

“From a Sacred Source”

# Études sur le Judaïsme Médiéval

*Fondées par*  
George Vajda

*Dirigées par*  
Paul B. Fenton

TOME XLII

---

## Cambridge Genizah Studies Series

*Edited by*  
Siam Bhayro, *University of Exeter*  
Geoffrey Khan, *University of Cambridge*  
Ben Outhwaite, *Cambridge University Library*

VOLUME 1

# “From a Sacred Source”

Genizah Studies in Honour of  
Professor Stefan C. Reif

*Edited by*

Ben Outhwaite and Siam Bhayro



BRILL

LEIDEN • BOSTON

2011

This book is printed on acid-free paper.

Library of Congress Cataloging-in-Publication Data

“From a sacred source” : genizah studies in honour of Stefan C. Reif / edited by Ben Outhwaite and Siam Bhayro.

p. cm. — (Etudes sur le Judaïsme medieval ; tome XLII) (Cambridge genizah studies series ; v. 1)

Includes index.

ISBN 978-90-04-19058-0 (hardback : alk. paper)

1. Judaism—History—Medieval and early modern period, 425–1789—Sources.  
2. Jews—History—70–1789—Sources. 3. Cairo Genizah. 4. Manuscripts, Hebrew—England—Cambridge—History. 5. Cambridge University Library. Taylor-Schechter Genizah Research Unit. I. Outhwaite, Ben. II. Bhayro, Siam. III. Reif, Stefan C., 1944– IV. Title. V. Series.

BM180.F76 2010

296.09'02—dc22

2010027811

ISSN 0169-815X

ISBN 978 90 04 19058 0

Copyright 2011 by Koninklijke Brill NV, Leiden, The Netherlands.  
Koninklijke Brill NV incorporates the imprints Brill, Hotei Publishing,  
IDC Publishers, Martinus Nijhoff Publishers and VSP.

All rights reserved. No part of this publication may be reproduced, translated, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior written permission from the publisher.

Authorization to photocopy items for internal or personal use is granted by Koninklijke Brill NV provided that the appropriate fees are paid directly to The Copyright Clearance Center, 222 Rosewood Drive, Suite 910, Danvers, MA 01923, USA.  
Fees are subject to change.

This volume is dedicated to the memory of Hazel and John Alexander, two people who knew the value of letter writing, daily letters to each other describing their love, their dreams, their plans, weekly letters relating everyday occurrences and news to distant parents and friends.

Their children grew up with this song:

*Mayn kind, mayn kind  
du forst avek  
in a vaytn land  
farges nit di brivele tsu der mamen*

This was the source of their excitement regarding the research into the Cairo Genizah and the reason for their active support during their lifetime.

Hazel Alexander (1912–1999)

John Alexander (1910–1994)



## CONTENTS

Contributors .....	xi
Preface .....	xiii
Stefan C. Reif: An Appreciation .....	xvii
<i>Ben M. Outhwaite</i>	
Professor Stefan C. Reif: List of Publications .....	xxiii
Legal Writing in Medieval Cairo: “Copy” or “Likeness” in Jewish Documentary Formulae .....	1
<i>Phillip I. Ackerman-Lieberman</i>	
The Paper and Textile Industry in the Land of Israel and Its Raw Materials in Light of an Analysis of the Cairo Genizah Documents .....	25
<i>Zohar Amar, Azriel Gorski, and Izhar Neumann</i>	
Is “The Cairo Genizah” a Proper Name or a Generic Noun? On the Relationship between the <i>Genizot</i> of the Ben Ezra and the Dār Simḥa Synagogues .....	43
<i>Haggai Ben-Shammai</i>	
Towards a Catalogue of the Magical, Astrological, Divinatory, and Alchemical Fragments from the Cambridge Genizah Collections .....	53
<i>Gideon Bohak</i>	
The Law of Power of Attorney in Maimonides’ Code of Jewish Law .....	81
<i>Mark R. Cohen</i>	
The Role of Egyptian Jews in Sixteenth-Century International Trade with Europe: A Chapter in Social-Economic Integration in the Middle East .....	99
<i>Abraham David</i>	

The Contribution of Genizah Texts to the Study of <i>Siddur</i> <i>Rabbi Solomon ben Nathan</i> .....	127
<i>Uri Ehrlich</i>	
Genizah Documents as Literary Products .....	139
<i>Miriam Frenkel</i>	
Judah ha-Levi on Writing the Kuzari: Responding to a Heretic .....	157
<i>Mordechai A. Friedman</i>	
The Cairo Genizah Unearthed: The Excavations Conducted by the Count d'Hulst on Behalf of the Bodleian Library and Their Significance for Genizah History .....	171
<i>Rebecca J.W. Jefferson</i>	
Vocalised Judaeo-Arabic Manuscripts in the Cairo Genizah ....	201
<i>Geoffrey Khan</i>	
Early Karaite Grammatical Thought as Reflected in a Commentary on Hosea .....	219
<i>Friedrich Niessen</i> ל"ט	
An Early Palimpsest Scroll of the Book of Kings from the Cairo Genizah .....	237
<i>Judith Olszowy-Schlanger</i>	
Compositional Technique in Qillirian <i>Piyyuṭim</i> for Rain and Dew .....	249
<i>Michael Rand</i>	
The Genizah and Jewish Communal History .....	289
<i>Marina Rustow</i>	
Persian-Arabic Bilingualism in the Cairo Genizah Documents .....	319
<i>Shaul Shaked</i>	



Orders of Payment, Orders of Supply, Instructions for Payment, and Statements of Credit in the Genizah and Other Collections at Cambridge University .....	331
<i>Avihai Shvitiel</i>	
The Weakening of the Bourgeoisie: Social Changes Mirrored in the Language of the Genizah Letters .....	343
<i>Esther-Miriam Wagner</i>	
Eretz-Israel <i>Maḥzorim</i> in the Genizah: From Palaeography to Liturgy .....	357
<i>Joseph Yahalom</i>	
“Consigned to the Genizah—But for Only a Third of a Century” .....	377
<i>Stefan C. Reif</i>	
Index of Subject .....	389
Index of Sources .....	399
Plates .....	407



## CONTRIBUTORS

Phillip I. Ackerman-Lieberman (Vanderbilt University)  
Zohar Amar (Bar Ilan University)  
Haggai Ben-Shammai (The Hebrew University of Jerusalem)  
Gideon Bohak (Tel Aviv University)  
Mark R. Cohen (Princeton)  
Abraham David (The National Library of Israel)  
Uri Ehrlich (Ben-Gurion University)  
Miriam Frenkel (The Hebrew University of Jerusalem and the Ben Zvi  
Institute)  
Mordechai A. Friedman (Tel Aviv University)  
Azriel Gorski (University of New Haven)  
Rebecca J.W. Jefferson (University of Florida)  
Geoffrey Khan (University of Cambridge)  
Friedrich Niessen ז"ר (University of Cambridge)  
Izhar Neumann  
Judith Olszowy-Schlanger (EPHE-Sorbonne)  
Ben M. Outhwaite (University of Cambridge)  
Michael Rand (Academy of the Hebrew Language)  
Marina Rustow (Johns Hopkins University)  
Shaul Shaked (The Hebrew University of Jerusalem)  
Avihai Shvitiel (University of Leeds)  
Esther-Miriam Wagner (University of Cambridge)  
Joseph Yahalom (The Hebrew University of Jerusalem)



## PREFACE

The Taylor-Schechter Genizah Collection, housed in Cambridge University Library, contains over 190,000 items that were recovered from the Ben Ezra Synagogue in Fustat (Old Cairo). For about 1,000 years, between the eleventh and nineteenth centuries, the synagogue's *genizah* was the repository for unwanted documents, making the recovered archive the most important source for both Mediterranean and medieval studies across many fields. The Taylor-Schechter Genizah Research Unit, also housed in Cambridge University Library, conducts and coordinates research into this priceless archive.

In August of 2007, scholars from the world of Genizah studies assembled in Cambridge for a conference organised by the Taylor-Schechter Genizah Research Unit. The conference was held to mark the retirement, in March of the previous year, of Stefan Reif, Professor of Medieval Hebrew at the University of Cambridge and, for the previous thirty-three years, Director of the Unit and a veritable champion of Genizah research in the United Kingdom and around the world.

