Woodblock dyeing and printing technology in China, *c.* 700 A.D.: the innovations of Ms. Liu, and other evidence

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Few would dispute that Joseph Needham's remarkable *Science and civilisation in China*, for all the contributions made by collaborators and now by his successors, remains very distinctively the product of a particular world view. Few would dispute, too, that in that initial world view gender issues did not loom large. Yet it is already possible to find, simply by reading at random in its pages, instances of inventions attributed clearly to women. One such instance that leaps to the eye is brought forward in the contribution on forestry by Nicholas Menzies, in which he notes the system devised by the daughter of a seventeenth-century timber merchant for the mensuration of timber. This appears to have been based on a series of lengths of silk worked out by the young lady concerned, a Ms. Guo, in her boudoir; no indication is given that she actually ventured into any distant forests to observe timber operations, though doubtless she need not have gone further than the family yard to gain the necessary information.[1] And when all the volumes relating to textile technologies have been completed, we may be sure that many more female inventors will find their place in *Science and civilisation*, for this area, above all others, was seen as 'women's work', and it is impossible to believe that the very high standards achieved in this field in China would have been reached without a substantial capacity for innovation on the part of the women involved. Of course for later Imperial China it is not necessary to wait that long: the omission of an awareness of gender in Needham's writings has already been remedied by the work of Francesca Bray, though reactions to her revised account of women and technology suggest that debate over the issue even for that period of history is perhaps still at a preliminary stage.[2]

It may be helpful, therefore, to start work cautiously on an earlier imperial age by examining closely one relatively well-known invention by a woman already listed briefly in standard works on textile technology, which as it happens provides not only some empirical information towards future research within the area already delimited by Francesca Bray, but also allows consideration of its possible connections with another form of technology, sometimes seen as related, where a long history of research continues to this day untouched by gender history.[3] This invention would at first seem to be none too well documented, since it occurs in a short passage of text of unknown origin, and only the family name of the woman in question is given. The following

[1] Nicholas Menzies, *Science and civilisation in China*, Volume VI, Part 3—Forestry (Cambridge: Cambridge University Press, 1996), 633–4. Her tables, he notes, precede by almost exactly a century those compiled by Edward Hoppus in 1736 for British foresters.

[2] Francesca Bray, *Technology and gender: fabrics of power in Late Imperial China* (Berkeley: University of California Press, 1997): note the remarks in review of this by E. Vermeer in *Nan Nü* 1.1 (1999), 167–9. Bray's rethinking of gender and technology is, of course, part of a larger project, now summarized in her essay 'Towards a critical history of non-Western technology', in Timothy Brook and Gregory Blue (ed.), *China and historical capitalism: genealogies of sinological knowledge* (Cambridge: Cambridge University Press, 1999), 158–209.

[3] For a brief account of the invention considered here in English within the overall context of Chinese textile history, see Chen Weiji *et al.* (comp.), *History of textile technology in Ancient China* (New York: Science Press, 1992), 324; cf. Chen Weiji *et al.* (comp.), *Zhongguo fangzhi kexue jishu shi* (Beijing: Kexue chubanshe, 1984), 269–70.

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presentation hopes to show, however, that these apparent difficulties do not prevent us from recovering useful information from the surviving fragment that describes it, information that is of considerable value in the larger context of the history of technology.

First, our only source for the passage describing the inventor's achievement is a work dating to some four centuries later than the apparent date of the invention, an anthology translatable as *The Forest of Tang anecdotes*, compiled from a large number of earlier sources under the succeeding dynasty, the Song, in about 1106.[4] But recent scholarship, though it has found no prior source for the passage in question, has vindicated the value of this anthology as a repository of much earlier material, while the family name of the woman inventor, Liu, does provide a reasonable hypothesis as to the derivation of our piece of text.[5]

