Agnieszka Helman-Ważny

Introduction

The present research aims to recover the little-known history of the production and usage of a collection of *tsakali* (ritual cards) belonging to a Tibetan spiritual system called Zhangzhung Nyengyü (the 'Aural Transmission from Zhangzhung'), including the cards' provenance, dating, and the specific techniques and technologies used in producing them. Further, we may also uncover what such a personal ritual object might tell us about the student–master relationship, teaching method and the people to whom this set belonged. In this way, our 'complete history' of these cards takes the form of a holistic research approach placing the material object at its centre, exploring the creative process from idea to artefact and connecting the object with the rituals and people who used it.

The book consists of an introduction, ten short chapters, an epilogue, and a handlist with an image catalogue presenting the recto and verso sides of the *tsakali*, as well as transcriptions and translations of their inscriptions and selected material features, such as paper and colourants. Each chapter presents the results obtained by particular disciplines and methodologies individually and independently of each other. The methods used are briefly described and the preliminary results of each study are presented and discussed; our complete history of the Zhangzhung Nyengyü *tsakali*, founded on the basis of these investigations, is presented in the epilogue.

Tsakali (*tsa ka li*) collections are among the main material objects used in Tibetan ritual, but they are not very widely known due to their specialised and private use. Whenever they feature in collections, it is always the rarity of this type of object that is emphasised. Further, their dating is often unclear, especially since such collections are usually composed of a number of other items resembling each other in form, though not necessarily produced at the same time, and used in different configurations. The most common questions that arise whenever a new set is presented are the following: to which tradition does the set belong? Where and when was it produced? Were all the cards manufactured at the same time? What can they tell us about the ritual expert or spiritual teacher who owed them?

Due to the complexity of this type of object, these seemingly basic questions are not at all easy to answer. This is why, when Charles Ramble offered to make his collection of *tsakali* available for material analysis, I willingly accepted the challenge. I was especially interested in carrying out the investigation as there were no previous systematic studies of such objects, nor any cross-disciplinary

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investigations of the materials these objects are made of. Furthermore, it was immediately possible to see that the set, composed of sixty-five Tibetan illuminated cards, was a rare fine-art piece, in addition to having obvious cultural value as a ritual object belonging to the Tibetan tradition.

At the material level, the *tsakali* consist of various elements – such as written text and images – produced with different materials: paper, ink and paint, with all of their basic components and intrinsic qualities. Depending on the magnification used to look at the object and its components, different areas of expertise and equipment are required to study them. Exploring the material composition of the object may provide important information about its production process, provenance, and use and reuse. For example, in the *tsakali* set examined here, the text consists of names written with red ink on the recto sides of the cards, inscriptions written in black ink on the verso sides, and numbers added later in blue ink. The images feature figures or ritual paraphernalia enclosed in frames on the recto sides of all cards. Further material components include pigments mixed with binding media (paints) and the techniques applied to the paint, as well as the iconography and style of the illuminations. The paper used as a support for the images and writing is made of various raw materials, such as plant fibres, glue and possibly other substances that may not always be detectable by scientific analysis. To understand the materiality of the object under study, besides these materials, we also need to consider the technology used in the production process. A complex programme of investigation was developed in order to address the complexity of this object.

The study presented here is based on a cross-disciplinary investigation conducted by the members and collaborators of the Cluster of Excellence 'Understanding Written Artefacts'. This investigation combines methods adapted and developed from a range of both science and humanities-oriented disciplines, driven by the idiosyncratic character of this particular object and its Tibetan context. Besides codicological, historical, anthropological and art-historical considerations, the framework of this study includes the pattern analysis of digitised images, as well as the application of advanced material-analysis techniques in order to analyse various physical and chemical aspects of this handwritten ritual artefact.