Held jointly at the University Library and Westminster College, Cambridge, the conference marked Stefan Reif's achievements by demonstrating the tremendous breadth and vitality of Genizah Studies today—a vitality that owes much to Reif's shrewd, vigorous and unstinting efforts over the period of his directorship. Notable Genizah scholars from the UK, Europe, Israel and the United States were invited to present papers on any aspect of Genizah manuscripts, from the codicological to the historical, the philological to the literary-critical.

Westminster College was chosen as the main venue for the conference due to its association with the benefactors Agnes Lewis and Margaret Gibson, the two intrepid Scottish ladies whose delivery of a fragment of the lost Hebrew text of the book of Ben Sira (Ecclesiasticus) to the Cambridge scholar Solomon Schechter led to the modern rediscovery of the treasures of the Cairo Genizah.

The story of the discovery of the manuscripts in the Genizah of the Ben Ezra Synagogue in Fustat is one that Stefan Reif has often told in his quest to bring this unique collection to the world's attention. For his own conference, however, the organisers allowed him to

roam more widely, and the result was one of the essential highlights of the three days, as Reif's after-dinner talk reminisced over his three decades in academe, in a typically humorous and pointed manner. This memorable address is imprinted on the minds of those who had the privilege to hear it, but in order that it should be preserved for posterity, it is reproduced as the final paper in this volume, albeit in a slightly expurgated form so as not to invite the interest of members of the legal profession.

Among the contributions to this volume is one in the name of our late—and much missed—colleague at the Genizah Research Unit, Dr Friedrich Niessen. Friedrich died in 2009 after a stalwart struggle against cancer. Though he had given a paper at the conference, his illness prevented him from submitting a written version for publication. We are extremely grateful to our colleague Dr Nadia Vidro, who used Friedrich's notes to produce for this volume a fascinating study of a unique Genizah manuscript.

This is the first volume in a new series—*Cambridge Genizah Studies*—that will showcase the vibrancy and vigour of the field of Genizah research. It is fitting, therefore, that the series commences with a tribute to the one responsible for the good health in which the field finds itself—Professor Stefan Reif. We are grateful to the publishers, E. J. Brill, in particular Jennifer Pavelko and Katelyn Chin, for their enthusiastic support from the first moment this series was conceived. Thanks are also due to Rebecca Jefferson, as co-convenor of the conference, Daniel Davies, Esther-Miriam Wagner and Sarah Sykes, for their assistance in preparing the manuscript for publication, and Tanya Silas, for her assistance in translating one of the articles. We are grateful to the Syndics of Cambridge University Library for permission to reproduce images of, and to quote from, manuscripts in the Taylor-Schechter Genizah Collection.

This collection of studies is warmly dedicated to Stefan, from his friends and colleagues in the field of Genizah Studies. The title of this book is taken from a recently-published anthology of medieval Hebrew poetry.<sup>1</sup> It seems fitting to quote it in context—

---

<sup>1</sup> P. Cole, *The Dream of the Poem: Hebrew Poetry from Muslim and Christian Spain 950–1492* (Princeton, 2007), p. 185.

I praise you with a heart that's pure,  
from deep within my prison:  
You fashion souls from a sacred source,  
a place of brilliance and wisdom.

Ben Outhwaite  
Siam Bhayro





## STEFAN C. REIF: AN APPRECIATION

It is a commonplace among Genizah scholars that the collection of manuscripts known as the Cairo Genizah has been discovered many times. Periodically, its tattered fragments have been disturbed, rummaged through, looted and relocated—in whole and in part—many times since they were first deposited in the Genizah chamber of the Ben Ezra Synagogue. The greatest part now sits in Cambridge University Library as the Taylor-Schechter Collection, the single largest and most important collection of medieval Jewish manuscripts in the world. The name very clearly marks the achievement of two nineteenth-century Cambridge scholars, Charles Taylor and Solomon Schechter, in bringing the manuscripts to Cambridge, though those in the know—and Stefan Reif has done his best to bring the whole story to the widest attention—recognise the essential roles played by the Jerusalem Rabbi Solomon Wertheimer and the indefatigable, and indispensable, Agnes Smith Lewis and Margaret Dunlop Gibson.

Its move to Cambridge was not the last time it would be discovered, however. After the initial excitement of the early finds—Ben Sira, the Zadokite Fragment, the Greek palimpsests—scholars moved on, and the Library, institutionally conservative, consigned the great majority of the manuscripts to storage, unconserved and still in their original packing cases. In the 1960s, the Collection was ripe for rediscovery. Spurred by an awakening interest in the importance of the documentary Genizah as a source for economic and social history, the Library appointed a new librarian over the Collection, with the aim of conserving and cataloguing the neglected remainder (probably 80,000 fragments). Dr Henry Knopf began the work, arranging for fragments to be cleaned and repaired and for a catalogue to be prepared, but he lasted only a few years before moving on.

And so arrived Stefan Reif, a name now inseparably connected with the modern rediscovery of the Cairo Genizah. Appointed in 1973 as a relatively junior librarian, he grasped quickly the unique promise of the Collection and came up with a ten-year plan—which he successfully negotiated through an initially reluctant Library hierarchy—to complete the conservation of the Collection and institute a research programme to catalogue and exploit—in the best possible way—the

medieval fragments. So convincing was Reif's plan, and so thorough the groundwork, that the University Library inaugurated the Taylor-Schechter Genizah Research Unit the following year, with Stefan Reif as its first Director.

Reif himself had had little experience of academic librarianship before being appointed as an Assistant Under Librarian at Cambridge University Library. Brought up in Edinburgh, he took a degree in Hebrew and Aramaic at Jews' College and University College London, before completing his PhD on Shabbethai Sofer's prayer-book. His first jobs were lecturing posts in Glasgow and Dropsie College, Philadelphia (itself blessed with a collection of Genizah manuscripts). His early training, heavy in rabbinic texts and traditional Jewish scholarship, had prepared him well for the task of tackling the disparate fragments of the Genizah, however. Furthermore, his lack of a background in librarianship probably allowed him more freedom to think and plan ambitiously for the Collection than might otherwise have been the case: from early on he recognised the importance of publicity, fund-raising and, most importantly, visible results—in the form of fragments conserved, microfilms produced and catalogues printed. He knew that success would best be measured by concrete achievements, not promise. Accessibility, too, was his watchword: as fragments were conserved, they were made available for general consultation; microfilms were produced and circulated; the bibliography and the catalogues became indispensable scholarly aids; latterly Stefan Reif was one of the first scholars in Cambridge to recognise the importance of digitisation and the potential of the internet for the future of Genizah research.

While this energetic approach initially disconcerted some of his more measured colleagues, over time the Library cherished the importance of the work that Reif was doing and recognised the extent to which this relied upon a rare combination of talents. In 1982, the Library's governing body, the Syndicate, singled him out to remark 'The importance of the considerable personal contribution of the Director cannot be overstated. His fund-raising ability complements in an unusual way the scholarship which he has brought to bear on this exceptionally important and for long neglected collection'.<sup>1</sup>

Over his thirty years in charge of the Genizah Research Unit, Reif raised more than one and a half million pounds towards the costs of

---

<sup>1</sup> *Cambridge University Reporter*, 7 April 1982, vol. CXII, Special No. 14, p. 38.

conservation, cataloguing and research, a colossal sum, much of it collected before fund-raising became a fashionable—and essential—part of the academic profession. Organisationally, Reif instituted a programme of research that continues to this day, with the production of catalogues (now online, rather than printed), the compiling of an essential bibliography of the Collection and the comprehensive imaging of the manuscripts (microfilm having been overtaken by the power of digital photography), all 193,000 of them.

Reif's fundraising skills, his gift for publicity and public-speaking, and his exceptional organisational talents are strings to his bow, but at heart Reif is and always has been a scholar, blessed with a quick and incisive mind, a robust debating style, and a deep knowledge of a multitude of fields, from philology to codicology, evidenced by a prodigious number of significant publications across a broad range of subjects, but concentrating in particular on the field of prayer. As a pioneer in the diachronic study of Jewish liturgy, establishing from a close reading of manuscripts how textual changes reflect the wider historical development of liturgical theory and practice, Reif has written the essential text on the evolution of rabbinic tefilla, *Judaism and Hebrew Prayer* (1993). This was followed by a volume of collected papers, *Problems with Prayers* (2006), which summarises much of Reif's more recent work on liturgy. In all, Reif's output amounts to well over two hundred scholarly publications in addition to over one hundred more popular pieces. Reif's contribution to the academic study of Hebrew and Judaism was recognised by his appointment as Professor of Medieval Hebrew in the Faculty of Oriental Studies, as then was, in Cambridge University.

