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On the Making of Local Paper. A Thirteenth Century Yemeni Recipe

Résumé. Cet article propose l'analyse et la traduction d'une recette de fabrication du papier provenant du Yémen au XIII^e^ siècle. C'est jusqu'à présent la deuxième recette de ce type en arabe qui ait été retrouvée. La première est donnée dans la *ʿUmdat al-kuttâb* d'Ibn Bâdîs (m. 454/1062) ; celle-ci est un chapitre de la *Mukhtaraʿ fî funûn min al-ṣunaʿ* attribuée à al-Malik al-Muẓaffar (m. 694/1294) qui explique comment fabriquer du papier à partir d'écorce de figuier et non de chanvre ou de lin comme c'est le cas dans la recette d'Ibn Bâdîs et dans les sources arabes médiévales connues jusque-là.

Abstract: The present article examines and provides a translation of a thirteenth century recipe for papermaking. The recipe in question originated in Yemen and constitutes the second hitherto discovered description of paper manufacture in the Arabic language. Just as the first recipe contained in the work of Ibn Bâdîs (d. 454/1062), this recipe represents a chapter from a manuscript of *al-Mukhtaraʿ fî funûn min al-ṣunaʿ* attributed to al-Malik al-Muẓaffar (d. 694/1294). It describes the making of paper from the bark of fig trees, as opposed to hemp or flax (or their products) mentioned in Ibn Bâdîs's *ʿUmdat al-kuttâb* and other Arabic medieval sources.

Our knowledge of the methods of papermaking in the Arab world is largely based on the well-known chapter from *ʿUmdat al-kuttâb waʿuddat dhawî al-albâb* ascribed to the Zirid ruler of North Africa al-Muʿizz ibn Bâdîs (d. 454/1062).[1] Recently,

1. For the first edition of this work see Ibn Bâdîs, 1971. A different edition of the chapter on papermaking can be found in Zayyât, 1992: 79-81. The first translation of the text of Ibn Bâdîs into German was made by J. von Karabacek (see Karabacek, 1888: 84-90). Other translations can be found in: Briquet, 1955: 166-167, Levey, 1962: 39-40 and Hassan & Hill, 1986: 192-194. The most up to date translation is that of G. Humbert which appeared in Irigoin, 1993: I, 278-280.

howewer, another work containing a recipe for papermaking has come to light. The work in question is *al-Mukhtaraʿ fî funûn min al-ṣunaʿ*, a copy of which is preserved in al-Khizâna (*al-kutubkhâna*) al-Âṣafîya, Hyderabad (India). Although the Hyderabad copy is anonymous, this title has been attributed to the Rasulid ruler of Yemen, al-Malik al-Muẓaffar Yûsuf al-Ghassânî (d. 694-1294).[2]

This version of the *Mukhtaraʿ* is nevertheless very different from the other two surviving copies held by Dâr al-kutub (Cairo) and Bibliotheca Ambrosiana (Milano), respectively. It contains 15 chapters, as opposed to the 10 found in the other two manuscripts, and includes the chapter on the making of local paper (*al-kâghad al-baladî*) which the other two copies lack. In view of this and the fact that the chapters not included in the Cairo and Ambrosiana manuscripts are written in a language containing many Yemeni terms, it appears that the Hyderabad copy is the original unabridged version and that the other two copies represent its shorter version. The abridged version, based on the Cairo and Ambrosiana manuscripts, has now been edited by Muḥammad ʿÎsâ Ṣâliḥîya (al-Malik al-Muẓaffar, 1989). To date, I have discovered two more abridgements of the abridgement in existence but neither contain the chapter on paper.

The chapter on papermaking from the Hyderabad manuscript has also appeared in print as part of an article entitled *Risâlatân fî ṣinâʿat al-makhṭûṭ al-ʿArabî* by Barwîn Badrî Tawfîq (Tawfîq, 1985: 275-286). It escaped my attention until I had completed my own version of the original *unicum*. This was a very fortunate oversight on my part as I was not influenced by his interpretation of the witness. The printed text, I regret to say, cannot properly be understood due to numerous misreadings and some fundamental textual errors. Many of the words relegated to the footnotes are actually correct ! Furthermore, as a result of an apparent ignorance of the subject, many unacceptable conjectures were introduced.

The *Mukhtaraʿ*, in its original form, is a compilation of various accounts of art and craft techniques by artisans who were themselves expert in their fields. According to the preface the author ordered each craftsman to express himself in his own words, a policy which may explain the different styles of writing found in the text. The existence of this manuscript was first signalled by ʿAbd al-Quddûs al-Hâshimî (Hâshimî, 1358/1939) who provided a short codicological and palaeographical description. According to him the copy consists of 118 leaves as opposed to 142 in an earlier foliation and measures 30 x 18/24 x 15 cm, with 43 lines per page. It has an illuminated headpiece, the rule border (*jadwal*) is executed in red and blue ink, and the chapter headings are rubricated. Furthermore, the manuscript contains numerous diagrams. It was copied by Muḥammad ibn Qawâm (Qiwâm) ibn Ṣafî ibn Muḥammad Ḍiyâʾ Turk Nâgûrî (Nâgawrî), known as Qâḍîdkân, in Rajab 876/1471, who wrote in a small, but clear *naskh* hand. The copyist was a Persian speaker, most probably of Indian (more specifically Nâgawrî) descent, as evidenced by his *nisba* and the fact that

2. For more information on the copies of this manuscript see Gacek, 1997: 58, n.1.

both Arabic and Persian are used in the colophon. The manuscript itself has a number of lacunae and unfortunately the chapter containing the recipe and the recipe itself are incomplete. To judge from a later foliation there is only one leaf missing. However, it appears that only a small portion of the recipe is wanting. The text is partially pointed and in places illegible due to water stains. The letters *dâl*, *dhâl*, *râ'* and *zây*, as well as medial *ʿayn*, *ghayn*, *qâf* and *fâ'*, are often difficult to distinguish. Thus, for example, such words as *dahaka*, *dahk* and *dahîk* can be read as *rahaka*, *rahk* and *rahîk* (lin. 46-49), and *daqqa* as *raqqa* (lin. 49), just as *mikhrash* and *mikhdash* can stand for the same word (lin. 27-31). In addition, the letter *kâf* is sometimes written without the line above (*shaqq*), which makes it look like *lâm* (e. g. lin. 17, 19), while the *hamzah* after the *alif* of prolongation at the end of words is rarely supplied.[3]

