ISLAMIC PAPER

A Study of the Ancient Craft

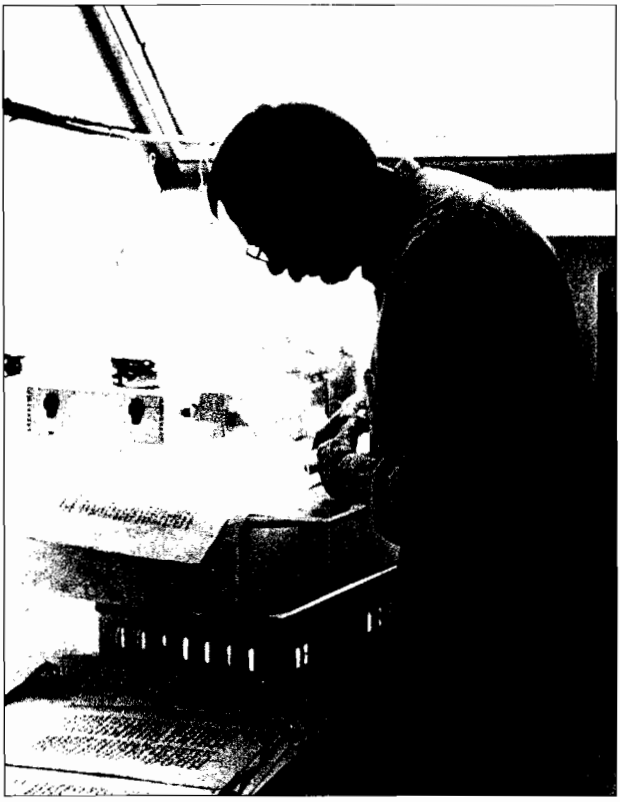
Helen Loveday

ISLAMIC PAPER

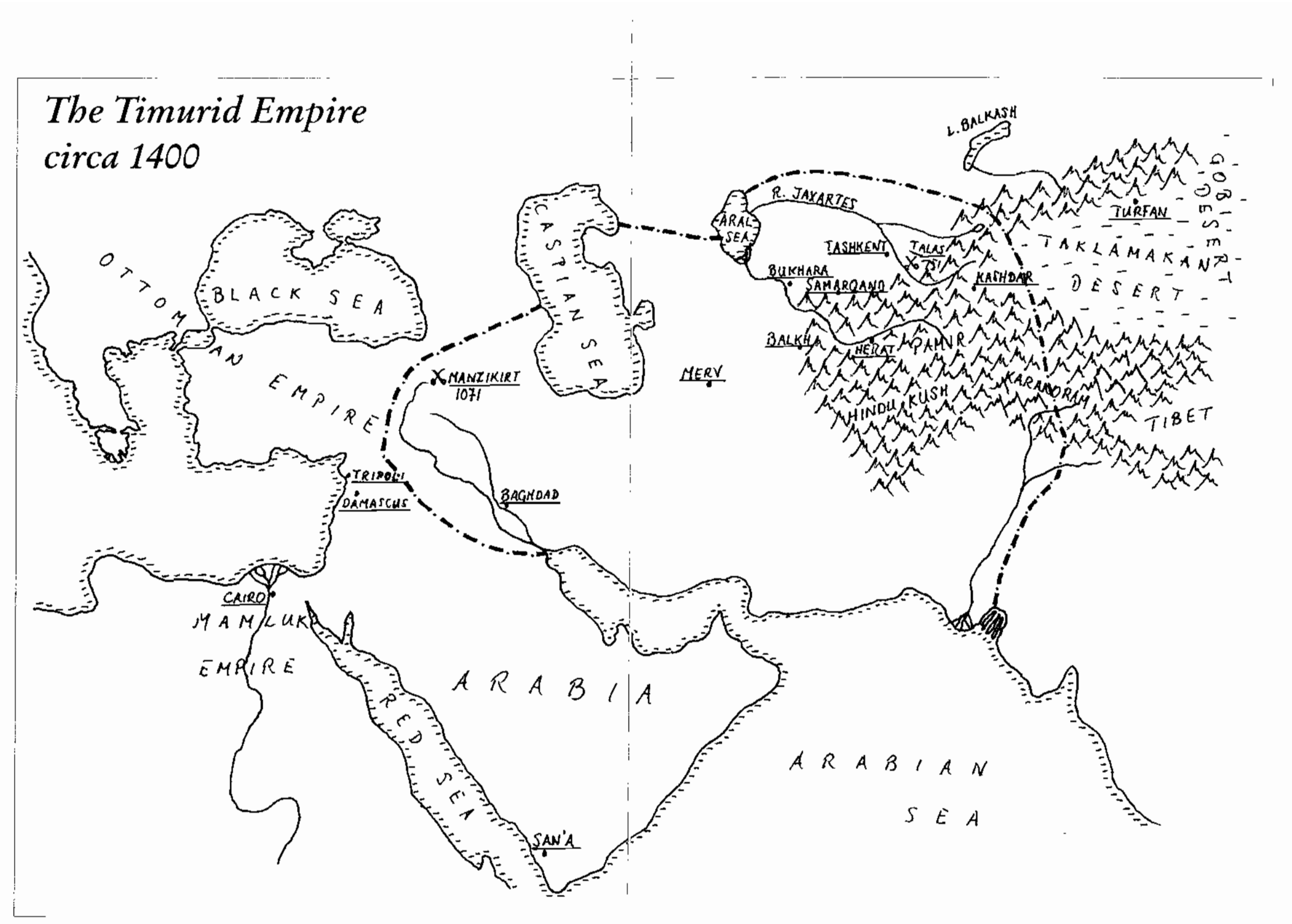
A Study of the Ancient Craft

Helen Loveday

This book is dedicated to the memory of
Don Baker (1932–1994)



The administrators of *The Don Baker Memorial Fund* would like to thank all Don's many friends and colleagues whose kind donations enabled the Fund to undertake a number of projects related to the conservation of works of art on paper in Don Baker's name, including the publication of this book. We are particularly grateful to Sheikh Nasser al-Sabah, Dr Nasser D. Khalili, Hashem Khosrovani, Sotheby's (London), Caroline Carey-Binladen and David Sulzberger, without whose generous support this project would not have been possible.


The Timurid Empire
circa 1400
L. BALKASH
GOBI DESERT
TURFAN
R. JAXARTES
ARAL SEA
TASHKENT
TALAS
KASHGAR
TAKLAMAKAN DESERT
BUKHARA
SAMARQAND
BALKH
HERAT
PAMIR
KARAKORAM
HINDU KUSH
TIBET
CASPIAN SEA
MANZIKIRT
1071
MERV
OTTOMAN EMPIRE
BLACK SEA
TRIPOLI
DAMASCUS
BAGHDAD
CAIRO
MAMLUK EMPIRE
ARABIA
RED SEA
SAN'A
ARABIAN SEA

Contents

PART II: A SYSTEMATIC ANALYSIS OF PERSIAN AND SYRO-EGYPTIAN PAPER

Foreword

I first became aware of the historic importance of paper in the Islamic world when I was Curator of the Oriental Institute Museum at the University of Chicago, and discovered the Moritz collection of Islamic bookcovers in the basement. With the help of Gulnar Bosch and Guy Petherbridge, we used the covers as a nucleus for an exhibition, *Islamic Bindings and Bookmaking*, held in Chicago in 1981, with an accompanying catalogue and two-day symposium. The ancillary material in the exhibition included a fragment of a paper book which had been identified by Professor Nabia Abbott amongst a collection of Arabic papyri which the Oriental Institute had acquired in the 1940's. This tattered and discoloured sheet is in fact the oldest known of the *Alf Laylah wa Laylah* ('A Thousand and One Nights') story, and had been re-used by a legal scribe, one Ahmad ibn Mahfuz, to try out various phrases and, more importantly, the date AH 266 (AD 879–80) is repeated several times. The paper book must have been old by the time it was dismembered and re-used, therefore dating almost to the time of the Abbasid caliph Harun al-Rashid (*reg.* AD 786–809), who has long had a legendary association with the Arabian Nights. Indeed, it is an interesting coincidence that among the mixed materials acquired by the Oriental Institute from Moritz in 1921 was a 9th-century boundary marker from Egypt mentioning the caliph Harun al-Rashid. As for the stories themselves, there are references to them in the 10th century, but the oldest previously known manuscript dates to the 14th century and Nabia Abbott's discovery predates that by some 500 years. But this extraordinary find has particular importance on another, non-literary level. Not only is it the oldest known dated example of paper from the Islamic world, but – as the fold and sewing marks show – the oldest surviving specimen of a paper book. As

Helen Loveday demonstrates in the present work, it is one of the landmarks in the history of papermaking in the Islamic world.

Don Baker (1932–1994) was a pioneer in the field of Islamic paper, both as a scholar and as a conservator of Islamic manuscripts. To his credit is the care of manuscripts in many collections, including the al-Sabah Collection in Kuwait. He also established the conservation department at the King Faisal Centre for Research and Islamic Studies in Riyadh, where he both worked and trained staff. Besides his practical and innovative skills, he wrote a number of articles on papermaking in the Arab world. He was closely associated with Camberwell School of Art as a visiting lecturer and, as a Fellow of the Royal Asiatic Society, he served on its Library Committee.

Don Baker's fundamental approach to papermaking in the Islamic world was concerned with a classification of paper based on a number of characteristics that resulted from variations in techniques of manufacture. This system – described in detail below – was designed as a means to localise the different centres of production and to establish a chronology of papermaking techniques. Towards the end of his life he began to concentrate on Persian paper, and he had already classified over 80 examples when the project was cut short by his untimely death. Helen Loveday has extended the series to include over a thousand dated samples from all areas of the Islamic world. From the body of this material, she has produced 14 detailed summaries of the typical characteristics of Persian and Syro-Egyptian papers from the 12th to the beginning of the 19th centuries. In this, she has carried Don Baker's work a significant step further, and her efforts must surely encourage other scholars to extend and refine the series, using the methodology which Don Baker established. As he remarked, 'the scheme I use is not that of the paper technologist: its vocabulary sometimes derives from the kitchen rather than the laboratory', and it is his practical, craftsman's approach which makes such a valuable contribution to the field.

John Carswell

Author's Preface

It has been a great honour to write this book in memory of the late Don Baker. Prior to his untimely death on 4 December 1994, we had met on but a handful of occasions. We talked about paper – rather Don talked, and I was inspired. Soon after, I was invited by The Don Baker Memorial Fund to catalogue his extensive archive of articles and notes in order to identify any original research that could, in some form, be published in his honour. This I began to do in October 1995.

The inspiration for this book therefore rests with Don. During his career as a paper conservator, he handled a vast and varied array of manuscripts and works of art from the Islamic world, and was acutely aware of the differences that exist between papers produced at various times in different regions. Not satisfied with accepting the existence of such variation, Don questioned how papers differed, and what this could tell us about their provenance and their date. Was it possible, he asked, to establish a typology of paper characteristics, and to identify trends in the technique of papermaking across the Islamic world, through the examination of the paper itself?

In order to find answers to these questions, Don devised a system of paper analysis according to which sheets of paper could be classified and compared objectively. His methodology is exceptional in terms of its breadth and scope, and reflects the depth and sensitivity of his understanding of the material in all its forms. Few could have devised a more thoughtful and learned check-list against which a sheet of paper can be measured.

Tragically, Don died before he could realize the full potential of this method of analysis. Although it is obvious from his perceptive and discerning approach to the study of paper that he had examined hundreds, if not thou-

sands, of sheets by the time of his death, his computer database – a new acquisition – belied the extent of his research. In order to investigate his original hypothesis, it was necessary to add to Don's record of paper characteristics, thereby producing a statistically viable body of material with which to work. Using his methodology, this is what I have done. With an expanded database now listing over 1000 entries, I have drawn conclusions about the nature and characteristics of papers produced in Egypt, Syria and Persia from the 12th until the beginning of the 19th century, as detailed in this volume.

In order to be placed within a historical context, the research is prefaced with an overview of the development of papermaking in the Islamic world, information about which has been drawn largely from primary and secondary sources. The choice of material is my own, as is its interpretation; therefore the responsibility for any conclusions drawn about the character of Islamic paper necessarily rests with me. However, this book would not exist without Don's inspiration. The greatest tribute to any scholar is that his research should be continued. In doing this, I hope that I have not only respected the integrity of Don's original investigations, but provided a number of stepping stones for further exploration in this fascinating field.

So many people have given me their time, advice and support during the course of this research. All have unashamedly encouraged my incorrigible love of Islamic paper, and for this I would like to give my deepest and heartfelt gratitude. In particular, I would like to thank the following for their generosity and kindness in allowing me access to their holdings: in London, The Royal Asiatic Society; The Oriental and India Office Collections; Sotheby's; Christie's; The Nasser D. Khalili Collection of Islamic Art; and in Jerusalem, The Khalidi Library. I would also like to thank Barbara Macfarlane for her kindness in allowing me to use the photographs reproduced in figures 1, 2, 3 and 5, and to extend my gratitude to Michael Pollock, Marcus Fraser, Professor John Carswell, Dr Julian Raby, Tony Bish, Dr Lawrence Conrad, Raymond Mew, Nahla Nassar, Katie Marsh and Edmund Fogden.

Finally, and above all, I would like to thank my husband Graeme, for his unfailing and inestimable support, love and encouragement throughout.

Introduction

In a private collection in London, there is an Armenian manuscript of *The Epistles of St Paul* dated AD 1210. The codex is sewn on alum-tawed split thongs, retains its original binding, and is opened and read from left to right. The influence of Western binding techniques on its form is pronounced. However, it retains a foredge flap, a practice largely associated with Islamic manuscripts, and the paper used throughout was produced in Persia. To see a Christian text, with all its similarities to a Western codex, written on characteristically Islamic paper, is a potent reminder of the complexities and intricacies of the study of manuscript production in general, and the history of papermaking in particular.

Paper is a material that has penetrated into every corner of ancient and contemporary society. The commencement of a papermaking process in China in at least the 2nd century BC,[1] heralded the introduction of a new, readily accessible and cheap means of communication, by which the written word could become as familiar to the masses as it once had been the privilege of the literate elite. It facilitated the production of the codex in hitherto unprecedented quantities and, with the introduction of printing in the 15th century, encouraged the extensive transference of ideas and concepts from east to west, and from one generation to the next. The early history of paper spans a millennium and links the eastern coast of China with the European Atlantic seaboard. The spread of the craft across two continents has mirrored the ebb and flow of civilisation, and the study of its development in Persia and the Middle East is the study of the social, political and economic interactions of a vast and diverse region.

Unfortunately, compared with the codicological study of Latin, Greek and Hebrew manuscripts, the study of Islamic manuscripts is as yet still in its

infancy. Although few civilisations have afforded books the prominence they have enjoyed in Islam, there are few accounts of their manufacture in Arabic and Persian texts.[2] This lack of primary source material has lead to the circulation of a limited number of facts about the materials and techniques of Islamic papermaking, thereby restricting the scope of information in secondary source material. The history of the development of Islamic papermaking has, as a result, been open to misunderstanding and misinterpretation.

In order to increase our understanding of the history and spread of this ancient craft, reference must be made to the paper itself. Through the analysis of the impressions left by the papermaker's mould on the sheet as it was being made, and the examination of how the surface of the paper was treated subsequently, our knowledge about the many and varied materials and practices of the papermaker can be broadened considerably. The aim of this book is therefore to publish the results of research into the nature and characteristics of Islamic paper, as gleaned through the systematic analysis of dated samples, and to bring into focus much of what appears to be conjecture in accounts of its introduction and development.

This work is divided into two parts, corresponding to the aims referred to above. The first is devoted to an outline of the history and spread of papermaking by hand in the Islamic world, from its introduction into Persia in at least the middle of the 8th century AD, until its demise in the Middle East and Persia in the 19th, following the introduction of machinery to the industry.[3] Examination of the phenomenal impact and spread of the craft throughout these regions is linked to information about trade and commerce, and an analysis of the needs and requirements served by the new material. Reference is made to writing materials used prior to and after the advent of paper, and the role that they assumed in the development of the codex. Information extracted from written sources concerning the materials and techniques of the papermaker is interpreted according to the results of a systematic analysis of dated samples; this is supported by a technical understanding of the nature, behaviour and properties of paper gained from an active involvement in the profession of paper conservation.

The information included in this section is neither extensive nor exhaustive, and no attempt has been made to rewrite existing research into the history of Islamic paper as carried out by scholars such as Joseph von Karabacek[4] and Johannes Pedersen.[5] An effort has been made to select from these and other sources of information that which is of key significance for the study and understanding of the craft, with the aim of placing the present research into the nature and characteristics of Islamic paper in its historical

context. To attempt to describe paper without prior explanation of its nature, properties and manufacture, would be difficult and misleading. Although we rarely know precisely when change initially occurred, and as a result cannot chart the history of papermaking in terms of well defined and linear periods of time, we can often state that a particular change had occurred by a certain date.

The second part of this work is devoted to the systematic analysis of Islamic paper, and focuses on the examination of the nature and characteristics of Islamic paper as gleaned through the analysis of dated samples according to stated criteria. The aim here is to provide an insight into the history of Islamic papermaking through reference to the physical evidence provided by the material itself.

As was mentioned above, the method of analysis upon which the present research rests was devised by Don Baker, and involves the classification of paper according to a comprehensive list of objective standards. This system of classification was the result of a detailed, in-depth study of the nature and properties of Islamic paper, from which he had begun to establish a tentative typology of the characteristics of paper originating from Egypt, Syria and Persia. With only minor modification, I have employed this method of analysis for the subsequent examination of 1000 dated samples. Correlation of the results has shown that it is possible to describe paper according to objective standards, and assign an approximate date and place of manufacture to hitherto unclassified samples with some degree of certainty. Although it is extremely difficult to apply an exact chronology to any changes in the materials and techniques of the papermaker, trends in papermaking practice can be identified, and the characteristics of paper from a given century and country of origin can be suggested.[6]

Investigation has focused largely on the characteristics of Persian, Syrian and Egyptian papers. Until the 19th century, the Persian cultural and political sphere was considerably wider than the present national boundaries of Iran, and encompassed lands that are now part of Iraq, the former Soviet countries of Central Asia, Afghanistan and Persia (Iran) proper. Therefore the study of Persian paper, together with that of Syria and Egypt, is the study of the materials and technology of a vast region, and no attempt has been made at this stage to identify trends in papermaking practice that are specific to one city and its environs. Although classification of paper according to date and country has been possible from information contained in copyists' notes and colophons, relatively few manuscripts have contained details about the centre in which they were produced, and research has been restricted accordingly.

The scope of analysis lies between the beginning of the 12th century AD and the beginning of the 19th. The lower limit has been set by the scarcity of extant dated material from before the 12th century: although fragments of three dated documents have survived from the 9th century AD, and I have examined a small number of papers dating to the 10th and 11th centuries,[7] a handful of examples is insufficient to establish a secure typology. By the beginning of the 19th century, the use of imported and machine-made paper for book and manuscript production was widespread, and a traditional industry was all but extinct in the Islamic world.

1. For further details concerning the introduction of paper, see below, pp.17–18.
2. For an extensive and comprehensive bibliography, see Bosch, Carswell and Petherbridge 1981, pp.2–4.
3. See below, pp.25–27.
4. Karabacek 1887, trans. Baker and Dittmar 1991.
5. Pedersen, trans. French 1984.
6. See below, pp.81–87.
7. See below, pp.24–25.

CHAPTER ONE

Writing Materials Prior to the Advent of Paper

In the years prior to and immediately after the advent of Islam in AD 622, materials available for recording and transmitting the written word included parchment, papyrus, wood, bark, tree leaves (especially palm), flat stones, fragments of pottery and, according to traditional accounts, the shoulder-blades of camels.[1] Parchment and papyrus were used preferentially by scribes and scholars across the Islamic world, and are the only writing materials referred to in the Qur'an, and always in connection with it.[2] Although it is unlikely that either were employed for its initial transcription,[3] they may have been used in its first codified form, available in the reign of caliph 'Uthman (AD 644–656). Parchment is a highly durable material, and the vast majority of extant Qur'anic fragments from the first few centuries of Islam are on some form of treated skin. But though less hardy, papyrus was also popular. Its use as a writing material in the 7th and 8th centuries AD is attested by the recovery in Egypt of a large number of sheets dating from this time.[4]

In the course of their work, scribes and scholars necessarily resorted to materials which were close at hand or, as with Egyptian papyrus, endemic to the area in which they were working. This is of vital importance: no clear division exists between the use of parchment in one area at one time, and the use of papyrus in another area at another time. Materials produced and manufactured in one region could be exported and used elsewhere. Recourse was made to the readily available, affordable, and most suitable medium, and codices often comprised both paper and parchment. Parchment leaves were generally inserted at the beginning and end of the textblock, but on occasion alternated with leaves of paper throughout.[5] Similarly, scrolls could consist of a range of materials: papyrus was generally used for the main body of text, and a prelim-

inary sheet known as the protocol, which was used to wrap around the outside of the document, was made either of thicker papyrus or of parchment. The entire scroll might then be wrapped in parchment for additional protection.

Papyrus

Papyrus has a history of use as a writing material dating back to Ancient Egypt. It played a crucial role in the development of the ancient civilisation from approximately 3000 BC, and persisted as the primary writing material of the Roman Empire and the Hellenistic Near and Middle East. The papyrus plant (*Cyperus papyrus*) thrives on the banks of the River Nile, and papyrus naturally became the most important writing material for those living in Egypt at the time of the advent of Islam. With the spread of the new religion it became an article of everyday use by those writing Arabic, employed primarily for official correspondence, legal documents, ledgers, tax receipts and, less frequently, for literary purposes. Its manufacture remained virtually an Egyptian monopoly: reports of its production for use as a writing material outside of Egypt are scarce,[6] and only in Sicily do we hear of the plant being grown extensively, where Ibn Hawqal found it in large quantities in AD 972–3.[7]

In the production of a sheet of papyrus, the stem of the plant was cut into long thin strips which were placed vertically side by side on a smooth surface, overlapping slightly. A second layer was then superimposed at right angles to the lower layer, and the two were wetted and hammered together. According to Pliny the Elder, writing in the 1st century AD, mud from the water of the Nile, used to moisten the board on which the strips were placed, served as a binder for the sheet;[8] however, recent analysis has shown that hammering effected the release of a natural gummy substance contained in the cell sap of the papyrus pith, which itself promoted the adhesion of the individual strips.[9] When pressed and dried, the sheet was rubbed with a piece of ivory or a shell to create a smooth surface for writing and, finally, a mallet was used to flatten any remaining puckers, ridges or similar imperfections in the surface.[10] The resulting material was smooth, strong, flexible and light in tone – barely recognisable in the dark, brittle remains that have survived until today.[11]

This ancient method of preparing the plant for writing remained virtually unchanged after the Muslim conquest of Egypt in AD 640 when, from this time onwards, Arabic appeared on the sheets side by side with Greek and Coptic. In the Islamic world, as in the Classical, sheets of papyrus were produced in a variety of sizes and qualities. In width, sheets could range from 12.7 cm to 37 cm, and in height from 30 cm to 58 cm.[12] A fine papyrus was used for official deeds and documents, which was probably equivalent to the Roman

Augusta and *Liviana* – both extremely thin, high quality sheets. References in Arabic papyri to the use of papyrus for wrapping items such as jewels, medicine and garments, indicate that a poor quality sheet, equivalent to the Roman commercial papyrus, *charta emporitica*, was also available, although not suitable for use as a writing material. This would suggest that a sheet of medium quality was produced for everyday use.