Beyond his activities at the Unit and Faculty, Reif was also actively involved at St John's College, Cambridge, where he remains a Fellow, and with whom he has enjoyed many productive collaborations. Beyond Cambridge, Reif is a founder-member of the British Association for Jewish Studies and was President of the Jewish Historical Society of England—no mean achievement for a Scot!

Over and above his many accomplishments as a scholar, administrator and fundraiser, it is possible that Reif will be remembered most of all as an enabler—someone who facilitated the participation of numerous scholars in first-hand and vigorous Genizah research. Since the earliest days of the establishment of the Unit, Reif was eager to bring scholars into the Library to work directly upon the manuscripts themselves, assisting scholars of international repute and specialist

expertise to find and explore the hitherto mostly inaccessible material. Moreover, throughout his thirty-three years as Director, he was keen to foster and instruct a succession of talented young scholars, initiating them into the recondite arts of Jewish manuscript studies. Alumni of the Unit, who honed their interpretative skills on semi-legible, torn and stained fragments, are now scattered across the globe—a new generation of scholars brought up on the importance of close textual analysis. Those initiated under Reif's careful watch include Simon Hopkins, Geoffrey Khan, Meira Polliack, Paul Fenton and the current Unit Head, to name just a few.

Genizah scholarship would not be as vibrant, instructive and pervasive were it not for the efforts of Stefan Reif over the last three decades. His personal example at Cambridge revitalised the field as a whole, as institutions worldwide came to realise the importance of their own Genizah collections and sought to emulate his achievements.

No summation of Stefan Reif's time at Cambridge University Library would be complete without paying tribute to his late wife Shulamit, who died earlier this year. Shulie began to work with Stefan in the Unit in 1976, and thereafter continued to work alongside her husband until his retirement in 2006. Hired as an editorial assistant, principally on the Genizah Series of catalogues, she in fact performed many roles, from bibliographer to translator, thus being the epitome of the 'fitting helper for him' (Genesis 2:18).

The great S. D. Goitein, in summarising the first stage of Genizah studies, wrote:

It was a happy coincidence that the Genizah was discovered near the turn of the century when Oriental and Jewish studies had reached an unprecedented peak. First-rate scholars used their unique knowledge to identify, or put into their historical context, the literary pieces that came to light, as well as to fix the sequence and mutual relationship in which unknown or little-known personalities or institutions stood to each other.<sup>2</sup>

As Marina Rustow remarks in her contribution to the present volume, the next stage moved beyond the literary and concentrated more on the documentary pieces. It was yet another happy coincidence that

---

<sup>2</sup> S. D. Goitein, *A Mediterranean Society: the Jewish Communities of the Arab World as Portrayed in the Documents of the Cairo Geniza* (5 vols plus Index volume by P. Sanders; Berkeley, 1967–1993), vol. I, p. 23.

this generation of scholars who arrived in Cambridge to wrestle with the Genizah fragments was greeted by a man of Reif's vision, range of skills and determination. This collection of studies seems an almost inadequate expression of gratitude, but it is nonetheless presented as a token of the esteem in which Reif is held.

Ben M. Outhwaite  
Cambridge 2010

THE PAPER AND TEXTILE INDUSTRY IN THE LAND  
OF ISRAEL AND ITS RAW MATERIALS IN LIGHT OF AN  
ANALYSIS OF THE CAIRO GENIZAH DOCUMENTS

Zohar Amar, Azriel Gorski, and Izhar Neumann

*Introduction*

The Arab conquest was followed in *al-Šām*<sup>1</sup> by several changes in agriculture and agriculture-based industry as part of an adaptation to the new conditions that were created in the region that had newly come under Islamic control.<sup>2</sup> It appears that the most significant change took place in the textile industry, as emerges from an analysis of many written sources.<sup>3</sup> The cultivation of flax, which had characterised the land of Israel in the Roman-Byzantine period, gradually disappeared. Although linen cloth continued to be the most popular apparel in the Middle Ages, it was imported mainly from Egypt. In contrast there was an increase in the production of more expensive textiles, such as silk and especially cotton. The growing of cotton, which had typically been cultivated in the land of Israel in the Byzantine period only to a limited extent, developed and took over more extensive areas after the Islamic conquest. One of the characteristics of the new situation was the development of local fields of expertise. Thus, for example, the cities of Ramla and Ashkelon specialized in the manufacture of fine cloth.<sup>4</sup> An examination of many textiles found in various archaeological sites throughout the land of Israel corroborates and corresponds to the description that emerges from the historical sources regarding

---

<sup>1</sup> This area includes today Israel, Syria, Lebanon and Jordan. In Jewish sources the term *al-Šām* was a name for the land of Israel. The documents that were examined for this study were written in the land of Israel but the discussion refers to the entire *al-Šām* region, so that the geographical terminology that we use in the article is context-dependent.

<sup>2</sup> A. M. Watson, *Agricultural Innovation in the Early Islamic World* (London, 1983); Z. Amar, *Agricultural Produce in the Land of Israel in the Middle Ages* (Jerusalem, 2000).

<sup>3</sup> Z. Amar, 'The Revolution in Textiles in Eretz Israel and Syria in the Middle Ages' (Hebrew), *Cathedra* 87 (1998), pp. 37–60.

<sup>4</sup> *Ibid.*, pp. 54–56.

the change in the textile industry and clothing fashions.<sup>5</sup> This ‘textile revolution’ also had many ramifications for the production of various by-products such as the paper and dye industries.

We have shown elsewhere that there was a connection between the paper industry and the cotton industry. To illustrate this point, the Hula Valley region, whose inhabitants had previously raised flax for cloth and papyrus for papermaking, turned to the cultivation of cotton and began to manufacture the new paper which was based on the local textile industry.<sup>6</sup> We wish to examine this account, which is strongly supported by an analysis of the historical sources, by analysing the composition of the paper taken from documents from the land of Israel in the Middle Ages which were found in the Cairo Genizah.

### *The Paper Industry*

The principles of the earliest technique for manufacturing paper were known in China but for a long period the secret of its discovery stayed within the borders of the Chinese Empire.<sup>7</sup> It was only in the wake of the Islamic conquests that the paper industry expanded, first to the Near East, and later reaching Europe.<sup>8</sup> Arabic literature notes the date of the discovery of the secret of paper (*kāḡad*) as 751, and this was according to a tradition whereby the technique was learned from Chinese

<sup>5</sup> Ibid., pp. 51–53.

<sup>6</sup> Z. Amar, ‘The Paper Industry in al-Šām in the Middle Ages’ (Hebrew), *Cathedra* 98 (2000), pp. 73–96. For an abridged version in English, see Z. Amar, ‘The History of the Paper Industry in al-Sham in the Middle Ages’, in Y. Lev (ed.), *Towns and Material Culture in the Medieval Middle East* (Leiden, 2002), pp. 119–133.

<sup>7</sup> T. H. Tsien, *Paper and Printing* in J. Needham (ed.), *Science and Civilisation in China* (7 vols; Cambridge, 1954–1998), vol. V:1.