The major points of interest in the recipe are:

a) It appears that, according to the recipe, paper was made of the white fibres of the inner bark, *liḥâ'* (the liber of the bast, as opposed to the cortex), of the fig tree (*ficus populifolia*) or *mudakh*. This word (also written *mudaḥ*) is of Yemeni origin and no longer used, the more common term being *tîn* or *balas*.[4] This piece of information is significant since Chinese paper was made from the bast fibres of the paper mulberry (*broussonetia papyrifera*), popularly known as *kozo*, and fig trees belong to the same family (*moraceæ*). The earlier reports on papermaking traditionally mention *qunnab* (hemp) and *kattân* (flax); usually hemp and flax products, such as cordage (ropes) and linen, respectively, were used, but unrefined hemp may have been the main ingredient of Ibn Bâdîs' recipe (Irigoin, 1993: 279, 281). Barwîn Badrî Tawfîq reads this word as *markh* and the same word is mentioned by Ḥabîb Zayyât (Tawfîq, 1985: 277; Zayyât, 1992: 77).[5] It is recorded by Aḥmad ʿÎsâ as *laptadenia pyrotechnica*, *cynancum pyrotechnicum* and *periploca ephedriformis*, all belonging to the *asclepiadaceæ* family (ʿÎsâ, 1981: 64, 108, 136). According to the same source the *periploca ephedriformis* is known in Yemen as *marakh* ! Other possible readings of this word are *marj* and *mizj*. Some sources link these words to the bitter almond tree[6]. However, in view of the above mentioned fact that the fig belongs to the same family as paper mulberry and it was used for bark paper in Mexico, Polynesia

3. I am grateful to Mufti Muhammad Azeemuddin, Editor-in-Chief of *Dâ'irat al-Maʿârif al-ʿUthmânîya* (Hyderabad), who was kind enough to send me a photocopy of the manuscript and later, due to its poor quality, transcribed, as best as he could, the text for me. My thanks also go to M. Zakyi Ibrahim for his assistance with the reconstruction of this chapter.

4. Moshe Piamenta (1991: II, 461) makes a reference from *mudaḥ* to *mudakh*. Both *badaḥ* and *madaḥ* (the latter qualified by the word al-Yaman, in brackets) are given in *ʿÎsâ*, 1981: 83. See also Freytag, 1975: III, 160, where the word is given as *mudaḥ* (*ficus religiosa*).

5. For a description of *markh,* see Lane, 1984: II, 2705. This word does not appear in Piamenta, 1991 or Varisco, 1994.

6. For *marj* and *mizj* see Dînawarî, 1973: 52, 268, 269, 283 and Dimyâṭî, 1965: 144.

Arabic text

[1]

(١) **الباب الخامس** (٢) في عمل الكاغد البلدي ووضع الاسرار في الكتب وما يمحوالدفاتر والرقوق (٣) صفة عمل الكاغد البلدي يؤخذ لحاء شجر المدخ فيبس وتقشر منه القشرة الظاهرة (٤) فيرمي بها وتؤخذ القشرة الداخلة البيضاء التي هي خيوط كالمتن فيبل(في الاصل يبل ؟) بماء حائر شبه (٥) البركة ويفرش تحته من ورق المقش ما يقيه من التراب ووسخ البركة ويكون الماء قدر ما يغمره مرار (كذا) كثيرة (٦) ويغطى فوقه في وسط الماء بورق المقش وتعمل فوق ورق المقش عيدان لطاف وعيدان صغار يمنعـ[ها] (٧) ويمنع الورق من الصعود وحتى لا يبان منه شيء ولا يطفو فوق الماء ويقيم في الماء منقعا اربعـ[ة] (٨) ايام بلياليها

[2]

ثم يخرج من حوض الماء ويعصر ما فيه من الماء ويترك في زاوية البيت وهو مرصوف كبيا شيئا (٩) فوق شـ [يء] ثم يفرش له من ورق المقش ما يقيه من تراب البيوت ويبقى مخمورا في الزاوية مغطى عليه ايضا بورق (١٠) [المقش] [ثـ] لاثة ايام بلياليها من غير زيادة لانه ان زاد عليه الرصف بالزاوية تلف وكان ورقه منقصفـ[ا] (١١) ثم يخرج من البيت ويضحى[على] صفا او سقف [مقـ]فض نقي من التراب في الشمس حتى يجف ولا تبقى (١٢) [فيـ]ه من رطوبة الماء [ويجف (؟)] جفافا بالغا (؟) ثم [يبله (؟)] بالماء ثانية ويعصره من الماء ويكببه كببا صغارا (١٣) [ص(؟)] كبة [مثل (؟)] النا[رنجة] ثم يخلي في مركن خرق الكبب (في الاصل الكتب؟) بعضها فوق بعض وينتول كبة واحدة بعد (١٤) واحدة منها وينقي ما تبقى فيها من قشور اللحاء الغليظ الاخضر ومن الوسخ ومن اخر(؟) ما تعلق بها من (١٥) [لال (؟)] حتى يصير نقيا من كل قشر وغش هذا وهو رطب ونقاته ما تكون الا بالطفر حتى يخلص من (١٦) جميع ما فيه ولا يحتاج الى تنسيل لان الدق ينسله وينعمه ويخلطه بعضه ببعض

[3]

ثم يضحى بالشمس (١٧) ثانية على موضع نظيف او ثوب حتى لا [يلحـ] قه تراب ولا قش ولا شيء يكدره ثم يبله بالماء ثالثة (١٨) في وعاء نظيف ويعصره ويكببه صغارا (؟) [كما (؟)] عمله الاول ويرده الى وعائه الذي كان فيه وهو (١٩) رطب ويخرج من الوعاء كبة كبة ويضع الكبة على [ ] في(؟) [الارض مثل حجر العصا[ر] [النظـ]فة [ ] ويستعمل (٢٠) دقماقا نظيفا من خشب العتم او من خشب [الـ] [او] من خشب [ ] ويكون بوجهين ويكون بقدر ما يرفعه الانسان (٢١) بيده ويتابع به الضرب ولا يتعب ولا يزال يضرب بالدقماق على الحجر حتى يمتد ويصير مثل عجين البر في كل يوم (٢٢) يضربه مرة واحدة ويعيده الى وعائه لا يزال لذلك خمسة ايام وبعد الخمسة الايام ويتقدم به في وعائه فيقبه (؟) (٢٣) على صفا فيه خشونة نظيف (كذ) فان عدم الصفا كان على حجر مثل حجر الطحن خشنة (كذا) ويرشه بالماء ويعجنه بيديه حتى (٢٤) يختلط شيئا بشيء