For enough is said of the family to make it quite clear that it is the same Liu clan discussed in the anecdote next following in the current text of the *Forest of anecdotes*, and the source of this next, more substantial, passage may be clearly identified as the *Yinhua lu (Notes made from conversation)*, a slim volume produced by the mid-ninth century writer Zhao Lin. Zhao Lin reveals in this that he was the son of a Liu mother, and that he was actually descended through her from one of the clan members mentioned in his tale.[6] All this is confirmed too by an epitaph of 840 for his mother, who in later life became a prominent Taoist nun, in which her family connections are traced in some detail.[7] The more extended passage in the *Forest of Tang anecdotes*, clearly deriving from Zhao's book, stands at the very head of his text as preserved separately today, and there is no preface, so one may readily surmise that our fragment was likewise originally placed just ahead of it as part of Zhao's work, but that the beginning of the text (always the outermost part in scroll or codex form) was damaged in the course of transmission some time after 1106, with the result that our anecdote was lost.[8]

This provisional assurance that we are dealing with a family tradition, passed down for a century and a half and then transmitted in writing, gains in strength when we consider the text in detail. Though it is rendered in summary into English in one recent publication on Chinese textiles, the word for word account of it that follows highlights some interesting features.

> The emperor Xuanzong's Liu *Jieyu* was both able and educated, and the emperor set great store by her. Her younger sister, married to a Mr. Zhao, being of a quick-witted and intelligent disposition, told craftsmen to carve wood blocks into an intricate flower pattern, to make a [mirror] image [on another block], and create a clamped resist (*jiajie*).[9] On the occasion of her elder sister's birthday, she presented a bolt of the resultant cloth to the

[4] See the entry on this work, the *Tang yulin*, in Yves Hervouet (ed.), *A Sung bibliography* (Hong Kong: The Chinese University of Hong Kong, 1978), 97–8.

[5] Zhou Xunchu (ed.), Wang Dang, *Tang yulin jiaozheng* (Beijing: Zhonghua shuju, 1987): this thoroughly annotated and indexed edition makes Wang's work much more useful than it would otherwise be.

[6] Zhou/Wang, *Tang yulin*, 4, 406.

[7] Edited in Zhou Shaoliang (ed.), *Tangdai muzhi huibian* (Shanghai: Shanghai guji chubanshe, 1992), 2201–2, from a rubbing in Beijing tushuguan.

[8] Zhao Lin, *Yinhua lu*. 1 (Shanghai: Guji chubanshe, 1979, reprint of Gudian wenxue chubanshe, 1957), 68. Zhao's family tradition seems to make the Liu siblings in his anecdotes one generation older than the official histories considered below; in such cases, it is not necessarily the standard account which is correct.

[9] Note that the word translated 'quick-witted', *qiao*, is remarked on by Bray, *Technology and power*, 47, as frequently attributed to women, as designating a form of second-best, none too profound intelligence; *hui*, translated here simply by 'intelligence' seems, however, to have been regarded as a more irreproachable quality.

> Wang Empress, which the emperor saw and was impressed by, so that he ordered his palace staff to manufacture [more] using her method. At that time [the method] was top secret, but gradually it got out, and spread about the land, so that even persons of no consequence at all wear [this cloth].[10]