Our study starts with a general presentation of the *tsakali* set in the context of its social history, artistic and cultural affiliation. *Tsakali* such as these are widely used in the rituals of both Bon and Tibetan Buddhism. They are usually produced as thematic sets whose number of cards may range from one to several hundred, and they are very difficult to understand outside of their ritual context. Thus, in Chapter 1, '*Tsakali* Illuminated Cards: Physical Description, Function and Context', by Charles Ramble, Christian Luczanits and myself, the Zhangzhung Nyengyü

tsakali set is presented as a physical written artefact based on a first visual assessment, undertaken with the naked eye and simple optical tools that can easily be used in the reading room of any library. The chapter provides basic catalogue and codicological information, such as size, form and condition; the type of language, script, illustrations and textual content; and initial macroscopic observations on the materials and technological features, retrieved by Dino-Lite digital microscope or with the naked eye. A handlist of the *tsakali* with the transliterated and translated text of the inscriptions, as well as further information on the materiality of the cards, is included in the appendix at the end of the volume.

There are many ways in which manuscripts can be studied. Usually, the approach depends on the educational background of the researcher in question and the discipline she or he represents. This means different approaches are followed, with different methods and tools used depending on the angle from which the research is undertaken. Traditionally, however, Tibetan material objects have been studied by scholars of the Tibetan language, who had the skills to understand the Tibetan text written on the object as well as its contextualised meaning. This is why we have started our investigation with the inscriptions on the cards and the historical context of the collection.

In Chapter 2, 'The Teachings of the Dzogchen Zhangzhung Nyengyü System and Their Transmission', Charles Ramble explains the meditative system known as the Dzogchen Zhangzhung Nyengyü, the 'Oral Transmission of the Great Perfection from Zhangzhung', to which our set of *tsakali* belong. It is principally members of the Zhangzhung Nyengyü transmission lineage who are depicted on the cards. Following a presentation of the main principles of the Dzogchen Zhangzhung Nyengyü system, this chapter offers brief accounts of the lives of the lineage members who are depicted on the *tsakali*.

The focus on the text in this study, though obvious, is only the starting point. The *tsakali* set is in fact both a written artefact as well as an object of art, as it contains extensive painting on the recto side of each card. Moreover, painting is a major element of this special ritual object. In addition to being examined by a specialist of Tibet, such an object should therefore be examined by a specialist trained in both Tibetan studies and art history.

In Chapter 3, 'Art-historical Analysis of the *Tsakali* Collection', Christian Luczanits discusses the set from an art-historical perspective, considering the derivation of its style and the basis of its iconography compared with those of portable paintings and murals from across the Himalayas. Besides the actual date of the set and its different parts, its potential place of manufacture is also assessed. This discussion is crucial to understand the complexity of such objects. At first glance, the set appears largely consistent and painted in a style most com-

monly associated with the fourteenth century. Luczanits also shows that when one looks at specific details, certain elements of the figures – such as the lower garment of the Buddha's dress – may indicate a somewhat later date. Issues of dating are also discussed in Chapter 2 and Chapter 10.

Tibetan written artefacts become objects of scientific examination when they eventually find their way into museum collections, and it is only in recent decades (for example, following the development of preservation as a scholarly discipline) that Tibetan written artefacts have been studied as both material and textual objects. The materiality of these objects, together with the technologies behind their production, have received greater attention in recent times due to growing interest in the cultural production and indigenous knowledge preserved within Himalayan communities.

When discussing the materiality of Tibetan written artefacts, one should be aware that they represent a topic that requires an interdisciplinary approach and precise definitions for the concepts and elements of the Tibetan cultural realm. Such a cross-disciplinary approach has been promoted in recent decades by the Cluster of Excellence 'Understanding Written Artefacts' (UWA) at the Centre for the Study of Manuscript Cultures (CSMC), which aims to investigate the rich diversity of global manuscript cultures in terms of their material objects. One of the most useful non-destructive methods of research applicable to the study of written artefacts is multispectral imaging (MSI), discussed in Chapter 4, 'Multispectral Imaging (MSI) and Statistical Image Processing to Analyse Pigment Distribution and Diverse Material Features', by Kyle Ann Huskin and Ivan Shevchuk.