<sup>8</sup> Of the many studies written on the history of the early papermaking industry in China and its development in the Middle Ages, we will mention here the most prominent and significant: J. von Karabacek, ‘Das arabische Papier’, in *Mitteilungen aus der Sammlung der Papyrus Erzherzog Rainer* (Vienna, 1887), vol. II–III, pp. 87–178; A. Grohmann, *From the World of Arabic Papyri* (Cairo, 1952); C. Singer et al., (eds), *A History of Technology* (8 vols; Oxford, 1954–1984), vol. II, pp. 411–416; D. Hunter, *Papermaking: the History and Technique of an Ancient Craft* (New York, 1943); D. Hunter, *Papermaking Through Eighteen Centuries*, reprinted (New York, 1971); A. Grohmann, *Arabische Palaographie* (2 vols; Vienna, 1967–1971), vol. I, pp. 98–105; A. Y. Hassan and D. R. Hill, *Islamic Technology: an Illustrated History* (London & New York, 1986); M. A. Doizy and P. Fulacher, *Papiers et Moulins des Origines A Nos Jours* (Paris, 1989); J. M. Bloom, *Paper Before Print: the History and Impact of Paper in the Islamic World* (New Haven & London, 2001).

captives who were taken with the fall of the city of Samarkand.<sup>9</sup> In any event, it is agreed that the Moslems learned about paper production from the people of Central Asia, who had already begun using rags as a source for their paper centuries before the coming of Islam and the use of paper became widespread by the end of the eighth or beginning of the ninth centuries, during the rule of the Abbasid dynasty. The new paper displaced the use of parchment and Egyptian papyrus, making them almost obsolete. The industry gathered momentum as time went by and spread widely.<sup>10</sup> In the tenth century Samarkand still maintained its status as the centre for the papermaking industry, unrivalled in the quality of its product.<sup>11</sup> However, from this period onward, additional centres of papermaking arose which demonstrated a high level of technological proficiency: in Damascus, Tripoli, Yemen, Egypt (c. 1040) and Morocco (c. 1100). It is not completely clear by what route and at what time the paper industry reached Europe, and according to several theories, it was via Italy or Muslim Spain, perhaps by way of the Crusaders who discovered its existence in the land of Israel.<sup>12</sup> Whatever the case may be, the industry spread over time to France, Germany, Italy and England. At the end of the fifteenth century there were papermaking plants throughout the countries of Europe and the use of parchment had ceased almost entirely.<sup>13</sup>

#### *Date of Introduction of Paper and Its Manufacture in al-Šām*

The sources do not state the precise date that the new paper reached *al-Šām*. The paper industry based on papyrus (*Cyperus papyrus*) was known in the Hula Sea region during the Roman and Byzantine

<sup>9</sup> There are scholars who believe that the actual date was earlier. For a range of opinions, see A. F. R. Hoernle, 'Who was the Inventor of Rag-Paper?', *Journal of the Royal Asiatic Society* 43 (1903), pp. 663–684 (668–671); K. Jahn, 'Das Iranische Papiergeld' in *Archiv Orientální* 10 (1938), pp. 308–340 (333); H. Beveridge, 'The Paper-Mills of Samarkand', *Asiatic Quarterly Review* 30 (1910), pp. 160–164.

<sup>10</sup> K. 'Awād, 'al-Waraq aw al-Kāḡad: Šinā'atuhū fī-l-'uṣūr al-Islāmiyya', in *Majallat al-Majma' al-'Ilmī al-'Arabī bi-Dimašq* 23 (1948), pp. 409–438.

<sup>11</sup> Ibn Ḥawqal, *Kitāb al-Masālik wa-'l-Mamālik*, edited by M. J. de Goeje (Leiden, 1870), p. 465.

<sup>12</sup> Amar, *Paper*, pp. 93–95.

<sup>13</sup> For a comprehensive summary of the milestones in the spread of paper, see, for example, Cl. Huart & A. Grohmann in *Encyclopedia of Islam*, 2nd edn (Leiden, 1978), vol. IV, pp. 419–420, s.v. 'KĀGHAD'; Tsien, *Paper and Printing*, pp. 296–303.



periods.<sup>14</sup> When referring to the members of the tribe of Naphtali who settled on the banks of this sea and engaged in the craft of papyrus-making, the rabbinical sages commented: ‘The sons of Naphtali are called such because they are twisted over seventy-two shafts, that is how they would produce the paper’.<sup>15</sup> In other words, they would knit together the strips produced by cutting the core of the papyrus reed and would thus create large sheets of paper. The paper made of papyrus was replaced during the Arab period by a new writing material made of cotton, which also grew in that region.<sup>16</sup>

The first historical record, and the most reliable, to mention the papermaking industry in the Land of Israel is that of al-Muqaddasī, a Jerusalem-born Moslem geographer who completed the writing of his book in 985. According to this account, the *kāḡad* was exported from Damascus and Tiberias.<sup>17</sup> One may assume that this industry had arrived in these places even earlier. We also hypothesise that the local paper industry required time to become adept at the new manufacturing techniques until it had achieved a level that enabled it to become not just a manufacturing centre but a centre for export as well.<sup>18</sup> In any case, in the tenth century the use of paper in *al-Šām* was so common that Bar Bahlul, the Syrian linguist of that period, translated *qirtās* (which in the past had been translated as ‘made of papyrus’) as ‘*kāḡad*’.<sup>19</sup> And, indeed, in later Arabic sources, the term *qirtās* appears only in the sense of sheets of paper produced by the new technique. Nāṣer-e Khosraw (11th c.) noted that in Tripoli an excellent quality of paper

<sup>14</sup> In a description of the papyrus-based paper industry, Pliny also mentions the growing of papyrus in Syria. See Pliny, *Natural History*, translated by H. Rackham (10 vols; London, 1938–1963), XIII, 73, (vol. IV, p. 143).

<sup>15</sup> GenR 94:8. See J. Theodor and Ch. Albeck (eds), *Midrash Bereshit Rabba: Critical Edition with Notes and Commentary*, 2nd edn (Jerusalem, 1965), p. 1180; S. Klein, ‘Paper and its Manufacture in the Land of Israel’, in S. Yeivin (ed.), *Trade, Industry and Crafts in Ancient Israel* (Jerusalem, 1937), pp. 61–84 (72–74).

<sup>16</sup> Amar, ‘Revolution’, pp. 58–60. Al-Muqaddasī states explicitly that the Hula Lake was ‘the source of cotton’, see al-Muqaddasī, *Aḥsan al-Taḡāsīm fī Ma‘rifat al-Aḡālīm*, edited by M. J. de Goeje (Leiden, 1906), p. 160.

<sup>17</sup> Al-Muqaddasī, *Aḥsan*, pp. 180–181.

<sup>18</sup> In the National Library in Damascus there is a book by Ibn Ḥanbal (d. 855) that was copied in 879. The Syrian historian Muḥammad Kurd ‘Alī mentions the conjecture that it was made of *al-Šām* paper, and in his time it was considered the earliest manuscript written in *al-Šām*; see M. Kurd ‘Alī, *Kitāḡ al-Šām* (6 vols; Damascus, 1925–1928), vol. IV, p. 243.

<sup>19</sup> R. Duval, *Lexicon syriacum auctore Hassano bar Bahlule voces syriacas græcasque cum glossis syriacis et arabicis complectens* (Paris, 1881–1901), vol. II, p. 920; Bloom, *Paper*, p. 47.

(*kāḡad*) was produced, like that in Samarkand and even finer.<sup>20</sup> From the documents of merchants in the Genizah dated 1052–1058 we learn of a widespread trade in paper in Tripoli, Damascus, Tyre, Jerusalem and Ramla. The enormous quantities of paper produced in *al-Šām* went mostly to Egypt.<sup>21</sup> This attests to the poor quality of Egyptian paper since at this date the papermaking industry in Egypt was not sufficiently developed to meet the demanding needs of the government bureaucracy.<sup>22</sup> Syrian paper was also exported to Byzantium.<sup>23</sup>

In his book on commerce, Pegolotti mentions the Damascene paper (*carte*) which could be purchased in the coastal cities of the land of Israel during the reign of the Crusaders (until 1291).<sup>24</sup> A Mamluk inscription from 1296 found in Jerusalem refers to a papermaking factory in Nablus.<sup>25</sup> According to al-Qalqašandī, government-owned paper factories were operating in all of the provinces of *al-Šām* during the first centuries of Muslim rule as well as in the Ayyubid and early Mamluk periods, in Damascus, Aleppo, Tripoli, Hama, Karak and Safed.<sup>26</sup> It is possible that some of the papermaking factories were not operating necessarily in the cities of the provinces themselves but in districts that were subject to them. An important factor in the location of paper-production plants is proximity to supplies of fresh water, which was essential for beating the fibre and forming the sheets. In this sense Tiberias, Damascus and the coastal cities of Tyre and Tripoli were suitable locations. In any case, the information cited by al-Qalqašandī

<sup>20</sup> W. M. Thackston (transl.), *Nāṣer-e Khosraw's Book of Travels (Safarnāma)* (New York, 1986), p. 13.

<sup>21</sup> M. Gil, *Palestine During the First Muslim Period* (Hebrew; Tel Aviv, 1983), vol. II, doc. 371, pp. 687–688; vol. III, doc. 480, p. 165; doc. 514, p. 294; doc. 516, p. 298; doc. 517, pp. 301–304; M. Gil, 'Palestine During the First Muslim Period (634–1099). Additions, Notes and Corrections' (Hebrew), *Te'uda* 7 (1991), pp. 281–345 (329); S. D. Goitein, *A Mediterranean Society: the Jewish communities of the Arab world as portrayed in the documents of the Cairo Genizah* (5 vols plus Index volume by P. Sanders; Berkeley, 1967–1993), vol. I, pp. 81 and 112.