It was usual for papyrus to be sold by the manufacturer in roll form, or in sections constituting one sixth of a roll, rather than as single sheets. One roll consisted of a number of sheets pasted together (20 according to Pliny, but sometimes as many as 70), one overlapping the other by approximately 2 cm.[13] Sections were known in Arabic as *ṭūmār*, from the Greek *tomarion*, and the length of segments of papyrus shorter than a 20-sheet roll were usually expressed as multiples or fractions of a *ṭūmār*. It is likely that the roll was the preferred form of distribution due to the fact that single papyrus leaves have a tendency to fray, particularly at their vertical edges: by joining them together, such that the right edge of one sheet covered the left edge of the following, damage to the sheets through handling was limited.

By the 4th century AD, the scroll was the standard form for documents and most other written material.[14] Papyrus was not only bought as a roll, but also used in this form by the scribe.[15] Joins in the roll were pasted in a consistent fashion so that it was possible to write smoothly across each overlap without encountering resistance. Its protected inside was always used in preference to the outer side, and if a sheet or section were cut from the roll for a document or letter, the side that was originally inside was written on first. Papyrus was a relatively expensive writing material, and in the 9th century AD a complete roll could cost as much as one and a half dinars; at that time one dinar was the annual rent of a *faddān* of arable land or of a shop.[16] Thus for economy, the verso of a sheet was often also used by scribes to continue the main text, or to include a completely different work within the scroll.

The success of papyrus as a writing material prior to the introduction of paper in the Islamic world should be viewed in terms of supply and demand. Across the Middle East, increasing scholarship and an expanding civil service created a need for a material that could be made in a range of thickness and qualities, and was easier to handle than available alternatives such as wood, skins and clay tablets. Papyrus not only met these requirements, and was suitable for use in both the scroll and early codex form, but grew and could be harvested in abundance on the banks of the Nile. It is not surprising that it remained the monopoly of the Egyptians, nor is it remarkable that those reliant on its import desired it as a material that they could harvest and manu-

facture themselves. We know, for example, of the attempts by the Abbasid caliph al-Mu'tasim (*reg.* AD 833–842) to establish a papyrus factory with Egyptian workers a little north of Baghdad, and can only hazard a guess at the cost and size of such an undertaking: not only were workers required, but the living plant had to be successfully transported over thousands of miles, and grown in suitably prepared conditions. We also hear of the caliph's anxiety lest the civil service should one day find itself without writing materials, and of his pleas to officials that they economise.[17]

From the apparent failure of the project, it seems that the presupposition that papyrus would grow in such an easterly region as Baghdad was misguided. But even if unsuccessful, it does give us some indication of the degree to which papyrus was in demand as a writing material in the early years of Islam. Until the 10th century AD, supply could certainly satisfy the requirements of the Egyptian literate; later, as demand outstripped supply, paper was available as a suitable alternative. However, to the east of the Nile, writing materials were required in equal – if not greater – amounts and, although papyrus could be imported, it was not readily available in the quantities required. A need for an alternative product was generated, and despite being harder to manufacture, parchment had provided an excellent alternative from at least the 1st millennium BC.

Parchment

Parchment, from the Greek *Pergamene*, and the Latin *Pergamena*,[18] is a generic term used to describe any animal pelt that has been de-haired by the action of either enzymes or lime, and left to dry in a wet state on a frame under tension. On drying, the skin becomes a considerably thinner, relatively inelastic material, which is flexible and largely opaque. It remains permanently set in this highly stressed state unless subsequently wetted. In this form, parchment can be distinguished from other forms of pelt, such as leather and alum-tawed skin. Vellum – derived from the Latin *vitellus* – shares the same origin as veal or *veau* in French, and is used strictly to describe a writing material made from calf skin. *Abortivum*, the Latin term occasionally applied to an extremely fine, flexible and opaque parchment, has given rise to the widespread misconception that the finest skins were taken from still-born or aborted calves. But if one considers the sheer quantity of 13th-century French bibles written on what could pass for uterine vellum, this proposition appears somewhat absurd.

Numerous writings on skin or leather have survived from ancient Egypt. In Arabia, where the leather industry was long-established and had generated

a considerable export trade, leather was almost certainly employed as a writing material. The move from leather to parchment would have occurred naturally out of a need for a thinner, harder, and less absorbent material which was more suitable for writing with ink and reed pen. We know that parchment was used as a support for writing in the West by the 2nd century BC, and can therefore assume that it was familiar to Persians and Arabs alike before the time of the Prophet Muhammad. In literature, Arabic terms referring to parchment thinness (*raqq* or *riqq*), and reused pieces of parchment (*tirs*) are mentioned occasionally, and although we may doubt the veracity of the tale, Ibn al-Nadim relates that the Abbasid caliph al-Ma'mun (*reg.* AD 813–833) owned a document written on leather that once belonged to the Prophet's grandfather.[19] According to Ibn al-Nadim, Persian scribes were accustomed to writing on buffalo, oxen and sheep skins, all of which were cured with lime.[20] He adds that skins were dry when they were prepared with lime, but could be softened with dates,[21] the latter presumably boiled in water. The value of parchment as a writing material in the 9th century AD is indicated by the sympathy felt by Ibn al-Nadim towards the people of Baghdad, who were forced to write for two years on palimpsets because the storehouses were plundered in the civil wars of the Abbasid caliph al-Amin (*reg.* AD 809–813).[22]

With the exception of Ibn al-Nadim's reference to the use of skin for writing, no other early accounts of the methods of parchment production have survived from the Islamic world. Nevertheless, examination of surviving parchment leaves indicates that goat and sheep skins were the usual materials of early Islamic parchment, with those of wild animals such as the gazelle used only on occasion; it is also apparent that skins were prepared by methods similar to those documented in medieval Europe, as described above.[23] As with papyrus, parchment was produced in a range of qualities, dependent to a large extent on the breed, age and overall health of the animal from which the pelt was taken. Goat skin, for example, has a different fibre size and network structure to calf and sheep skin, and is a wonderfully soft and flexible material. A poorer quality skin is taken from an elderly, relatively inactive beast. Scar tissue resulting from cuts, blemishes and bites is identified with relative ease within the finished sheet, and it is also possible to recognise the area on the animal's body once covered by the skin. Thus the flank, a relatively fleshy area of the body between ribs and hip, yields a loose and stretchy skin, while the skin taken from the spine can be identified due to the tightly packed hair roots covering individual vertebrae. Quality was equally determined by the manner in which the animal died or was killed. Slaughtering by stunning, for example, facilitated good bleeding and thorough drainage of the blood vessels, pre-

venting the appearance of a coloured pattern of arteries, veins and capillaries in the final parchment. Death through natural causes, on the other hand, often resulted in the retention of blood in the vascular system during processing, and the reaction of iron compounds present in the blood with the lime to form darkly coloured pigments.[24]

Despite the fact that an animal's species, diet, and physical condition affected the quality of a skin, careful processing and manufacturing could, nevertheless, help to improve the strength, flexibility and durability of most types of parchment.[25] Although it was a relatively expensive material, and not regarded as a disposable commodity, the quality of parchment available for manuscripts and single-leaf documents in the Islamic world was often exceptionally high for those who could afford it, as may be seen in surviving examples from the 8th to the 10th centuries AD. Through its use, documents and manuscripts were afforded durability and prestige. Greater luxury was conferred through the use of a dye yielded from the murex shell-fish, which was used to stain leaves a rich blue-black, thus emulating the manuscripts and documents of the Byzantine court.[26] Documentary evidence indicates that the tax authorities to the Sasanian king Khusrau Parviz (*reg.* AD 590–627) were coloured with yellow saffron and sprinkled with rose-water, reputedly because the smell of the original white skin displeased him.[27] Following this Persian example, the use of yellow parchment was apparently introduced into the public administration in Baghdad.[28]

By the 7th–8th century AD, the book in codex form had already passed through some five centuries of technical evolution, and was a well-functioning combination of materials and structures.[29] At this stage, the religion and culture of Islam was still in its infancy, but was rapidly penetrating the Middle East and consolidating its power.[30] It is therefore not surprising that from its conception, the usual and most popular form of written work in the Islamic world was the codex. Due to its properties of strength, durability and flexibility, parchment was the natural material for its construction, far better suited to its mechanical requirements than papyrus. Codices with leaves of parchment are known to have existed in the regions which were to become the heartlands of Islam, and a small number of parchment codices dating from the first four centuries of Islam have survived, the majority of which are in the national collections of Tunis and Cairo.[31] Writings on parchment in roll form are rare, and the scroll in whichever material is found infrequently in the Muslim tradition; Islamic literature existing independently of two covers is something of a curiosity.

Despite the high regard with which it was viewed, parchment was used infrequently as a writing material prior to the 9th century AD, and less exten-

sively than papyrus, due to its cost and availability. Intellectual activity was confined to a small population, and the material was used primarily for official documents, scholarly works and the copying of Qur'ans. At the beginning of the 9th century however, levels of literacy began to rise, and the output of scholars rose accordingly. Growth in the production of Persian and Arabic literature was rapid, and the scope of translation from Greek was broadened to include Aristotle, Hippocrates, Galen, Ptolemy, Euclid, and others. Although most translators were Nestorian Christians, Jews and pagans who flourished in the tolerant court of Baghdad, a number of outstanding translations originated from Persia. Biographies of the Prophet Muhammad and his companions, chronicles of Arab conquests, compendiums and geographies of the Islamic domain, and the codification of Muslim tradition and law (*ḥadīth* and *sharī'ah*), served to stabilize and unify the Muslim culture, and large scale conversion to Islam was common. The increase in the quantity of written work produced during the Abbasid period (AD 750–1258) was dramatic, and a demand for writing materials was generated across the Islamic world in unprecedented quantities.

Ultimately, supplies of parchment were insufficient to cope with an increasingly literate population, and the material had to yield preference to a cheaper, more readily available medium that could meet the demand for books as the new religion flourished. According to Ibn Khaldun (d. AD 1406),

> Originally, copies of scholarly works, governmental correspondence, and diplomas were written on parchment, because there was great prosperity at the beginning of Islam and the works that were written were few. The production of books and writings then developed greatly. Government documents and diplomas increased in number. There was not enough parchment for all that.[3.2]

As demand for existing writing materials began to outstrip supply, the introduction and spread of papermaking from the East offered paper, in ever increasing quantities, as the perfectly suitable alternative.

1. A survey of the materials used for writing is given in Ibn al-Nadim's *Fihrist* ('Index'), written in Iraq in the 10th century AD; see Pedersen, trans. French 1984, p.54. In addition to the materials listed above, silk, skin, parchment, papyrus and paper are mentioned.
2. Parchment: *riqq* (Surah *al-Ṭūr*, LII, verse 3); papyrus: *qirṭās* (Surah *al-An'ām*, VI, verses 7 and 91).
3. According to al-Suyuti, wooden tablets, among other materials, were used for this purpose; see Pedersen, trans. French 1984, p.54.
4. Pedersen, trans. French 1984, p.57.
5. Sibwaili's *Gramatica*, Paris, Bibliothèque Nationale, MS Arabe 6499; written in Spain in AH 558 (AD 1162–3).
6. In the reign of the Abbasid caliph al-Mu'tasim, a papyrus factory with Egyptian workers was established in Baghdad, but it would appear that the presupposition that

papyrus would grow in this more easterly region was misguided. See Pedersen, trans. French 1984, p.59. For papyri found outside Egypt, see Khan 1993, pp.13–14.

7. Ibn Hawqal, quoted in Quraishi 1989, p.30.

8. Pliny, *Naturalis Historia*, quoted in Khan 1995, p.11.

9. Lewis 1974, pp. 47–9; see also Khan 1995, p.11.

10. Pliny, *Naturalis Historia*, quoted in Khan 1995, p.11.

11. Khan 1995, p.1.

12. Grohmann 1924, pp.40–41.

13. Khan 1995, p.13.

14. There is little or no ancient material referring to the construction of the papyrus codex, although it is possible that from the time of the late Roman Empire, sheets were made especially to the formats needed for codex production. It can be assumed that the manufacturer fabricated individual leaves which would remain unpasted, thus avoiding the hindrance of cutting up rolls for the manufacture of codices.

15. 'Lengthy documents had the form of *rotuli*, i.e., rolls that are unrolled vertically. Literary texts, on the other hand, were usually written on the roll in columns, with the lines running parallel with the fibres and perpendicular to the joins of the sheets. This type of roll was read horizontally.' See Khan 1995, p.13.

16. Khan 1995, p.15.

17. Pedersen, trans. French 1984, p.59. See also pp.14–15 above.

18. According to Pliny, in his *Naturalis Historia*, XIII, ii, and quoting the earlier Roman writer Varro, Ptolemy V Epiphanes of Egypt (*circa* 205–*circa* 185 BC) feared that the library of Eumenes II King of Pergamum (*circa* 197–159 BC) might one day surpass the library of Alexandria, and duly laid an embargo on the export of papyrus from Egypt in order to retard the literary progress of the rival city. Eumenes, thus debarred from obtaining papyrus rolls, was driven to the development of parchment as an alternative writing support; see Diringer 1982, pp.170–71.

19. Pedersen, trans. French 1984, p.5.

20. Pedersen, trans. French 1984, pp.55–6.

21. Referred to as the Kufic method of preparation, after the town of Kufa in Iraq; see Bosch, Carswell and Petherbridge 1981, p.25.

22. Ibn al-Nadim, quoted in Bosch, Carswell and Petherbridge 1981, p.25.

23. Ibn al-Nadim, quoted in Bosch, Carswell and Petherbridge 1981, p.25.

24. Clarkson 1992, p.5.

25. 'Each skin must therefore be accepted as a highly individual material which will tend to outwit categorisation. Any generalisations regarding standardisation of technique must be looked on with suspicion.' See Clarkson, 1992, p.5.

26. For further information about the use of blue parchment for the transcription of the Qura'n, see Bloom 1989, pp.95–9, and Stanley [1996], pp.7–15.

27. Pedersen, trans. French 1984, p.56.

28. Pedersen, trans. French 1984, p.56.

29. Bosch, Carswell and Petherbridge 1981, p.23 and note 1. There is, however, no exact date for the first appearance of the codex as we know it. It seems certain that in the later decades of the Roman Republic, senate documents and perhaps also legal reference books existed in this form; but for a long time the codex was considered of less value than the roll, the latter dominating literate society until the 4th century AD.

30. Bosch, Carswell and Petherbridge 1981, p.23.

31. Bosch, Carswell and Petherbridge 1981, p.25.

32. Ibn Khaldun, trans. Rosenthal 1967, p.328.

CHAPTER TWO

Papermaking in the Islamic World

Before considering when papermaking was introduced into Central Asia, one must consider how the material first entered Persia. Paper was in use in China in at least the 2nd century BC.[1] The Arabic term for paper, *kāghad*, derives from the Persian *kāghadh* (*kāghaz*) which is believed to be of Chinese origin.[2] By the 2nd century AD, China and the West were linked via an intricate network of roads and tracks covering Eurasia, crossing the 10,000 land miles between Peking and Rome. This cat's-cradle of highways, along which individual merchants traced the routes that best served their commercial needs, provided the primary means by which Imperial Rome was supplied with silk from Han China, and came to be referred to as the Silk Road.[3] Its principal northerly route started from Ch'ang-an, present-day Sian, and pushed in a north-westerly direction around the Taklamakan desert, passing eventually out of Chinese territory into Central Asia and Persia. Continuing via Samarqand, Bukhara and Merv, it divided southwards to Baghdad, Damascus, and the eastern Mediterranean coast, and westwards across Anatolia towards Constantinople. Much of the route was but a series of caravanserais dotted through arid deserts and windswept mountains. Nevertheless, relationships between the main trading towns were mutually nutritious; the trade of silk, gold, and horses mirrored the trade in ideas and beliefs, and oasis towns blossomed into thriving centres of art and learning.

Travel across the great Eurasian land mass was rudimentary and expensive. Transport was largely restricted to mules, camels and oxen, and any overland itinerary was dependent upon the political stability of the regions through which tradesmen passed. Regular trade between China and Europe was only possible when the security of itinerant merchants could be guaran-

teed. Nevertheless, by the 3rd century AD, long distance travel by sea had been revolutionised by the discovery of the cycle of monsoon winds in the Indian Ocean. Without the need to hug the coasts, it was possible for mariners to sail between Egypt and India in four months, and a ship with a capacity of 200 tons would carry the equivalent load of a caravan of camels.

Although sea travel directly affected the spread of papermaking from east to west, it was primarily via the Silk Road that paper, and a knowledge of the process by which it was made, spread into Persia. The length of its overland routes, combined with the centralised nature of the Chinese state and a reticence to reveal the secrets of papermaking, meant that it took at least six centuries for a knowledge of the craft to cross Eurasia. By this time paper produced in China was a dispensable commodity, used to wrap goods intended for export along the trading routes. Nevertheless, trade between Central Asia and China, and the presence of the Chinese in Eastern Persia, ensured that paper was a familiar commodity to the Persians by the middle of the 7th century AD. It was imported into Samarqand from China as early as AD 650, a date which corresponds to its first mention by Arab writers.[4] There are even accounts that the official letters of the Prophet Muhammad to the rulers of the neighbouring states were written on paper,[5] which would date its use to the years prior to AD 650. By AD 660, Chinese armies were present in India, Central Asia and Afghanistan, and the T'ang Dynasty had established brief protectorates in Turkharistan, Sogdiana, Ferghana, and Eastern Persia; Chinese military presence in these regions required bureaucratic support, and a need for paper was generated accordingly. The Chinese traveller It-sing recorded that he witnessed the use of paper in India in AD 671, although no such early specimens have survived.[6]

The traditional account of the introduction of paper into the Middle East is contained in a medieval Arabic text dated 1482, as uncovered by the Spanish orientalist Miguel Casiri (1710–1791), who dated the introduction of paper into Samarqand to the beginning of the 8th century,

> In the city of Samarqand a very fine paper is used, that is found nowhere else except amongst the Chinese. The Arabs, after their conquest of that city (in 704 A.D.), introduced amongst themselves the methods of its manufacture.[7]

An equally popular explanation states that in the aftermath of a battle on the banks of the Talas River in the Khangali region of Central Asia, allied Muslim forces routed a Chinese army capturing, among others, Chinese papermakers. The latter were taken to Samarqand, where the first papermaking centre in the Islamic world was established in AD 751,

> Prisoners of war were brought from China. Among these was someone who knew [about] the manufacture of paper and so he practised it. Then it spread until it became a main product for the people of Samarqand, from whence it was exported to all countries.[8]

The apparent neatness and simplicity of this account has prompted many to doubt its accuracy.[9] However, if one considers the distance and nature of the terrain separating China and Eastern Persia, it may well have taken such an event to provide an adequately skilled work force for an indigenous industry. To see the Silk Road as a single entity, along which a constant stream of goods and ideas poured in an orderly fashion in every direction, is to impose upon it our modern concepts of roads and highways. Its principal routes were unimaginably long, crossing some of the harshest terrain in the world, and transport was rudimentary. Goods took years of constant travel to pass from east to west, and delays caused by local wars or natural disasters could easily disrupt trade. The diversity of cultures, tribal groupings, languages and religions crossed by the Silk Road ensured that goods passed through numerous hands as they journeyed, increasing in price with every exchange. Few people knew what was over the horizon, even fewer travelled from one town to the next, and almost none ventured along its entire length. It is unlikely that itinerant craftsmen would have undertaken the hazardous journey from China to Persia, therefore perhaps the only way for a group of papermakers to arrive in Central Asia was by way of an invading army. Throughout history, and particularly in times of hardship, craftsmen have volunteered for, or have been forcibly conscripted into, the military forces, tempted perhaps by the tales of enrichment that plunder and pillage might supply. After their defeat by the Muslim armies, many of the fleeing Chinese would have been taken prisoner, the price for which was either slavery or death. Our group of papermakers, aware perhaps of the rarity of their skills, may have attempted to barter their freedom for labour. Or, alternatively, the Muslim conquerors may have realised their importance, and set them to work immediately. In the end, it amounts to the same thing for, in either case, what is certain is that paper must have been a recognisable and appreciated commodity in Persia by the 8th century AD.

Although it is unlikely that papermaking actually commenced in Samarqand in AD 751, the city does seem to have enjoyed either a monopoly or an overwhelming predominance in papermaking for some time in the early years of Persian and Middle-Eastern paper history.[10] An indigenous industry grew at an astonishing rate: abundant crops of hemp and flax, and water from irrigation canals, provided the natural resources for its success; not only was the local demand filled, but 'paper of Samarqand' became an important article

of commerce, regarded with an esteem equal to that of the finest quality Chinese papers.

A plentiful supply of pure water was as much a prerequisite for paper production then as it is now and, inevitably, papermaking spread from Samarqand to towns where this fundamental resource could be found. The use of paper in Baghdad is indicated between the years AD 754–5,[11] and by 794–5 papermaking factories had been established in the city.[12] Papermills were founded in Tihama and San'a in the south west of the Arabian peninsula, and in Cairo during the 9th century AD, where there is written evidence to suggest that, like sugar, paper was mass produced in impressive *maṭbakh*s (kitchens) in the area of Fustat, the southern part of Cairo.[13] With an established textile industry, Egypt was well suited for paper manufacture, and by the end of the 10th century AD, the country was well known for its paper. By the 11th century, it was a dispensable commodity: a Persian traveller, Nasir-i Khusrau (b. AH 394/ AD 1003–4), travelling at this time was amazed to find the merchants of Cairo using paper to wrap their goods.[14] The renowned Baghdad doctor, 'Abd al-Hatif, visiting Egypt at the beginning of the 13th century, related that Bedouin stole linen from the mummies, which, if suitable, was used again as clothing; if it was unsuitable, it was sold as the raw material for paper used to wrap groceries.[15]

By the 10th century AD, papermaking had also reached the Syrian cities of Damascus, Tripoli, and Hama. Damascus enjoyed a thriving export trade in paper, and exported enormous quantities of it to Egypt, despite the country's own indigenous industry.[16] From the letters of a medieval Jewish merchant, trading in rose marmalade (a popular preserve), dried fruit, oil, medicinal plants, and coins minted in Syria, we know that paper was a staple item of trade exported by him from Damascus. One delivery of 28 camel loads weighed approximately 14,000lbs.[17] In the 10th century AD, paper was also exported to Europe, where it was sold under the latinized name, *charta damascena*. From Syria, papermaking spread along the North African littoral into Tunis, Tlemcen, Ceuta and Fez by the second half of the 10th century AD. Around the year AD 1200, the town of Fez is reported to have had 400 millstones, some used solely for the preparation of paper fibres.[18] It is most likely that papermaking was introduced into Europe from Fez in the 12th century. In the early years of Muslim rule paper was also imported into India from Persia, but by the reign of the Mughal emperor Akbar (*reg.* 1556–1605), it was produced indigenously, notably in Kashmir.[19]

In Turkey, a paper industry was not established until the middle of the 18th century. After the Ottoman conquest of Egypt in 1517, paper merchants

and craftsmen were among those taken to Istanbul, presumably with the hope of establishing a papermaking centre; but the industry failed to materialize. This may have been due to a lack of water in Western Anatolia: although there are rivers in Turkey, many of them are seasonal, and not suitable for papermaking. It may also have been due to the availability of a plentiful supply of paper from both the East and the West. From the advent of Islam in the 7th century AD, until the coming of the Ottoman Turks in the 14th, Anatolia occupied an anomalous position in the region, sitting between an emerging Islamic East and a developing Christian West. Until the late 11th century, it was a bastion of Christian civilisation, harking back to the great days of Rome.[20] This was at once an advantage and a disadvantage for the Byzantine Greeks. Compared to their neighbours, they had advanced social and economic structures, but at the same time, were notoriously conservative. Whereas the Europeans in the West and the Persians and Arabs in the East developed and became stronger, the Greeks, beset on both sides, were decadent and wary of change. The gains made by the Seljuk Turks on the one hand and the emerging Italian maritime powers (Venice and Genoa) on the other, were largely at their expense. By the time the fight for ascendancy throughout Anatolia and Greece had been won by the Ottoman Turks, the dominance of paper in both the East and the West was assured, and a peaceful and stable Anatolia may have had no need for its own papermaking industry.