The authors report on the use of this non-destructive and non-invasive method, which is the most advanced approach for recovering erased, palimpsested or otherwise obscured text. The technique can also easily facilitate many different avenues of research, and here it has been applied to the *tsakali* with this goal in mind. MSI produces a diverse set of images with a decent spectral resolution and very good spatial resolution. Statistical processing of the reflectance and fluorescence images produced a kind of pigment map, for instance, which guided subsequent material analysis using XRF and Raman spectroscopy. The transmissive images revealed the substrate's fibre structure, revealing anomalies to be explored with paper analysis techniques. MSI also produces high-resolution, true-colour images that fulfil all the typical needs of archival digitisation; these images served as the basis for the handwriting style and pattern recognition analysis discussed in Chapter 5, 'Analysing the Visual Patterns of the Zhangzhung Nyengyü *Tsakali* Collection Using Machine-Learning Approaches', by Hussein Mohammed and Agnieszka Helman-Ważny.

The collection was given to Charles Ramble by Lopön Tenzin Namdak Rinpoche, a Tibetan religious leader and teacher of the Bon tradition. The sixty-five cards were originally a part of a larger set or sets that were concealed during the Cultural Revolution in China, when many monastic libraries were destroyed and many books burned. Tenzin Namdak Rinpoche believed that the collection might have been produced in Dolpo, but he was uncertain about this. The collection was not dated, and no other provenance information was provided apart from the accounts of the lineage members who are depicted in the *tsakali*, discussed in Chapter 2. The remaining cards, representing the lineage masters of the two other main Dzogchen systems of the Bon religion, are now preserved in the Triten Norbutse Monastery in Kathmandu, Nepal. When Khenchen Tenpa Yungdrung Rinpoche, the abbot of the Triten Norbutse Monastery, was asked whether the sixty-five *tsakali* formed a set of their own and whether this set differed from others, he answered that they all belonged to the Bon Dzogchen tradition, and that they were all of the same quality, materials, style of painting, purpose and even dimensions. This would mean that the full set may contain a couple of hundred cards, from which sixty-five were selected to offer to Charles Ramble due to his particular interest in the Zhangzhung Nyengyü system. Thus, this study may in the future be expanded to cover the remaining collection in Kathmandu.

Keeping in mind that the full set is much larger than the sixty-five cards examined here, several visual pattern analysis and computer vision methods have been applied to the digital images of this collection. This investigation demonstrates the potential of these machine-learning approaches and their applicability to manuscript research. Furthermore, the results of these computational methods can be used as supporting information in the decision-making process for several research areas, such as paper analysis, art-historical research, identification of scribes, and others.

In Chapter 6, 'Multiscale Microscopic Analysis of the Paper and Fibres of the *Tsakali*', Agnieszka Helman-Ważny discusses the results obtained by the use of both digital and optical microscopy to study the raw materials composing the paper of the *tsakali*. Fibre analysis tells us what the *tsakali* paper is made of, since the primary feature of paper is the type of raw material used in its production. The ability to distinguish separate plant species in paper fibre is why fibre analysis, if and when applicable, is helpful in locating regional origin and sometimes in dating, especially when using a comparative study that entails overlapping typologies. Other aims were to learn about the relationship between the raw materials and the properties of the resultant paper, and to deduce the origins of the paper by comparing the fibre identification results with local occurrences of the same plant. At the methodological level, this study also discusses the possibilities and

limitations of different types of microscopes in the characterisation of the fibres and other components of the paper, as well as the potential contribution of such research to the provenance study.

In Chapter 7, 'The Application of Small- and Wide-angle X-ray Scattering to the Study of the Paper Support and Pigment Distribution', by Sylvio Haas and Agnieszka Helman-Ważny, discusses how information about the local nano-structure can be obtained from X-ray scattering signals. The focus of this study was to develop a protocol to identify the resemblances in the paper composition of each card. At the same time, the characterisation of the *tsakali* paper contributed to the development of an innovative experimental X-ray scattering-based approach to complement current analytical methods of antique paper identification and raw material characterisation.

Chapter 8, 'Analysis of Paper Components with FTIR (DRIFTS) Spectroscopy', by Claudia Colini, Lucas F. Voges and Stephan Seifert, discusses the application of Fourier transform infrared spectroscopy (FTIR), independently of microscopy, to study the *tsakali* paper components, especially for the identification of fillers, sizing agents and degradation processes. Previously, it has also been used for fibre identification, although the presence of different sizes and of multiple types of fibres in the same object might compromise the results. This method is based on the excitation of chemical bonds in a molecule by IR light with characteristic frequencies, resulting in specific types of molecular vibrations. These vibrations are detected and recorded in spectra: the position and intensity of the peaks provide information about the chemical composition and crystalline structure or geometry of the molecule. Comparing reference spectra to those of unknown substances proved extremely effective for their identification. Furthermore, chemometric approaches like principal component analysis (PCA) will be applied to fingerprinting. PCA generates new variables (principal components) that represent the main variances of the spectra and, hence, can be used to analyse the similarities and differences between them.