[4]

ثم ينزله في الماء في حوض مجتمع فيه الماء نظيف من الوسخ ويخوضه [فيه (؟)] حتى ينخلط بالماء ثم يشنه (٢٥) [و(؟)] هو يخوضه بالماء حتى تذهب منه جميع الشنة التي فيه وهي ليف الشجر وهو يشنه ويجمعه كبة كبة ثم (٢٦) يتقدم الى حوض مقفض اكبر من القالب عرضا وطولا نظيفا (كذ) من الوسخ فيأخذ من الماء الصافي ما يملأه ولا يكون (٢٧) في الماء شيء من وعث ولا كدر ولا قشور ثم ينزل الكبب في الحوض كلها ويخرشها بعود رأسه فيه اربعة عيدان (٢٨) صليبا مزوجا مثل مجدح اللبن ضربا جيدا في الماء حتى تختلط جميع الكبب في الماء ويبقى مثل الجفر الذي يندف من القطن (٢٩) في الماء ثم يشنه (في الاصل يشيه ؟) بالخرقة ثانية ويعمله كببا كل كبة بقدر الاترنجة او كيف ما شاء ويضع الكبب على حافة الحوض ثم يرجع (٣٠) ينزل في الحوض من الكبب قطعة قطعة كل بقدر الليمون المركب او النارنجة شيء ينعمل منه خمس ورق (كذا) او ما (٣١) يقاربها ويخرشها من الساعة ثانية بالمخرش حتى يختلط الشجر المذكور المدقوق في الماء

[5]

وينزل فيه القالب ويطلع (٣٢) فيه الشجر بقدر حتى يطلع متساويا وتكون الورقة متساوية من جميع جوانبها وعلى قدر اثخانها التي يريد فاذا (٣٣) تساوت الورقة في القالب فيكون بجنبه على الايسر لوح واطيء على قدر القالب بطوله وعرضه فيضعه (٣٤) ويفرش فوقه ثوبا ابيض وكلما طلع في القالب ورقة قلب القالب على وجهه الذي فيه الورقة ومسحه (٣٥) بحرف كفه مسحتين او ثلاثا حتى تسقط الورقة من القالب وتصير ممتدة فوق الثوب واللوح كلما عمل ورقة (٣٦) حطها فوق الاخرى الى حد مائة ورقة فما فوقها وكلما نقص الماء الذي بالحوض مما يقدحه بالقالب صب عليه ماء (٣٧) اخر حتى يكون الحوض ملآنا من الماء لان الشجر يركد اذا قل الماء فيزيد له ماء اخر كلما نقص

[6]

فاذا فرغ من جميع الشجر (٣٨) الحاصل معه في الحوض من الذي يورده وبقي الورق مرصوفا بعضه فوق بعض فيضع فوق الورق خرقة (٣٩) نظيفة تغطيه جميعه ويأخذ حجرا مستوية الوجه فيضعها على الخرقة التي فوق الورق وهو يرزم بها جوانب (٤٠) الورق الذي تحت الخرقة حتى يخرج ما فيه من الماء وتبقى فيه رطوبة لا غير ثم يرفع الحجر والخرقة من فوق الورق (٤١) ثم يرجع يفرد الورق كل خمس ورقات او ما يقاربها وحدها ثم يضحيها في الشمس على صفا نظيف بحيث لا يناله (٤٢) تراب ولا (في الاصل والا) وسخ ويخليه حتى يجف وتبقى فيه رطوبة هينة فيرفع الورق من الصفا ويرجع يفرده ورقة ورقة (٤٣) في موضع نظيف بحيث لا يصله الهدي ولا التراب ولا القش فيفرش له فوق اللوح الاول خرقة نظيفة ويضعه (٤٤) عليها وهو يخلصها ورقة ورقة ويضعها واحدة فوق واحدة حتى يكمل الجميع ثم يرجع يضحيها على الصفا في الشمس كل (٤٥) خمس ورق (كذا) وحدها حتى تجف وتضحي وتنشف من الماء ولا تبقى فيها رطوبة بالجملة الكافية ثم يرفعه ويرصفه خمس (٤٦) ورقات حتى يكمله ويضع عليه اللوح وفوق اللوح حجر يرزمه بها

[7]

ثم تدهك من الذرة البيضاء (٤٧) الرطبة التي تسمى العياشي (؟) او الازرق (؟) (في الاصل الارزق) او الشـ[ر]يجي الرطب الذي لا يغلب قدر نصف الزبدي النفري لمائة ورقة (٤٨) وعلى حساب ذلك فتندا (كذا) تلك الذرة حتى يزول قشرها ثم تدهك دهكا ناعما بالمرة الى قدر سبع مرات وتترك في (٤٩) اناء الى ان تحمض الى يوم ثاني (كذا) ثم تشن بخرقة خشنة حتى يخرج منها ما دق من الدهيك ويبقى المقل(؟) ويربي في قدره ويواظب (؟) (٥٠) عليه حتى ينضج وينطبخ مثل طبخ النشا نشا الغراء ثم ينزل الى اناء اخر وتؤخذ خرقة تكبب كبة لها مقبض (٥١) وهو يضعها في المنشا (؟) ويأخذ منه ما علق بالخرقة ويمسح به وجه الورقة ويقلبها ويمسح به قفاها ولا يزال لذلك (٥٢) حتى جميع الورق (كذا) وجها وقفا عملا مستويا بقدر لا ينكثر ولايقل وهو يضع الورق (كذا) واحدة فوق اخرى الى حد عشرين (٥٣) ورقة او ثلاثين ورقة ثم يمد على الورق المنشا ورقة معه (كذ) نشا ثم يرفعها على غفارة ويضحيه في الشمس على سقف (٥٤) مقضض نظيف من التراب وسواه

[8]