The Transition from Papyrus and Parchment to Paper

By the middle of the 10th century AD, Egyptian manufacture of papyrus as a writing material had been largely replaced by paper; the latest extant example of dated papyrus was written in AH 323 (AD 935).[21] From Persia to North Africa, the use of parchment for official documents seems to have continued, alongside paper, into the middle of the 11th century. But nowhere and at no time was the transition from the use of papyrus or parchment to paper straightforward or without uncertainty, and we must assume that prior to the 11th century AD, parchment, papyrus, and paper were all in use as writing materials in the westernmost territories of Islam.[22] Throughout the Middle East, codices could comprise both paper and parchment gatherings,[23] and in the Near East in particular, scribes and calligraphers would have been required to write on papyrus and paper in the course of their work. In his *Al-'Iqd al-Farīd* ('The Costly Pearl'), which was written at the beginning of the 10th century, the Spaniard Ibn 'Abd Rabbih includes a description of the kinds of reeds that were best suited for writing on skin, paper, and papyrus respectively.[24]

By the middle of the 10th century AD, the use of paper as the primary writing material of the Islamic world was widespread, but it was not without struggle that paper achieved its dominance. If we consider Baghdad, the religious and cultural centre of Islam, and at that time one of the richest cities in the world, it would appear that the adoption of a new writing material was met with some resistance. The first papermaking mills had been founded in the city by AD 795; if we accept the traditional date of AD 751 for the introduction of papermaking into Samarqand, it therefore took less than 50 years for this skill and technology to travel the 2000 miles that separates the two cities. The speed at which papermaking spread is indicative of how the material was regarded. It is curious then that the Abbasid caliph al-Mu'tasim (*reg.* AD833–842) attempted to found a papyrus plantation on the banks of the Euphrates,[25] when a small paper industry was already established in the city, and paper had been employed as a writing material for almost 100 years. Chronologically, this attempted introduction of papyrus manufacture to Baghdad is somewhat surprising. We can only assume that many would have been reluctant to use a new commodity in preference to a material which had such a long history of use. It is also probable that certain merchants and middlemen had a vested interest in the survival of the papyrus trade, and would therefore not have welcomed the introduction of a rival product.

But if paper did not win universal acceptance in the early years of its use, it gained considerable status and popularity within a remarkably short period of time, and was even recommended for copying the Qur'an.[26] In Baghdad, paper was used preferentially to papyrus and parchment within 70 years of its manufacture there, as is indicated by a report that the Tahirid governor of Baghdad, when short of paper, was forced to resort to papyrus during the wars of al-Musta'in and al-Mu'tazz (*reg.* AD 862–866 and AD 866–869 respectively). Finding the latter undesirable, he instructed his secretary to be brief and to write in a small hand.[27] Although there is reference to papyrus in Egypt by al-Mas'udi in AD 956,[28] by the 10th century its importance as a writing material had decreased considerably.[29] Paper had successfully supplanted papyrus even in its native land, where the manufacture of the latter almost completely ceased. It is also interesting that in his *Rasā'il*, al-Jahiz addresses a bitter complaint to his patron Muhammad ibn 'Abd al-Malik al-Zayyat (d. AD 847) who had forced him to use leather and parchment instead of Chinese or Khurasanian paper, further pointing out the advantages of rag paper (*waraq quṭnī*) as a superior writing material.[30]

Why was the expansion of papermaking in the Islamic world so rapid, so total, and so far reaching? Increasing levels of literacy, encouraged by the

political unification of the Middle East and Persia, created a demand for a greater supply of writing material. This coincided with the introduction of paper, a product which could be made cheaply and quickly, was available almost universally, and was ideally suited to the manufacture of the codex. There are many parallels between its adoption throughout the Islamic world in the 9th century AD, and the establishment of a papermaking industry in Southern Europe by the 14th. The emergence of more sophisticated political and social entities in the West, coinciding with the advent of printing in the 15th century, created a similar demand for writing material in unprecedented quantities.

The overwhelming advantage that paper had over its rivals was the ease with which it could be manufactured locally, and its low cost.[31] The import of goods throughout the medieval world was extremely expensive. Pliny, for example, estimated that through expenses incurred on the journey, merchandise that reached Rome from China was sold for one hundred times its original cost.[32] This is confirmed by Chinese sources, for the Chin-shu annals note that Parthian middlemen reaped one hundredfold profits on goods taken across the Silk Road.[33] The same is probably true for the stocks of Chinese paper that reached Samarqand. The high cost of imported Chinese papers is indicated by the story told of the calligrapher Ibn al-Bawwab (d. AH 413/ AD 1022) who, as payment for his labour, accepted a stock of white Chinese paper in place of 100 dinars and a robe of honour.[34]

Another advantage of paper over parchment and papyrus was the widespread availability of its raw materials. Linen and hemp – the two primary fibres used in the manufacture of Islamic paper – grew in abundance in the Middle East, whereas the papyrus plant was exclusive to the Nile Valley. Unlike parchment, paper could be produced in unlimited quantities, making the written word, in the form of the codex, widely available for the first time in history. However, early papers tended to be more fragile, and had a rougher surface than parchment; they were less impervious to ink, and less amenable to pigments used by illuminators.[35] As a result, parchment did not suffer the same fate as papyrus, and was used in the production of luxury manuscripts until the 11th century AD. Although the difference in price between parchment, papyrus and paper in the 9th century may not have been as great as is sometimes thought,[36] paper inevitably became cheaper and of a higher quality as its manufacture and use became widespread. This meant that the use of papyrus and parchment became less economically attractive. An increasing demand for paper effected a drop in demand for papyrus and parchment, which consequently became even more expensive and harder to obtain.

Sources of Early Paper Samples

Given the lack of documentary sources, our knowledge of the use of paper in the early Islamic period is largely dependent on the examination of extant samples, of which very little remains. This is due in part to the fragility of the material, but mainly to the destruction of a number of libraries established during the first two centuries of the Muslim era. In Baghdad, the library of Harun al-Rashid and al-Ma'mun was raised to the ground by the Mongols in AD 1258; 3,000,000 manuscripts were destroyed by fire when the library at Tripoli was sacked by the crusaders; another great library at Alamut suffered at the hands of the Mongols. Of greatest significance was the destruction of the library of the Mosque of the Prophet at Medina by fire in AD 1273.[37] A wealth of information relating to the early period of Islamic history was lost, as were thousands of samples of early papers. The loss of such valuable collections of manuscripts has resulted in an inability to compare early Islamic papers with contemporary Chinese samples on a large scale. Had this been possible, answers to many of the questions surrounding the use of Chinese paper in Sogdiana, and the earliest date of its manufacture by the Persians, could have been found. For example, examination of papers uncovered in Tung Huang, dated to around the 10th century AD,[38] and Persian paper dated to the 11th,[39] show many more similarities than differences between their method of manufacture; from this we can only assume that early Islamic samples were very similar to those made further to the east.

Although there is a scarcity of dated manuscripts from the 8th and 9th centuries AD (the 2nd and 3rd centuries AH), a few early papers have survived. The earliest dated samples include the following:

1. *University of Leiden, ms. Leiden Cod.Or. 298*
This manuscript, which is dated AH 252 (AD 866), contains a large part of the famous work *Gharīb al-Ḥadīth*, a book on unusual terms in the traditions of the Prophet, by Abu 'Ubayd al-Qasim ibn Tallam.[40]

2. *Oriental Institute, Chicago, OI 17618*
The opening bifolio of *Alf Laylah wa Laylah* ('A Thousand and One Nights'), consisting of the title page and first page of text, is the oldest paper from a codex to which a date can reasonably be attributed. This fragment was later reused as waste paper by a professional legal witness who noted down a number of phrases used to witness legal documents. One such phrase is dated 'the last of Safar of the year six and sixty and two [hundred],' corresponding to

20 October 879.[41] The book would have been a rare and prized possession, and a conservative estimate would allow at least half a century of use before its becoming aged and falling into a deteriorated condition. Thus the paper is considered to predate that of the copy of *Gharīb al-Ḥadīth* mentioned above.

3. *Zahiriyyah Library, Damascus*
A copy of *al-Masā'il* of Ibn Hanbal, dated AH 266 (AD 879). This is the only other known dated codex of the 3rd century AH.[42]

4. *Cambridge University Library*
The library houses a large selection of manuscripts and papers uncovered in Cairo in 1890 (the so-called 'Geniza Documents'). The papers form part of a large collection of personal and commercial writings of a Cairene Jewish community, who believed that any piece of written work could contain the name of God, and should therefore not be destroyed. Thus the papers were placed in a depository and housed in a chamber that was probably constructed as an addition to the Ben Ezra Synagogue, when the latter was restored in AD 1025. There are documents for almost every year from AD 1002–1266, after which they become rarer. Although the papers yield a certain amount of information about the paper trade during the 11th century, they tell little about its manufacture.[43]

The Decline of Papermaking in the Islamic World

From its introduction in Samarqand, the craft of papermaking spread rapidly through Persia and Syria, into Egypt, Morocco and Muslim Spain. It finally reached Europe late in the 12th century AD, more than 400 years after Chinese papermakers were supposedly captured in Samarqand, and over a 1000 years after paper was invented in China.[44]

The medieval Arab world was a unit of enormous economic potential, and paper rapidly became a staple item of export alongside such items as textiles and sugar. From its inception, the paper trade from east to west flourished, and from the 11th century AD onwards, the material was exported in huge quantities to the Byzantine Empire and the Christian West. However, by the 14th century, a European paper industry was well established, and the export trend began to reverse; ultimately the cultured and literate élite who influenced patronage looked westwards for their supplies. By the mid-14th century, European papers were imported into the Islamic world,[45] and were used increasingly in the Arab chancelleries of North Africa; by the 15th century, Northern Greek manuscripts were written on Italian paper.[46]

Although European competition did not immediately suppress the indigenous Middle Eastern paper industry, it effected a considerable drop in the volume of output. With regard to its decline, parallels can be drawn with the Syro-Egyptian textile industry. By the 15th century, European textile manufacture was technically advanced, and materials were highly prized in the East in terms of their quality and price. In Egypt and Syria, governmental intervention reduced incentives for technological change, and falling revenues discouraged investment further.[47] The successful merchant was vulnerable to financial squeezing with the cost of expanding military forces, and any profits he had made were regularly passed to the amirs, the ruling princes. When the Mamluks of Egypt fell to the invading Ottomans in 1517, Cairo became an artistic and commercial backwater, and the textile industry starved as a result.

The Egyptian papermaking industry failed because it could not match the low cost and high quality of paper being produced in Europe, a situation that was reflected across the Islamic world. Mechanisation in Europe signified the production of a good quality, relatively cheap paper, on a scale that could not be matched in Persia and the Middle East. European paper, notably from Fabriano and Treviso, was produced specifically to meet the needs of the Islamic market, and by the 15th century was being imported into the region by the Venetians and Genoese. The export trade to the East grew to such an extent that from the 17th century onwards, the use of European paper for manuscript production was widespread, as is evident from examination of manuscripts originating from Egypt, Syria, Persia, and North Africa. The growing cultural and economic dominance of the Great Powers – notably Britain and Russia – in the 19th century, created an even larger increase in the import of Western manufactured goods. For the first time in their history, the governments of the Central Asian and Middle Eastern states came under the direct control of the European powers, and Western entrepreneurs purchased monopolies on the production and supply of everyday goods such as paper.

Western papers made for export to the East were sized and burnished according to Middle Eastern custom (although sizing was with gelatine rather than starch), and were often re-burnished once bought. The 17th-century traveller Evliya Celebi mentions the paper merchants of Istanbul who 'adorn their shops with Persian and Venetian paper ...; they pass [the time] smoothing and glazing paper in their shops.'[48] Watermarks were included that were designed specifically for a Middle Eastern clientele, with popular motifs including the crescent, the star, and a crown. The three crescents watermark (known in Venice as *Trelune*) was included extensively in export papers of the 17th and 18th centuries.

The inclusion of the term *waraq baladī* (locally produced paper) in the inventory of an Egyptian paper merchant dated 1650, indicates that paper was made in Egypt in the 17th century;[49] the existence of dated paper originating from 17th- and 18th-century Syria and Egypt corroborates this. But by the end of the 18th century, paper sold in Egypt came almost exclusively from Europe, and an indigenous industry was extinct in the Middle East until the introduction of papermaking machinery in Egypt in the 19th century. In Persia, the tradition of papermaking by hand appears to have extended into the 19th century, but it was also severely affected by the European trade. With the exception of India, where handmade paper has seen a considerable revival in the past 50 years, the craft of papermaking appears to have all but vanished from the Islamic world.

1. The invention of paper in China is traditionally attributed to Tsai Lun in AD 105. But whilst it is accepted that he played a large part in the refinement of the techniques of paper manufacture, it is unlikely that his was the first paper ever produced. The considerably earlier date of at least the 2nd century BC is accepted by most scholars today as a probable date for the development of the papermaking process; see Quraishi 1989, p.31. The earliest reference that can be traced to a writing material resembling paper is that of Nearchos, an admiral of Alexander the Great, who refers to a writing material named *sindosi* in the 4th century BC. Sundhu has been identified as the basin of the Indus traversed by Alexander in BC325, and *sindosi* is described as well beaten cloth or well beaten linen. Although not paper, reference to this material points to the existence of a manufacturing process similar to that of papermaking in the Indus region at this early date; see Ramaseshan 1989, p.104.
2. Huart –Grohmann 1978, pp. 419–20. See also Khan 1995, p.78, where several derivative words concerning paper and its manufacture are listed.
3. Fisher 1988, p.14.
4. Bosch, Carswell and Petherbridge 1981, p.26.
5. Quraishi 1989, p.30.
6. Ramaseshan 1989, p.103.
7. Bosch, Carswell and Petherbridge 1981, p.26 and note 27.
8. Al-Hassan and Hill 1986, p.191.
9. For an in-depth and comprehensive examination of questions and issues surrounding the introduction of paper to the Islamic world, see Quraishi 1989, pp.29–36.
10. Bosch, Carswell and Petherbridge 1981, p.26.
11. Bosch, Carswell and Petherbridge 1981, p.27.
12. Karabacek 1887, trans. Baker and Dittmar 1991, p.33.
13. This evidence was found in a large selection of manuscripts and papers uncovered in Cairo in 1890 (the so-called 'Geniza Documents'). See above, p.9, and note 43, below.
14. Bosch, Carswell and Petherbridge 1981, p.27.
15. Pedersen, trans. French 1984, p.54.
16. It is interesting to note that paper was also imported into Egypt from China until at least the middle of the 13th century AD; see Quraishi 1989, p.33.
17. Goitein (trans.) 1973, p.89.

18. Karabacek 1887, trans. Baker and Dittmar 1991, p.38.
19. Parmu 1969, pp.414–16.
20. The defeat of the Byzantines by the Seljuk Turks at Manzikert (Malazgird) in AD 1071, and the subsequent capture and humiliation of their empire under Romanus IV Diogenes, signalled the end of Christian power in much of Anatolia, as well as the loss of Antioch, Damascus and Jerusalem. It was a decisive event in the downfall of the Byzantine Empire.
21. Quraishi 1989, p.30.
22. Perdersen, trans. French 1984, p.62.
23. See above, p.9, and note 5, p.15.
24. Pedersen, trans. French 1984, p.62.
25. See above, note 6, p.15.
26. Al-Qalqashandi, *Ṣubḥ al-A'shā*, quoted in Bosch, Carswell and Petherbridge 1981, p.27.
27. Bosch, Carswell and Petherbridge 1981, pp.26–7.
28. Al-Mas'udi, quoted in Khan 1995, p.2.
29. Karabacek 1887, trans. Baker and Dittmar 1991, p.12.
30. Abbott 1972, p.179. I am grateful to Professor John Carswell for this reference.
31. It should be remembered that much of the Middle East was, and still is, too dry for the manufacture of paper. Some areas needed to import the material, and we can assume that this promoted price differences within local regions.
32. Pliny, *Naturalis Historia*, quoted in Warmington, 1974, p. 274.
33. Pliny, *Naturalis Historia*, quoted in Warmington, 1974, p. 274.
34. Yaqut ibn 'Abd Allah, quoted in Quraishi 1989, p.33.
35. However as Karabacek notes, due to the fact that parchment and papyrus were largely impervious to ink, writing could easily be scratched out or washed away from their surfaces and then altered to deceive. For some, this was reason enough to change to paper; Karabacek 1887, trans. Baker and Dittmar 1991, p.32.
36. We know that papyrus was a relatively expensive writing material, but unfortunately it is not easy to make exact comparisons with the relative costs of parchment and paper. While we possess many manuscripts which mention the price of parchment, and acounts which record the purchase of parchment and paper, the significance of the terms is not always clear. Parchment was generally bought by the bundle (usually a dozen and a half whole skins), by the dozen skins, by the individual whole skin, or by the quire. However, when quires are mentioned, we have no way of knowing their dimensions or even the number of pages, and can draw no firm conclusions about costs as a result.
37. Quraishi 1989, p.32.
38. British Library, Oriental and India Office Collections, Stein 5892.
39. Khalidi Library, Jerusalem, MS.AR.91, dated AH 418 (AD 1027).
40. Baker 1991, p.29.
41. See Bosch, Carswell and Petherbridge 1981, pp.223–4, no.98.
42. Baker 1991, p.29.
43. For the Geniza documents, see S.D. Goitein, *A Mediterranean Society: The Jewish Communities of the Arab World as Portrayed in the Documents of the Cairo Geniza*, I–V, 1967–88.
44. See above, note 1, p.27.
45. A Qur'an in the Nasser D. Khalili Collection of Islamic Art is copied on Italian watermarked paper datable to circa AD 1340; see James 1992, p.146 and note 2.
46. Bosch, Carswell and Petherbridge 1981, p.32.
47. Lapidus 1984, pp.29 and 34.
48. Bosch, Carswell and Petherbridge 1981, p.37.
49. Walz, ed. Daly 1985, p.30.

CHAPTER THREE

The Nature of Paper and its Production

The Nature, Properties, and Characteristics of Paper

There is some irony in the fact that the word paper is derived, via French (*papier*) and Latin (*papyrus*), from the Greek *papyros*.[1] Partly as a result of this derivation, and partly from ignorance of the nature of the two materials themselves, paper and papyrus have often been confused. However, the two are fundamentally different, and the term paper denotes a material whose combination of properties cannot be found in any other. Paper is a unique product made by the intermeshing of hydrated fibres under controlled conditions, and may be defined as a matted or felted sheet of fibres formed on a fine screen or mould from a water suspension. This basic definition can be applied as equally to paper today as to the first paper made in China at the beginning of the Christian era. In the *Shou Wen Chieh Tzu* ('Analytical Dictionary of Characters'), compiled by Hsü Shen at the end of the 1st century AD, we find the word *chih* for paper defined as *hsü i chan yeh* ('a mat of refuse fibres'), the key words being *hsü* ('refuse fibres') and *chan* ('mat').[2]

The basic material of paper is cellulose – a chemical compound of the elements carbon, hydrogen and oxygen – as found in materials such as rags, straw, wood and bark. When immersed in water, cellulose fibres swell. In their swollen state, a suspension of fibres in water can be deposited as a layer of pulp on a mould through which all excess water can drain away. On drying, a coherent mass of fibres remains on the mould, the fibres acting as their own cement if soaked in water and allowed to dry in close contact with one another. Although paper behaves as though it were a homogeneous material, on examination through a microscope a sheet is identified as a network of a multitude of fibres, arranged randomly and layered on top of one another, with

numerous channels of air between them. One might almost say that paper consists of a large number of holes surrounded by fibres.

The structure of paper is fundamental to its nature. Unlike woven cloth, it is composed of single short fibres arranged largely at random, as opposed to a regular, woven, manner. Unlike plastic films and metal foils, it is fibrous. Unlike papyrus, it is manufactured from fibres whose properties have been changed by maceration or disintegration, rather than by the lamination of whole or undisintegrated plant lengths. Unlike woollen felt or leather, it is laminar: each fibre is deposited largely in the plane of the sheet, occupying a particular level within its thickness. For convenience, the properties of paper may be grouped together as follows:

Mechanical properties

Individual cellulose fibres have remarkably high tensile strengths. When a sheet of paper is torn, the fibres themselves are seldom fractured to any great extent – it is generally the bond between fibre and fibre that breaks.[3] In the plane of the sheet, paper is also strong, especially towards tensile and bursting stresses, but at right angles to the plane, it is weaker. However, cellulose fibres possess only a limited degree of elasticity, the bonds between the fibres moving only slightly. Although a sheet of paper possesses a high degree of flexibility and can be rolled or folded, any damage caused along a fold is permanent, and its layered structure will be damaged internally if placed under stress.

Absorptive properties

Paper is absorbent to moisture. When a drop of liquid is placed on an unsized sheet such as blotting paper, the liquid will not dry by evaporation; it is absorbed by the constituent cellulose fibres, and drawn into the fine, interconnected channels which exist within the paper. This fact is very important, since it governs the behaviour of inks on paper: if paper were non-porous, inks placed on its surface would have to dry either by evaporation or by chemical change, both comparatively slow processes. As a result, printing would be extremely difficult. As it is, the liquid carrier of the ink (water or oil) sinks rapidly into the pores of the paper, leaving a layer of comparatively dry, hard pigment on the surface. Only if these channels are blocked will paper be almost impervious to all fluids, and also vapours and gasses.