Before turning to the technology described, a few more words are necessary about the Lius involved here. *Jieyu* is, of course, not a personal name, but a title in the imperial harem for a fairly eminent (third grade) imperial concubine who served as an assistant to an empress.[11] The lady in question is well known to history: she gave birth, for example, to an imperial prince who later on was so concerned for the fate of his own thirty-six children that he fell several days behind Xuanzong's retinue as they escaped westwards from the rebel An Lushan, and so earned a severe imperial reprimand.[12] The clan to which this man's mother belonged also later produced the famous writer Liu Zongyuan (772–819), with the result that researchers have gathered together a great deal of information about it, far beyond the couple of pages that Zhao Lin himself records. In his English-language study of Liu Zongyuan, Jo-shui Chen provides an excellent summary of the Liu clan's long-term history (a history already alluded to with pride by Zhao Lin, who notes that they might be found in books on pre-Tang history), remarking on its Northern origins, its long record of scholarship, and its peak of influence about 650 when an imperial consort with a Liu mother incurred the jealousy of the young Empress Wu, leading to the execution of the clan's most famous statesman and a period of eclipse from which it never quite recovered, though it always remained conspicuous in the second rank of the Tang aristocracy.[13] He particularly notes the Lius' strong sense of clan identity, which would explain why Zhao Lin's mother would have transmitted this anecdote to him, while even though they were more Chinese than some sections of the North China aristocracy, who had Inner Asian origins, the relative independence of thought which seems to have characterized both Zhao's mother in her religious career and this earlier inventor may perhaps reflect the greater freedom granted women in the North because of social influences from beyond the Chinese world.[14] Francesca Bray, drawing on Chinese research, confirms at any rate that the involvement even of city ladies in textile technology was at its height between the Han and the Tang.[15] We should also mark the reference to the Wang Empress, since this

[10] Zhou/Wang, *Tang yulin*, 405. Cf. the brief paraphrase in English and restatement in Chinese, in the two versions of the textile history of Chen Weiji, noted above, n3.

[11] R. des Rotours, *Traité des fonctionnaires et traité de l'armée* (Leiden: E. J. Brill, 1948), 257: 'femmes qui aident et assistent l'impératrice'.

[12] Liu Xu, *Jiu Tang shu* 107 (Beijing: Zhonghua shuju, 1975), 3267–8; cf. Ouyang Xiu, *Xin Tang shu* 82 (Beijing: Zhonghua shuju, 1975), 3613.

[13] Jo-shui Chen, *Liu Tsung-yüan and intellectual change in T'ang China* (Cambridge: Cambridge University Press, 1992), 34–47; the basic source for the ramifications of the family is the genealogical table in *Xin Tang shu* 73A, 2835–46; the older sister in our anecdote is mentioned by Chen at the end of his n13 on p. 36.

[14] Chen, *Liu Tsung-yüan*, 46–7, comments on the sense of family among the Lius. The influence of non-Chinese custom on the position of women is not a simple one, especially when one considers the political role of imperial women: see the collected papers of Jennifer Holmgren, *Marriage, kinship and power in Northern China* (Aldershot: Variorum, 1995), which reveals a number of different specific patterns over the course of time. As a generalization, however, all scholars would probably agree that the early Tang dynasty allowed a greater freedom of action for aristocratic women than was enjoyed by élite women from Song times onward.

[15] Francesca Bray, *Technology and power*, 199–200. The one early instance she gives of a woman introducing sophisticated new technology to the production of textiles, 200–01, though set in the Former Han, derives from a source of the same post-Han period: cf. William H. Nienhauser, 'Once again, the authorship of the *Hsi-ching tsa-chi* (Miscellanies of the Western capital)', *JAOS*, 98 (1978), 219–36.

serves to date the incident quite clearly to after 712, the date of her elevation to the title, and to before 724, when she herself died—indeed, given that her childlessness was causing severe tensions with her husband by 722, it probably dates to some time before then.[16]

Now this dating is of particular value, in that it precedes by a quarter of a century or so the earliest incontestably dated example we possess of woodblock printing of text, from within a Korean pagoda erected in 751, and textile printing has in the past been seen as an important forerunner to the printing of books.[17] In fact, although textile printing has been traced in Europe to as early as the sixth and seventh centuries A.D., the use of blocks in impressing dyes on textiles in China has now been traced back yet further, well into the third century B.C.[18] This would appear to antedate too the earliest reliable records of textile printing from the world of antiquity, and again suggests a Chinese origin for the technology.[19] But we should perhaps not be surprised that it took a while for the notion that text could be printed in a similar fashion to emerge. Sister Maryta M. Laumann, citing Chinese research, points out that it has been discovered from a close examination of Han period textiles that 'as many as 1200 printing motions were necessary to complete one meter of three coloured silk fabric'.[20] No wonder, then, that the earliest blocks for textile imprinting that have been discovered, from the second century B.C. are not of wood at all, but of brass.[21]