ويلزق اطراف الورق [على(؟)] القضاض برطوبة (؟) النشا حتى لا تطيرها الريح (٥٥) ولا تنكمش الى ان تجف وينشف النشا الذي فيها ثم [يمر(؟)] رأسه حادا (؟) مثل المشرط ويقطع به اطراف (٥٦) الورق الملزقة على القضاض حتى يخلصها بسهولة ولا ينخرق بحرية من طرفها الملزق الى طرفها [ ] ثم يرفع (٥٧) الورق دسوتا يابسة ثم يصقله ورقة ورقة على حجر ملساء مثل الرخامة بحجر(؟) اخرى تكون بيده [ ] ملساء مدورة (٥٨) مثل المصقلة او بخرزة المصاقل الزجاج او اللوح بقدر ما يقبض عليها الصانع ويصقل الورقة على الطول وجها وقفا (٥٩) حتى يكمل صقالها ثم يعطفها على وجهها نصفين ويمسك طرفها بيساره (في الاصل بتساره؟) حتى لا يميل طرفاها ثم يكسر وسطه بالمصقلة (٦٠) ولا يزال يصقل الجميع ويكسرها وهو يضعها واحدة فوق واحدة حتى يكمل الجميع ثم يدست الورق خمسا خمسا (٦١) على مكاسرها ويرصفه تحت لوح ويعمل فوقه حجرا ترزمه ليلة واحدة بعد الصقال ثم يأخذ عمودا (؟)[ ]

and Africa, and in papermaking in Burma (Bell, 1990: 68), the form *mudakh* (*mudaḫ*) seems to be the more likely reading.

b) One cycle of paper production was calculated to produce 100 sheets. The initial stage of soaking and beating the bast fibres took 12 days. At the end of this process the paper pulp was so fine that it resembled tufts of puffy cotton fibres (*jaffur*, lin. 28).[7] This may lend extra strength to the argument put forward by Karabacek (1991: 43) that Arab paper was never produced from cotton but rather the pulp was so fine as to ressemble cotton. According to Bell (1990: 59), however, paper was made from cotton rags in Xativa, Spain in 1151, while cotton was used in India in various combinations, for example, in pure cotton, cotton/wool and rice straw/cotton paper (e. g. Macfarlane, 1987).

c) A supple, as opposed to a floating mould (*qâlib*) was used. The mould was dipped in the vat containing pulp. The sheet was then removed from the mould and put out to dry. However, just as in the description given by Ibn Bâdîs, it is not unlikely that the technique of drawing the pulp from the vat may have been that which pertains to a floating mould.[8] The lines in question (31-32) read: *wa-yaṭlaʿ fîhi al-shajar bi-qadr ḥattá yaṭlaʿ mutasâwiyan wa-takûnu al-waraqa mutasâwiyatan min jamîʿ jawânibihâ waʿalá qadr athkhânihâ allatî yurîd* ("and he dips a mould into the vat and covers it with a certain amount of pulp until it is level and all the sides of the sheet are even according to the thickness he desires").

d) In order to transfer a fresh sheet of paper from the mould, a wooden board covered with a white cloth was placed against the mould. The mould was then tipped over and the back of the mesh of the mould rubbed with the edge of the hand in order to free the sheet (lin. 34-35).

e) White sorghum (*dhura*) was used for sizing, as opposed to wheat (*burr*) or rice (*aruzz*) starch. The author uses the word *nashan* for *dhura*-paste (see lines 50-56), whereas in other texts *nashan* is usually associated with wheat starch (*ḥinṭa*) (see e. g. Asadî, 1988: VII, 286).

f) A part of line 53 reads: *thumma yamudd ʿalá al-waraq al-munshâ waraqa maʿahu* (!) *nashan* ("and then he stretches (places) over the pasted sheet a sheet of paper with paste"). Although the sentence in Arabic is not as clear as one might wish, it appears that two sheets of paper may have been pasted together to form one thicker sheet. The sheets must have been very thin as the author of the text reports that one ball of fibre (*kubba*) the size of a lemon would yield five sheets, presumably from an average size mould. The practice of pasting two sheets together was first discussed by Karabacek (1991: 51) but later questioned by Don Baker and Malachi Beit-Arié (Baker, 1991: 31, Karabacek, 1991: 89, Beit-Arié,

7. For the word *jaffur* see Asadî, 1988: III, 66.

8. Irigoin, 1993: 290. Note, however, that the sentence in the text of Ibn Bâdîs is much more explicit.

1996: 12). Karabacek based himself on a passage from the *Iḥsân al-taqâsîm* of al-Muqaddasî (4/9th cent.) (Muqaddasî, 1967: 100) where the Arabic text reads: *wa-bi-al-Yaman yulazziqûna al-durûj wa-yubaṭṭinûna al-dafâtir bi-al-nashâ* ("and in the Yemen they paste the sheets of paper together and line the book covers with wheat starch" (Karabacek, 1991: 51).[9]

g) As mentioned earlier, one ball of fibre (*kubba*) was the size of an orange or lemon and yielded five sheets (lin. 30). The author uses three words in this connection: *untrunja, lîmûn and nâranja*. The *utrunja* is bigger than the *nâranja* and *lîmûn*. Sheets of newly-made paper were at first stacked in piles of 100, then separated into lots of five sheets each. These were later glazed, folded in the middle, stacked in groups of five bifolia (*dast*) and presumably sold to scribes in this form. This papermakers' practice may explain why, in the majority of cases, gatherings in Arabic codices consist of ten leaves (*quinion*). In the West the gathering, in general, consisted of eight leaves (i. e., four bifolia, known as a *quaternion*) which were formed by folding the original sheet twice. Why they were stacked in fives is interesting. One might be tempted here to ascribe this practice to the idea that odd numbers were preferred in the Islamic world following the prophetic tradition which says: *inna Allâh witr, yuḥibbu al-witr* ("God is one, he loves the odd number"). However, as in the case of the uneven number of lines per page, which appears to have its origin in the arrangement of the lines in the *miṣtara* (ruling board), the answer may lie somewhere else.[10] The numbers 100 and 10 are moreover easily divisible by 5.

Translation

CHAPTER FIVE
On the making of local paper (al-kâghad al-baladî)*,*
placing secrets in letters and making erasures
in paper codices and on parchments

[1] — The manner of making local paper. The bast (liber, phloem) of the fig tree (*mudakh*) is taken and dried. The outer layer (*qishra*) is peeled off, and he (the papermaker) throws it away, but the white inner layer is kept. It looks like the fibres of a cord (*matn*) (Piamenta, 1991: II, 459). It (the bast fibre) is soaked (macerated) in fresh (?) water (*mâ'ḥâ'ir*)[11] such as (comes from) a pool (*birka*). It (the

9. Or "in al-Yaman they paste papers together and line the inside covers of their books with starch" (Muqaddasî, 1994: 92).