Optical properties

Although cellulose fibres are more or less transparent, and as such translucent to light, paper generally exhibits a high degree of whiteness and opacity. The

effect is due to the reflection and consequent scattering of light from the large number of fibres in the sheet. The greater the degree of scattering of light, the greater the degree of whiteness and opacity. For maximum scattering of light, the channels between the fibres must be small, numerous, and filled only with air.[4] If the passages are blocked or filled with a liquid, both opacity and whiteness are reduced. Thus paper which has been oiled or waxed is always much duller and more translucent than untreated paper.

The Materials and Techniques of the Papermaker

> The best white flax is purified from its reed. It is moistened and combed until it softens. Then it is soaked in quicklime a night until morning. It is then rubbed with the hands and spread out in the sun until all of it dries in the daylight. It is then returned to water of quicklime, not the first water. It is so the next night until morning. It is then rubbed a night as in the first rubbing and spread out in the sun. This is done so three or five or seven days. If the water of quicklime is changed twice a day, then it is better.
>
> If its whiteness is brought out, then cut it with the scissors little by little. It is then immersed in sweet water for seven days. The water is changed every day. When the quicklime has gone out from it, then it is pounded in a mortar very finely while it is moist. Then, nothing will be left of the lumps. Other water is put on it in a clean vessel. It is dissolved until it reaches a silky viscosity. Then it is introduced into the moulds in the desired size. These are made from the straw used for baskets, nails, and the walls are collapsible. Under it is an empty rib. The flax is beaten with the hand vigorously until it is mixed. Then it is thrown with the hand flat in the mould so that it will not be thick in one place and thin in another. When it is evened, then its water dries away. It is found proper in its mould. When the desired is attained, it is adjusted on a flat tablet. Then it is bound to a wall and straightened with the hand. It is left until it is dry. It separates and falls off.[5]

This description of papermaking is taken from the key Arabic treatise on the techniques and formulae for the preparation of various types and colours of ink, *'Umdat al-Kuttāb wa 'Uddat Dhawī al-Albāb* ('Staff of the Scribes and Implements of the Discerning'), by the 11th-century Maghribi craftsman, Ibn Badis. In essence, the principles of the craft that he describes continued virtually without change until the beginning of the 19th century, when mechanisation infiltrated the Middle Eastern industry, and the introduction of printing in the Islamic world demanded different paper characteristics (low degree of sizing, for example).[6] But although the description contains most of the key elements of the papermaking process in the Islamic world, it lacks sufficient detail for a full understanding of the craft. Clarification of the fundamental materials and techniques of the papermaker is given below alongside details of how the practice grew and evolved from that of the early Chinese papermakers.

Raw materials

An abundant crop of flora producing a high yield of pure fibre is fundamental for the growth and maintenance of a successful paper industry. In China, mulberry, rattan and bamboo were employed extensively in textile manufacture, and eventually became the chief raw materials for papermaking. But it is evident that hemp was used by the earliest papermakers to make a paper that was pliable but tough, fine and waterproof, and suitable for calligraphy, bookmaking and official documents. The oldest paper specimens of the Han dynasty discovered in Lop-nor, Pachhiao and Chü-yen were made of hemp, and manuscripts found in Tun Huang, dating from the 5th–10th centuries AD, consisted of hemp, jute, and China glass.[7]

In the Middle East and Persia, where neither the mulberry tree nor the rattan plant grew indigenously, linen and hemp were the principal fibres of the papermaker, retaining their prominence throughout the history of the craft. Evidence contained in documentary sources and uncovered through the analysis of the papers themselves, suggests that these fibres were generally not used in their raw, bast state, but were extracted in their processed state from textiles, rope and cordage.[8] According to Rashid al-Din, the famous 14th-century Ilkhanid court historian, paper used in the time of the Abbasid caliph Harun al-Rashid was made from old ropes used in shipping.[9] However it would be a mistake to dismiss entirely the use of fibres in their bast state. First, a number of references are unspecific with regard to the origin of the fibre: 'As to the Khurasan paper, that is made of linen,' says Ibn al-Nadim,[10] and some writers point specifically to the use of raw linen fibres for the manufacture of paper.[11] Secondly, papermaking fibres extracted from textiles and cordage can be distinguished under magnification from those used in the raw or bast state: the former exhibit signs of extensive beating and maceration; the latter are considerably longer, and less fibrillated. Through this method of examination, the use of raw fibres has been confirmed.[12]

Paper could be manufactured from linen or hemp exclusively, or could comprise a combination of both fibres. However, due to the near identical appearance of the fibres under magnification, the percentage content of each within a sheet is not easily determined, and it is therefore not known whether there was a preference for the use of one fibre over the other, or whether papers made from pure linen or pure hemp were preferred over papers containing both. Unfortunately, linen and hemp were ubiquitous across the Islamic world, and identification of their use in a sheet adds little to the geocultural classification of paper.

Maceration of the pulp

Maceration is the two-stage process by which fibres in their woven or corded state are reduced to a workable pulp through steeping in a liquid, and then beating. Steeping, resulting in the disintegration of the woven fibres, is a process which was adopted by the Islamic world from the East, and differs very little across the world. It involves the gathering together of the raw materials in a heap, their saturation in water (frequently with the addition of lime), and their fermentation in this sodden state for anything up to ten weeks. The resulting mass is boiled, placed in cloth bags, and suspended in a running stream, the action of which removes all unwanted impurities, and the greater part of any alkaline residues.

It is likely that the earliest method of beating the fermented fibres was by pestle and mortar, as described by Ibn Badis,[13] and as practised in some parts of India and East Asia today. The mortar was made of a rough stone, sunk into the ground; when heavy pestles, balanced on pivots, fell repeatedly onto the sodden material beneath, the substance could be reduced to a pulp suitable for the formation of sheets of paper. This elementary method of beating the cleansed rags was doubtless in imitation of earlier Chinese techniques, and was later refined by both the Chinese and Islamic papermakers. A trip-hammer was introduced to channel manpower more efficiently: workers trod upon the end of a tilt-bar attached horizontally to the hammer, causing the latter to fall heavily upon the substance below. Another form of beating by water-powered wheels must also have been employed in the Islamic world, as seen in a manuscript, written and illustrated in Kashmir circa 1850–60, now in the Oriental and India Office Collections: here the basic equipment of the Kashmiri papermaker is depicted, including a water-powered undershot stamping mill.[14]

The mould

Through the process of maceration, processed or raw plant fibres are reduced to a workable state, so that when held in a suspension of water, they can be lifted from the water onto a sieve-like screen or mould. Excess water drains through the small openings of the screen, leaving a homogeneous sheet of interwoven fibres upon its surface. This thin layer of intertwined fibre, made of a myriad of filaments, is paper. The formation of such a layer of fibres supported on a piece of cloth or a mat is fundamental to the art of papermaking; the invention of an implement capable of picking up these matted fibres, and yet permitting the water to escape, is axiomatic to the whole process. Although improvements in the design of the screen or mould have resulted in

the advancement of papermaking techniques, the principle of forming a sheet of paper as described above has undergone no change in almost 2000 years, and is employed today by the most advanced of papermaking machinery. The mould is as important to the papermaker as the loom is to the weaver.

The wove mould

Although there is no diagram or clear description of the construction of the mould in early literature, it is probable that the first mould was nothing more than a square of coarsely woven cloth held within a four-sided bamboo frame. As described by Dard Hunter,[15] this elementary mould could have been successfully used for making paper in two distinct ways. The first method involved the immersion of the mould into the fibre stock, perpendicular to its surface; once in the water it was turned horizontally and drawn up under the macerated fibres floating on the water's surface, lifting them as a sieve, and allowing the water to drain through the weave of the cloth. The second involved pouring the fibre solution onto the cloth, the latter held flat so that the water could drain through its woven mesh. With either method, the thickness of sheet was determined by the quantity of pulp deposited on the mould's surface; surplus stock was allowed to run over the far edge of the mould into the vat of pulp, to be used again.

As a result of either action, the mould was covered with the macerated fibre. It was shaken from right to left, then from back to front, in order to produce a fairly uniform and even layer of fibres. These motions crossed and matted the fibres, making the sheets of paper almost equally strong in both directions, at the same time as expelling considerable amounts of water from the sheet. The deposits of fibre adhering to the cloth were left to dry upon the mould's surface; the resulting sheet could be removed from the mould only after the moisture from the sheet had evaporated. In the sun, individual sheets required approximately half an hour to dry prior to their safe removal from the mould; consequently, papermaking in large quantities required numerous moulds, and was a time-consuming and labour-intensive craft.

The laid mould

For papermaking to advance, it was necessary to devise a method of producing a sheet of paper which could be removed from the mould whilst still wet, thereby enabling the craftsman to form sheets continually on the same mould. For this end, the mould covering had to be constructed of a smooth and firm material from which the moist sheet would readily free itself. Initially, such a mould covering was made by placing thin strips of rounded bamboo side by side, and stitching or lacing them together at regular intervals with silk, flax,

camel-, yak-, or horsehair. This laced mould cover resembled a piece of matting, and was held in position on the frame of the mould by two lengths of wood, known as deckle sticks. The construction of the laid mould, as invented in China, and used subsequently from east to west, therefore consisted of three main parts: (i) the rectangular mould frame defined by four pieces of wood mortised at the corners, with a number of wooden crossbars or ribs; this structure supported (ii) the mould cover made of closely juxtaposed lengths of bamboo, laced together by lines of stitching at intervals; this cover was held onto the supporting mould frame by (iii) two deckle sticks.[16] An impression of the bamboo, reed or grass strips, hair or silk stitches, was left in every sheet of paper made upon the mould. The marks or indentations made by the pieces of bamboo are referred to as laid lines; the less noticeable impressions of the stitches are termed chain lines.

As with the wove mould, the entire laid mould was placed into the solution of pulp, and drawn horizontally upwards and out of the water, leaving a quantity of macerated fibres on its surface (figure 1).[17] Paper stock was prevented from flowing beyond the top and bottom edges of the mould covering through the inclusion of bamboo rods laced to the mat at its extremities, parallel with the laid bamboo strips. The flow of pulp to the right and left was restricted by the deckle sticks, held parallel to the chain stitching. The four outside edges of the mould were positioned and secured in such a manner that flow of pulp was contained, and sheets of paper were formed almost to the size of the mould covering.[18]

The mould cover could not only be separated from the mould frame, but was flexible along one axis (parallel to the laid lines), and could be rolled as a result. Thus when the wet sheet of paper had solidified sufficiently – indicated by a distinctive lustre over its surface – the cover or laced matting could be removed from the frame and turned upside-down. The newly formed sheet of paper was removed from the mould by placing the upturned matting on a flat surface, and rolling it away from one long edge to the other, leaving the sheet, flat and unwrinkled, on the surface below (figure 2). This action, known as couching, was completed in a single, quick, deft motion.[19] Thumb and finger imprints can, on occasion, be identified at the outer edges of a sheet of paper, made by the coucher whose hands, gripping the side of the mould, extended onto the moist sheet of paper leaving their mark on the highly impressionable surface below.

The materials of mould construction

Chinese sources are silent about the construction of the mould in the earliest years of papermaking, but without a doubt, bamboo was the primary material

Figure 1

Papermaking in Rajasthan: removing the the laid mould from the vat of fibre stock. An even layer of macerated fibres remains on the surface of the mould, following the movement of the mould from left to right and back to front.

Photo: Barbara Macfarlane, Khadi Papers, Chichister

Figure 2

Papermaking in Rajasthan: couching the newly formed sheet on to a stack (post) of paper beneath.
Photo: Barbara Macfarlane, Khadi Papers, Chichister

for the mould cover, and was employed almost exclusively for papermaking in the Far East. This is corroborated by an illustration and description of a mould in the work of Sung Ying-Hsing of the late Ming dynasty, where reference is made to the use of bamboo for the flexible cover.[20]

Through the analysis of dated samples of paper, it is evident that both wove and laid moulds were familiar to the early papermakers in Samarqand in the middle of the 8th century AD. But although a number of papers reveal no clearly differentiated laid or chain lines, and would appear to have been made on a type of wove mould, it seems that the vast majority of papermakers employed laid moulds from an early date; the more elementary wove mould was resorted to infrequently. This is not surprising: by the time of the introduction of papermaking into Persia, the use of the laid mould was fundamental to the Chinese, and the Persians were more likely to have started making paper on this mould, rather than wove. This proposition can be supported by the observation that the vast majority of papers examined show laid mould markings only. Although some papers initially appear to be wove, laid lines are generally revealed on closer inspection (evidence of the method of manufacture is usually disguised by poor quality pulp). Bamboo was not readily available and therefore generally not used for mould construction. In Samarqand and further west into the Islamic world, reeds and dried grasses were the preferred materials for the construction of the laid cover until they were replaced by metal wire. It is not known at precisely what time this change began to take place, nor where it occured, but from the analysis of dated samples, it would appear that wire moulds were available for use from the 17th century onwards.

In India, the mould cover was composed primarily of numerous lengths of dried grass laid side by side, and laced together at intervals with horsehair. The grass (*Andropogon Micranthus*) grows abundantly in India and is still popular today as a practical papermaking surface. In Spain, vegetable filaments were used for mould construction for a relatively short period of time. A papermaking industry was established by the Moors in the 12th century, and it is thought that wire (initially probably iron) replaced the natural fibre moulds shortly after. Metal was used in precisely the same manner as the vegetable matter, and the wires also impressed laid and chain lines in all sheets of paper formed upon them, reproducing almost in counterpart the lines left by the bamboo moulds. Hand in hand with the change from vegetable to metal, came the move in Spain to a mould cover that was fixed permanently to the mould frame.[21] This early Spanish fixed mould lacked sufficient supporting struts or ribs to bear the weight and hydraulic pressure of the water and

pulp draining through its cover; as a result, the wires sagged, and distorted mould marks were produced at the centre of the sheet. But later, with the addition of supporting ribs, this Spanish-style mould became dominant throughout Western Europe.

Drying

Sheets of paper made on the relatively elementary wove mould were left to dry on the woven textile upon which they had been formed; removal of the newly formed sheet from the mould was not possible whilst the paper was still wet. The laid mould, with its independent and flexible mould cover, facilitated the separation of the moist sheet from the screen and its transfer to a flat surface in order to dry. Once removed from the mould, the paper could be dried in any one of a number of ways: spread flat against boards or, as is customary in Bengal today, against smooth metal plates; brushed against smooth masonry walls in the sun; laid across ropes or poles spread upon the ground; hung upon drying lines, as washing is dried in the sun. The manner in which a sheet was dried can often be determined through the examination of imprints remaining on its surface. Paper dried upon a plaster wall, for example, has a slightly rough and textured surface on one side (figures 3, 4); sheets dried on wooden boards or metal plates, on the other hand, are considerably smoother, and in the case of the metal plates, noticeably glossy on the side once against the plate. Papers hung upon lines contain the impression of the line over which they were draped, generally identified at one edge.

The method of drying sheets of paper on walls or other flat surfaces is alluded to in what is believed to be the first literary mention of papermaking, a poem by the 12th-century poet Manuchihri Damghani, who likens a paper workshop to a snow-covered desert,

> The land from Balkh to Khavaran has become like the workshop of Samarqand. The doors, roof and walls of that workshop are like those of painters or paper makers.[22]

This simile derives from the fact that the wet sheets of paper were hung on the walls or spread on the ground to dry, with a large area needed for the purpose.

In the Islamic world, the technique of couching one sheet upon another to form a stack or post was also practised (figure 5). However it was not customary to interleave newly formed sheets of paper with felt, or a similar compact and matted substance of hair or wool, as in the Western tradition. Considering the extensive use of felt in the Central Asian Steppes for clothing, tents, saddles and other items, this is somewhat surprising. But perhaps the technique was simply not known.[23] Stacks of paper were placed vertically on boards or walls to dry: moisture and cohesive forces ensured that the sheets did not sep-

Figure 3

Papermaking in Rajasthan: sheets of paper drying upon plaster walls.
Photo: Barbara Macfarlane, Khadi Papers, Chichister

Figure 4

Detail of Qur'an leaf, Syria or Egypt, mid 16th century. The paper retains the imprint of the plaster wall upon which it was dried.

Photo: Don Baker

arate and fall; they could be left until dry, and then peeled away individually. Alternatively, a large stack of newly formed sheets could be pressed using a lever and stones to remove excess moisture, such that the weight of the unit was reduced tenfold. The pressed sheets would still have required further drying, and it is probable that they were left as a stack to dry completely; to encourage a more rapid process, the stack could have been broken down into smaller units or spurs. Either way, excessive cockling or curling of the papers could be avoided. After pressing, the now homogeneous sheets could be separated, one from the other, without tearing.

The Indian tradition of drying paper upon lines is corroborated by the illustration of crafts and trade in the aforementioned Kashmiri manuscript.[24] Although it is not known to what extent this method of drying was practised in the Middle East and Persia, it is unlikely that it was employed for papermaking on a large scale: if pressed sheets are separated and hung on a line to dry, a smoothness comparable to that resulting from the process of drying as a stack, or upon a flat surface, cannot be achieved.

Sizing

The process of sizing, by which a sheet of paper is strengthened and made impervious to ink, has a history of use dating back to early Chinese papermaking. In the East, the earliest methods of sizing involved covering the surface of sheets with a thin coating of gypsum or gum tragacanth. Later, a rice-based starch was used, obtained through straining boiled rice through a piece of clean linen, and collecting the starch-filled water beneath. In the Islamic world, solutions of rice and wheat were the most popular form of sizing, with reference to their use in a verse by Suzani Samarqandi (d. AH 562/ AD 1166–7), who compares the bright waterproof feathers of the stork with sized and burnished paper, 'He saw feathers of the stork as polished and glazed paper.'[25]

One way of adding size to the paper was by brushing the solution onto both sides of the finished sheet of paper. From the extract below, it would appear that the paper was moist prior to the introduction of size, presumably because fibres in their wet state are swollen, and more receptive to the addition of water-based mediums. It is possible, therefore, that newly formed sheets, if placed on a wall or similar flat surface to dry, could have been sized whilst in this position: sizing in this manner would have prevented the curling of the sheet with the introduction of the starch. This process was mentioned by Qadi Ahmad, quoting a poem by Mawlana Sultan 'Ali,

On āhār *paste*
Prepare the *āhār* paste from starch.

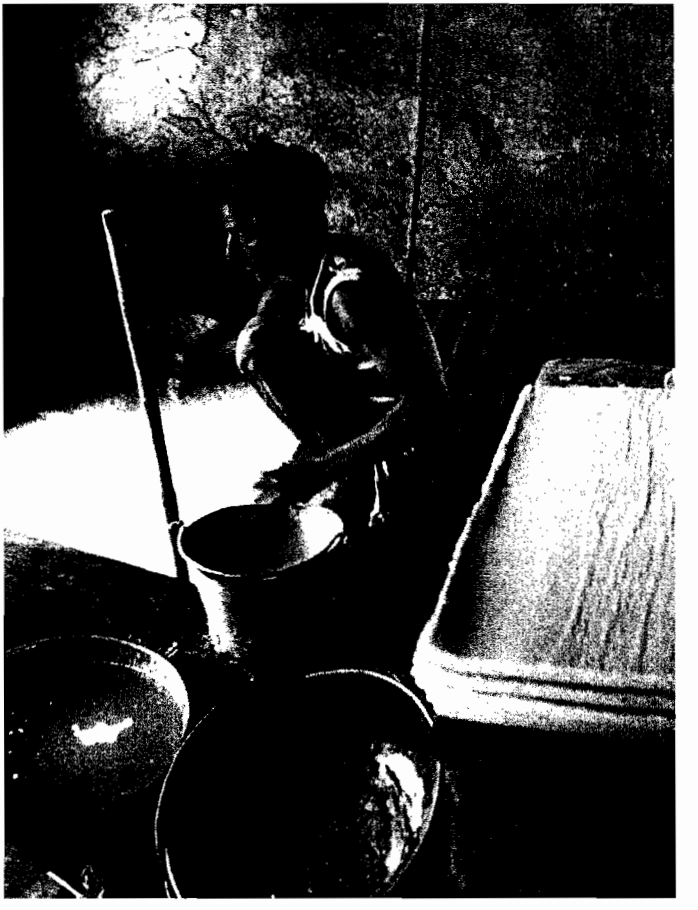


Figure 5

Papermaking in Rajasthan: sheets of paper placed one upon the other to dry as a stack.
Photo: Barbara Macfarlane, Khadi Papers, Chichister

Learn these words from an old man (repeating) ancient words.
First make a paste, then pour in water.
Then boil this for a moment on a hot fire;
Then add to this starch some glue (*li'āb-i sirish*).
Strain [so that it is] neither too thin nor too thick,
Spread it on paper and see
That the paper should not move from its place;
When you are applying *āhār* to your paper
Moisten the paper slightly with water, carefully.[26]

Alternatively, the whole sheet could be dipped into a tub of size, giving the paper an inherent strength and durability, and an evenness of size distribution throughout. In the West, this became a popular method of sizing, and was referred to as tub sizing; but with regard to sizing in the East, relatively little is known, and any information that we have refers to the method of sizing with a brush. Although it is extremely difficult to distinguish papers according to how they were sized, it would appear that this first method was preferred; by brushing the size onto the sheet, the papermaker could control the quantity of size on the paper's surface, and therefore determine the nature of the paper's finish with precision.

In order to produce a smooth and glossy surface, the sized sheet was burnished with one of a number of implements upon a flat surface (figure 6).[27] According to Qadi Ahmad, quoting the poem by Mawlana Sultan 'Ali mentioned above,

On polishing paper
The paper must be polished so
That no creases appear in it.
The board for polishing should be wiped clean
With a strong hand, but neither hard, nor softly.[28]

The choice of burnishing implement appears to have varied from region to region, with the most widely mentioned being agate and onyx; glass was used relatively infrequently. A Mughal description of the production of books includes the illustration of a pestle-like tool with a stubby handle and broad rounded base.[29] In Turkey, large oval glass balls were employed, as was an implement comprising a bar of wood holding a rectangular piece of hard polished stone (such as agate) with rounded edges.[30] The latter is still used today by paper marblers and calligraphers.

