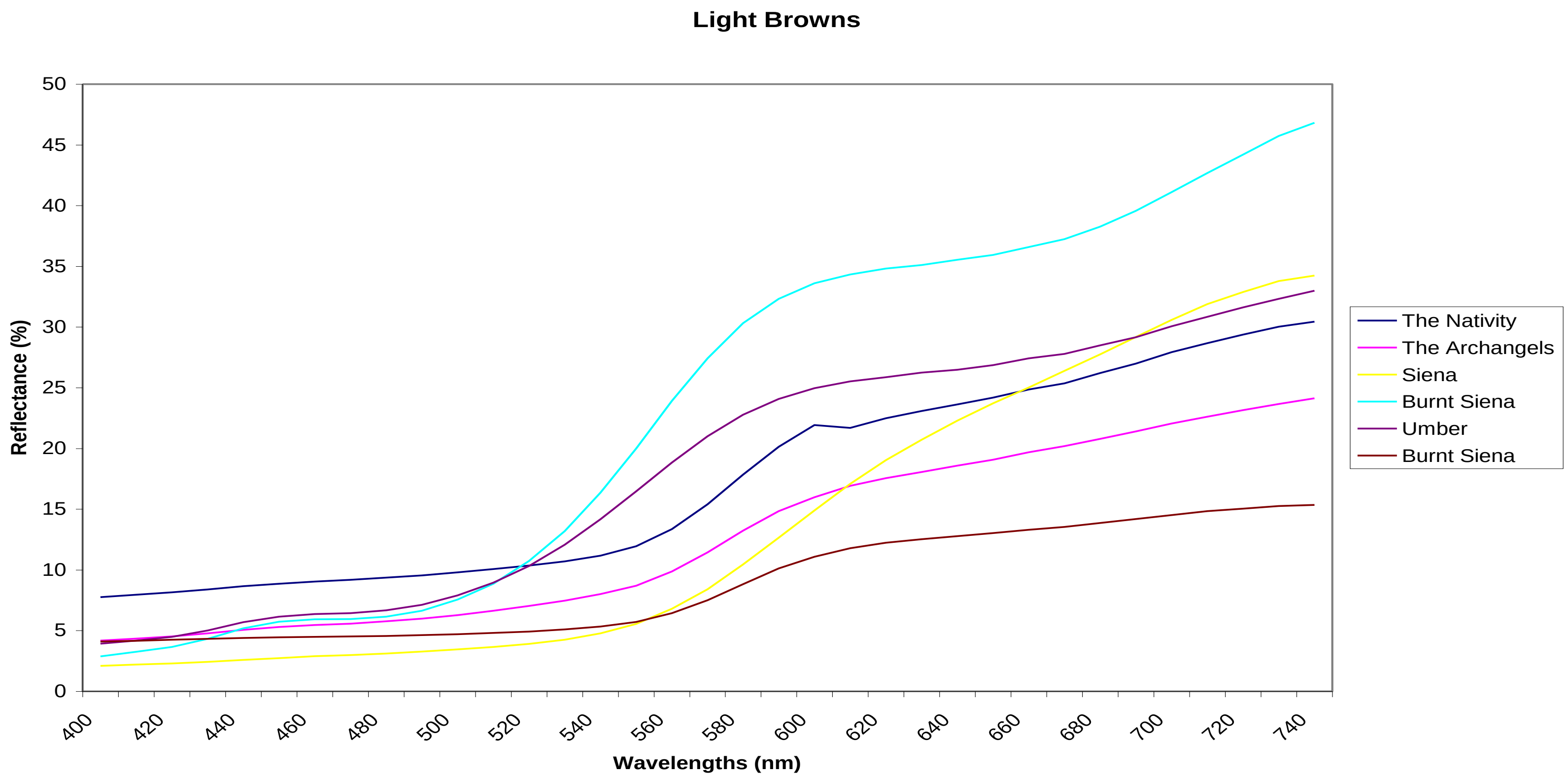

Fig. 68: Representative reflectance curves of the light browns in the churches of the Nativity and of the Archangels and selected standard pigment samples.