10. One way to create lineation is to fold a sheet of paper along its width into a concertina file shape and use the folds as guidelines for the grid on the page. The resulting number of folds in this case is always uneven (odd).

11. The word in the text appears to read *ḥâyir*. Another possibility could be *jâ'ir* from *jîr*, "lime"). Although the use of lime was well known during maceration, fresh water was also used and the context seems to point to the word *ḥâ'ir* (comp. Dozy, 1967: I, 344 = "réservoir", "étang").

واسيلها جيدا وتنقيه بتطييره واتخير عليه فما عرضيا والت عليه به ان شا الله تعالى

صفة اخرى تقارب الاولى ياخذ صاعا فلعيا اربعة اجرافا رنه والمح عليه مثله زنقا فاذا اخلطته فاسحقه على ملاطه حتى يطيب مثل الكحل واغسله بالماء والملح حتى يخرج سواده برفق وسحه ثم اجعله عليه كثيرا اوصفا فقد ركت به على ما بينت واصفته مورعه واكتبه به ريشه فانه جيد

صفة اخرى تجيرة لغسل اللازورد يوخذ اوقيه قلفونه رومية وربع اوقيه رصد وشرع رياهم ونيت زيتون تخلط الجميع وتطبخ على النار حتى يجمع ثم ترفع عن النار وتترك حتى يبرد ويوخذ اللازورد الغشيم الجيد ويسحق ناعما وتخلط بجزء من الجميره بحجر حديد حتى لا تزجج الجمرة تحتمل شيا سحيما في دست بكون لين الحرارة ثم يوخذ عصارة مذهونة فتجعل الجميرة فيها ثم يصب عليها من الماء ما يغمرها ثم يمرسها ثم يرفع ذلك الماء الى اخر ثم يعود يصب على الجميرة ما اخر ويعمل شيا ما قبل في الاول ولا يزال يصنع هكذا حتى يخرج ما الجميره ابيض ثم ياخذ الماء الذي يرسق منه به يدهان مجلس اللازورد فاني لا اعلمه ثم ياخذ ما رسب في اسفل الاناء فيجمعه في الظل ثم ترفعه ان شا الله تعالى

صفة اخرى في غسل اللازورد يوخذ من اللازورد وهو مايتا درهم ونمانون درهما وبوخذ له من الجميرة التي تغسل بها رطل بالمصري وهو مايه واربعة وسبعون تفله وهذه حوايج الجميرة فلفوته ثمان اوقية لكل سرا وسبع صطلي اوقيه ونصف حجري لبان طيب ابيض نصف اوقيه يجمع هذه الحوايج وتركبه دست فخاري بمبض ويوقد تحته النار ترفق حتى يذوب الحوايج الثلاث ما تلي اللبان ثم تكسحه وتركه عندك فاذا ذوبت الثلاث الحوايج ترمي عليه اللبان قليلا قليلا حتى يسيح فاذا ذاب الجميع حركه وانت تحركه في الدست واخرجه من مقدار عدس وحطه في ماء بارد وجربه فان امتد معك مثل العلك فهو جيد وان تقصف صب عليه من زيت الزيتون سليه ان ما هذا القوام المذكور ثم صفه في منيز صوف رفيع ويكون تحته ماء بارد فاذا درعت من الصفيه وزنه فان جامعك الثليثين فهو جيد والا فاعد العمل حتى يصير الوزن فيه ثلثي وزنه الاصلي ثم تحطه في الدست ثم الدار ويكون سكب عليه اللازورد وهو مسحوق قبيلا ولا تمال تحركه وصب عليه ماء لواصافيا فاسقه ثم تمشه في منيز صوف في صحن بورهون بالزجاج جديد فالصفيه الاولى والثانيه جميعا ول جميعا مثله ماحه والصفيه الثالثه عليه والرابعه مثلهما ماحه فاترك بطبخه اربع مرات في كل مرة صفه فالاولى والثانيه هرا بعال الطيب والثالث والرابع دون ذلك وكون ملاك العمل الرفق بورود النار ولا تكثر العليان فتحتني محترق وسود فاذا كان باله سعط في شعله جاذ لك جيد ان شاء الله تعالى

الباب الخامس

في عمل الكاغد البلدي ووضع الاسرايه المكتب ومايحو الدفاتر والرقوق

صفة عمل الكاغد البلدي يوخذ لحا سجر المرخ فينبس وتشرمنه القشرة الظاهرة فيرمي هاو يوخذ القشرة الواخله البيضا التي هي خيوط كالمتن سلعا وجايز شبه البركه ويفرش تحته من ورق المعص ما بينه من التراب ويرسخ اليركه ويكون الماء قدر ما يعوم مراد كثير ويعطى فوقه في وسط الماء بورق المعص ويعمل فوق ورق المعص عيدان لطاق وعيدان صغار حتى يغيب ويمنع الورق من الصعود وحتى لا يبان منه شي ولا يطفو فوق الماء **ويقام** في الماء منقعا اربعة ايام بلياليها ثم يخرج فتحوض الماء وتعصر ما فيه من الماء وتركه في زاويه البيت وهو موصوص كساس فوق شيء ثم ترش له من ورق المعص ما بينه من تراب البيوت وسي محمودا في الزاوية معطى عليه ايضا ورق ستة ايام بلياليها مع عرمادة لانه ان زاد عليه الرهف بالزاوية خف وكان ورقه سقيه ثم يخرج من البيت ويصب عليه ماء او سفيه صفي في من التراب في الشمس حتى يجف ولا يبقى فيه من رطوبه الماء ثم يجف جفافا تاما ثم سه بالماء وتعصره من الماء وتكبسه كما صعارا بين سدين الناد ثم يخرج من عرق الكتب بعضها فوق بعض وسول كبه واحده بعد واحده وما يبقى مع فيها من شعور اللحا الغليظ الاخضر من لوسخ وين لرما يعلق عا من لا حتى تصير نقا من كل قشر وعش هذا وهو طيب ونعانه ما تكون الا بالطرق حتى تخارص من جميع ما فيه ولا يحتاج حلا نبه لان الدق يسله وسمه ويخلطه بعضه ببعض ثم تعطى يابسه على موضع تطيب او ثوب حتى لا يسقه تراب ولا شي ولا سي ملدره ثم سله بالماء الذي فيه ابيض ويعصره ويكبسه صفة على عمله الاول ودوزه الى وعانه الذي كان فيه وهو

pool) is lined with palm leaves used for brooms (*waraq al-miqashsh*)[12] in order to protect it from dirt and other impurities. The pool is filled with a good quantity of water and on top of the bast are placed palm leaves and, on top of them, small sticks which prevent it and the palm leaves from rising to the surface. The bast is soaked for four days and nights.