Sizing and burnishing were carried out either by the papermaker or by the paper dealer, and occasionally by the scribe or calligrapher himself. The twin processes not only imparted strength to the paper, but made its surface more suitable for use as a writing material. On the one hand, the starch, gypsum or

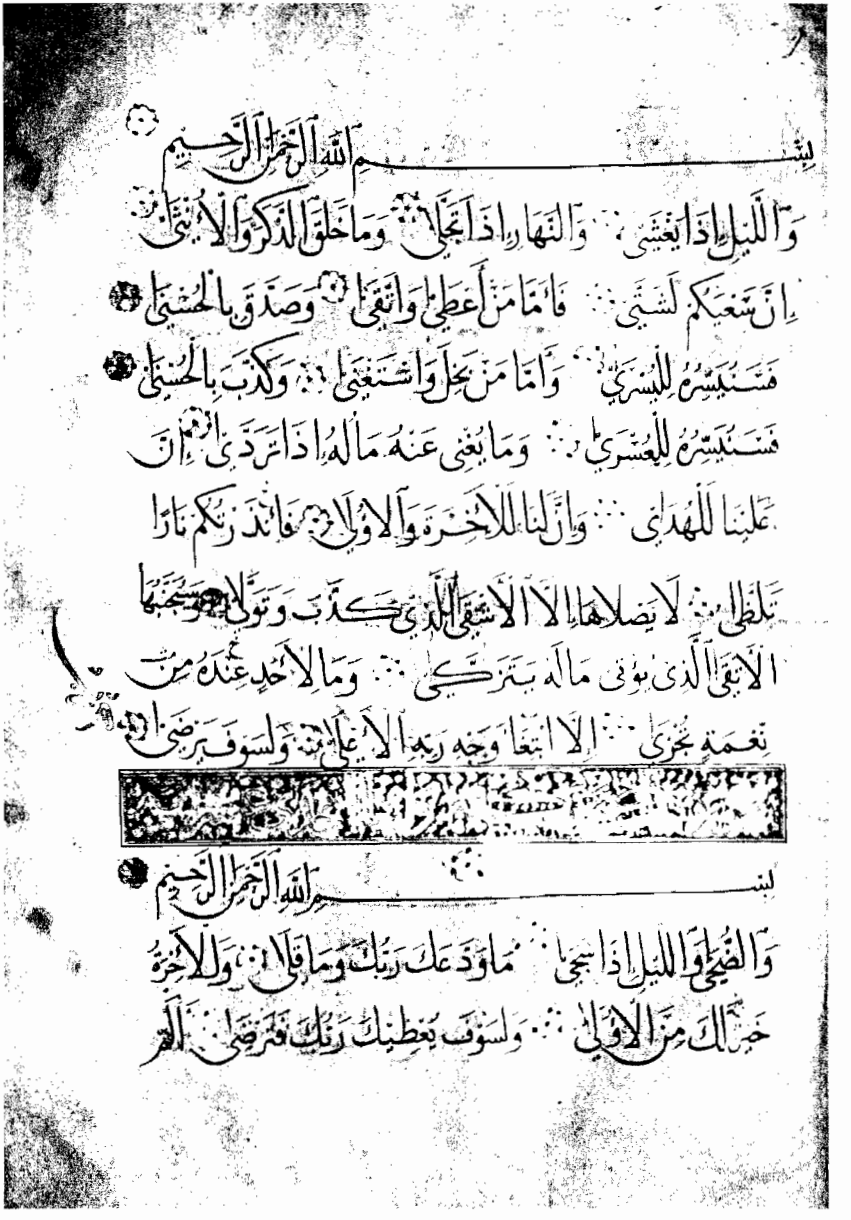


Figure 6

Qur'an leaf, Egypt or Syria, late 15th century, showing a high degree of surface gloss resulting from the twin processes of sizing and burnishing.
Photo: Don Baker

Figure 7

Detail of a Qur'an leaf, Egypt or Syria, mid 14th century AD. The delamination of the paper is a result of (i) a low degree of interfibrillar bonding within the web of the sheet, and (ii) the creation of two distinct sides of the sheet through sizing and burnishing practices.

Photo: Don Baker

gelatine (as used in the West) rendered the finished sheet relatively impervious to ink such that the text, illumination and illustration did not sink into the fibre network. On the other hand, as a result of both processes, a smooth, compact surface was produced upon which it was easy to write. This surface was a prerequisite for inks developed for parchment surfaces, and for which pen types and calligraphic styles had evolved, and was favoured by scribes and calligraphers centuries after the decline in popularity of parchment as a writing material. Sizing and burnishing also helped to improve the overall appearance of the sheet, and the use of poor quality pulp in the manufacturing process could be disguised with judicious craftsmanship. The discovery of a clumsily-made, unrefined paper beneath a layer of sheen is not unusual.

It is a misconception, however, that the process of sizing and burnishing promoted greater opacity and whiteness in the resultant sheet. If anything, the twin processes increased the paper's translucency, and rendered it considerably duller in colour: if the passages between the fibres that make up the paper's structure are filled with a liquid, light cannot scatter and reflect, and it is this constant scattering that promotes opacity and whiteness.[31] Thus it is possible to see through a sheet of paper when wet, but not when dry. In order to increase a paper's opacity and colour, a mineral filler, such as china clay, calcium carbonate or titanium dioxide, must be added to the paper when in pulp form. To my knowledge, there is no history of use of such fillers in the Middle Eastern and Persian craft of handmade paper.

1. Gaur 1979, p.30.
2. According to the definitions given in the same ancient lexicon and its commentaries by later scholars, *hsü* means fibrous remnants obtained from rags or from boiling cocoons, and *chan* refers to a mat made of interwoven rushes used for the covering; see Needham and Tsien Tsuen-Hsuin 1985, p.35.
3. The bond between fibres in a dry sheet of paper is, however, drastically loosened by water; consequently, a wet sheet of paper has a greatly reduced strength by comparison.
4. British Paper and Board Maker's Association 1950, p.28.
5. Ibn Badis, trans. Levey 1962, p.39.
6. Although Arabic books had been printed in Italy before the end of the 15th century, the first book to be printed in the Islamic world was not until 1825, when the first press was established in Cairo; see Carter, revised Goodrich 1955, p.151.
7. For further information about the raw materials of the earliest Chinese papers, see Needham and Tsien Tsuen-Hsuin 1985, pp.52–64.
8. Pedersen, trans. French 1984, p.67; Bosch, Carswell and Petherbridge 1981, p.28.
9. Bosch, Carswell and Petherbridge 1981, p.28.
10. Ibn al-Nadim, quoted in Pedersen, trans. French 1984, p.61.
11. Ibn Badis, trans. Levey 1962, p.39.
12. Personal communication with Sarah Bertalan, Department of Paper Conservation, The Metropolitan Museum of Art, New York.

13. Ibn Badis, trans. Levey 1962, p.39.
14. British Library, Oriental and India Office Collections, Add.Or.1699, folio 41a; illustrated in Bosch, Carswell and Petherbridge 1981, p.21, colour plate A.
15. Hunter 1947, p.78.
16. Bosch, Carswell and Petherbridge 1981, p.29.
17. It is probable that this technique was used in preference to the practice of pouring the fibre solution on to the mould, although it is not known to what extent, and from which period, it was favoured. Nevertheless, when papermaking was introduced into Muslim Spain in the 12th century AD, the technique of dipping was employed exclusively, as it would be later throughout Western Europe.
18. Hunter 1947, p.86.
19. To couch, from the French verb *coucher* ('to lay down'); Old French *colcher*, from *colchier*; from the Latin *collocare* ('to place').
20. Needham and Tsien Tsuen-Hsuin 1985, p.67.
21. Bosch, Carswell and Petherbridge 1981. p.29.
22. Afshar 1995, p.79.
23. It is equally possible that Middle Eastern and Persian moulds differed sufficiently from Western examples, that sheets were freed with greater ease from the former, and felts were not needed to provide a means of attraction for the paper.
24. See p.33 and note 14, above.
25. Afshar 1995, p.86.
26. Qadi Ahmad, trans. Minorsky 1959, p.114.
27. Sheen could equally, if accidentally, be imparted to paper through its method of drying against a smooth wooden board or metal plate. A distinct gloss was imparted to the side of the sheet brushed against the wood or the metal; consequently it is not unusual to find one sheet of paper with two sides of differing sheen.
28. Qadi Ahmad, trans. Minorsky 1959, p.114.
29. Smithsonian Institution, Washington DC, no.54.116; reproduced in Bosch, Carswell and Petherbridge 1981, p.36.
30. Bosch, Carswell and Petherbridge 1981, p.37 and fig.2.
31. See above, pp.30–31.

CHAPTER FOUR

Qualitative Characteristics of Islamic Paper

The techniques and materials employed by the papermaker constituted the essence of his craft. But if the fundamental principles of papermaking differed little from East to West, the manner in which techniques were practised varied greatly, ensuring that a sheet of paper was unique to the person or mill who produced it. Not only was there a marked variation in paper characteristics from sheets produced in different regions, towns and mills, but often a noticeable difference in quality of paper produced by the same hand.

Determination of Quality

To a large extent, paper quality is determined by fibre type. On the basis of their location in the plant, fibres are classified roughly as follows: seed hair (cotton and linen); bast fibres (flax, hemp, jute, ramie); wood fibres (coniferous and deciduous woods); leaf fibres (esparto, manila, sisal); and grass (straw, bamboo, bagasse, maize stalks). Traditionally, Islamic papers were made from a combination of linen and hemp, imparting softness, strength, bulk, opacity, purity, durability and absorbency to the sheet. As with the earliest European papers, they were typically of high quality and tended to deteriorate little over time.

Quality of paper is determined equally by the manner in which the raw materials are beaten. Absorbency and strength are directly related to the extent to which fibres are separated and fractured: through the partial removal of the outer cellulosic wall, fibres increase in surface area and flexibility, and bond more readily with neighbouring matter. The greater the area of contact between the fibres, the greater the degree of bonding; the greater the degree of bonding, the stronger and less absorbent the sheet. In the Islamic world, satu-

rated pulp was not beaten extensively and, consequently, the papermaking fibres remained little modified: some were split, but extensive fibrillation was rare, and clumping of fibres was common. Thus Islamic paper will readily absorb moisture, and is prone to water staining. Cellulose fibres are affected by changes in moisture content, as reflected in the dimensional instability of paper, and if a sheet of paper becomes wet and is then dried, its strength is affected permanently.

Paper durability is dependent upon the composition of the sheet, the manner in which it is made, and the environment in which it is produced and housed. Islamic papers were typically long fibred due to the nature and characteristics of linen and hemp, and the restrained beating of the paper stock. Thus, although Islamic paper has a good tensile strength, and is not easily torn, it is easily abraded, and can be split in the plane of the sheet (figure 7).[1] However, the addition of size to the sheet helped to enhance the bonds between the fibres, ensuring that its internal structure relaxed little over time, and was hardly affected by folding or excessive handling. Mineral fillers were not added to the pulp, and lignin, the complex organic polymer that is largely responsible for the acidic breakdown of wood-based papers, was absent from the sheet. Essentially, there was nothing inherent in the paper to promote or accelerate its deterioration, and through the addition of lime during the maceration process, the paper was further protected from acid degradation. Pollutants which are contributory to the acidity and breakdown of paper, such as sulphur dioxide, oxides of nitrogen, hydrogen sulphides and ozone, were barely present in Persia and the Middle East prior to industrialisation. Daily cycling of temperature and relative humidity, known to be detrimental to the physical properties of paper, was equally untypical.

Grade

Papers were categorised in terms of grade and usage, and labelled accordingly. With regard to quality, we find Persian terms such as *kāghaz-i daftarī* ('common paper'); *kāghaz-i khām* ('raw or unrefined paper'); and *kāghaz-i kāhī* ('straw paper', meaning poor quality sheets). With regard to the method of production and intended use, there are terms such as *kāghaz-i āhār muhrah* ('glazed paper'); *kāghaz-i barqī* ('glossy paper'); *kāghaz-i taḥrīr* ('writing paper'); *kāghaz-i charb* ('smooth paper'); and *kāghaz-i mashq* ('exercise or calligraphy paper').[2] Terminology also referred to the place of manufacture – for example Isfahani, Baghdadi, Dawlatabadi, Samarqandi, Shami, and Hindi. Of these, Samarqandi was the most famous, with reference to it from the 10th century AD onwards,[3] and to quote a poem by the calligrapher Mawlana

Sultan 'Ali, written *circa* AH 1015 (AD 1606–7),

> *On Paper*
> There is no paper better than Chinese (*khiṭā'ī*),
> However much you may try.
> Saffron, henna, and a few drops
> Of ink are (the means of the test?).
> Until then, do not approve!
> How good is Samarqand paper!
> Do not reject it, if you are wise.
> Writing upon it comes clearly and well,
> But the paper should by clean and white.[4]

Paper could equally be named after the rulers or high officials governing the province where it was produced. *Al-sulaymānī* paper was probably named after Harun al-Rashid's controller of finance in Khurasan; *al-ja'farī*, after Ja'far ibn Yahya, vizier of Harun al-Rashid; *al-ṭālḥī*, after Talha ibn Tahir, governor of Khurasan in AD 822–828; *al-ṭāhirī*, after Tahir ibn 'Abdallah, governor of the same place in AD 844–862; and *al-nūḥī*, after the Samanid Nuh ibn Nasr, who ruled over Transoxania in AD 942–954.[5]

Colour

Paper is naturally off-white in tone. Through the addition of a colour, either by brushing or dipping the sheet, the Islamic papermaker could alter the appearance of his product dramatically. His delight in colour, and that of contemporary calligraphers and readers, is identified in the many and varied decorated pages of manuscripts produced across the centuries. There is no record of colour being added to the pulp in the initial stages of papermaking, and cross sections taken from coloured sheets show that the interior fibres are whiter in tone than those on the surface, indicating a preference for applying colour after the formation of the sheet. A range of colours was available to the papermaker, these being either simple or compound in composition. Blue was generally produced from indigo or aloe; yellow from saffron and lemon; red from the dissolved bodies of the mealy bug; olive green from blue with saffron added; green from saffron with verdigris; and violet from blue and red. Popular colours included *āl* (reddish-yellow), *ḥinnā'ī* (reddish orange), *līmūnī* (lemon green), *fustuqī* (pistachio green) and *nukhūdī* (buff).[6] According to Ibn Badis,

> The red in dyeing is of many types. In one, the best possible sapanwood is taken. There are two types: one is the "little" and the other is the "princely". An ounce is taken of the powder. It is immersed in water a night or a day. It is then put into a copper pot, a clean utensil. On it is poured ten ratls of the best powdered, sieved wild galī. It is then boiled on a good

fire until half the water is lost. The essential of the process is that a rod is left in it. Drip it on your thumb. If it remains and does not drip, then it is successful. It is taken down and purified. If desired, this may be repeated on that type which is sold. The first is the better of the two. It is left until it cools. Then dye with it. For dyeing, paper is put in the solution with care and then spread in the shade.[7]

Colouring of paper was carried out for a number of reasons: for aesthetic effect; for symbolic significance; or for the comfort of the reader. Blue was equated with mourning, such that orders for the death sentence were issued to criminals on blue paper in Syria and Egypt. Red could symbolise humanity, and was used frequently when presenting petitions for justice; it equally symbolised festivity and joy, and for this reason light red and rose-tinted papers were particularly popular. A full red colour was considered a prerogative in official correspondence of individuals of high rank, or on whom special favours had been bestowed.[8] Pure white was believed by some to be harmful to the naked eye, and colour was required to reduce the glare of paper in bright light. On the merits of coloured paper, Mawlana Sultan 'Ali writes,

The color of paper best for writing
There is no better color than that of Chinese (*khiṭā'ī*) paper.
There is no need for you to test:
Writing on it is good, it is also good for gold,
It is excellent and it embellishes good writing.
For writing slightly tinted (*nīm-rang*) paper is suitable,
That it should be restful to the eye.
The red, green, and white colors
Strike the eye, like looking at the sun.
Darkish colors suit colored writing.[9]

Size of sheet

From the advent of papermaking, a degree of standardisation of terminology existed with regard to the size of paper produced. Usually a single sheet was known as *darj*, plural *durūj*, and a page was *qarṭās* (the European *Charta*), plural *qarāṭīs*.[10] Al-Qalqashandi mentions nine different types and sizes of papers. Of these, the best quality was the full-size *baghdādī* (1099 × 733 mm), used for writing the caliph's documents and treaties; the *shāmī* ('Syrian') was of various grades and sizes, one of which – the *ḥamawī* – was used in governmental departments. Among the remaining grades was the lightweight *waraq al-ṭayr* ('Bird's Paper', measuring 91 × 61 mm), so-called because it was thin enough to be sent by carrier pigeon.[11]

Nine theoretical sizes of paper have been suggested by Joseph von Karabacek, the three most popular measuring 290 × 420 mm, 420 × 580 mm

and 580 × 840 mm.[12] On the basis of these measurements, Jean Irigoin has noted the following: first, paper sizes were the same in Egypt and Syria; second, the width of the finished sheet is two thirds its length; and third, the width of the sheet is the same as the length of the size of sheet immediately below it, as the measurements above show.[13] This standardisation of size was ingenious as it permitted the use of different formats by appropriate folding of the sheets.[14]

Echoing the sale of papyrus, sheets of paper were occasionally pasted together and sold in large rolls from which the user cut suitable pieces. It was more usual, however, for the buyer to receive sheets in the format in which they emerged from the frame, and this could vary widely. The sheet was folded to size, and 20 such standard sheets were called *dast* ('hand') in Persian, translated into Arabic as *kaff*, and heard in the French expression, *main de papier*. Five 'hands' were called a *rizmah* or 'bundle', a term which is used extensively in the West: in English, ream; French, *rame*; German, *Ries*; and Danish, *Ris*.[15]

Watermarks

The practice of transferring insignia into a sheet of paper through incorporating a twisted wire or cord motif in the construction of the mould, was unknown in the Islamic world. This may be due to the fact that the moulds were flexible, and the flexing action of the screen would have inhibited the durable attachment of such a device.[16] It is equally possible that this method of marking paper was not known. However, the distribution and grouping of laid and chain lines present in a sheet can be measured and categorised to some extent. Patterns in chain-line groupings in Syro-Egyptian papers are distinct and often highly individual. In Persian papers they are rarely seen, although it is unlikely that chain lines were altogether absent from the mould's construction: only through the inclusion of silk or animal hair stitching could grass moulds be given support. If it was the case that in Persia any additional stitching was not intended to be seen, we can assume the opposite in Syria and Egypt. It can be argued that although we do not know the extent to which these markings were intended as a means of classification and identification, design was intentional and evidently served a purpose.

It was only in Spain that anything approaching a Western watermark was found. However this was still not a true watermark, but a zig-zag indentation running from the head to the tail of the sheet, or a series of overlapping diagonal crosses, drawn with a brush or a pointed implement while the newly made

paper was still moist. Markings such as these are found in papers produced in the regions of Valencia and Catalonia in the 12th to mid-14th centuries AD, and are also included in papers used in Fez, Tunis, Tlemcen and Ceuta. The latter indicates the close trade connections between the Valencia/Catalonia regions and the Maghrib. The practice of marking sheets of parchment with pricks and knife marks in order to identify the parchment maker or tanner was common in the Middle Ages, and the continuing use of this device in modern-day Morocco may shed some light on the significance of the marks.[17] It is interesting to note that the oldest example of the zig-zag pattern is found in the aforementioned codex of Sibwaili's *Gramatica*.[18] Pages of paper alternate with those of parchment, and both are marked with the same pattern. But other than what we can interpret from this, very little is known about this very particular Spanish practice.[19]

1. In China, there is a tradition of producing laminated paper composed of anything up to four fine sheets, but in the Islamic world this is unusual. Papers manufactured in the Middle East and Persia have a tendency to delaminate due to the creation of two distinct sides of a sheet of paper, resulting from sizing and burnishing practices. If a sheet is sized and burnished on both sides, it is possible to divide the sheet because the bonds between the fibres will break more readily than the bonds created between the fibres and the size. Delamination of Islamic papers should not therefore be regarded as evidence for the lamination of separate sheets of paper during the papermaking process.
2. Afshar 1995, p.79.
3. Afshar 1995, p.87.
4. Qadi Ahmad, trans. Minorsky 1959, p.113.
5. Huart – Grohmann 1978, p.419.
6. Afshar 1995, p.85.
7. Ibn Badis, trans. Levey 1962, pp.43–4.
8. Bosch, Carswell and Petherbridge 1981, p.34.
9. Qadi Ahmad, trans. Minorsky 1959, p.113.
10. Karabacek 1887, trans. Baker and Dittmar 1991, p.54.
11. Al-Qalqashandi, quoted in Bosch, Carswell and Petherbridge 1981, p.31.
12. Baker 1991, p.30.
13. Irigoin 1963, pp.19–20.
14. Bosch, Carswell and Petherbridge 1981, p.31.
15. Pedersen, trans. French 1984, p.67.
16. Bosch, Carswell and Petherbridge 1981, p.30.
17. Bosch, Carswell and Petherbridge 1981, p.30.
18. See above, note 5, p.15.
19. For further information, see Valls I Subira 1970, pp.3–18.

CHAPTER FIVE

Protocol for Paper Classification

As mentioned above, the aim of this research is to identify the characteristics of a sheet of paper that are significant for its classification according to its origin and date of manufacture, and to plot a chronology of these characteristics in order to evaluate trends, patterns and changes in the craft of papermaking in Syria, Egypt and Persia from the 12th century AD until the beginning of the 19th century.[1] The intention is to corroborate and add to existing research into paper typology carried out by scholars such as C.M. Briquet,[2] J. von Karabacek,[3] and M. Beit-Arié.[4]

This study has involved the analysis of the paper of 1237 dated manuscripts according to the criteria detailed below, and the subsequent collation of all information gathered. Manuscripts have been selected at random from public and private collections and libraries, and in terms of subject matter, they include Qur'ans, prayer books and religious works; scientific manuscripts and cosmographies; and a range of literary and illustrated works such as *Shāhnāmah*s and *dīvān*s (anthologies). Of the above, Qur'ans form the largest single category, totalling 18% of all manuscripts examined. There is some disparity in the percentage number of manuscripts examined from Persia (59%), compared to those produced in Syria and Egypt (41%). Greater emphasis has been placed on the former due to the difficulty in the classification of Persian papers according to chain- and laid-line distribution.[5] A lack of distinct mould markings may have contributed to the fact that, compared to Syro-Egyptian paper, relatively little is known about the manufacture of paper in Persia.

Protocol for Paper Classification

The validity and success of any systematic analysis of paper is dependent on the quantity of dated examples examined, and the existence of a standard,

objective means of describing each item. The greater the number of manuscripts examined, the more accurate and refined the final classification, providing that all have been examined in an identical fashion. Outlined below are details of the specific properties and characteristics of a sheet of paper that are significant for its classification, against which all subsequent sheets should be measured. Other relevant information should also be noted: the title, date and place of origin of each work, and the size and folio reference of each sheet of paper examined.

(i) Quality

The quality of a paper can be described as good, medium or poor. Of all the standards, this is the most subjective – an immediate impression of the degree of refinement that has gone into making the sheet, and the manner in which its surface has been subsequently treated.[6] A record of the crispness of the finished sheet is taken.

(ii) *Thickness*

Thickness is measured in millimetres with a micrometer (1 Division = 0.01mm). Measurements are taken across the sheet and from ten pages selected at random from the manuscript, in order to account for variation in paper thickness throughout the manuscript.

(iii) *Surface characteristics*

These include the natural colour of the sheet and the manner in which its surface has been treated.