<sup>22</sup> M. D. Yusuf, *Economic Survey of Syria during the Tenth and Eleventh Centuries* (Berlin, 1985), p. 129.

<sup>23</sup> M. Lombard, *The Golden Age of Islam*, translated by J. Spencer (Amsterdam, 1975), p. 190.

<sup>24</sup> F. B. Pegolotti, *La Pratica della Mercatura*, edited by A. Evans (Cambridge, Mass, 1936), p. 294.

<sup>25</sup> M. van Berchem et al., *Matériaux pour un Corpus Inscriptionum Arabicarum* (4 parts; Cairo, 1894–1985), vol. II, p. 214.

<sup>26</sup> Al-Qalqašandī, *Ḍaw' al-Šubḥ al-Musaffar: abridgement of Šubḥ al-A'ašā*, edited by M. Salāmah (Cairo, 1906), pp. 415–416.

and the other sources regarding the thriving Syrian paper industry reflect the situation until the end of the fourteenth century.

The sources also provide several interesting details about the manner in which paper was manufactured and its qualities. In *al-Šām, kāḡadī* (a manufacturer or seller of paper) was recognised as a profession.<sup>27</sup> In a commercial document from the Genizah dated 1057, there is mention of the ‘*alāma* of Ibn Imām’, which was the trademark of the paper manufacturer named Ibn Imām who apparently resided in Damascus.<sup>28</sup> In *Sefer ha-Miṣvot* of the Karaite Levi b. Yefet, a resident of Jerusalem, which was written in Arabic at the beginning of the eleventh century, another interesting allusion is made to the process of papermaking in the region. In reference to the prohibition against eating any leavened product on Passover, mention is made of clothes and paper (*kāḡad*) which are bleached. This is further reinforced by the translator H. Ben-Shammai who adds the word *našā*’ which means ‘starch’.<sup>29</sup> Starch made out of wheat was used in the Arabic paper industry for sizing.<sup>30</sup>

#### *Raw Materials in the Papermaking Industry*

One of the revolutionary changes that took place in the papermaking industry following the Islamic conquests is connected with the raw materials used. The major raw material used in the Chinese papermaking industry was taken from the bark of the Paper Mulberry (*Broussonetia papyrifera*) and other trees.<sup>31</sup> Analytical tests made of five Chinese documents from 768–787 showed that they were made of

<sup>27</sup> M. Shatzmiller, *Labour in the Medieval Islamic World* (Leiden, 1994), p. 117.

<sup>28</sup> S. D. Goitein, *Letters of Medieval Jewish Traders* (Princeton, 1973), p. 90; Gil, *Palestine*, vol. III, doc. 514, p. 294. The reference is probably to a stamp by the manufacturer, similar to that which had been used in the papyrus making industry; see Grohmann, *World*, pp. 32–34. This does not refer (contra Gil, *Palestine*, vol. I, p. 194) to a watermark.

<sup>29</sup> H. Ben-Shammai, ‘A new fragment from the original Arabic version of *Sefer ha-Miṣvot* of the Karaite Levi b. Yefet’ (Hebrew), in *Šenaton ha-Miṣpaṭ ha-Ivri* 11–12 (1984–1986), pp. 99–133 (111–112).

<sup>30</sup> Hassan and Hill, *Islamic Technology*, p. 195.

<sup>31</sup> For more about plants that were used in the paper industry in the Far East, see Hunter, *Papermaking History*, p. 32; Hunter, *Papermaking through Eighteen Centuries*, pp. 155–156; Tsien, *Paper and Printing*, p. 53.

different plants as well as scraps of woollen cloth and hemp.<sup>32</sup> However, it seems that these materials were not available in Samarkand, and therefore the Arabs were forced to use flax as a substitute. Other tests carried out on paper used for letters written in Arabic, dated 874–909, have shown that they were made almost entirely of a linen base, either plants that had been processed or scraps of cloth. It is certain that neither raw nor spun cotton were in use industrially in the earliest period of the eastern papermaking industry.<sup>33</sup> The use of cotton came later, probably during the ninth or tenth centuries and was one of the most important changes introduced by the Arabs to this industry. As stated, this crop later entered the agriculture of *al-Šām*, and by the Middle Ages *al-Šām* was the principal cotton exporter to Europe.<sup>34</sup>

Like the soap-making industry, which was closely connected to the thriving cultivation of olives in the land of Israel, both in its location and in raw materials, the paper industry also began to make use of the cotton industry's by-products.<sup>35</sup> All of the manufacturing and marketing centres of paper specifically referred to in the records also served as cotton centres.<sup>36</sup>

Cotton could be used as a raw material both from the field or from worn-out clothes made of cotton and other substances. There are several accounts of this in the halakhic literature and Jewish commentaries written in the Middle Ages. For example, the term *neyar meḥaqa* (BT *Megilla* 19a), R. Simḥa, one of Rashi's students, wrote 'And in the *responsa* of the Ge'onim I have found that they make it of cotton, which is called *qīṭōn* (in Arabic), where remnants from the land of Ishmael are wrapped around, and it is still new. The ink adheres to it and the writing lasts many days, and it is called *kāḡad*'.<sup>37</sup> This source suggests the introduction into France of the new papermaking technology, which originated in the Middle East. In any case, we see from this source that the major raw material used in the papermaking industry

<sup>32</sup> Hoernle, 'Who was the Inventor', pp. 672–675; for similar findings relating to Chinese documents from the third to the tenth centuries, see Tsien, *Paper and Printing*, p. 54.

<sup>33</sup> See Hoernle, 'Who was the Inventor', p. 665; Hunter, *Papermaking through Eighteen Centuries*, p. 156; Hassan and Hill, *Islamic Technology*, p. 195.

<sup>34</sup> E. Ashtor, 'The Venetian Cotton Trade in Syria in the Later Middle Ages', *Studi Medievali* 17 (1976), pp. 675–715.

<sup>35</sup> See Amar, 'Revolution', pp. 40–43.

<sup>36</sup> Amar, *Paper*, p. 85.

<sup>37</sup> S. Hurwitz, *Maḥzor Viṭri of Rabbenu Simḥa* (Hebrew; Berlin, 1893), p. 532.

was cotton. For this purpose they used scraps that came ‘from the land of Ishmael’, in other words, the waste product of cotton textiles or rags, which was the primary raw material in papermaking.<sup>38</sup> This is supported by the Arab historian Kurd ‘Alī, who states that *al-Šāmī* paper was made of cotton, old rags and even silk.<sup>39</sup>

*The Art of Copying and the Paper Trade in Light of the  
Genizah Documents*

An additional explanation of the fact that the paper industry was integrated relatively quickly into the local material culture is related to the craft of manuscript copying, which was an important economic and cultural activity among the Jews of *al-Šām*. It is no coincidence that Tiberias became a centre for the paper trade, as a major Jewish spiritual centre as well as a centre of masoretic activity, the book-copying industry was well-developed there.<sup>40</sup> In the eleventh century most writing was done on paper.<sup>41</sup> Proof of this is the fact, for example, that most of the Cairo Genizah documents originating in the land of Israel are made of paper, with only a few on parchment.<sup>42</sup>

The writing material itself demonstrates the prevalence of paper in that period. However, the use, trade and marketplaces for this writing material are mentioned more than once in the same traders’ letters that were found in the Genizah. In a letter sent from Dalton, Israel, to Tiberias in 1030, Solomon ha-Kohen b. Joseph mentioned his work as a copyist of books made of paper. In this letter he also noted that

<sup>38</sup> R. I. Burns, ‘The Paper Revolution in Europe: Crusader Valencia’s Paper Industry: a Technological and Behavioral Breakthrough’, *Pacific Historical Review* 50 (1981), pp. 1–30 (27–28).

<sup>39</sup> Kurd ‘Alī, *Kittat*, vol. IV, p. 243.

<sup>40</sup> See Gil, *Palestine*, vol. I, pp. 147–150. On the craft of manuscript copying, see also pp. 191–194; N. Allony, *The Tiberian School of Hebrew Grammar* (Hebrew; Jerusalem, 1995), pp. 17–24.