[2] — It is then taken out of the pool (*ḥawḍ*), the water is squeezed out of it and it is left in the corner of the house, which is lined with the palm leaves to prevent it from being soiled with dirt, in the form of balls of fibre (*kubab*) stacked one on top of the other. It is left thus wet (fermenting) (*makhmûran*),[13] and covered with palm leaves, for not more than three days and nights. For if it were left there in the corner for longer than this, it would be ruined and the palm leaves would break (desintegrate). (After the three days and nights) the bast is taken out of the house and dried thoroughly in the sun (*yuḍaḥḥâ*), on rocks (*ṣafan* or *ṣafâ'*) or a clean, plastered roof (*saqf muqaḍḍaḍ*)[14] until there is no moisture left in it. Then, for the second time, he (the papermaker) soaks it in water, squeezes (presses) it so that the water comes out and makes it into small balls of fibre […], each ball the size of an orange (*nâranja*). He empties the bast fibres (*khiraq al-kubab*) into a pitcher-shaped container (*mirkan*),[15] one on top of the other, then takes one ball after another and, while they are moist, cleans them from any remaining thick green bast (layer) and other impurities […] attached to them, until no husks (*qashr*) or dross (*ghashsh*) remains. The cleaning (of the bast) is done by means of pounding (*ṭafr*).[16] There is no need to separate it into fibres (*tansîl*) as the beating (*daqq*) separates them, softens them and makes them blend together.

[3] — Then, for the second time, (the bast) is dried in the sun in a clean spot or on a piece of cloth so that no dirt or chaff (*qushsh*) adheres to it and nothing soils it (*yukaddiruhu*). Once again, for the third time, he (the papermaker) soaks it in water, in a clean container (*wiʿâ'*), then squeezes the water out and forms

12. This word is mentioned four times in the text (l. 5, 6 and 9). In the first instance it is not pointed and looks like *al-mfs* or *al-mqs*. In the second instance it looks like *al-mʿsh* and in the last two occurences like *al-mʿs*. A root *mʿs* or *mʿsh* which would fit this context could not be found. According to Dozy (1967: II, 348), *miqashsha* is a broom made of the leaves of a date tree or, quoting E. W. Lane, "it is short and flat, and is made of the thickest part of a palm-stick; the larger portion of which, being well soaked, is beaten until the fibres separate". It does not feature in Piamenta, 1991.

13. The word in the text is unpointed and can be read as *majmûdan* or *makhmûran*.The latter seems to make more sense. See Piamenta, 1991: I, 137: *khammara* = "to wet". See also a comment by Latham (1960: 139), where the word is translated as "soaking". Fibres before pounding usually go through a process of fermentation (Irigoin, 1993: 283).

14. *Qaḍḍa* ("plaster, cement") concrete with *qaḍâḍl qaḍâḍa* ; *muqaḍḍaḍ* ("cemented, plastered") (Piamenta, 1991: II, 402).

15. "Large pitcher-shaped vessel made of clay [put up in walls and cornices] as a bird's nest" (Piamenta, 1991: I, 188).

16. See Piamenta, 1991: I, 152 under *dafr* and *ṭafr* ("to push by force", "to flood"). The context shows that *ṭafr* is synonymous with *daqq* and *ḍarb* ("crushing", "beating").

it into small balls, exactly as before. While still wet, he puts it into the container in which it was previously. Then he takes one ball after another out of the container and places each ball […] on a clean stone slab such as is used for pressing (*ḥajar al-usṣâr*). In order to beat (*ḍarb*) the balls, he uses a small mallet (*duqmâq*) made of wild olive (*ʿutm*) or some other wood […], which has two heads (*wajhân*) and can be lifted with one hand. He continues pounding the balls on the stone until they are flat and become like a wheat dough (*ʿajîn al-burr*). Each day, he beats it (the pulp) once and then returns it to the container; this (procedure) is repeated for five days. After the five days, the pulp is emptied from its container onto clean, coarse rocks (*ṣafan*), and if rocks are not available, he uses a rough millstone (*ḥajar al-ṭiḥn*). He then sprinkles it with water and kneads it with his hands until everything blends together.

[4] — Afterwards, he places it (the dough-like mass) in a pool (*ḥawḍ*) filled with clean water and stirs it (*yukhîḍuhu)* so that it is well mixed with water. He strains the pulp (slurry), while stirring the water, so that all coarse fibres (*shanna, lîf al-shajar*)[17] come out. He thus gathers one ball of fibre (*kubba*) after another and places them in another clean, plastered pool (vat) (*ḥawḍ muqaḍḍaḍ*), of a greater length and breadth than the mould (*qâlib*), and fills it with clean water. The water should not contain any impurities (*waʿth, kadar, qushûr*). He then places all the balls in the vat and beats (stirs) them well with a wooden tool (*mikhrash*) at the end of which are two crossed pieces of wood, like a churn-staff (*mijdaḥ*)[18], so that they are well mixed and become like tufts of puffy fibres teased from cotton (*al-jaffur alladhî yandif min al-quṭn*). After this, he strains the pulp, for the second time, with a cloth (*khirqa*) and makes balls of the size of a citron (*utrunja*) or as he wishes. He places the balls on the edge of the vat (*ḥawḍ*) and takes one chunk after another, each the size of a lemon (*lîmûn murakkab*) or orange (*nâranja*), and returns them to the vat. He makes approximately five sheets of paper from one ball. He beats the balls, for the second time, using the *mikhrash* so that the fine pulp (*shajar*) is well mixed with water.

[5] — Subsequently, he dips a mould (*qâlib*) into the vat and covers it (*yaṭlaʿ*) with a certain amount of pulp (*shajar*) until it is level and all the sides of the sheet (*waraqa*) are even, according to the thickness he desires. When the sheet of paper is levelled in the mould, he has at his side a flat wooden board (*lawḥ*) of the same size as the mould, in terms of length and width, and places it on its (the mould's) left side. He covers the board with a white cloth (*thawb*). And whenever he forms a sheet in the mould, he turns the mould on its face, the side which contains the sheet (*i. e.* up side down), and rubs it (*i. e.* the back of the mould) several times with the side of the palm of his hand until the sheet falls off the

17. The verb *shanna* means "to sift", "strain" (Piamenta, 1991: I, 267) and the noun *shanna* presumably, what remains in the sieve after straining.