– *Natural colour*: ranges from white to cream to dark cream to biscuit to brown. Papers are matched against a colour chart, making judgements about hue more objective than if left to the memory and opinion of the examiner.[7]

– *Treatment of surface*: sized (lightly or heavily) and/or burnished. Papers show considerable surface modification, particularly in respect of how much rice or wheat starch was employed for sizing purposes, and how evenly their surface was burnished to produce a gloss. As one paper will be noticeably soft, lightly sized, and with little evidence of burnishing, so the next may be heavily sized, extremely glossy, and with distinct grooves across its surface from the use of a burnishing tool.

(iv) *Quality of pulp*

This covers the distribution of the fibres and any inclusions within the sheet, together with its degree of opacity.

– *Distribution of fibres*: from uniform to floccular, examined through

transmitted light. The distribution of fibres in some papers is even, with little clumping and minimal variation in density. Other papers show distinct clouding and/or swirling of fibres, with marked clumping and great variation in density across the sheet.

– *Inclusions*: the uncharacterizable bits, specks and flecks that can be seen in a sheet of paper. A note is made of whether a paper has few or many inclusions, and whether it is noticeably fibrous in its general appearance.

– *Translucency*: from opaque to translucent, with degrees in between – in effect, the 'see through' factor of the paper.

(v) *Mould construction*

Paper moulds are either laid or wove. If the former, chain- and laid-line characteristics must be noted (see vi and vii, below).

(vi) *Chain-line characteristics*

These include a description of the individual chain lines, their alignment and the manner in which they are grouped.

– *Grouping and separation*: spaced at regular or random intervals, or grouped in twos, threes, alternating twos and threes, etc. Measurement of all intervals is taken in millimetres.

– *Direction*: horizontally or vertically aligned to the spine of the book. Chain lines run across the short dimension of the uncut sheet, their direction indicating the number of bifolia into which the sheet was divided.

– *Thickness*: from fine to approximately 2mm wide. Chain lines are matched against a series of lines of varying thickness drawn on to a sheet of Melinex,[8] the latter placed on top of the sheet of paper and both examined through transmitted light. The finest line is the width of a fine line drawn with a pencil; the thickest is approximately 2mm wide. When it is possible to measure against a ruler, this is done.

– *Clarity*: from distinct to fuzzy to indistinct. Quite simply, how well the chain lines can be seen.

– *Character*: straight, waving, or tending to deviate from their central axes. With regard to the latter, chain lines appear to be perfectly straight, but veer to the left or right at the head or tail of the sheet.

(vii) *Laid-line characteristics*

These include a number of diagnostic factors, such as the number of laid lines per centimetre, their alignment and their type.

– *Number of laid lines per centimetre*: although more accuracy is achieved through measuring the width of 20 laid lines, it is seldom possible to iden-

tify this number in one area; measurement of the number of laid lines in a smaller area would be unhelpful.
– *Direction*: horizontally or vertically aligned to the spine of the book, as above.
– *Thickness*: from fine to approximately 2mm wide, measured as above.
– *Clarity*: from distinct to fuzzy to indistinct, as above.
– *Character*: straight, 'sagging' or tending to curve at one end; at right angles to the chain lines, or out-of-square.
– *Type*: reed, grass or wire. In respect of their width and the regularity of spacing, a possible reconstruction of the papermaking mould can be proposed.

(viii) *Rib shadows*
The position of rib shadows (alternating or corresponding with chain lines) and their clarity are noted. Rib shadows – appearing as bands of greater density in a sheet of paper – are formed by the channelling of pulp in certain areas, defined by the ribs of the supporting frame of the mould. Their presence is of particular use for determining the way a piece of wove paper has been folded in the formation of a quire.

(ix) *Comments*
Any additional information about the paper which is not covered by the categories listed above; for example, greater degree of burnishing on one side of the paper than the other; marked variation in the quality of paper used throughout a book; and marbling or decoration of the paper.

1. See above, pp.7–8.
2. Briquet 1886.
3. Karabacek 1887, trans. Baker and Dittmar 1991.
4. Beit-Arié 1981, 1983a, 1983b.
5. See above, pp.61 and 64.
6. Although relative to the experience and opinion of the examiner, this is an important consideration. The vast majority of papers are categorised as being of medium quality, however some are clearly of a higher or lower grade. It is important to be able to establish why a paper appears to be either refined or crude: it is not infrequently the case that the pulp used for what would appear to be a top-quality paper, is the least well prepared of all.
7. The extent to which papers have darkened over time is unknown, but if we consider the quality of raw materials used in the papermaking process, it is unlikely that papers have changed in tone to any great extent. Paper used for manuscript production is affected very little by heat or light, and is generally indicative of original colour.
8. A chemically inert, optically clear, polyester film.

CHAPTER SIX

Summary of Findings

1. *Persian Paper*[1]

Quality and thickness

Papers produced prior to the 15th century are typically sturdy. A marked density is produced from a high quantity and compactness of fibres within the web of the sheet. Papers vary in thickness, from 0.11–0.22mm, with no mean, and apparently no standardisation of weight or grade. Paper is not heavily sized, and consequently does not have a rigidity that one might associate with its robust character. The impression is one of a strong material, not dissimilar to blotting paper.

From the 15th century onwards, paper becomes noticeably thinner, ranging from 0.04–0.15 mm, with an average thickness of 0.09mm. Papers are heavily sized and, in respect of their crispness and distinct crackle when handled, begin to take on characteristics that we might identify with brown paper.

Colour

From the 12th until the beginning of the 19th century, there is a gradual lightening in tone of most papers. At the beginning of the period, papers can range from dark cream to brown. However, from the 14th century onwards, the spectrum of colours begins to narrow, and by the 15th, papers are predominately cream, with little variation on this base colour. There is a marked shift in quality and intensity of tone at the beginning of the 19th century, with papers adopting a dull, greyish, off-white appearance. This shift in colour from cream to white is largely the result of a change in fibre stock, the quality and colour of which may have been affected by an increased use of bleaching

agents within the textile industry. A noticeable dulling of the sheets is linked to the use of considerably more sizing within and on the surface of the paper.

Surface characteristics

Papers produced during the 12th century contain virtually no size within the web of the sheet, and there is little indication of starch on its surface. Between the 13th and the 15th centuries, very little sizing is applied to the newly formed sheet of paper; if the sized sheet is burnished at all, there is very little evidence of the use of the burnishing tool. To the touch, papers are textured and slightly rough.

From the 15th century onwards, sizing is applied in ever-increasing amounts, and a layer of starch is readily seen on the paper's surface. It is probable that a density of coating is achieved through brushing the size on to the sheet, rather than dipping the paper into a vat of solution. The sized sheet is burnished extensively, but it is rare that pressure applied to the burnishing tool creates indentations or grooves in the paper. The twin processes of sizing and burnishing give the sheet a distinct sheen, and the paper is almost sticky to the touch. By the beginning of the 19th century, paper is sized to such an extent that any glaze on its surface tends to crack and craze through flexing of the sheet.

Quality of pulp

The quality of pulp of the earliest dated examples of paper varies considerably. Although evidence of the use of a refined, well-macerated fibre solution is not unprecedented, the vast majority of papers are formed from fibre stock which has not been beaten extensively, and which contains clumps of raw material and an array of inclusions. The distribution of fibres within the sheet tends to be uneven and floccular. This quality of pulp characterises papers dating from the 12th century until the end of the 14th (figure 8).

From the 15th century onwards, improvement in the quality of pulp is marked. There is a greater uniformity of fibre distribution, and a reduction in the quantity of inclusions within the sheet.[2] Whole individual fibres are visible with increasing regularity, both on the surface of the paper and in the web of the sheet, as seen through transmitted light. These fibres are distinct, and can measure up to 2 cm in length.[3]

Papers from the 16th and 17th centuries are extremely fibrous – that is, the number of individual fibres that can be identified per square centimetre is higher than in previous centuries (figure 9). This is due to improved beating techniques, resulting in a reduction in the tendency of fibres to clump. A large number of papers dating to the 17th century contain flecks of very small par-

ticulate matter, giving the sheet a speckled appearance. This phenomenon is not seen in papers dating to any other century.

Translucency

The degree of paper translucency is dependent on three factors: the thickness of the sheet; the density of fibre distribution; and the quantity of sizing within the fibre structure. From the 12th century onwards, papers become more translucent, corresponding with a decrease in thickness of sheet, and an increase in surface sizing. Although early papers tend to be virtually opaque, some exhibit a high degree of translucency, due to an uneven distribution of fibres within their structure. It is important to note that a thinner paper can be more opaque than a thicker sheet if the quantity of sizing applied to the latter is greater.

Mould construction

Papers produced in Persia from the 12th century onwards are predominantly laid. Of the total number of dated examples examined, only 3% were made on a wove mould. Due to the highly dense and/or fibrous nature of many sheets, identification of mould markings is difficult, and it is easy to mistake a laid for a wove paper. But in the vast majority of cases, laid lines are identified on close examination of the sheet through transmitted light. Mould markings are often more pronounced in areas of degradation or discolouration.

From the 12th until the end of the 14th century, papermaking moulds were constructed of either reed or grass. Reed moulds typically contained between 5 and 7 lengths of reed per centimetre, measuring between 1–1.5 mm (occasionally 2mm) in width. Laid lines identified in the sheet of paper are straight, with very little curve.[4] No chain lines or rib shadows are visible.

Papers formed on grass moulds from the 12th until the 15th century ordinarily contain 7 to 8 laid lines per centimetre, of up to 1mm in width. Laid lines can waver, and there is often a noticeable curving of the line at its head or tail, corresponding to one edge of the sheet of paper (figure 10). From the 15th century onwards, the number of laid lines per centimetre increases to between 8 and 10, and there is a corresponding decrease in width of line of approximately 0.5mm. Papers produced towards the end of the 18th century characteristically contain up to 16 laid lines per centimetre. These lines are distinct, fine and very straight, and point to the use of wire moulds for the manufacture of the sheets.

Persian paper is not generally associated with the inclusion of chain lines within the sheet. But although these supporting lines are not readily visible, their absence should not be assumed. From the 13th century until the end of

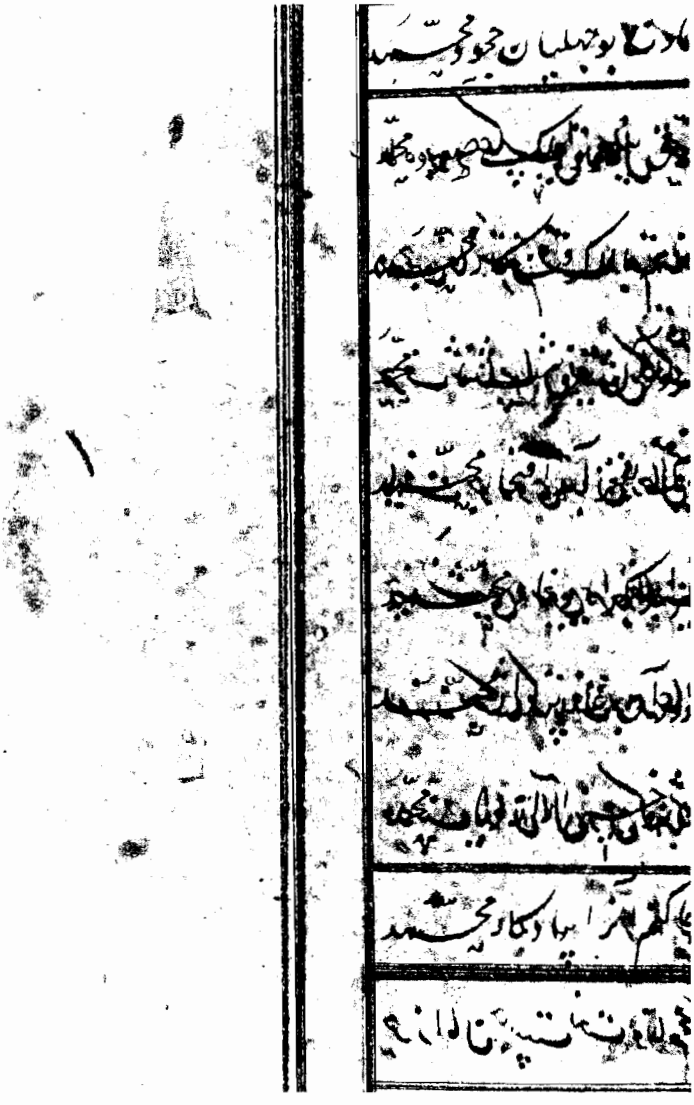


Figure 8

Detail of a manuscript leaf, Persia, late 14th century AD, showing uneven distribution of fibres within the sheet; clumping of fibres; some inclusions.
Photo: Helen Loveday

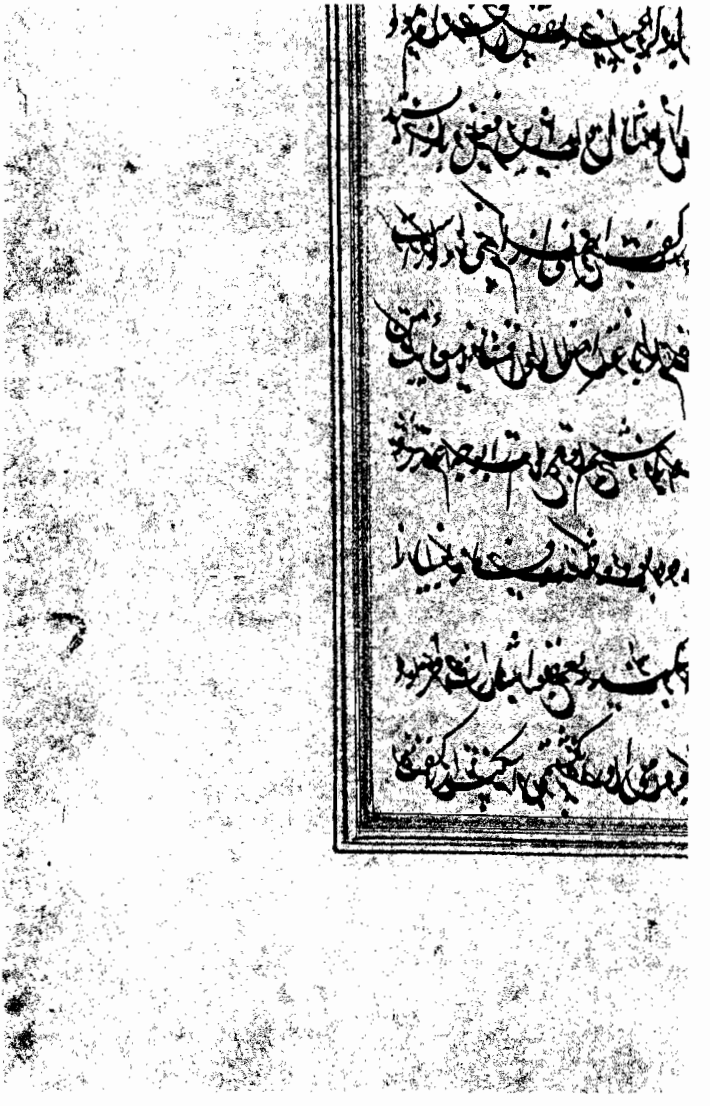


Figure 9

Detail of a manuscript leaf, Persia, late 16th century. The well beaten pulp has resulted in a fibrous paper of even fibre distribution.
Photo: Helen Loveday

the 17th, chain lines can be identified, although their appearance is sporadic, and whole lengths are rarely seen. When visible, chain lines are spaced at regular intervals of 15, 25 and 30 mm across the sheet (figure 11), or arranged in pairs. With regard to the latter, the distance between the chain lines is approximately 15 mm, and the interval between the pairs approximately 45 mm. A surprising 20% of papers examined contained an impression of one of the above arrangements. None of the papers examined contained rib shadows.

11. *Syro-Egyptian Paper*

Quality and thickness

Papers originating from Syria and Egypt are characterised by their sturdy and durable nature. As with Persian paper, density is produced from a high quantity and compactness of fibres within the web of the sheet. From the 12th until the 18th century, papers are consistently strong. Although there is some lessening of density from the 15th century onwards, papers never achieve the crispness associated with their Persian counterparts. There is a marked variation in thickness of sheet, with papers ranging from 0.04 mm – 0.30 mm over the 700 years covered by this survey. An average thickness of between 0.15–0.20 mm can be tentatively ascribed to all centuries.

Colour

The variation in colour of Syro-Egyptian paper mirrors that of Persian paper. From the 12th century until the end of the 18th, there is a gradual lightening in tone of most papers.[5] At the beginning of the period, papers can range from dark cream to a brown hue. From the 14th century onwards, the spectrum of colours begins to narrow, and by the 15th, papers are predominately cream, with little variation on this base colour. There is no change in quality and intensity of tone of papers manufactured at the end of the 18th century and beyond.

Surface characteristics

Through the introduction of slightly more sizing at an early date, papers are initially smoother than those originating from Persia. However, from the 13th century onwards, there is no marked increase in quantity of sizing applied to the sheet, and papers retain a degree of softness as a result. Papers are burnished, but again to a lesser degree than Persian papers. The marks of the burnisher's tool are virtually never seen, and papers are rarely glossy.

Quality of pulp

At the beginning of the 12th century, papers are generally formed from relatively poor fibre stock: fibres are not beaten extensively, and the pulp contains

Figure 10

Detail of a manuscript leaf, Persia, 16th century, showing the curving of laid lines away from the central axis at folio edge.
Photo: Helen Loveday

clumps of raw materials and an array of inclusions. As with Persian paper, the distribution of fibres within the sheet tends to be uneven and floccular, and paper has a distinct mottled and patchy appearance. By the middle of the century, there is a noticeable improvement in the quality of pulp: though fibrous, with whole individual fibres seen within the sheet and on its surface, it becomes more uniform, and contains fewer inclusions; . However, there appears to have been little refinement of the process of maceration from the end of 12th century onwards, and papers never achieve the uniformity of fibre distribution characteristic of Persian paper from the 15th century onwards.[6]

Translucency

From the 12th century until the end of the 18th, Syro-Egyptian paper becomes increasingly translucent, but not to the same degree as Persian paper form the 15th century onwards. This is due to the fact that papers are somewhat thicker, and not as heavily sized.

Mould construction

As with Persian paper, paper produced in Syria and Egypt from the 12th century onwards is predominantly laid. There appears to be little tradition of the manufacture of paper on wove moulds, with only 0.5% of the total number of dated Syro-Egyptian manuscripts examined showing no laid-line markings.

In the 12th century, paper was formed on moulds constructed of either reed or grass. The reed mould used by the Syrian and Egyptian papermakers was identical to the reed mould of the Persian craftsmen. Papers therefore generally contain 5 to 7 straight laid lines per centimetre, of between 1–1.5 mm in width. There are no chain lines or rib shadows. From the beginning of the 13th century onwards, grass moulds were used with greater frequency; as a result, papers made on reed moulds from the 14th century onwards are rarely found, if at all. This is in contrast to Persian papermaking, where the use of reed moulds ran side by side with that of grass until the beginning of the 15th century.

With regard to the quantity and quality of laid lines visible in the sheet, grass moulds used in Syria and Egypt from the 12th century onwards were very similar to Persian moulds of the 15th and 16th centuries. Papers therefore contain an average of 7 to 10 laid lines per centimetre, of between 0.5–1 mm in width. Lines are distinct and fairly straight, although there is some curving at the head or tail. From the 16th century onwards, there is a slight increase in the number of laid lines per centimetre, with a highest number of 12. These lines wave and sag considerably more than in previous centuries, and become noticeably less distinct.

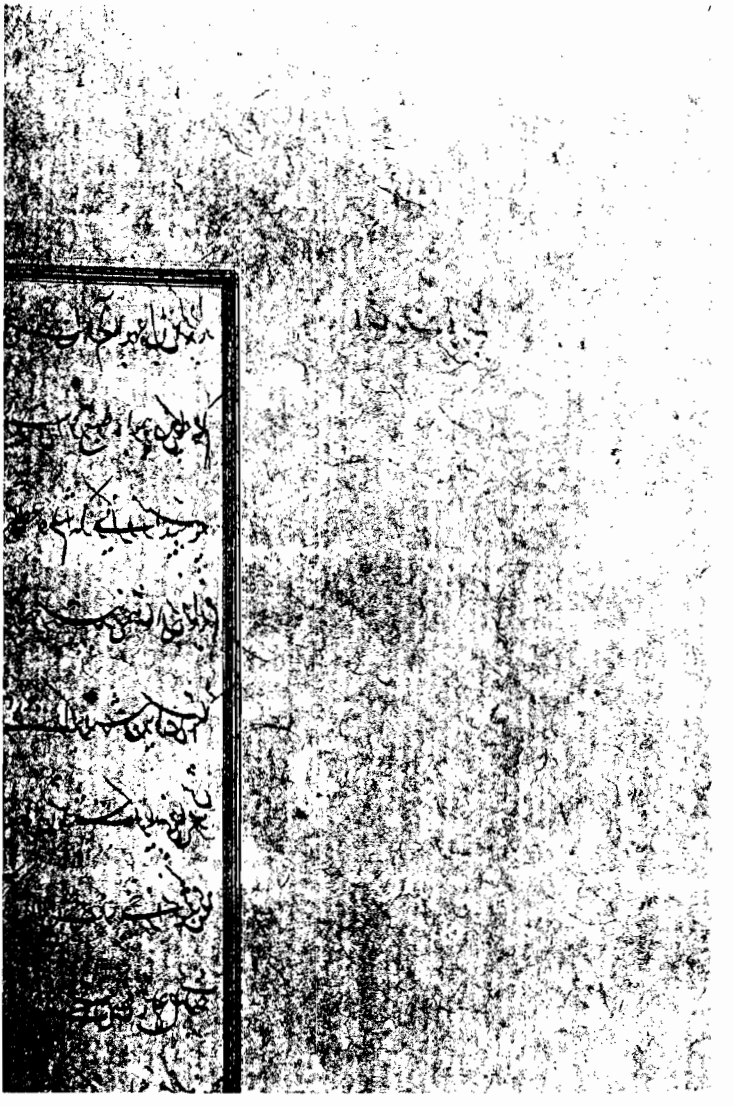


Figure 11

Detail of a manuscript leaf, Persia, dated AH 959 (AD 1551–2), showing chain lines spaced at regular intervals across the sheet.
Photo: Helen Loveday