In Chapter 9, 'Multi-instrumental Analysis of Pigments and Dyes', Sebastian Bosch, Olivier Bonnerot and Sowmeya Sathiyamani report on various instrumental analyses applied to study a wide range of different colourants found in the *tsakali*. These are paints based on mineral pigments, dyes derived from plants, or mixtures of these. A map of pigments from the multispectral data prepared by Ivan Shevchuk and Kyle Ann Huskin is used as a starting point for further non-invasive analysis with XRF, VIS and Raman, as discussed here. The XRF measurements taken from four different panels of the manuscripts are compared with a view to identifying these colourants.

In Chapter 10, 'Radiocarbon Dating of *Tsakali* Paper', Tomasz Goslar and Agnieszka Helman-Ważny discusses the possibilities and limitations of radiocarbon AMS dating methods for the *tsakali* collection. It offers a good reference point, as its method is independent of all other methods.

Differences between the approaches of the humanities, hard sciences and computational sciences, apart from the different methods and expertise involved, also emerge from the scale at which the object is approached. On the macro scale, it is mainly content, such as text and illustrations, that is studied, or codicological features such as layout, format and materials at the general level. To access more detailed information, one needs to look at the object on a micro scale in order to study its materials. This requires all kinds of microscopy, from a standard optical microscope to large X-ray facilities such as synchrotron. Scale level is crucial, as we can identify different features at different magnifications. For example, with the digital Dino-Lite microscope, we can observe the texture of paper, techniques of painting and writing, order of layers, and sometimes some other features of the surface.

More humanities-related approaches, by contrast, usually consider the object under study as a single unit. For example, translations, transcriptions and other text analyses are done in the context of the whole object that needs to be read. When considering material analyses, techniques like digital microscopy make it possible to study the whole object, even though observations are necessarily limited to smaller selected areas due to the length of time required for such observations or the costs associated with the use of high-performance lab equipment. Producing large amounts of repetitive data, for example from microscopic observations, is not always necessary to conclude analyses with successful identifications of specific materials. This is why every study usually starts with the most representative parts or points of the object. In our study, depending on the specific research questions, we first discuss the possibilities and limitations of every method before developing the protocol that was later applied rigorously to the selected *tsakali*. Table 1 below presents a list of all the *tsakali* and the methods used to study them.

An important question that should be raised here concerns the extent of the research that has to be planned to be representative of an object or a collection. In the present case, our object is the set composed of sixty-five different cards. If we were to perform material analyses on each individual card, many years would be required to complete the study. While the examination of each card is necessary for macroscopic observations, it would be impossible for other procedures, for example synchrotron-related techniques, and other sophisticated methodologies that would require a far greater investment of time and resources. The limitations also come from the assessment of whether it is possible to sample the object for material analysis.

Table 1: Selection of *tsakali* for study by particular methods.