18. For *mikhrash* and *mijdaḥ* see Lane, 1984: I, 389 and 723.

mould and rests on the cloth-covered board. Whenever he makes a sheet, he places it on top of another, up to a hundred, not more. And when the water in the vat decreases, as a result of drawing it with the mould, he adds more water until the vat is full, because the pulp (*shajar*) thickens when there is not enough water. And whenever the (level) of the water goes down, he adds more.

[6] — When he has finished with all the pulp which was in the vat and the sheets remain stacked one on top of the other, he places a clean cloth (*khirqa*) on top of the sheets to cover them all. He takes a stone with a level (flat) face (side) and puts it on top of the cloth which covers the paper and he presses with it (*yarzimu bihâ*) the sides of the sheets until all the water comes out and they remain only damp. He then lifts the stone and cloth from the paper stack (post) and again separates the sheets into groups of five or so. He puts them out to dry in the sun, on clean rocks, where there is no soil or dirt, and leaves them alone until they contain an insignificant amount of moisture. After that, he lifts the paper off the rocks and once more separates the sheets one by one in a clean spot where there is no clay (*hadî*) or soil or husks and places them one above the other, on top of the first wooden board, covered with a clean cloth. Then he again brings out the sheets to dry in the sun, separated into groups of five, until they are completely dry and there is no dampness in them whatsoever. He lifts the sheets up and stacks them all in fives and places on top of the stack (post) a wooden board and a stone to press it down.

[7] — Subsequently, a quantity of white moist sorghum (*dhura*), which is called *al-ʿayyâshî* (?) or *al-azraq* (?) or *al-shurayjî*,[19] and which does not exceed one half of the *zabadî al-nafarî* measure[20] for one hundred sheets, is crushed (ground). It is soaked accordingly until all the husks (*qishra*) are eliminated and is gently mashed with a spatula (*marra*) up to seven times. Then it is left in a container (*inâ'*) till the next day so that it becomes sour. It is then passed (strained) through a coarse cloth until the fine mash comes out of it and it remains (?) […]. The mash (*muqill*) is left as it is and it increases in volume (?). It is then cooked until it is well done, just as one cooks starch (*nashan*) for glue (*gharan*, *ghirâ'*). Next, it is placed in another receptacle (*inâ'*). A cloth, in the shape of a ball (*tukabbib kubba*) and having a handle (*miqbaḍ*), is taken. He (the papermaker) places it in a receptacle of paste (*minshâ*), takes the paste which adheres to the cloth and with it pastes the front (*wajh*) of the sheet, turns it upside down and smears its back (*qafan*). He does this for all the sheets, recto and verso, in an even way. He stacks the sheets one on top of the other up to twenty or thirty sheets. He then

19. This is the reading given by Varisco (1994: 173). The other varieties of sorghum are not given in this work and they do not feature in Varisco, 1985: 53-88.

20. The *zabadî* (pl. *azbûd*) is a dry measure used for crops (see Varisco, 1994: 164-165). According to Piamenta (1991: I, 195), 2 *zabadî* = 0.5 *ṣâʿ* = *qawba*. Both *ṣâʿ* and *qawba* appear to be wooden mugs or bowls. *Nafar* (pl. *anfâr*) is also a measure or weight (see Piamenta, 1991: II, 492).

stretches (places) over the pasted sheet a sheet with paste. Then he picks it (them ?) up and places it (them ?) on a headcloth (*ghifâra*) to dry in the sun on a clean plastered roof (*saqf muqaḍḍaḍ*).

[8] — He sticks (attaches) the edges of the sheets onto a plastered area (*qiḍâḍ*), while the paste is still moist, so that the wind will not carry them away and so that they will not become crinkled and so that the paste (*nashan*) which is on them will dry. Thereafter, he takes a sharp cutter […], such as a *mishraṭ*,[21] and cuts the glued edges off the plastered area so that they are easily separated and do not tear […]. After that, he picks up the dry sheets five at a time (*dusûtan*)[22] and burnishes them one at a time on a smooth stone, such as a marble slab (*rukhâma*), with another smooth and round stone such as a *miṣqala* or with a glass bead (*kharazat al-maṣaqil al-zujâj*) or a wooden tablet (*lawḥ*)[23] of the size that the papermaker (*ṣâniʿ*) can handle. He burnishes the sheet lengthwise, back and front, until all sheets are done. Then, he bends a sheet (*yaʿṭifuhâ*) on its front (*wajh*) into two halves and holds it by its edges on the left side so that they (edges) do not move. He folds (*yaksir*) its middle with a burnisher (*miṣqala*), polishes and folds all sheets and, when finished, places them one on top of the other. Subseqently, he groups them five by five and lays them on their folds (*makâsirihâ*) underneath a wooden board with a stone on top to press them down for one night after the burnishing. Then he takes [… ?].

BIBLIOGRAPHIE

ASADÎ (AL-) (Muḥammad Khayr al-dîn), 1981-88, *Mawsûʿat Ḥalab al-muqâranah*, [Alep], Jamîʿat Ḥalab, Maʿhad al-turâth al-ʿilmî l-ʿarabî, 7 vols.

BAKER D., 1991, « Arab papermaking », *The Paper Conservator* 15, 28-34.

BEIT-ARIÉ M., 1996, « The Oriental Arabic Paper », *Gazette du livre médiéval* 28, 9-12.

BELL L., 1990, *Plant Fibres for Papermeking*, McMinnville, Or., Liliaceæ Press, 132 p.

BRIQUET C.-M., 1955, « Le papier arabe au Moyen Âge et sa fabrication », *Briquet's Opuscula, The complete work of Dr C. M. Briquet without Les filigranes*, in E. J. Labarre (dir.), Hilversum, Paper Publications Society, 162-170.

21. *Mishraṭ*, a cutter. For a description of this tool see al-Malik al-Muẓaffar, 1471: f. 21.

22. This is an interesting usage of the word *dast* (from the Persian "hand"). Comp. Dozy, 1967: I, 441: *dastat waraq* ("main de papier"); Lane, 1984: I, 878: "quire or 25 sheets folded together". Muḥammad ibn Muḥammad ibn al-Ḥâjj al-Fâsî (d. 737/1336) also uses the term *dast* but the exact meaning is not given. He mentions however the price paid for one dast, namely 3 or 4 dirhams, depending on the quality of paper in terms of its whiteness (*bayâḍ*) or glossiness (*ṣiqâl*) and whether it was made in the summer (inferior quality, browner in colour) or in winter (see Ibn al-Ḥâjj, 1929: IV, 81).