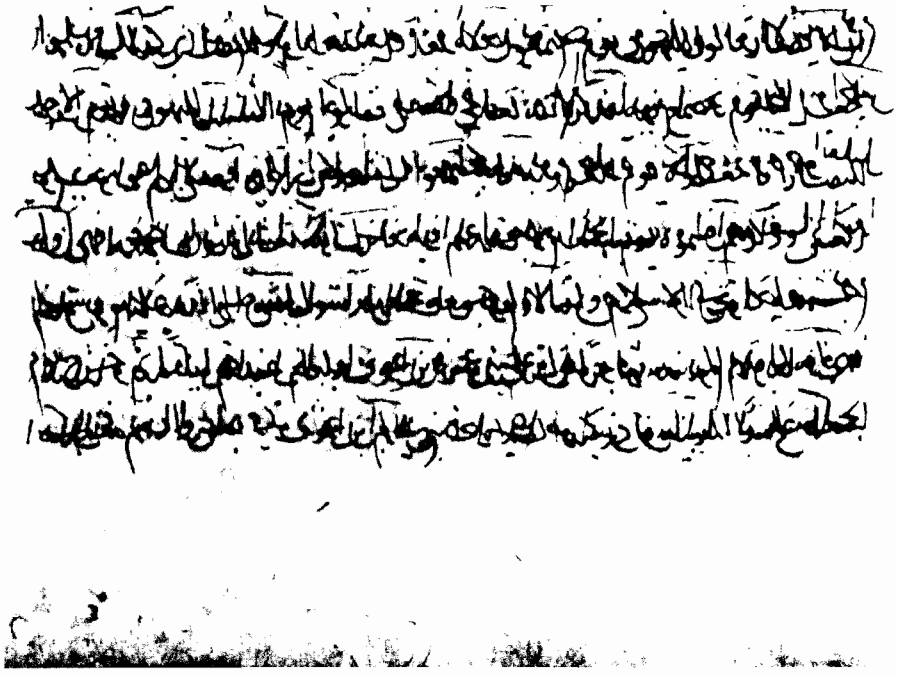


Figure 12

Detail of a manuscript leaf, Syria or Egypt, early 13th century AD, showimg chain lines arranged in groups of three.
Photo: Helen Loveday

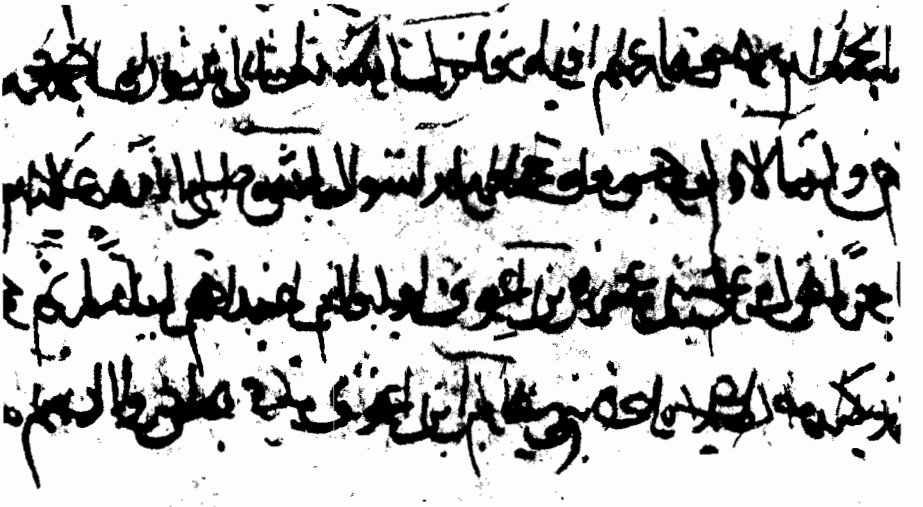


Figure 12a

Detail of Figure 12.
Photo: Helen Loveday

Syro-Egyptian paper is characterised by the inclusion and arrangement of chain lines within the sheet; examination of the manner in which chain lines are grouped largely corroborates Malachi Beit-Arié's classification of papers.[7] Until the 13th century, the pattern and distribution of chain lines is largely irregular and unclear. From then onwards, chain lines are arranged predominantly in groups of three (figures 12, 12a); groups of two and four – and alternating groups of two and three, or three and four – are noticeably less popular but not unknown (figure 13). The majority of chain lines grouped in threes occur in papers dating from the 14th and 15th centuries; between the individual chain lines are intervals of 10–15 mm, and between the groups are intervals of approximately 40–45 mm.

The grouping of chain lines in pairs is regarded as the oldest configuration, and is generally not found in papers manufactured after the beginning of the 13th century. However, pairs of chain lines have been identified in a manuscript which is dated AH 1047 (AD 1637–8).[8] Chain lines grouped in fours are seen in the paper used in a Mamluk manuscript dated to AH 762–82 (AD 1360–80).[9] Alternating groups of two and three appear to have been common only in the 14th century; the earliest manuscript in which this arrangement is found is dated AH 773 (AD 1371–2).[10] Alternating groups of three and four have been identified in one manuscript dated AH 971 (AD 1563–4).[11] Chain lines spaced at regular intervals are very unusual; papers in which this arrangement has been found were all dated to between the 13th and 15th centuries.

Rib shadows are seen in papers made on grass moulds dating from the 12th century onwards. They alternate with the chain-line groupings, and are approximately 15–20 mm wide (figure 14). From the 16th century, their inclusion is less frequent, and from the 18th century they appear sporadically. When present, they highlight the growing tendency for chain lines to curve away from their central axes, most noticeably at the edge of the sheet.

A Comparison of Persian and Syro-Egyptian Papers

The development of papermaking in Persia stands in marked contrast to the history of the craft in Syria and Egypt. Persian papermaking is divided into two distinct phases, the first spanning a period of seven centuries (AD 700–1400), and the second dating from the beginning of the 15th century until the beginning of the 19th. The technique of papermaking changes dramatically from one period to the next. However, the development of papermaking in Syria and Egypt is less easily discerned, and progress is gradual rather than dramatic. Until European papers flooded into the Islamic

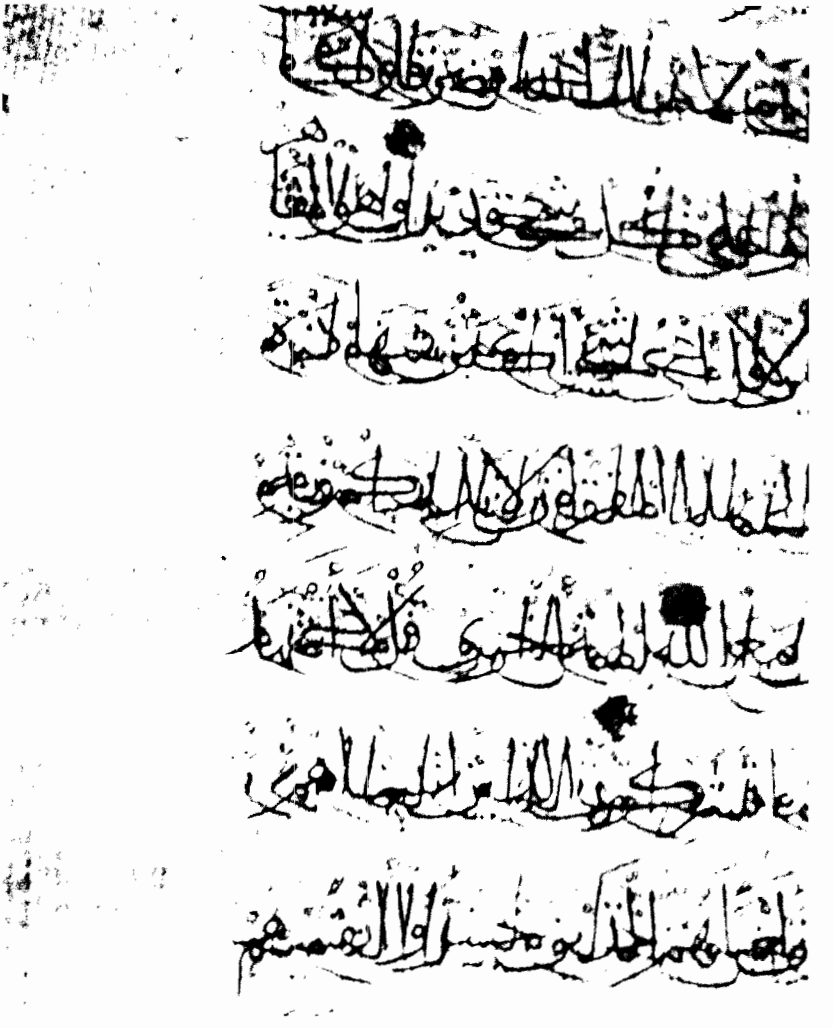


Figure 13

Detail of a Qur'an leaf, Syria or Egypt, mid 14th century AD; pairs of chain lines are visible in the margin.
Photo: Don Baker

world in the 19th century, and papermaking machinery was introduced into the papermaking industry, variation in papermaking practice was relatively slight. Any obvious changes were largely restricted to the construction of the mould, and to the distribution of chain and laid lines within it.

Differences in the techniques of paper manufacture across the Islamic world were not distinct until the 15th century. Although familiar to the earliest Islamic papermakers, wove moulds appear to have been used only infrequently from the 12th century onwards. Reed and grass moulds were used extensively, and in terms of laid-line quality and distribution, the construction of both was virtually identical from east to west. The degree of sizing and burnishing of a sheet of paper varied little across the regions. But from the 15th century onwards there was a growing divergence in papermaking practice, with paper made in Persia becoming noticeably thinner and crisper. This could only be achieved with the development of a finer, higher quality pulp, which in turn demanded a greater use of size to compensate for the decrease in paper weight.

Change is symptomatic of an increasing division between Arab and Persian cultures, with the separate development of the papermaking craft in Persia linked primarily to the conquest of the region by Timur (*reg.* AD 1370–1405). The Timurid Empire spread from the Mediterranean to the Aral Sea, but did not penetrate further south than Damascus, which was taken and sacked in AD 1401. Timur was the last and possibly the most ruthless of the Mongol invaders, bringing to an end 200 years of conquest that had unified the Eurasian world. Despite the damage caused to Persia, the invasions gave almost a century of peace, permitting the exchange of goods and ideas between the far east and the far west on an almost unprecedented scale. Persia and China were, for a time at least, linked culturally, if not politically. Although the Timurids conquered and destroyed with barbarity, their support of the arts was equally legendary. In building their capital at Samarqand, Timur and his successors forcibly resettled craftsmen from all over their Empire; one has only to consider the surviving architecture at Samarqand, and to view Timurid manuscript illustration and illumination, to understand the extraordinary flowering of artistic genius that was encouraged by this amalgamation. It is likely that papermakers also benefited from this exchange of ideas, and that new techniques and methods of manufacture were implemented. Meanwhile, under the powerful control of the Mamluks, Syria and Egypt were spared the devastation that had befallen lands further east, and Arab culture was preserved. But whilst traditions of law, mysticism and literature flourished, these regions were denied the artistic catalyst that resulted in the meeting of China and Central Asia.

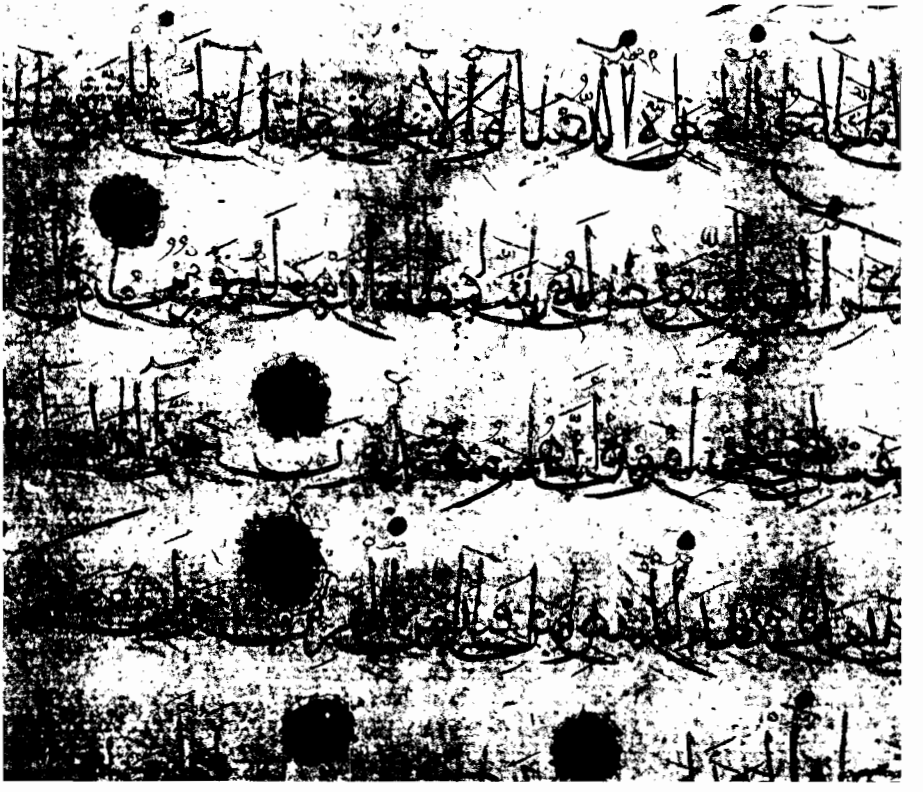


Figure 14

Detail of a Qur'an leaf, Syria or Egypt, mid 14th century AD, showing pairs of chain lines alternating with rib shadows.
Photo: Don Baker

With the exception of the change in papermaking practice in the 15th century, progress and development in the Persian craft are not easily discerned through the analysis of dated examples. Impressions in the web of the sheet left by the mould on which the paper was made are subtle, and although it is possible to distinguish reed from grass and from wire, characterisation of papers made on grass moulds is difficult through lack of distinct and regular chain-line patterns. To a large extent, refinement of pulp is indicative of date of manufacture, as is the treatment of the surface of the newly formed sheet of paper. There is noticeable variation in the colour of paper across the centuries, and at either end of the spectrum papers can be classified according to their brown or off-white hue. But most papers dating from the end of the 14th century until the beginning of the 19th are characteristically cream or dark cream in colour.

Syrian and Egyptian papers are distinguished largely by the character of the mould on which they were formed. Although refinement of fibre stock changes little from the 13th century onwards, the quality and construction of papermaking moulds can vary quite dramatically; it is therefore possible to classify papers according to the construction of the mould, and the distribution of laid and chain lines within the sheet. However, there appears to be greater fluidity in the arrangement of chain lines than at first thought, and papers from one century to the next do not necessarily contain different chain line groupings. From the 17th century onwards, there is a noticeable decline in the quality of mould construction: wayward chain lines, sagging and indistinct laid lines, and sporadic rib shadows in a sheet of paper, point to its manufacture in either the 17th or 18th century (figure 15).

On comparison of these selected facets of Islamic paper manufacture, one could surmise that classification of Persian paper is relative to quality of pulp and treatment of the surface of the paper; classification of Syro-Egyptian paper, on the other hand, is generally restricted to the construction of the mould on which the paper was formed. Thickness, colour, and translucency, although intimately related, tell us little about the date and origin of the material. But conclusions such as these are as misleading as they are helpful. If we consider paper manufactured under the Qajars in Persia from the beginning of the 19th century, we see a very thin, crisp paper, sized and burnished to such an extent that it is virtually translucent, and its colour is dulled to a greyish off-white; fibre distribution is uniform, and sheets contain anything up to 16 laid lines per centimetre. Mamluk paper dating from the mid 13th until the 16th century is typically cream; it is a dense and sturdy material, containing distinct chain line groupings, with approximately 8 to 10 laid lines per centimetre;

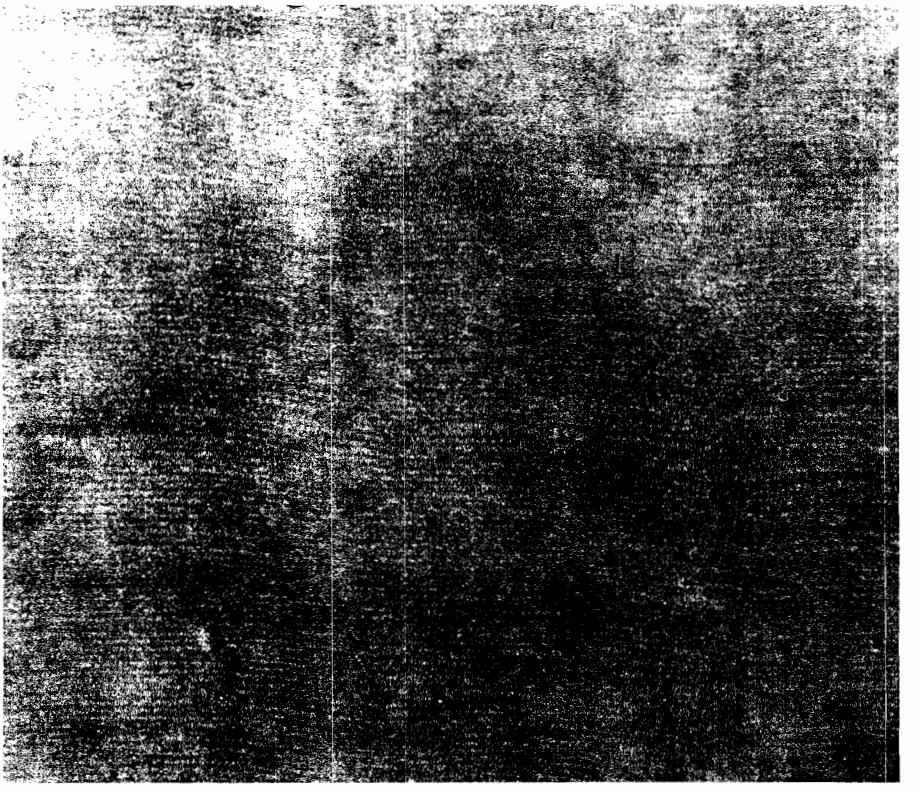


Figure 15

Flyleaf from a manuscript, Syria or Egypt, mid 18th century. The decline in the quality of mould construction is evinced by sagging laid lines and indistinct chain lines.
Photo: Helen Loveday

fibre distribution tends to be uneven, and the paper is generally not heavily sized and burnished. As these examples demonstrate, a typology of paper characteristics is founded upon a series of considerations, and the aim of analysis is the drawing together of these elements. The nature and properties of the fibres, the extent to which they were macerated and subsequently bonded together, the construction of the mould on which the paper was formed, and the manner in which the newly formed sheet was then treated, all determine the characteristics and properties of the resulting sheet. The sum of the parts is greater than the whole.

1. The data presented in this chapter is given in table form in the Appendix; see below, pp.81–87.
2. Degree of uniformity is, nonetheless, still dependant on the amount of pulp remaining in the vat from which the papermaker is working. If he is using what are in effect the dregs at the bottom of the vat, no matter how proficient the papermaker is, the resulting sheet will be considerably less uniform, and will contain more inclusions than the sheet formed from a fresh vat of pulp.
3. British Library, Oriental and India Office Collections, Add 7626.
4. Laid lines in reed moulds are generally packed tightly together, and the space between the lines is considerably smaller than the width of the laid lines themselves. Laid lines in grass moulds are thinner and distributed at larger intervals. A set number of laid lines can occupy the same area as an equivalent number of of reed lines due to this difference in spacing.
5. Some periods of papermaking have, nonetheless, given us papers of a typical colour: cream-coloured papers from Syria and Egypt are found in the Mamluk period, and many Ottoman Qur'ans of the 19th century are biscuit coloured. See Baker 1989, p.67.
6. It is interesting to note that from this time there is an apparent increase in the amount of Persian paper used by Arab scribes in Egypt, Syria and Palestine. Persian papermakers from the 14th century onwards led the way in producing a more uniform paper pulp, and it is possible that with the increased use of Persian paper in the more westerly regions of the Islamic world came a desire to emulate its characteristics in Syro-Egyptian paper.
7. Beit-Arié 1981, pp.29–32.
8. Khalidi Library, Jerusalem, MS.AR.969.
9. Private collection, Yemen; see Sotheby's, London, 24 April 1996, lot no.9.
10. Khalidi Library, Jerusalem, MS.AR.237.
11. See Sotheby's, London, 16 October 1996, lot no.34.

CHAPTER SEVEN

Conclusions

> The composing of books is more effective than building in recording the accomplishments of the passing ages and centuries. For there is no doubt that construction eventually perishes, and its traces disappear, while books handed from one generation to another, and from nation to nation, remain ever renewed ... Were it not for the wisdom garnered in books most of the learning would have been lost.[1]

The introduction and development of papermaking throughout Persia, the Middle East and the Western Mediterranean, is one of the principal technological achievements of Islamic civilisation. In response to varied demands, the ancient craft spread at a phenomenal rate, affecting and reflecting the social, political and economic climates of the time. By the end of the 7th century AD, the book in codex form had been ornamented, treasured, and preserved by Christians and Jews for approximately three hundred years, and Islamic book production was a natural evolution of previous practices. With the introduction of paper, the codex was established as the primary form in which the written, and later the printed word, could be recorded. It was displayed as material evidence of culture and position, and became a vehicle by which the scattered ideas of thinkers could be disseminated across continents. The power of the book for transformation and propagation remains without equal.

The techniques by which the earliest papers were made are naturally vague after a lapse of approximately 2000 years. No records describing the production of the first Chinese papers are known, and our knowledge and understanding of the materials, tools and techniques of the Islamic papermaker, based on a handful of textual accounts, is limited. It is apparent, nonetheless, that the fundamental principles of papermaking by hand have changed little from its inception to the present day, and the basic character of the material has persisted with only slight modification. Paper remains a non-

uniform sheet of locally varying density, porosity and opacity, made from the interweaving of hydrated cellulose fibres under controlled conditions. Its properties include a good mechanical strength, combined with lightness and flexibility, porosity, and an absorbency for liquids such as writing and printing inks. It is naturally white and largely opaque, despite the apparent transparency of its fibres.

There are, nevertheless, appreciable differences in the techniques of maceration, sizing and burnishing, from east to west, and from one generation to the next: change in mould construction is often dramatic. Knowledge of the nature of such contrasts and comparisons is axiomatic to our understanding of the evolution and development of the ancient craft. Although no contemporary examples of the papermaker's mould are known to exist, variation and progression in construction can be traced through the examination of the impressions left in the sheet by its constituent materials. Knowledge of how paper stock was produced can be gleaned through the examination of individual fibres under magnification, or of the whole sheet through transmitted light. An understanding of how a paper's surface was treated is achieved through the physical and chemical examination of residual size and colour, and the identification of indentations left by the burnisher's tool.

Towards a Tentative Typology

On the examination of chain- and laid-line distribution in his own collection of papers from Indo-China, Bengal, and Europe, Dard Hunter concluded,

> From this it will be seen that location or period has little bearing on the number of lines found in old papers, and that therefore there is no possible way of cataloguing or indexing these impressions in paper so that a particular time or place of origin may be determined. Ancient paper, both Oriental and Occidental, must be placed by its general characteristics, and not by any list of rules that can be given as infallible.[2]

There is a great danger of trying to reduce to order that which cannot be ordered. Any attempt to codify, categorise and apply rules to the history of Islamic papermaking is inevitably to discover the exception that disproves the rule. As there is variation in product from east to west, so papers made by the same craftsman on the same mould and with pulp from the same vat, can differ dramatically in respect of their quality and thickness, and all may be found in one manuscript. Variation in paper quality is not always connected with geography and time, but often reflects the papermaker's struggle to achieve his daily quota. The exception is indicative of a manufacturing process that was governed by human nature; the norm is evidence of evolving trends and increasing expertise in a highly skilled craft.