Here, however, the terminology makes clear that Ms. Liu was concerned not with the simple transfer of dye to a textile surface, but with the use of a resist, that is, a device for excluding dye from part of the textile. The best known of these, and probably the origin of the use of the character *jie*, 'tie', in the original Chinese terminology used in our source is of course the 'tie and dye' technique, where the compression of the textile into a knot excludes part of it from contact with the dye even when fully immersed.[22] Another form of resist which can actually be applied with a stamp is the wax resist, which effectively excludes dye and can be removed subsequently by heating; signs of a stamped wax resist have been detected in materials older than the seventh century from Astana in Central Asia.[23] Considerably later, wax was also used

[16] Denis Twitchett (ed.), *Cambridge history of China*, Volume Three (Cambridge: Cambridge University Press, 1979), 344, 381.

[17] Tsien Tsuen-hsuin, *Science and civilisation in China*, Volume v.1, Paper and printing (Cambridge: Cambridge University Press, 1985), 322, 311.

[18] Chen, *History of textile technology*, 323, citing *Wenwu* 1980. 11, p.29.

[19] Constance R. Miller, *Technical and cultural prerequisites for the invention of printing in China and the West* (San Francisco: Chinese Materials Center, 1983), 23–4, starts her account of textile printing with an observation that 'Herodotus (450 B.C.) describes the clothes of the Caucasus tribes as having pigment-coloured print designs'. According to the translation by Aubrey de Sélincourt of Herodotus, *The Histories* (London: Penguin Books, 1972 revised edition), 123, 'Along the west of it [the Caspian] stretches the chain of the Caucasus, the longest and loftiest of all mountain ranges, inhabited by many different tribes, most of whom live off wild fruits. It is also said that there are trees here of which the leaves when crushed and mixed with water produce a dye with which the natives paint ['εγγραφειν in the original] figures on their clothes, and the dye is so permanent that the designs never wash out but last as long as the material does, as if they had been woven into it when it was first made; and that these people copulate in the open like animals'. There would seem to be no obvious mention of printing here. Miller's next reference, to the importation of Indian printed textiles mentioned by Strabo (63 B.C.–A.D. 20), is, given what we know of Sino-Indian trade at this point, quite easy to reconcile with a Chinese source for the Indian knowledge of the technology.

[20] Maryta M. Laumann, *The secret of excellence in Ancient Chinese silks* (Taibei: Southern Materials Center, 1984), 94, citing research in *Kaogu* 1979.5, 474–8.

[21] Betsy Stirling Benjamin, *The world of Rōzome: wax-resist textiles of Japan* (Tokyo, New York and London: Kodansha International, 1996), 69.

[22] Many writers, even in Tang times (the example given is Bai Juyi), use the character *xie* (Mathew's no. 2637) for *jie*, and this form of the term is the one usually cited by lexicographers.

[23] Benjamin, *Wax-resist textiles*, 73.

in conjunction with the technique invented by Ms. Liu by the southern Yao minority, according to the *Lingwai daida* of 1178; the description of their method, as translated by Betsy Stirling Benjamin, forms an interesting counterpoint to that in the *Forest of Tang anecdotes*:

> First, carve two wooden plates with the same pattern with holes bored through; second, place a piece of cotton cloth between these plates; next, fill the engraved wooden plates with liquid wax; take off the plates; place this cotton cloth in indigo dye; and finally take the wax off by heating. Then you will see a beautiful, fine blue and white cotton cloth in wax-printing.[24]