23. Although the word in the text looks like *nawḥ* ("ploughshare", see Piamenta, 1991: II, 499), the more likely reading is *lawḥ*. This word is mentioned by both Ibn Bâdîs (1971: 143, Levey, 1962: 38) and al-Malik al-Muẓaffar (1471: f. 10) in connection with the polishing of the gold leaf.

DIMYÂṬÎ (AL-) (Maḥmûd Muṣṭafâ), 1965, *Muʿjam asmâʾ al-nabatât al-wâridah fî Tâj al-ʿarûs lil-Zabîdî*, Cairo, 230 p.

DÎNAWARÎ (AL-) (Abû Ḥanîfa), 1974, *Kitâb al-nabât, al-qism 2*, Cairo, Biblioteca islamica 26, 20-454-IX p.

DOZY R., 1967, *Supplément aux dictionnaires arabes*, 3e éd., Leyde/Paris, E. J. Brill/Maisonneuve et Larose, 2 vol, XXXII-865 et 858 p.

FREYTAG G. M., 1975, *Lexicon Arabico-Latinum*, Beirut, Librairie du Liban, 4 vols in 2.

GACEK A., 1997, « Instructions on the Art of Bookbinding attributed to the Rasulid Ruler of Yemen al-Malik al-Muẓaffar », in F. Déroche et F. Richard (dir.), *Scribes et manuscrits du Moyen-Orient*, Paris, BNF, 57-63.

HÂSHIMÎ (AL-) (ʿAbd al-Quddûs), 1358/1939, « Kitâb al-mukhtaraʿ fî funûn min al-ṣunaʿ », *Al-mabâḥith al-ʿilmîya min al-maqâla al-sanîya allatî ulqiyat fî al-iḥtifâl al-sanawî li-jamʿîyat Dâʾirat al-Maʿârif al-ʿUthmânîya al-munʿaqad sana 1357*, Hyderabad, 152-158.

HASSAN (AL-) A. Y. and HILL D. R., 1986, *Islamic Technology: an illustrated History*, Cambridge, Cambridge Univ. Press, XV-304 p.

IBN AL-ḤÂJJ AL-FÂSÎ (Muḥammad ibn Muḥammad), 1929, *al-Madkhal*, Cairo, 4 vols.

IBN BÂDÎS (AL-Muʿizz), 1971, « ʿUmdat al-kuttâb wa-ʿuddat dhawî al-albâb », ed. ʿAbd al-Sattâr al-Ḥalwajî and ʿAlî ʿAbd al-Muḥsin Zakî, *Majallat Maʿhad al-Makhṭûṭât al-ʿArabîya* 17, 44-172.

IRIGOIN J., 1993, « Les papiers non filigranés : état présent des recherches et perspectives d'avenir », in M. Maniaci and P. Munafò (dir.), *Ancient and medieval book materials and techniques*, Città del Vaticano, Bibl. apostolica vaticana (Studi e testi I, 357-358), 265-312.

ʿÎSÂ (Aḥmad), 1981, *Muʿjam asmâʾ al-nabât*, Beirut, Dâr al-ʿâʾid al-ʿarabî, 5-64-227-xi p.

KARABACEK J. Von, 1888, « Neue Quellen sur Papiergeschichte », *Mitteilungen aus der Sammlung der Papyrus Erzherzog Rainer* IV, 75-122.

— 1991, *Arab Paper, 1887*, transl. by Don Baker and Suzy Dittmar, additional notes by Don Baker, London, s. n., 90 [+ VI] p.

LANE E. W., 1984, *Arabic-English Lexicon*, Cambridge, The Islamic Texts Society, 2 vols, XXXI-3064 p.

LATHAM J. D., 1960, « Observations on the text and translation of Jarsîfî's Treatise on 'Hisba' », *Journal of Semitic Studies* 5: 124-143.

LEVEY M., 1962, *Medieval Arabic Bookmaking and its Relation to early Chemistry and Pharmacology*, [Transactions of the American Philosophical Society, N. S., 52/4],Philadelphie, American Philosophy Society, 79 p.

MACFARLANE H., 1987, *Handmade Papers of India*, Winchester, Hampshire, Alembic Press, [47 p.].

MALIK (AL-) AL-MUẒAFFAR (Yûsuf Al-Ghassânî), 876/1471, *Al-Mukhtaraʿ fî funûn min al-ṣunaʿ*, Ms. Hyderabad, Misc. 221.

— (Yûsuf Al-Ghassânî), éd., 1989, *Al-Mukhtaraʿ fî funûn min al-ṣunaʿ*, dirâsa wa-taḥqîq Muḥammad 'Îsâ Ṣâliḥîya, Kuwait.

MUQADDASÎ (AL-) (Muḥammad ibn Aḥmad), 1967, *Iḥsân al-taqâsîm fî maʿrifat al-aqâlîm (= Descriptio Imperii Moslemici)*, ed. M. J. de Goeje, Leiden, E. J. Brill, 498-vii p.

— 1994, *The Best Divisions for Knowledge of the Regions:* a translation of *Aḥsan al-taqâsîm fî maʿrifat al-aqâlîm*, transl. by B. A. Collins, Reading, Center for Muslim contribution to civilization, Garnet publ., 460 p.

PIAMENTA M., 1991, *Dictionary of post-classical Yemeni Arabic*, Leiden/New York, Brill, 2 vol., XXIV-541 p.

TAWFÎQ (Barwîn Badrî), 1985, « Risâlatân fî ṣinâʿat al-makhṭûṭ al-ʿarabî », *Al-Mawrid* n° 14/4, 275-286.

VARISCO D. M., 1985, « The Production of Sorghum (*dhura*) in Highland Yemen », *Arabian Studies* 7: 53-88.

— 1993, « Texts and pretexts: The Unity of the Rasulid State under al-Malik al-Muẓaffar », *REMMM* 67/1 : 13-24.

— 1994, *Medieval Agriculture and Islamic Science. The Almanac of a Yemeni Sultan*, Seattle-London, Univ. of Washington Press, 349 p.

ZAYYÂT Ḥ, 1992, *Al-Wirâqa wa-ṣinâʿat al-kitâba wa-muʿjam al-sufun*, Beirut, Dâr al-Ḥamrâ', 155 p.