<sup>41</sup> On the use of paper (*kāḡad*) for copying old books, there are many references in the Genizah; see N. Allony, *The Jewish Library in the Middle Ages: Book Lists from the Cairo Genizah*, edited by M. Frenkel and H. Ben-Shammai (Hebrew; Jerusalem, 2006), pp. 12, 38.

<sup>42</sup> In particular, note the following documents from Eretz Israel, which are all written on paper: Gil, *Palestine*, vol. II, docs 17–18 (p. 22–24), 24–25 (pp. 37–41), and the letters on behalf of the ‘lepers of Tiberias’ from the first half of the 11th century, docs 252–267 (pp. 457–475).

'I sent a gold coin to Kadesh'.<sup>43</sup> This may be a reference to payment for paper purchased in Kadesh. It would seem that the papermaking industry itself was concentrated in the city of Kadesh, while the marketing centres were in Tiberias and Damascus.<sup>44</sup> From the correspondence conducted by Moses (Mūsā) b. Ya'qūb between 1057 and 1058, we learn about an extensive trade in paper in Damascus and Tyre. His commercial documents also itemize the transport costs for the shipment of paper by camel.<sup>45</sup> He reported in one document, 'I transported twenty or more sacks of paper to Ramla and the shipment arrived safely'.<sup>46</sup> Daniel b. 'Azarya also mentioned these places in connection with the purchase of paper, 'I have already sent to Tyre regarding the purchase of sheets of paper (because there is no) fine paper here... Regarding the paper, in Ramla the trade in paper is more as desired'.<sup>47</sup> Israel b. Nathan from Gush Halav, in one of his letters to Egypt in 1060, asked that paper be purchased for him for the copying of books.<sup>48</sup> A year later he confirms the transfer to Egypt of eleven bales of paper that he had in Jerusalem.<sup>49</sup> In another letter Daniel b. 'Azarya asked 'Eli b. 'Amram, who was living in Fustat, to copy for him pamphlets of geonic *responsa*, 'Seek out an agile scribe and buy good paper, not Egyptian, but rather Spanish or from Tripoli'.<sup>50</sup> While in most cases the Genizah documents do not explicitly note the site of paper production, there are clear references to Tyre and Tripoli, as the historical sources also attest. Another important centre of scribal activity in the late Middle Ages was Jerusalem.<sup>51</sup> Although there are accounts from earlier periods of a lively trade in paper, there is still no clear-cut information about a local papermaking industry.

<sup>43</sup> Gil, *Palestine*, vol. II, doc. 250, p. 454–455. See also J. Braslavsky, *Studies of our Land, its Past and Relics* (Hebrew; Tel Aviv, 1954), pp. 69–70.

<sup>44</sup> See Amar, 'Revolution', p. 60.

<sup>45</sup> Goitein, *Society*, vol. I, p. 81; Gil, *Palestine*, vol. III, doc. 514 (p. 294); doc. 516–517 (p. 298–304); see also vol. I, p. 194.

<sup>46</sup> Gil, *Palestine*, vol. III, doc. 517, p. 303, line 7.

<sup>47</sup> Gil, 'Additions', p. 329.

<sup>48</sup> Gil, *Palestine*, vol. III, doc. 474, p. 151.

<sup>49</sup> Gil, *Palestine*, vol. III, doc. 480, p. 165.

<sup>50</sup> Gil, *Palestine*, vol. II, doc. 371, pp. 687–688.

<sup>51</sup> M. Beit-Arie, 'Hebrew Manuscripts Copied in Jerusalem before the Ottoman Conquest', in B. Z. Kedar (ed.), *Jerusalem in the Middle Ages* (Jerusalem, 1979), pp. 244–278.

*Raw materials in light of an analysis of the Genizah documents*

Until now only isolated studies have been published on the composition of early paper.<sup>52</sup> The purpose of this study is to examine and reassess the conclusions that we reached in earlier studies—based on an analysis of the historical sources—through a scientific analysis of the paper manufactured in the land of Israel in the Middle Ages.

The research questions that we posed are:

1. Which raw materials were used in paper originating in *al-Šām*?
2. Was this a first-time use of the materials, or were the fibres recycled from worn-out clothing or rags?
3. Can we learn more about the techniques of paper production at the time, especially the use of auxiliary materials?

*Research Methods*

In this study, we examined twenty-one documents (see Table 1) written in various locations in the land of Israel during the eleventh and twelfth centuries.<sup>53</sup> Our working hypothesis is that the paper of the documents was also manufactured in the land of Israel, an important centre for paper production. Many Genizah documents make reference to a lively trade and export of paper from many locations, such as Tiberias and Ramla. In these cases, it is the paper of the document itself that bears witness to the process and product that it is documenting. However, even if there is no certainty that all of the paper examined for this study was produced in *al-Šām*, there is still great importance for the study of early paper used in the Middle East, its raw materials and an understanding of its manufacturing techniques.

---

<sup>52</sup> Hoernle, 'Who was the Inventor', p. 669; J. M. Bloom, 'Paper in Fatimid Egypt' in M. Barrucand (ed.), *L'Egypte Fatimide son Art et son Histoire* (Paris, 2002), pp. 395–401.

<sup>53</sup> All of the documents are from the Library of the Jewish Theological Seminary. The first research results were presented in the Papers of the 27th International Congress of Paper Historians, 3–10 September 2004, Duszniki Zdrój, Poland.

Table 1. Paper Fragments Used in This Study

Sample number	Signature	Dated	Place	Sample number	Signature	Dated	Place
1	ENA 2804, f.8	1025	Jerusalem	12	ENA 3765, f.4	ca. 1055	Jerusalem
2	ENA 4020, f.42	1025	Jerusalem	13	ENA 2722, f.1	1057	Jerusalem
3	ENA 2804, f.12	1028	Ramla	14	ENA 2804, f.7	1055	Jerusalem
4	ENA 2804, f.13	1028	Ramla	15	ENA 4010, f.32	1030	Jerusalem
5	ENA 2804, f.19	1030	Ramla	16	ENA NS1, f.40	1060	Gush Halav
6	ENA 2804, f.17	1043	Jerusalem	17	ENA 4010, f.8	1065	Jerusalem
7	ENA 2804, f.18	1048	Jerusalem	18	ENA 4100, f.53	1076	Ramla
8	ENA 4020, f.6	1039	Ramla	19	ENA 2806, f.8	1112	Ashkelon
9	ENA 4020, f.48	1030	Jerusalem	20	ENA 2727, f.35	1130	Ashkelon
10	ENA NS 17, f.8	ca. 1035	Tiberias	21	ENA 2567, f.150	Early 12th century	Banias
11	ENA 2804, f.4	ca. 1050	Tiberias				

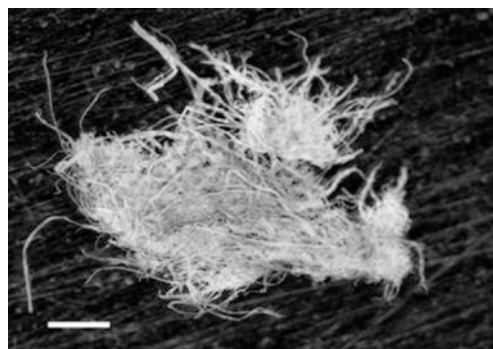


Figure 1. Genizah paper fragment, sample 2 (scale bar = 0.5 mm).

The samples were examined and photographed using microscopy (see Figure 1). Under a stereomicroscope, four separate fibres were removed from each paper fragment. Polarized Light Microscopy was used to characterise the fibres as to birefringence, extinction, and determination (using a ruby plate) of their direction of twist in the 'dry twist test'. The identification was done by comparison to known modern and ancient samples of fibres.

A degradation scale was created (see Table 2), consisting of a description of the fibre and a rating for its degradation, as a subjective scale to rank and compare the principal characteristics of the fibres studied. In the results section (below, see Table 3), each identified fibre type is followed by its degradation rating in parentheses.



Table 2. Relative Degradation Scale

Description	Grade
No degradation	5
Slight degradation or discoloration	4
Degraded	3
Heavily degraded	2
Degraded beyond identification—whole fibre	1
Degraded beyond identification—fibre fragments	0

### Results

The results of the analyses detailed in Table 3 demonstrate that cotton is the main fibre type present (see Figure 2).