This, of course, would give the opposite pattern to that achieved by Ms. Liu's method (assuming her blocks were carved out with the flower patterns left in relief). For although her method is classified by some Chinese scholars as a form of stencil technique (since stencils were used as well as block stamps), it is probably best understood as described by Jack Lenor Larsen from the Japanese examples going under the equivalent term of *kyōkechi*, which exist from as early as the Nara period.[25] 'Cloth is pressed so firmly between the two blocks as to resist dye penetration. Traditionally both of these blocks are carved in a high relief which is identical and in register. Deep channels between the raised motifs, and often drilled holes as well, allow the dye liquor to circulate through the blocks. Often the blocks are very large, so a complete scarf can be done at one time'.[26] Chinese scholars add the detail that the cloth concerned was apparently folded in half, so as to create a symmetrical pattern.[27]

The presence of some examples in Japan of cloth produced by this technique contained in the imperial treasure house known as the Shōsōin, closed in 756, does raise some problems for our account of Ms. Liu's invention, since some of these examples are sometimes alleged to be of seventh-century date.[28] Were such dates accurate, they would suggest that she was not the actual inventor of the technique, but at the very least the note we have ascribed to Zhao Lin would be useful in dating the introduction of the method to court circles. In this case Ms. Liu's role would be similar to that of the eunuch Cai Lun, another figure equally obscure for similar gender reasons, whose 'invention' of paper, we now know, was long preceded by the manufacture of simple forms of paper for wrapping.[29] Furthermore, if the method was in fact not confined to court circles in origin, this would indeed explain why, by the time the Shōsōin collection closed, it included examples which are said to be of Japanese manufacture.[30] But it is not clear on what grounds examples of this type of manufacture can be assigned dates quite so early, and on the assumptions given above concerning the date of Ms. Liu's work, at least a generation could have passed before the secret reached Japan and Japanese craftsmen started to produce their own work using her method, if that is what may be deduced from the surviving records and material evidence there.

[24] Benjamin, *Wax-resist textiles*, 67, translating *Lingwai daida* 6.11a (*Zhibuzu zhai congshu* edition). Almut Netolitzky, *Das Ling-wai tai-ta von Chou Ch'ü-fei* (Stuttgart: Franz Steiner Verlag, 1977), 108, in her German translation, refers also to W. Eberhard's work for more information on textiles among Southern peoples. For a brief account of the *Lingwai daida* in English, see Hervouet, *Sung bibliography*, 158–9.

[25] For stencils, see Chen Weiji's summary cited in n3 above.

[26] Jack Lenor Larsen, *The dyer's art: ikat, plangi, batik*. (New York: Van Nostrand Reinhold, 1976), 74.

[27] Li Renbo, *Zhongguo gudai fangzhi shi gao* (Changsha: Yuelu shusha, 1983), 96.

[28] For example by Larsen, *Dyers art*, 74.

[29] Tsien, *Science and civilisation*, v.1, 38–41.

[30] Benjamin, *Wax-resist textiles*, 77, 79.

For our present purposes, in any case, it is the link with text printing from woodblock which is of interest, and for this it will suffice to use Ms. Liu's presentation to the empress as a simple *terminus ante quem*. For, staying in Japan, most scholars have noted that the achievements of the Nara period waned in the course of time, with one exception: the technique continued to be used in its most basic form for dyeing with safflower dye, or *benibana*. And even when conspicuous use of this brilliant crimson was forbidden by sumptuary legislation, it continued to be used for the underwear of imperial ladies in waiting into the Edo period, according to an essay by Monica Bethe contained in a monograph by Amanda Mayer Stinchecum.[31] As a result, some of the blocks which were used for this clamp-resist method, presumably following a pattern basically little changed since Tang times, are preserved to this very day in Kyoto. I have not yet had an opportunity to inspect them, but Bethe does describe the technique and the materials used in a very helpful fashion: 'Elaborate designs, often in imitation of other techniques like *shibori*, were carved in relief into wooden boards, two boards of mirror-image being placed face to face, with the cloth sandwiched between them...'.[32] 'Old boards (carved very much like woodblocks except for the extra holes and ducts) and clamp systems still exist and can be investigated at the Kyoto Textile Research Center (Kyoto Senshoku Shikenjo) at Karasuma Kamidachiuri'.[33]