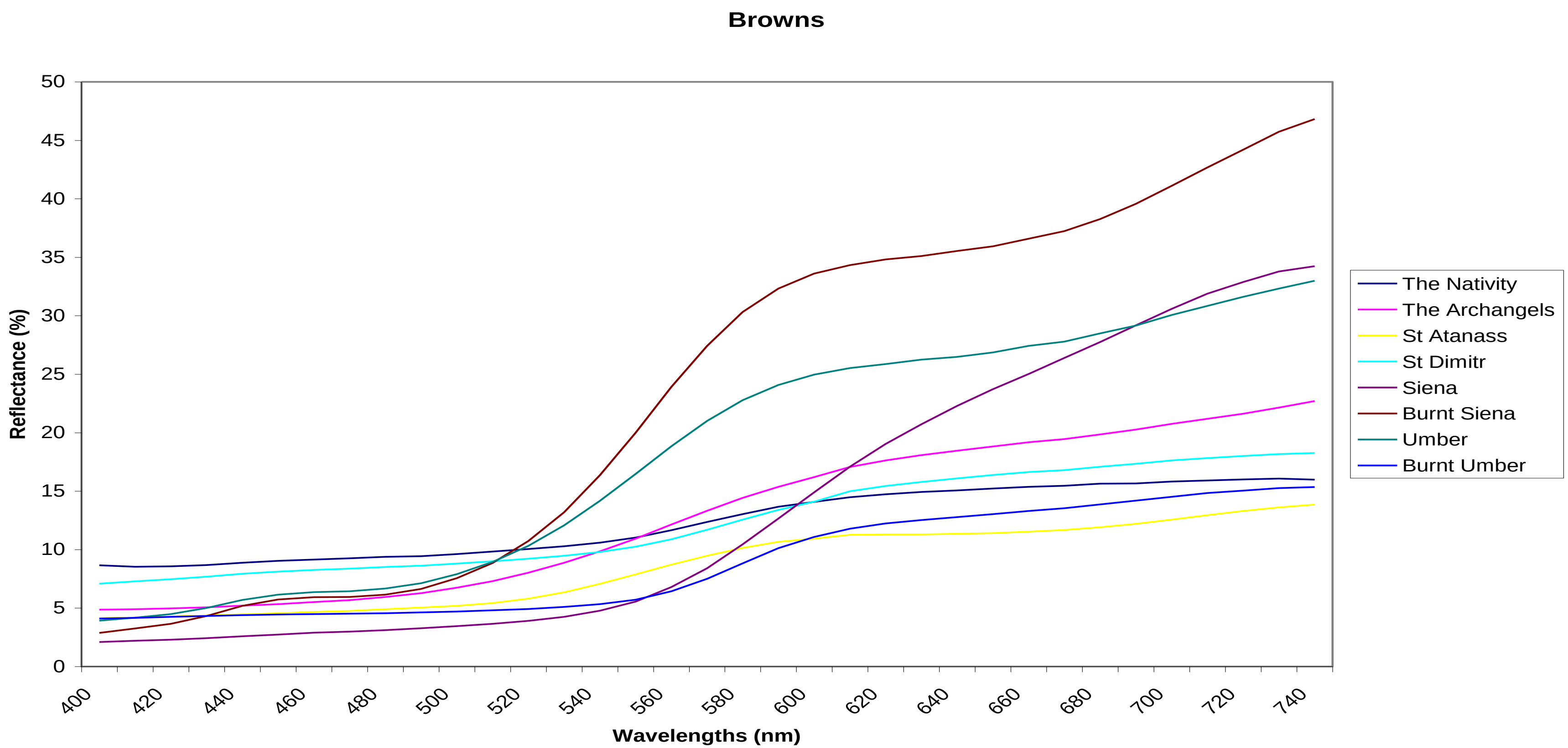

Fig. 69: Representative reflectance curves of the other browns in the four churches and selected standard pigment samples. All curves have their dominant wavelength band starting in the red-orange part of the visible spectrum, between 585 nm and 600 nm.