To describe all papers with consistency, precision, and according to objective standards is a practical impossibility; characteristics such as colour and thickness are susceptible of almost infinite gradation within the limits of the medium.[3] However, a tentative typology of paper characteristics can be established through the systematic analysis of dated samples, and to some extent paper can be classified according to stated criteria. Information concerning the date and place of manufacture of uncategorised samples can be uncovered through the collation of collected data. This information is essentially corroborative, and should be used to supplement existing evidence, rather than as a primary means of classification.

However, the study of Islamic paper is as perplexing and frustrating as it is fascinating, and the production of a tentative typology of paper characteristics is but a first step towards a greater understanding of the materials and techniques of the papermaker, and the development of Islamic bookbinding techniques.[4] The spread of the craft reflects the complexities and intricacies of the history of a vast and multifaceted people. Growth and decline in the papermaking industry must be viewed as a sequence of responses to social, economic, and political circumstances, and to religious and intellectual stimuli.

Vital questions about the development of the craft remain unanswered. Although not dramatic, there are some characteritics of paper used in Anatolia that distinguish it from paper used in Persia, Syria and Egypt. Examination of Ottoman Qur'ans has revealed a preference for a bright cream and characteristically sturdy paper in manuscript production until approximately the 17th century. If there was no indigenous papermaking in Anatolia until the 18th century, where was this paper imported from? What are the characteristics of Chinese papers dating to the 15th century, and are Chinese papermaking practices reflected in the Persian craft at this time? Only if answers to questions such as these are found, can we further our understanding of the interdependence and independence of development of the craft across the Islamic world, and the spread of learning and technology from east to west.

1. Al-Jahiz, *Kitāb al-Ḥayawān*, quoted in Bosch, Carswell and Petherbridge 1981, pp.5–6.
2. Hunter 1930, p.197.
3. Waley 1989, p.8.
4. Change rarely occurs in isolation and without implication, and progress in papermaking practices effected changes in book production. For example, the dramatic shift in the nature and quality of Persian papers dating from the 15th century resulted in a variation of sewing technique, due to increased thinness and crispness of the sheet. Sturdy sewing hemp, as used in the binding practices of earlier centuries, was replaced in Persia by thin silk, in order to reduce the potential for tearing and splitting of the paper along the spinal fold.

APPENDIX

Table of Results

The information detailed on the following pages is intended as a guide to the characteristics of Persian, Syrian and Egyptian papers from the 6th – 12th centuries AH (12th – 18th centuries AD).

This typology of paper characteristics has been established through the systematic analysis of dated samples, and is indicative of trends in the craft of papermaking over seven centuries. Not all papers will fit this classification – many will be exceptions to the rule.

Therefore, when used as a means of classifying undated papers, the information in the table must be viewed as corroborative evidence, rather than as the primary means of identification.

	Persian Paper	*Syro-Egyptian Paper*
Quality	dense and sturdy, but without a marked stiffness	dense and sturdy, but without a marked stiffness
Thickness	varies from 0.11–0.22mm; no average thickness	varies from 0.08–0.23mm; no average thickness
Colour	ranging from dark cream to brown	ranging from dark cream to brown
Surface characteristics	extremely lightly sized and burnished; tending to be rough	lightly sized and burnished; smooth; tending to be soft
Quality of Pulp	uniform to floccular; fibrous; variable quantity of inclusions; occasional clumping of fibres	uniform to floccular; fibrous; variable quantity of inclusions; occasional clumping of fibres
Translucency	medium to opaque	medium to opaque
Mould construction	reed or grass	reed or grass
Reed mould	laid, with no chain lines	laid, with no chain lines
– laid lines	5–7/cm; 1–1.5mm (occ. 2mm) thick; tending to be distinct; fairly straight; space between lines is less than width of one laid line	5–7/cm; 1–1.5mm (occ. 2mm) thick; tending to be distinct; fairly straight; space between lines is less than the width of one laid line
– chain lines	(none)	(none)
Grass mould	laid, with no chain lines	laid, with sporadic inclusion of chain lines
– laid lines	7–8/cm; 1mm thick; tending to be indistinct; some curving, esp. at head or tail of line	8–10/cm; 0.5–1mm thick; tending to be indistinct; some curving of the line, esp. at edge of sheet
– chain lines	(none)	no clear arrangement; from occ. single lines, to groups of 2 and 3; 0.5mm thick; indistinct
Rib shadows	none apparent	none apparent on papers from reed moulds, but distinct on papers from grass moulds: app. 20mm wide; shadows alternate with chain lines if present

	Persian Paper	*Syro-Egyptian Paper*
Quality	dense and sturdy, but without a marked stiffness	dense and sturdy, but without a marked stiffness
Thickness	varies from 0.11–0.20 mm; no average thickness	varies from 0.10–0.30 mm; average thickness of sheet: 0.15–0.20 mm
Colour	ranging from dark cream to brown	tending to be dark cream, but occasionally darker
Surface characteristics	lightly sized and burnished; tending to be rough	sized; lightly burnished; smooth
Quality of pulp	uniform to floccular; fibrous; variable quantity of inclusions; occasional clumping of fibres	uniform to floccular; fibrous; some inclusions; whole individual fibres seen within the sheet
Translucency	medium to opaque	medium
Mould construction	reed or grass	occasionally reed; predominately grass
Reed mould	laid, with no chain lines	laid, with no chain lines
– laid lines	5–7/cm; 1–1.5 mm (occ. 2mm) thick; tending to be distinct; fairly straight; space between lines is less than width of one laid line	5–7/cm; 1–1.5 mm (occ. 2mm) thick; tending to be distinct; fairly straight; space between laid lines is generally less than the width of one laid line
– chain lines	(none)	(none)
Grass mould	laid, with chain lines visible sporadically	laid, with increasing number of chain lines
– laid lines	7–8/cm; 1mm thick; tending to be indistinct; some curving, esp. at head or tail of line	8–10/cm; 0.5–1mm thick; ranging from distinct to indistinct; generally straight, but with some curving at head or tail of line
– chain lines	sporadic; visible as short single lengths, or very occasionally in pairs; no regular spacing	arranged in groups of 3; occasioanlly spaced at regular intervals; 0.5–1mm thick; indistinct
Rib shadows	none apparent	none apparent on papers from reed moulds; distinct on papers from grass moulds ; approximately 20 mm wide; shadows alternate with individual chain lines or chain-line groupings

	Persian Paper	*Syro-Egyptian Paper*
Quality	dense and sturdy, but without a marked stiffness	dense and sturdy, but without a marked stiffness
Thickness	varies from 0.11–0.26 mm; no average thickness	varies from 0.11–0.24 mm; average thickness of sheet: 0.15–0.20 mm
Colour	ranging from cream to light brown or biscuit	tending to be dark cream, only occasionally minimally darker
Surface characteristics	lightly sized and burnished; tending to be rough rather than smooth	sized; lightly burnished; smooth
Quality of pulp	uniform to floccular; fibrous; variable quantity of inclusions; occasional clumping of fibres	uniform to floccular; fibrous; some inclusions; whole individual fibres seen within the sheet
Translucency	medium to opaque	medium
Mould construction	reed or grass	grass
Reed mould	laid, with no chain lines	(not used)
– laid lines	5–7/cm; 1–1.5 mm (occ. 2mm) thick; tending to be distinct; fairly straight; space between lines less than width of one laid line	
– chain lines	(none)	
Grass mould	laid, with chain lines visible sporadically	laid, generally with chain lines
– laid lines	7–8/cm; 1mm thick; tending to be indistinct; some curving esp. at head or tail of line	8-10/cm; 0.5-1mm thick; increasingly distinct; generally straight, but with some curving at head or tail of line
– chain lines	sporadic; visible as short single lengths, or very occasionally in pairs; no regular spacing	arranged in groups of 3; occ. spaced at regular intervals; *after 1350*: papers can include chain lines arranged in groups of 4, or in alternating groups of 2 and 3; 0.5–1mm thick; feint, but distinct
Rib shadows	none apparent	generally present; app. 15–20 mm wide; shadows alternate with individual chain lines or chain-line groupings

	Persian Paper	*Syro-Egyptian Paper*
Quality	noticeably crisper than earlier papers	firm, but less dense and sturdy than earlier examples
Thickness	varies from 0.04–0.15 mm; average: 0.09–0.12mm	varies from 0.10–0.25 mm; average: 0.15–0.20 mm
Colour	ranging from cream to dark cream	ranging from cream to dark cream
Surface characteristics	sized; burnished; smooth; increasingly glossy	sized; lightly burnished; smooth
Quality of pulp	*before 1450*: uniform to floccular; fibrous; some inclusions; occ. clumping of fibres; whole fibres seen within the sheet; *later*: increasingly uniform; fibrous; occ. inclusions and clumping of fibres; whole fibres seen within sheet	uniform to floccular; fibrous; fewer inclusions; whole fibres occasionally seen within the sheet
Translucency	*before 1450*: medium *later*: medium to translucent	medium to translucent
Mould construction	grass	grass
Reed mould	(not used)	(not used)
Grass mould	laid; chain lines visible only sporadically	laid; rarely without chain lines
– laid lines	8–10/cm; 0.5–1mm thick; tending to be distinct; some curving esp. at head or tail of line	7–10/cm; 0.5–1mm thick; feint but distinct; generally straight, but with some curving esp. at head or tail of line
– chain lines	sporadic; visible as short single lengths, very occ. in pairs; no regular spacing	predominantly arranged in groups of 3; very occasionally spaced at regular intervals; 0.5–1mm thick; feint, but distinct
Rib shadows	none apparent	generally present; app. 15–20mm wide; shadows alternate with individual chain lines or chain-line groupings

	Persian Paper	*Syro-Egyptian Paper*
Quality	crisp; not dissimilar to the feel of fine brown paper	firm; becoming noticeably crisper
Thickness	varies from 0.07–0.14mm; average: 0.09mm	extraordinarily variable, from 0.04–0.25mm; no average thickness
Colour	ranging from cream to dark cream	ranging from cream to dark cream
Surface characteristics	sized; burnished; smooth to very smooth; generally glossy; individual fibres increasingly visible on surface	sized; lightly burnished; smooth to very smooth
Quality of pulp	largely uniform; increasingly fibrous; few inclusions; clumping of fibres; whole fibres seen within the sheet	uniform to floccular; fibrous; few inclusions; whole fibres occasionally seen within the sheet
Translucency	medium to translucent	medium to translucent
Mould construction	grass	grass
Reed mould	(not used)	(not used)
Grass mould	laid, with chain lines visible only sporadically	laid, with chain lines; latter increasingly abscent towards end of century
– laid lines	8–10/cm; 0.5–1mm thick; tending to be distinct; some sagging and curving esp. at head or tail of line	7–12/cm; ranging from fine to 1mm in thickness; feint but distinct; tending to curve and sag
– chain lines	visible sporadically as short single lengths, or very occasionally in pairs; no regular spacing	predominantly arranged in groups of 3; 0.5–1mm thick; generally feint and indistinct
Rib shadows	none apparent	only occasionally present; app.15–20mm wide; shadows alternate with chain-line groupings

	Persian Paper	*Syro-Egyptian Paper*
Quality	crisp; similar to the feel of fine brown paper	firm and fairly crisp
Thickness	varies from 0.06–0.15 mm; average: 0.08mm	extraordinarily variable, from 0.06–0.26mm; no average thickness
Colour	ranging from cream to dark cream	ranging from cream to dark cream
Surface characteristics	sized; burnished; smooth to very smooth; generally glossy; individual fibres visible on the surface	sized; lightly burnished; smooth to very smooth.
Quality of pulp	largely uniform; fibrous; noticeably speckled; few inclusions; very little clumping of fibres; whole individual fibres seen within the sheet	uniform to floccular; fibrous; few inclusions; whole fibres occasionally seen within the sheet
Translucency	medium to translucent	medium to translucent
Mould construction	grass	grass
Reed mould	(not used)	(not used)
Grass mould	laid; chain lines appearing with greater regularity	laid, with or without chain lines
– laid lines	*before 1650*: 8–10/cm; 0.5–1mm thick; tending to be distinct; some sagging and curving esp. at head or tail of line; *later*: 8–12/cm; from fine to 1mm in thickkness; tending to be less distiinct than in earlier papers; some sagging and curving esp. at head or tail of line	7–12/cm; ranging from fine to 1mm in thickness; feint but distinct; tending to curve and sag
– chain lines	regularly spaced when visible; but absent from many papers	predominantly arranged in groups of 3; 0.5–1mm thick; generally feint and indistinct
Rib shadows	none aparent	only occasionally present; app. 15–20mm wide; shadows alternate with chain-line groupings

	Persian Paper	*Syro-Egyptian Paper*
Quality	crisp; similar to the feel of fine brown paper	firm and fairly crisp
Thickness	less variable: 0.06–0.11mm; average: 0.08mm	extraordinarily variable: from 0.04–0.25mm; no average thickness
Colour	ranging from cream to dark cream; *later*: grey or off-white in tone	ranging from cream to dark cream
Surface characteristics	sized; burnished; smooth to very smooth; generally glossy; *later*: heavily sized and burnished; very smooth; glossy	sized; lightly burnished; smooth to very smooth
Quality of pulp	uniform; fibrous; very few inclusions; individual fibres seen within the sheet only occasionally	uniform to floccular; fibrous; few inclusions; whole individual fibres occasionally seen within the sheet
Translucency	medium to translucent; *later*: increasingly translucent	medium to translucent
Mould construction	grass	grass
Reed mould	(not used)	(not used)
Grass mould	laid, with no chain lines	laid, with or without chain lines; mould-markings not easily classified
– laid lines	8–12/cm; fine to 1mm in thickness; tending to be indistinct; some sagging and curving esp. at head or tail of line; *later*: 10–16/cm; very fine; distinct; fairly straight	7–14/cm; very fine to 1mm (occ. 1.5mm) in thickness; feint but distinct; tending to sag; noticeable curve at head or tail of line
– chain lines	(none)	generally in groups of 3; single lines appear sporadically; 0.5–1mm thick; feint and indistinct; tending away from central axes; not at 90° to laid lines, or parallel to rib shadows
Rib shadows	none apparent	appear randomly; app. 15–20mm wide; shadows alternate with chain lines or chain-line groupings; at 90° to laid lines

Bibliography

Abbott 1972
N. Abbott, *Studies in Arabic Literary Papyri*, III, Chicago, 1972.

Afshar 1995
I. Afshar, 'The Use of Paper in Islamic Manuscripts as Documented in Classical Persian Texts', in *The Codicology of Islamic Manuscripts*, Proceedings of the Second Conference of Al-Furqan Islamic Heritage Foundation, London, 1995, pp.77–91.

Baker 1989
D. Baker, 'A Note on the Expression "... a Manuscript on Oriental Paper"', in *Manuscripts of the Middle East*, 4, Leiden, 1989, pp.67–69.

Baker 1991
—, 'Arab Papermaking', *The Paper Conservator*, 15, Institute of Paper Conservation, London, 1992, pp.28–35.

Beit-Arié 1981
M. Beit-Arié, *Hebrew Codicology: Tentative Typology of Technical Practices Employed in Hebrew Dated Manuscripts*, Jerusalem, 1981.

Beit-Arié 1993a
—, *Hebrew Manuscripts of East and West: Towards a Comparative Codicology*, The Panizzi Lectures 1992, The British Library, London, 1993.

Beit-Arié 1993b
—, *The Making of the Medieval Hebrew Book*, Jerusalem, 1993.

Bloom 1989
J.M. Bloom, 'The Blue Koran. An early Fatimid manuscript from the Maghrib', in *Les Manuscrits du Moyen-Orient: Essais de Codicologie et de Paleographie*, ed. F. Déroche, Istanbul/ Paris, 1989, pp.95–99.

Bosch, Carswell and Petherbridge 1981
G. Bosch, J. Carswell, and G. Petherbridge, *Islamic Bindings and Bookmaking*, exhibition catalogue, The Oriental Institute, The University of Chicago, 1981.

Briquet 1886
C.M. Briquet, 'Recherches sur les premiers papiers employés en Occident et en Orient du xe au xive siècle', in *Memoires de la Société Nationale des Antiquaires de France*, XLVI, Paris, 1886.

British Paper and Board Maker's Association 1950
British Paper and Board Maker's Association (Technical Section), *Papermaking: A General Account of its History, Processes, and Applications*, London, 1950.

Carter, revised Goodrich 1955
T.F. Carter, *The Invention of Printing in China and its Spread Westward*, 2nd edition, revised by L.C. Goodrich, New York, 1955.

Clarkson 1992
C. Clarkson, 'Rediscovering Parchment: The Nature of the Beast', in *The Paper Conservator*, 16, Institute of Paper Conservation, London, 1992, pp.5–26.

Diringer 1982
D. Diringer, *The Book Before Printing*, New York, 1982.

Fisher 1988
R.B. Fisher, *The Marco Polo Expedition – A Journey Along the Silk Road*, London, 1988.

Gaur 1979
A. Gaur, *Writing Materials of the East*, London, 1979.

Goitein (trans.) 1973
S.D. Goitein, *Letters of Medieval Jewish Traders*, (trans.), Princeton, 1973.

Grohmann 1924
A. Grohmann, *Allgemeine Einführung in die arabischen Papyri, nebst Grundzügen der arabischen Diplomatik*, Corpus Papyrorum Raineri Archiducis Austriae, III, Series Arabica, I/1, Vienna, 1924.

al-Hassan and Hill 1986
A.Y. al-Hassan, and D.R. Hill, *Islamic Technology: An Illustrated History*, Cambridge, 1986.

Huart –Grohmann 1978
Cl. Huart –A. Grohmann, 'Kāghad', in *The Encyclopaedia of Islam*, IV, 2nd edition, Leiden, 1978, pp.419–20.

Hunter 1930
D. Hunter, *Papermaking Through Eighteen Centuries*, New York, 1930.

Hunter 1947
—, *Papermaking: The History & Techniques of an Ancient Craft*, New York, 1947.

Ibn Badis
Ibn Badis, "Umdat al-Kuttab wa 'Uddat Dhawi al-Albab (Staff of the Scribes and Implements of the Discerning)', trans. M. Levey, in *Medieval Arabic Bookmaking and its Relation to Early Chemistry and Pharmacology*, Transactions of the American Philosophical Society, New Series, 52, 4, 1962.

Ibn Khaldun
Ibn Khaldun, *The Muqaddimah*, trans. F. Rosenthal, London, 1967.

Irigoin 1963
J. Irigoin, 'Les Types de Formes Utilisés dans l'Orient Mediterraneen (Syrie, Egypte) du xie au xive Siècle', in *Papiergeschichte*, 13, Mainz, 1963.

James 1992
D. James, *The Master Scribes. Qur'ans of the 11th to 14th Centuries*, The Nasser D. Khalili Collection of Islamic Art, II, London, 1992.

Karabacek 1887, trans. Baker and Dittmar 1991
J. von Karabacek, *Das Arabische Papier*, Vienna, 1887, trans. D. Baker and S. Dittmar, (*Arab Paper*), London, 1991.

Khan 1993
G. Khan, Bills, *Letters and Deeds. Arabic Papyri of the 7th to the 11th Centuries*, The Nasser D. Khalili Collection of Islamic Art, VI, London, 1993.

Khan 1995
—, 'Arabic Papyri', in *The Codicology of Islamic Manuscripts*, Proceedings of the Second Conference of Al-Furqan Islamic Heritage Foundation, London, 1995.

Lapidus 1984
I.M. Lapidus, *Muslim Cities in the Later Middle Ages*, Cambridge, 1984.

Lewis 1974
N. Lewis, *Papyrus in Classical Antiquity*, Oxford, 1974.

Needham and Tsein Tseun-Hsuin 1985
J. Needham, and Tsien Tseun-Hsuin, *Science and Civilisation in China*, V, 1, Cambridge, 1985.

Pedersen, trans. French 1984
J. Pedersen, *The Arabic Book*, trans. G. French, Princeton University Press, New Jersey, 1984.

Qadi Ahmad, trans. Minorsky 1959
Qadi Ahmad ibn Mir Munshi al-Husayni, *Calligraphers and Painters: A Treatise by Qādī Aḥmad, son of Mīr-Munshī*, trans. V. Minorsky, Freer Gallery of Art Occasional Papers, III, 2, Washington dc, 1959.

Quraishi 1989
S. Quraishi, 'A survey of the development of papermaking in Islamic Countries', in *Bookbinder*, 3, 1989, pp.29–36.

Ramaseshan 1989
S. Ramaseshan, 'The History of Paper up to

1948', in *Indian Journal of History of Science*, XXIV, 2, 1989, pp.103–21.

Stanley [1996]
T. Stanley, *The Qur'an and Calligraphy*, Bernard Quaritch Ltd, Catalogue 1213, London, n.d. [1996].

Valls I Subira 1970
O. Valls I Subira, 'Paper and Watermarks in Catalonia', in *Monumenta Chartae Papyraceae Historiam Illustrantia*, I, Amsterdam, 1970.

Waley 1989
M.I. Waley, 'Problems and Possibilities in Dating Persian Manuscripts', in *Les Manuscrits du Moyen-Orient: Essais de Codicologie et de Paleographie*, ed. F. Déroche, Istanbul/ Paris, 1989, pp.7–15.

Walz, ed. Daley 1985
T. Walz, 'The Paper Trade of Egypt and the Sudan in the Eighteenth and Nineteenth Centuries', in *Modernisation in the Sudan: Essays in honor of Richard Hill*, ed. M.W. Daley, New York, 1985, pp.29–48.

Warmington 1974
E.H. Warmington, *The Commerce Between the Roman Empire and India*, London, 1974.

Published by The Don Baker Memorial Fund

Distributed by Archetype Publications
www.archetype.co.uk

Printed by P J Print

ISBN 1-873132-03-4

The aim of this book is to publish the results of research into the nature and characteristics of Islamic paper, as gleaned through the systematic analysis of over 1000 dated samples. The study has shown that it is possible to establish a tentative typology of paper according to a comprehensive list of objective standards. Descriptions of the physical characteristics of papers originating from Persia, Syria and Egypt, from the 12th until the 19th century, provide a means by which papers can be compared and contrasted. Although it is difficult to apply an exact chronology to changes in the materials and techniques of the papermaker, trends in papermaking practice can be identified, and the characteristics of paper from a given century and region can be suggested. Used alongside other corroborative details, it is possible to assign an approximate date and place of manufacture to hitherto unclassified samples with some degree of certainty.

In order to place this research into an historical context, the book begins with an overview of the development of papermaking by hand in the Islamic world. It examines the impact and spread of the craft throughout Persia and the Middle East, and examines its success when compared to other contemporary writing materials, and its failure to compete with imported Western papers.

Helen Loveday is an accredited member of the Institute of Paper Conservation. She is a practising conservator, specialising in manuscripts and works of art on paper from the Islamic world.

ISBN 1-873132-03-4

9 781873 132036