Table 3. Types of Fibres and Degrees of Degradation

Sample number	'Fibre' 1	'Fibre' 2	'Fibre' 3	'Fibre' 4	Comment
1	Wool (5)	Cotton (4)	Flax (4)	Mix	The mix is mostly flax (3) with cotton (3) as a minor constituent.
2	Not identified (1)	Not identified (0)	Cotton (3)	Flax (3)	
3	Cotton (4)	Cotton (2)	Cotton (3)	Not Identified (1)	
4	Cotton (3)	Cotton (4)	Not identified (4)	Cotton (3)	
5	Cotton (3)	Flax (4)	Cotton (5)	Cotton (3)	
6	Cotton (5)	Mix	Cotton (4)	Cotton (5)	The mix is cotton (5) and flax (4).
7	Cotton (3)	Cotton (4)	Cotton (4)	Cotton (3)	
8	Mix	Cotton (5)	Cotton (3)	Cotton (3)	The mix is cotton (5), rabbit hair (3), unidentified hair (1). 'Fibre' 3 also contains a synthetic fibre contaminant.
9	Cotton (4)	Cotton (3)	Cotton (3)	Cotton (5)	
10	Cotton (4)	Flax (3)	Cotton (2)	Flax (4)	
11	Flax (5)	Cotton (2)	Mix	Cotton (3)	The mix is flax (2) and cotton (4).
12	Flax (4)	Cotton (3)	Cotton (4)	Cotton (5)	
13	Cotton (3)	Cotton (2)	Cotton (2)	Cotton (2)	
14	Cotton (3)	Cotton (2)	Cotton (3)	Cotton (4)	
15	Cotton (4)	Cotton (2)	Cotton (4)	Mix	The mix is cotton (5) with flax (4) as a minor component.
16	Cotton (2)	Cotton (4)	Cotton (2)	Cotton (2)	Paper fragment is laminated.
17	Not identified (3)	Cotton (3)	Cotton (4)	Cotton (2)	

Table 3 (*cont.*)

Sample number	'Fibre' 1	'Fibre' 2	'Fibre' 3	'Fibre' 4	Comment
18	Cotton (2)	Cotton (2)	Flax (4)	Cotton (5)	Flax ultimates of 'Fibre' 3 are still in bundle.
19	Cotton (2)	Cotton (2)	Flax (4)	Cotton (3)	
20	Flax (3)	Cotton (2)	Cotton (3)	Cotton (2)	
21	Flax (4)	Flax (4)	Cotton (5)	Cotton (2)	Flax ultimates of 'Fibre' 2 are still in bundle. Paper fragment is laminated.

### Discussion and Conclusions

#### 1. Raw Materials

The results clearly show that the principal raw material used in our paper samples was cotton ( $\approx 73\%$ ) with flax being only a secondary constituent ( $\approx 14\%$ ). Other fibre types represent only 13% of the fibres present. The results concur with the historical sources on the agricultural innovations of the Arabs during the Middle Ages (and the resulting 'textile revolution' in *al-Šām*). Cotton began to be cultivated instead of flax, and thus it became more common in the manufacture of textiles.

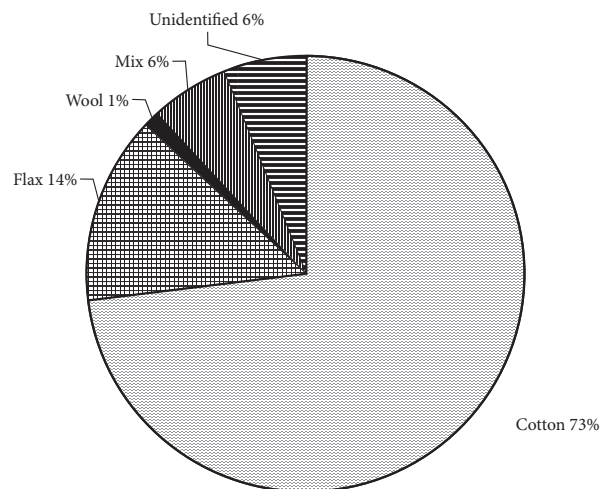


Figure 2. Relative percentages of fibre types

## 2. *The Source of the Raw Material*

Most of the fibres used in our paper fragments were not originally intended for papermaking. This, in conjunction with the historical sources, indicates that papermaking was based on a secondary use of material, namely worn-out clothing and rags, which underwent a process whereby it was broken down into its constituent fibres. These fibres were then used for the manufacture of paper. This conclusion is supported by the state of preservation of the fibres. Thus Loveday, who studied many Egyptian papers from the same period, stated 'Analysis of the papers themselves suggest that the fibres were generally not used in their raw state, but were extracted in their processed state from textiles, rope, and cordage'.<sup>54</sup>

In 68% of the paper fragments different degrees of preservation of the same fibre type were found. This difference in degradation was especially apparent in cases where there are two or more fibres of the same fibre type attached to each other and with the individual fibres having a different state of degradation (Sample 6, Fibre 2; Sample 8, Fibre 1; Sample 11, Fibre 3). The most likely explanation is that the fibres used for paper production came from different sources.

In five documents the raw material is a combination of cotton and flax fibres. This supports the hypothesis that these materials are remnants of different pieces of clothing that had been broken down into fibres that were later combined in the papermaking process. The finding of the dyed wool fibres in Sample 1, if not a contaminate, would also support a used-clothing hypothesis. It was not accepted practice to use dyed fibres in the papermaking process.

The conclusion that the source of the raw material is worn-out clothing has implications not only for the history of the paper industry. It also provides a method to identify the raw materials used in the textile industry in *al-Šām*, and throughout the Middle East in general during that period.<sup>55</sup>

Rabbit hair was found together with other raw materials in a document from the city of Ramla (Sample 8). One could claim that this

---

<sup>54</sup> H. Loveday, *Islamic Paper* (London, 2001), p. 32.

<sup>55</sup> In two samples (out of twelve) of flax material, the flax ultimates are still in a bundle, indicating that the quality of the flax processing was not good and the fibres were not properly separated from the stalk. Subsequent work will target how typical this phenomenon was through an analysis of ancient linen garments.

is a marginal and non-representative finding that somehow found its way into the paper. However, the historical sources suggest that there was a unique industry producing clothes from rabbit hair in the land of Israel at that time. References to 'rabbity wool' are found in Jewish halakhic sources from the Mishnah and Talmud, where it is mentioned together with camel wool and other raw materials used in the textile industry.<sup>56</sup> A direct and important source documenting this industry is by the Muslim writer Mahmūd ibn 'Umar Zamaḡṣarī (d. 1144) who wrote explicitly that in *al-Šām* clothes were manufactured from rabbit pelts.<sup>57</sup> It is worth emphasising that we are not maintaining that rabbit hair (or silk, as the historical sources note) was the main source of raw material for the paper industry, but rather that it was likely to appear in a blend of cotton or linen as part of the composite of fibres from which clothes at that time were made.

### 3. *Techniques of Papermaking and Auxiliary Materials*

Our findings can be related to three points connected with the paper-making process.

1) There were differences in the structural integrity of the different paper fragments. Some were very flat and held together as a unit. Others were thicker, looser and came apart easily into two layers or into separate masses of fibres. This difference in paper integrity may reflect different modes of production. It may also represent different centres of paper production that utilised different manufacturing processes.

2) One document came apart into two layers. The fibres of the two layers appeared on stereomicroscopic examination to be different (Sample 17). One layer was stiff with a yellowish surface in which the fibres were not distinct. The other layer was a loose mesh of distinct individual fibres.

A comparison with hand papermaking today may explain the above. Thick paper is achieved by dipping a screen through the pulp in the vat to form a layer that is couched off (removed from) the screen to

<sup>56</sup> *Tosefta Kilayim* 5, 11 and *Šabbat* 9, 3, 201, see M. S. Zuckerman (ed.), *Tosefta, Mishna und Boraita*, reprinted (Jerusalem, 1970), pp. 80 and 121. See also BT *Menahot* 39b; GenR 20 (Theodor and Albeck, *Midrash*, p. 197), which state that Adam's clothes were made of camel hair and rabbit hair.

<sup>57</sup> Mahmūd ibn 'Umar Zamaḡṣarī, *Asās al-Balāḡa* (Cairo, 1922), p. 375.

a felt (an absorbent surface); then another layer is formed by dipping the screen and lying it down upon the first. This procedure can be repeated two or three times. The resultant two or three layers are then pressed and dried to form a thick sheet of paper.

3) Some researchers postulate that the use of wheat starch for sizing was introduced to the papermaking industry by the Arabs. Starch is very visible in polarised light microscopy. No starch was found in any of the samples examined, and thus disputes this hypothesis.