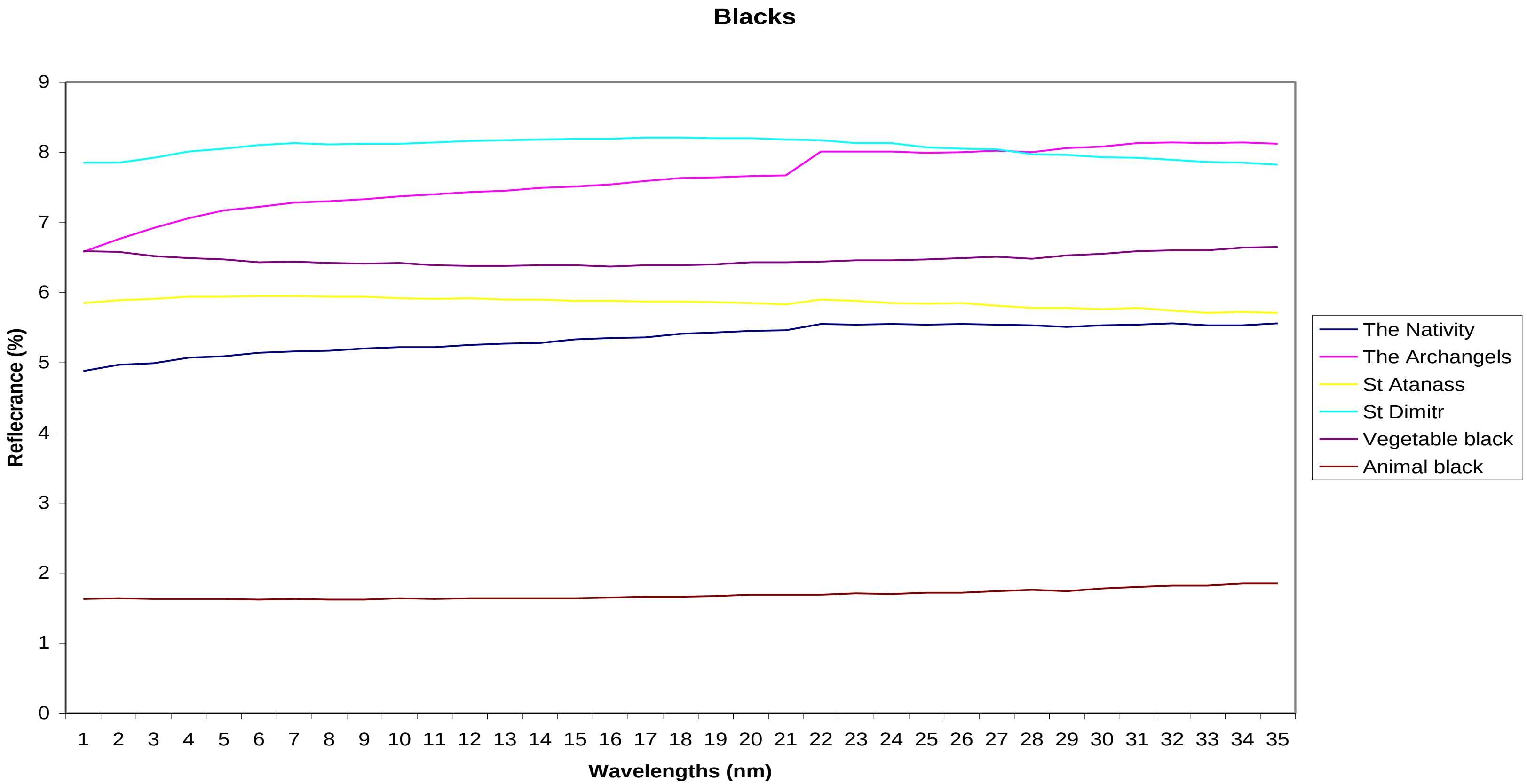

Fig. 70: Representative reflectance curves of the blacks in the four churches and selected standard pigment samples.