Original *tsakali* no. and name	Inscription (see Ch. 2)	Paper technology (see Ch. 1)	Paper fibre analysis (see Ch. 6)	Art history (see Ch. 3)	MSI (see Ch. 4)	Pattern and line detection (see Ch. 5)	X-ray scattering (see Ch. 7)	FTIR (DRIFTS) spectroscopy (see Ch. 8)	Multi-instrumental (see Ch. 9)	^{14}C (see Ch. 10)
0 Bum pa (vase)	×	×	×	×	×	×	×			×
1 Ye nyid kyis ston pa	×	×	×	×	×	×	×		×	
2 Thug[s] [b]rtse'i ston pa	×	×	×	×	×	×	×			
3 Cir yang sprul pa'i ston pa	×	×	×		×	×	×	×	×	
4 Tshad med 'od ldan	×	×	×	×	×	×				
5 Yab 'Phrul gshen snang ldan	×	×	×		×	×				
6 rGyud khungs kyi ston pa	×	×	×		×	×	×			
7 Yum Zang za rig btsun	×	×	×		×	×		×		
8 Sras 'Chi med gtsug phud	×	×	×		×	×	×	×		
9 gShen gSang ba 'dus pa	×	×			×	×				
11 Klu bon Pha nam skyol po	×	×		×	×	×				
12 Mi bon Khri lde zam bu	×	×		×	×	×	×			
13 Zhang zhung Nam skyol po	×	×			×	×				
14 Sras khri shod rgyal ba	×	×			×	×				
15 Ra sang bsam grub	×	×			×	×				
16 Sras Dar ma shes rab	×	×		×	×	×				
17 Sras Dar ma Po de la	×	×			×	×				
18 Zhang zhung khri 'phan la	×	×			×	×				
19 Mu ye lha rgyung	×	×			×	×		×		
20 rMa gshen leg[s] bzang	×	×			×	×				
21 Sras sTag la	×	×			×	×				
22 Ra sangs g.yung drung	×	×			×	×				
23 De sras g.Yung 'phan	×	×			×	×	×	×		
24 dGe 'bar don grub	×	×			×	×				
25 De sras dGe 'phan	×	×			×	×	×	×	×	
26 De sras dGe' rgyas	×	×			×	×				
27 Zhang zhung rNam rgyal	×	×			×	×				
28 Mu rgyung dkar po	×	×			×	×				
29 Hor ti chen po	×	×			×	×				
30 Don grub pa	×	×			×	×				
31 Ra sangs 'phan rgyal	×	×			×	×				
32 Ku [Gu] rib gsas rga	×	×		×	×	×				

Original *tsakali* no. and name	Inscription (see Ch. 2)	Paper technology (see Ch. 1)	Paper fibre analysis (see Ch. 6)	Art history (see Ch. 3)	MSI (see Ch. 4)	Pattern and line detection (see Ch. 5)	X-ray scattering (see Ch. 7)	FTIR (DRIFTS) spectroscopy (see Ch. 8)	Multi-instrumental (see Ch. 9)	^{14}C (see Ch. 10)
33 Zla ba rgyal mtshan	×	×			×	×				
34 Ta pi hri tsa	×	×			×	×				
35 sNang bzher lod po	×	×			×	×				
36 rGyal gzigs gsas chung	×	×			×	×				
37 dMu' gshen tso ge	×	×			×	×				
38 dMu gshen tso stang	×	×			×	×				
39 Sho gram chen po	×	×			×	×				
40 rGyal ba blo gros	×	×			×	×				
42 Gu ge blo ldan	×	×		×	×	×				
43 Pu rang kun dga'	×	×			×	×				
44 rNal 'byor gsas mchog	×	×			×	×				
45 Khyung 'byid mu thur	×	×			×	×				
46 bDe ba ring mo	×	×			×	×				
47 rTog med zhig po	×	×			×	×				
48 lHun grub mu thur	×	×			×	×				
49 gShen rgyal	×	×			×	×		×		
50 rNgos grub rgyal mtshan	×	×			×	×				
51 Bla ma kun 'dul	×	×			×	×		×		
52 Yang ston chen po	×	×			×	×				
53 Dam pa 'bum rje	×	×			×	×				
54 bKra shis rgyal mtshan	×	×			×	×				
55 Ye shes rgyal mtshan	×	×			×	×		×		
56 rGyal mtshan rin chen	×	×			×	×				
57 Ngang pa shes rab	×	×			×	×				
58 Bla ma rgyal mtshan	×	×			×	×				
A Zhing lnga gtso' bo	×	×	×	×	×	×	×		×	
B gSang ba 'dus pa	×	×	×	×	×	×	×	×		
C lCe rgyal bar ti	×	×	×		×	×		×		
D gSang ba ngang ring	×	×	×		×	×	×	×	×	×
E Mu cho ldem drug	×	×	×		×	×		×		
F Ti sang rang bzhin	×	×	×		×	×		×		
G Chag med ye shes g.yung drung	×	×	×	×	×	×		×		
H rKo'o Ye shes rgyal mtshan	×	×	×	×	×	×		×		