### *Summary*

This study is a multidisciplinary combination of history and natural science, and it may constitute a significant breakthrough in understanding the technology of the early paper industry. By testing and comparing different samples of paper that were produced in different papermaking centres during the Middle Ages, it may be possible to draw up a typology of the various types of early paper. This will allow the identification of manufacturing centres and a means for dating paper according to its composition. Further, this work demonstrates the possibility of studying medieval textiles through the analysis of early paper.

This is just the first stage of the study; examining additional documents from *al-Šām* and comparing them with documents from other centres such as Egypt, Iraq and North Africa can offer a more extensive and in-depth evaluation of the results of the study.

### *Acknowledgements*

All the documents come from the collection of the Library of the Jewish Theological Seminary of America. We sincerely thank Mayer Rabinowitz, the former Director of the JTS Library, the JTS Library's Conservation Department, and Nellie Stavisky, a paper conservator, who allowed us to examine these documents and without whose help the study could never have been accomplished.

## Bibliography

- N. Allony, *The Tiberian School of Hebrew Grammar* (Hebrew; Jerusalem, 1995), pp. 17–24.
- , *The Jewish Library in the Middle Ages: Book Lists from the Cairo Genizah*, edited by M. Frenkel and H. Ben-Shammai (Hebrew; Jerusalem, 2006).
- Z. Amar, 'The Revolution in Textiles in Eretz Israel and Syria in the Middle Ages' (Hebrew), *Cathedra* 87 (1998), pp. 37–60.
- , *Agricultural Produce in the Land of Israel in the Middle Ages* (Jerusalem, 2000).
- , 'The Paper Industry in al-Šām in the Middle Ages' (Hebrew), *Cathedra* 98 (2000), pp. 73–96.
- , 'The History of the Paper Industry in al-Sham in the Middle Ages', in Y. Lev (ed.), *Towns and Material Culture in the Medieval Middle East* (Leiden, 2002), pp. 119–133.
- E. Ashtor, 'The Venetian Cotton Trade in Syria in the Later Middle Ages', *Studi Medievali* 17 (1976), pp. 675–715.
- K. 'Awād, 'al-Waraq aw al-Kāḡad: Šinā'atuhū fī-l-'uṣūr al-Islāmiyya' in *Majallat al-Majma' al-'Ilmī al-'Arabi bi-Dimašq* 23 (1948), pp. 409–438.
- H. Ben-Shammai, 'A new fragment from the original Arabic version of *Sefer ha-Miṣvot* of the Karaite Levi b. Yefet' (Hebrew), in *Šenaton ha-Mišpaṭ ha-'Ivri* 11–12 (1984–1986), pp. 99–133.
- M. Beit-Arie, 'Hebrew Manuscripts Copied in Jerusalem before the Ottoman Conquest' in B. Z. Kedar (ed.), *Jerusalem in the Middle Ages* (Jerusalem, 1979), pp. 244–278.
- M. van Berchem et al., *Matériaux pour un Corpus Inscriptionum Arabicarum* (4 parts; Cairo, 1894–1985).
- H. Beveridge, 'The Paper-Mills of Samarkand' in *Asiatic Quarterly Review* 30 (1910), pp. 160–164.
- J. M. Bloom, *Paper Before Print: the History and Impact of Paper in the Islamic World* (New Haven & London, 2001).
- , 'Paper in Fatimid Egypt' in M. Barrucand (ed.), *L'Egypte Fatimide son Art et son Histoire* (Paris, 2002), pp. 395–401.
- J. Braslavsky, *Studies of our Land, its Past and Relics* (Hebrew; Tel Aviv, 1954).
- R. I. Burns, 'The Paper Revolution in Europe: Crusader Valencia's Paper Industry: a Technological and Behavioral Breakthrough', *Pacific Historical Review* 50 (1981), pp. 1–30.
- M. A. Doizy and P. Fulacher, *Papiers et Moulins des Origines A Nos Jours* (Paris, 1989).
- R. Duval, *Lexicon syriacum auctore Hassano bar Bahlule voces syriacas græcasque cum glossis syriacis et arabicis complectens* (Paris, 1881–1901).
- M. Gil, *Palestine During the First Muslim Period* (Hebrew; 3 vols; Tel Aviv, 1983).
- , 'Palestine During the First Muslim Period (634–1099). Additions, Notes and Corrections' (Hebrew), *Té'uda* 7 (1991), pp. 281–345.
- S. D. Goitein, *A Mediterranean society: the Jewish communities of the Arab world as portrayed in the documents of the Cairo Genizah* (5 vols plus Index volume by P. Sanders; Berkeley, 1967–1993).
- , *Letters of Medieval Jewish Traders* (Princeton, 1973).
- A. Grohmann, *From the World of Arabic Papyri* (Cairo, 1952).
- , *Arabische Palaographie* (2 vols; Vienna, 1967–1971).
- A. Y. Hassan and D. R. Hill, *Islamic Technology: an Illustrated History* (London & New York, 1986).
- A. F. R. Hoernle, 'Who was the Inventor of Rag-Paper?', *The Journal of the Royal Asiatic Society* 43 (1903), pp. 663–684.
- S. Hurwitz, *Maḥzor Viṭri of Rabbenu Simḥa* (Hebrew; Berlin, 1893).

- D. Hunter, *Papermaking: the History and Technique of an Ancient Craft* (New York, 1943).
- , *Papermaking Through Eighteen Centuries*, reprinted (New York, 1971).
- C. Huart & A. Grohmann in *Encyclopedia of Islam*, 2nd edn (Leiden, 1978), vol. IV, pp. 419–420, s.v. 'KĀGHAD'.
- Ibn Ḥawqal, *Kitāb al-Masālik wa-'l-Mamālik*, edited by M. J. de Goeje (Leiden, 1870).
- K. Jahn, 'Das Iranische Papiergeld', *Archiv Orientalní* 10 (1938), pp. 308–340.
- J. von Karabacek, 'Das arabische Papier', in *Mitteilungen aus der Sammlung der Papyrus Erzherzog Rainer* (Vienna, 1887), vol. II–III, pp. 87–178.
- S. Klein, 'Paper and its Manufacture in the Land of Israel', in S. Yeivin (ed.), *Trade, Industry and Crafts in Ancient Israel* (Jerusalem, 1937), pp. 61–84.
- M. Kurd 'Alī, *Kitāḥ al-Šām* (6 vols; Damascus, 1925–1928).
- M. Lombard, *The Golden Age of Islam*, translated by J. Spencer (Amsterdam, Oxford & New York, 1975).
- H. Loveday, *Islamic Paper* (London, 2001).
- Al-Muqaddasi, *Aḥsan al-Taqāsīm fī Ma'rifat al-Aqālim*, edited by M. J. de Goeje (Leiden, 1906).
- F. B. Pegolotti, *La Pratica della Mercatura*, edited by A. Evans (Cambridge, Mass, 1936).
- Pliny, *Natural History*, translated by H. Rackham (10 vols; London & Cambridge, Mass., 1938–1963).
- Al-Qalqašandī, *Ḍaw' al-Šubḥ al-Musaffar: abridgement of Šubḥ al-A'ašā*, edited by M. Salāmah (Cairo, 1906).
- M. Shatzmiller, *Labour in the Medieval Islamic World* (Leiden, 1994).
- C. Singer et al. (eds), *A History of Technology* (8 vols; Oxford, 1954–1984).
- W. M. Thackston (transl.), *Nāṣer-e Khosraw's Book of Travels (Safarnāma)* (New York, 1986).
- J. Theodor and Ch. Albeck (eds), *Midrash Bereshit Rabba: Critical Editions with Notes and Commentary*, 2nd edn (Jerusalem, 1965).
- T. H. Tsien, *Paper and Printing*, in J. Needham (ed.), *Science and Civilisation in China* (7 vols; Cambridge, 1954–1998), vol. V:1.
- A. M. Watson, *Agricultural Innovation in the Early Islamic World* (London & New York, 1983).
- M. D. Yusuf, *Economic Survey of Syria during the Tenth and Eleventh Centuries* (Berlin, 1985).
- Mahmūd ibn 'Umar Zamaḡšarī, *Asās al-Balāḡa* (Cairo, 1922).
- M. S. Zuckerman (ed.), *Tosefta, Mishna und Boraitha*, reprinted (Jerusalem, 1970).