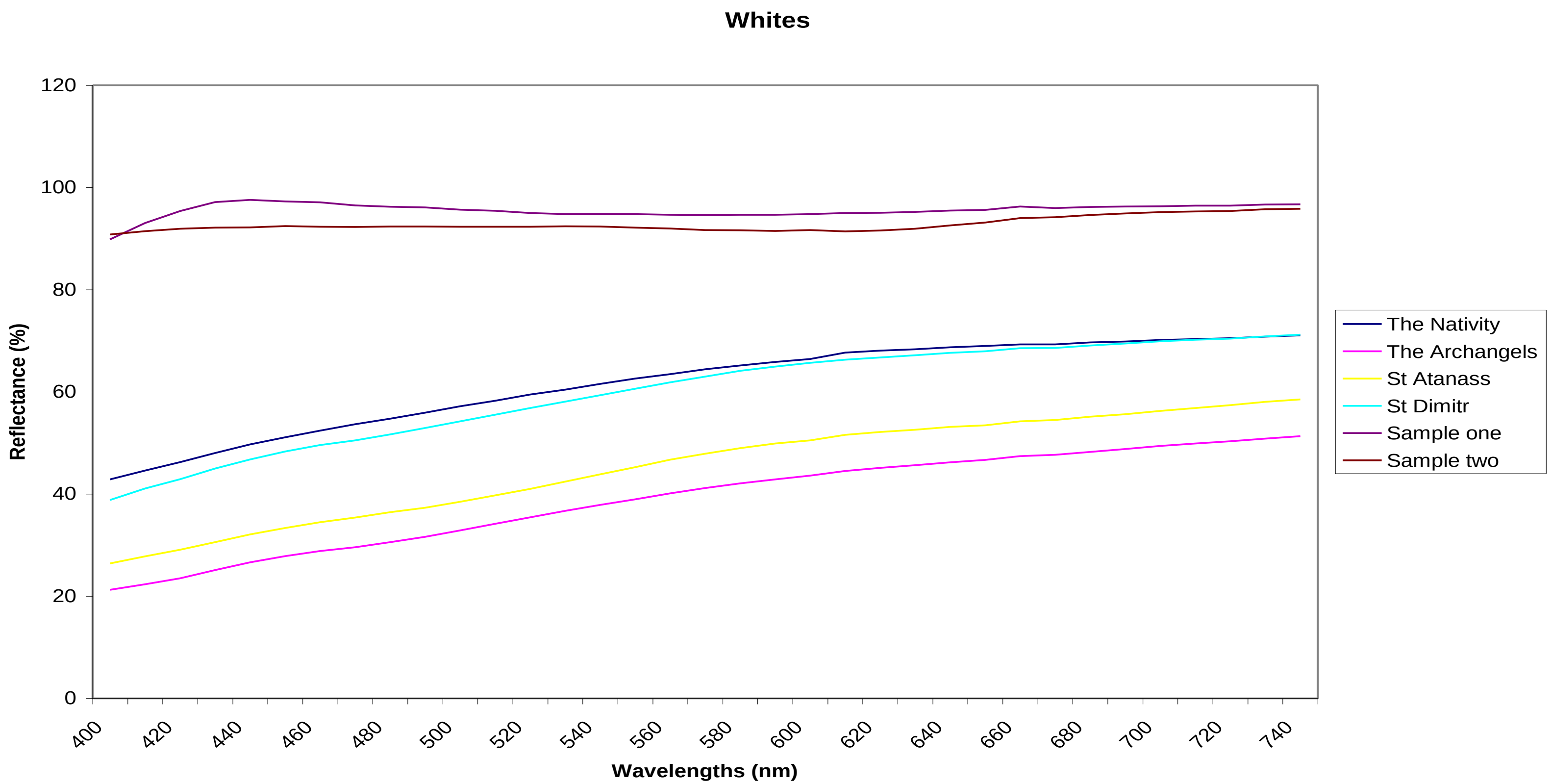

Fig. 71: Representative reflectance curves of the whites in the four churches together with the reflectance of two samples of calcium carbonate.