The foregoing quotations from secondary works on Japanese textiles surely give us everything we need to know to imagine what Ms. Liu's invention was. Clearly it involved, as far as her craftsmen were concerned, an ability to carve substantial blocks of wood—not necessarily at this stage scarf size, but bigger than could be wielded easily by hand for stamping—into intricate patterns in high relief, and also the ability to transfer and reverse these patterns on to another block—most obviously, one imagines, by applying ink to the first set of raised surfaces and bringing them together with the second block to mark the area to be isolated. The textiles then dyed could actually be quite thin, in that they were held immobile and did not need to receive the blow of a stamp. Granted that the technology used in woodblock printing is not identical, I see in these processes no skills necessary to printing which were not indubitably present by 724 at the very latest.[34] Furthermore, since the technique appears to have become quite widespread rather rapidly, we may also feel confident that the necessary skills were not confined to a small minority but shared by a considerable community (perhaps soon enough even an international community) of woodworkers. This does not of course in itself prove that these skills were used for printing text, any more than printing metaphors in religious literature prove that an appreciation of the speed, accuracy and replicability of the automatic transfer of text led in itself to the employment of printing techniques.[35] But it would certainly seem that by the early eighth century there were no longer any conceptual, technological nor even manpower barriers to the spread of printing beyond the stamping phase towards the use of woodblock printing as we know it.

[31] Amanda Mayer Stinchecum, *Kosode: 16th–19th century textiles from the Nomura Collection* (New York: Japan Society and Kodansha International, 1984), 72; Monica Bethe has contributed the essay on pp. 58–77 on 'Color: dyes and pigments', largely on the basis of Japanese research.

[32] ibid, 72.

[33] ibid., 217, n24.

[34] For a description of the skills required for traditional Chinese woodblock printing, see Tsien, *Science and civilisation*, v.1, 196–201.

[35] T. H. Barrett, 'Images of printing in seventh century Chinese religious literature', *Chinese Science* 15, 1998, 81–93.

And it may be possible to construe the evidence more positively. Granted that we must credit Ms. Liu (or just possibly some earlier unknown craftsman) with considerable powers of imagination in working out a completely new means of creating a resist, is it possible that the several elements involved in the idea came together *ex nihilo*? Or might the idea of carving patterned blocks in high relief and laying materials on them come from an observation of the woodblock printing process? The latter seems on reflection much more likely, and rather than seeing Ms. Liu's encounter with the Wang empress as marking a point by which nothing stood in the way of printing, we might rather take 724 as a tentative *terminus ante quem* for the use in court circles of a woodblock printing process already more sophisticated than the stamping on paper which we now know existed in the preceding century.[36]

Admittedly, as evidence of the spread of printing in the early eighth century, the tale of Ms. Liu and her invention can only count as indirect evidence, but it is by no means the only evidence of this type. Two further examples may be cited relating to the use of seals, which seems to have undergone a remarkable shift somewhat before her time, for reasons that may equally reflect the influence of the example of woodblock reproduction. The first is well known to Chinese scholars, who do take it to constitute evidence of printing itself, though that might depend on one's definition of the term, since no more was involved than the stamping of a seal on a piece of paper.[37]