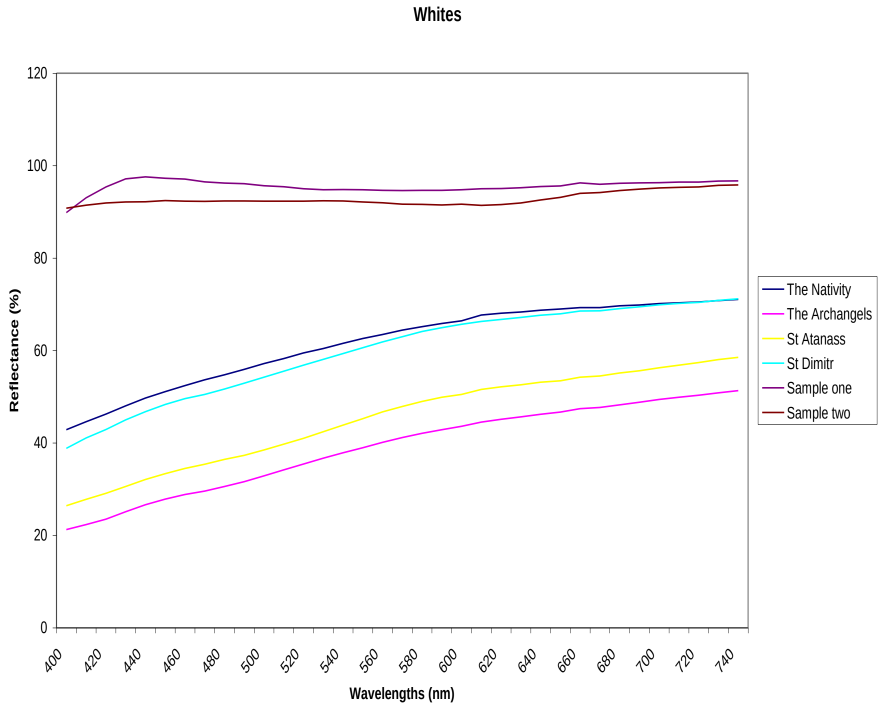

Fig. 72: Representative reflectance curves of the whites in the four churches together with the reflectance curves of two samples of calcium carbonate.

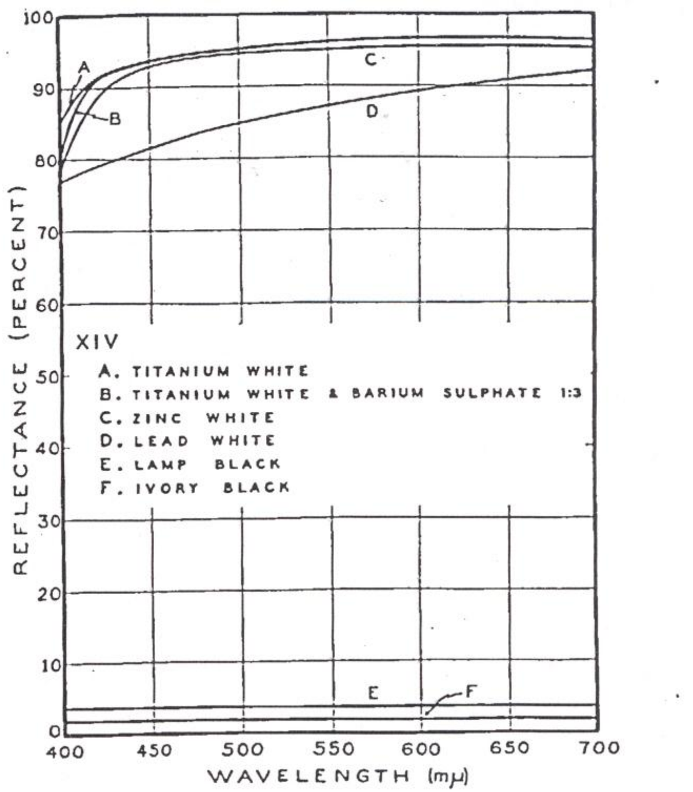

Fig. 73: Representative reflectance curves of the white and black pigments after N. F. Barnes (Barnes, *Technical Studies in the Field of the Fine Arts*, Vol. 7 (1938).