What made the use of the seal different in this case was that it was imprinted on paper for distribution, not simply to mark possession, and then used as a sort of security pass to the palace, to judge by the first occurrence of the term, which dates to 691.[38] The source for this dating, though itself completed in 1084, is the highly regarded *Zizhi tongjian*, which drew on sources now lost, and much earlier than those of Tang date which later mention the same event. The second example is less well documented, in that it is only to be found in the *Bai-Kong liutie*, the mid-twelfth century expansion of a Tang encyclopedia first compiled by Bai Juyi (772–846), the sources for which have never been systematically examined.[39] At any rate this work, which again would have had access to Tang sources now lost, avers that in the time of the Empress Wu (i.e. the late seventh century) so many new titles of honour were created that sealmakers could not keep up, and so simply created standardized blank seals, in the imprint of which the holders could sign their names.[40] This too could only be called printing by stretching a definition, and though it refers in general to a well-known historical phenomenon of the reign of the empress, namely increased social mobility within the ruling élite, the source for this specific passage concerning blank seals remains unclear.[41] But it does appear likewise to attest to the fact that the conception of the seal had shifted from the specific

[36] T. H. Barrett, 'Evidence for 7th century Taoist printing', *Needham Research Institute Newsletter* 17 Dec. 1998, p. [5].

[37] Scholars who support the view that this use of seals amounted to printing include Cao Zhi, *Zhongguo yinshuashu de qiyuan* (Wuhan: Wuhan daxue chubanshe, 1994), 280, and Pan Jixing, *Zhongguo, Hanguo yu Ouzhou zaoqi yinshuashu de bijiao* (Beijing: Kexue chubanshe, 1997), 56, 270.

[38] Sima Guang, *Zizhi tongjian* 204 (Beijing: Zhonghua shuju, 1957), 6475.

[39] For the original work and for its later expansion, see Ssu-yü Teng and Knight Biggerstaff, *An annotated bibliography of selected Chinese reference works*, Third Edition (Cambridge, MA: Harvard University Press, 1971), 87–8.

[40] Kong Quan, *Pai-Kong liutie* (Siku quanshu edition), 13.3b. This passage is not in the Tang version of the encyclopedia, for which see the preceding note.

[41] The general aim of the empress was to weaken the aristocracy with regard to the imperial institution, a goal achieved by the decimation through terror of the upper ranks of her officials and the promotion of a much wider group of persons of somewhat less distinguished origin: see R. W. L. Guisso, *Wu Tse-t'ien and the politics of legitimation in T'ang China* (Bellingham, Washington: Western Washington University, 1978), ch. vi and vii.

to the generic, from the production of single impressions to be used in different circumstances to the production of multiple copies for distribution, though in this case the distributed items were not issued from a single matrix, but actually constituted matrices themselves, albeit ones which could be converted to produce impressions for specific use only by the addition of manuscript. Once again we may wonder in that case whether the widespread use of woodblock printing may not have prompted this change in the handling of impression-stamping devices, and indeed a subtle change in the attitudes involved as well.

This mention of official seals also raises some interesting questions about an indubitably Tang source, an edict contained in the *Tang huiyao* and dated to late in the year 746. In this the penalty decreed by forging a freehand 'seal' is declared to be the same as for forging a cast or engraved seal.[42] Why was it necessary to introduce such a measure at this time, and why were cast or engraved seals in such short supply that the practice of imitating them freehand even in official documents had become widespread? Could it be that those craftsmen with the skills to create seals were now busy applying themselves to a new but related technology? Certainly this snippet of information increases the likelihood that the record of an earlier dearth of seal carvers in the Empress Wu's reign derives from a reliable contemporary source.

But to return to Ms. Liu, whatever we make of her story, perhaps enough will have been said here to suggest that she deserves a more prominent place in history than has been her lot so far. Nor should we despair of finding out more about her in the future: a first trawl through the voluminous indexes to Tang epigraphy has turned up no materials obviously likely to shed further light on her, but it is quite possible that somewhere in these records—or in records yet to be excavated—some further mention of her life, if only as wife to Mr. Zhao or as mother to Zhao children, may yet be uncovered. As remarked at the outset, the reconsideration of women and technology in China has, despite the excellent start made by Francesca Bray's work, after all only just begun.

[42] Wang Pu, *Tang huiyao* 41 (Shanghai: Shanghai guji, 1991), 873.