



The Bologna Stone

Medieval Standardized Paper Sizes

$\sqrt{2}$

1.41421

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The Bologna Stone: Medieval standardized paper sizes

“QUESTE SIENO LEFORME DELCHUMUNE DEBOLLOGNADECHEGRANDEÇA DENE ESSERE LECHARTE DEBA(M)BAXE CHE SEFARANO INBOLLOGNA ESSO DESTRETO CHOME QUI DESOTTO EDIUIXADO”

(These are the moulds of the city of Bologna, which say what the sizes of the sheets of cotton paper must be, which are made in Bologna and the surrounding area, as is set out here below.)*



The existent stone is likely a 17th century reproduction: it would be an improbable anachronism for the Guild of Apothecaries logo to have appeared on a 14th c. stone. I have therefore removed the Apothecaries' gilded advertisement from our papermaker's stone.

**The use of the word "cotton" here is a red herring due to ambiguity in the original terminology, meant to distinguish paper from parchment or vellum; the papers of the time were made from linen and hemp. Translation courtesy of Neil Harris/IHL.*

As we consider the textures of Renaissance paper, an understanding of the standard sizes and papermaking protocol of the time is invaluable. For example, ascertaining the original sheet size and orientation is key when determining whether an artifact is a back mark or merely a random fold or crease.

Medieval Italian cities often affixed plaques or stones establishing the official sizes for local manufactures onto the exterior of public buildings. The citizens of medieval Bologna were able to compare their paper with such an official stone, engraved with paper names and physical dimensions. This artifact is known to some English speakers as "the Bologna stone" (confusingly, a name often used to refer to the unrelated luminescent mineral baryte) despite remaining almost entirely unknown, by any name, to contemporary citizens of Bologna.

The original marble stone was affixed on the Palazzo d'Accursio building on Piazza Maggiore, which had housed the council of the city elders since the 14th century. Now kept in the lapidarium of Bologna's Museo Civico Medievale, the existent stone is a limestone replica; it is likely that the original marble, having lost its luster or become damaged over the centuries, was faithfully reproduced in the 17th



Guild of Apothecaries logo

century courtesy of the Guild of Pharmacists, who added their carved and gilded imprimata – a pestle and mortar – on either side of the inscription.

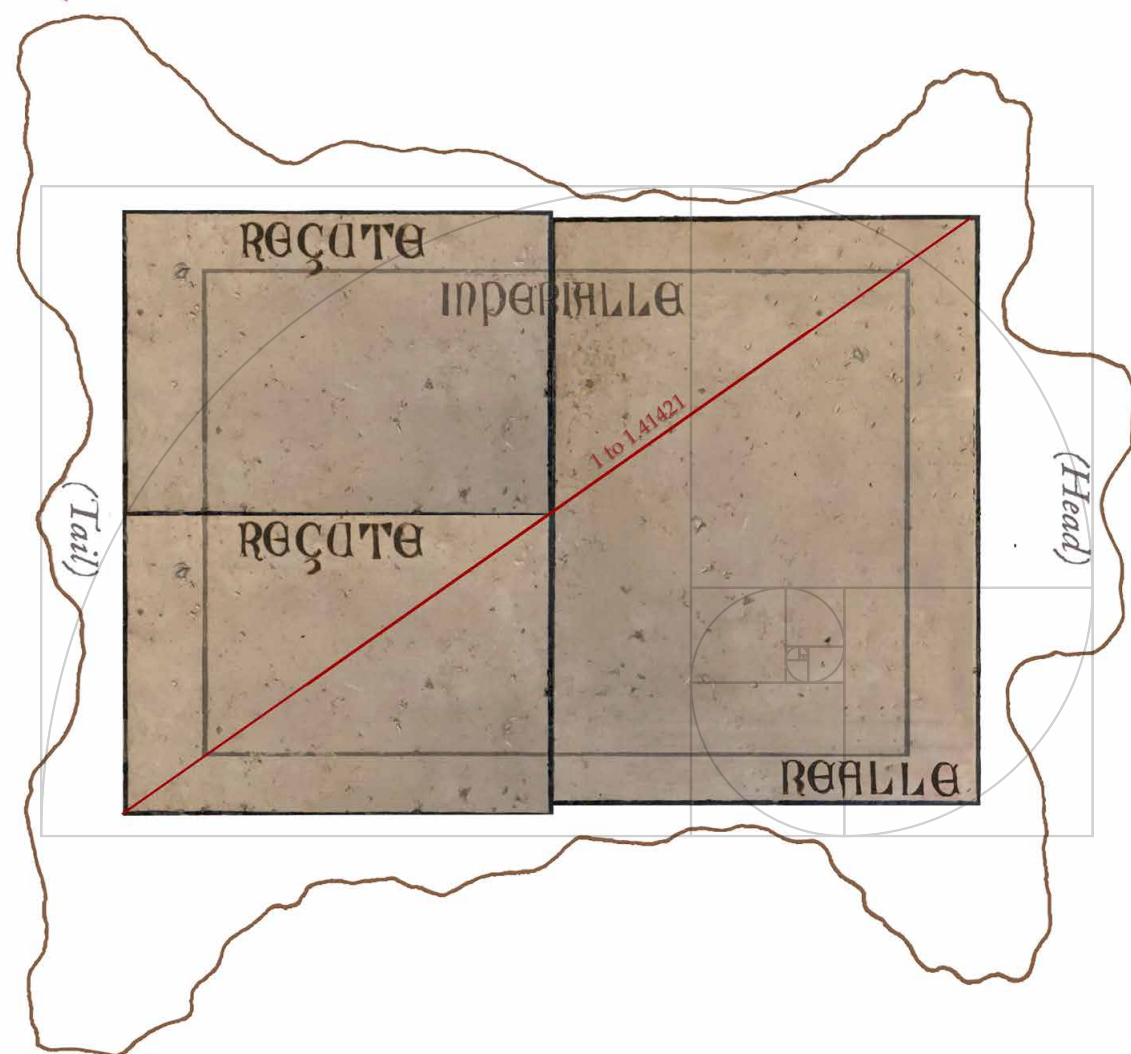
Inscribed in the stone was a system to formalize and standardize the terms and sizes for paper: Imperiale (Imperial), Reale (Royal), Mecane (Median) and Reçute (Chancery).

In the case of a dispute about sheet sizes, a piece of paper could be placed on the stone and compared to the official measure. It is likely that despite the use of the word "moulds" in the inscription, the stone actually describes the dimensions of the paper itself, as carrying one's moulds and deckles to the city center would be much more difficult than transporting a few sheets of paper. That the inscription appears in Italian, rather than in Latin, suggests that it was intended for widespread use, even by those possessing only basic reading skills.

According to paper historian Neil Harris's excellent article "The Shape of Paper," published by the Institut d'histoire du livre in Lyons:

The terms "Imperial" and "Royal" applied to large sizes of paper, albeit with some variations, remain in constant use for the whole of the handmade paper period and beyond; "Medium," albeit with a greater oscillation, also survived for a long time. The fourth term reçute defines a sheet more generally known in Italian as "comune" and in English as "chancery" (itself a derivation from the Italian "cancellaresco," i.e. the Papal administration): this is the essential dimension that, albeit with minor variations, will dominate the papermaking market for centuries to come, especially after 1500 and the advent of printing. [...] The term derived from parchment making and stood for reciso or "cut", i.e. it was half of a full sheet of Royal, which was the usual size derived from the animal. The link confirms the close relationship maintained between parchment and paper in the Fourteenth century, which was only really broken by the advent of printing and the vast gearing up of the paper industry.

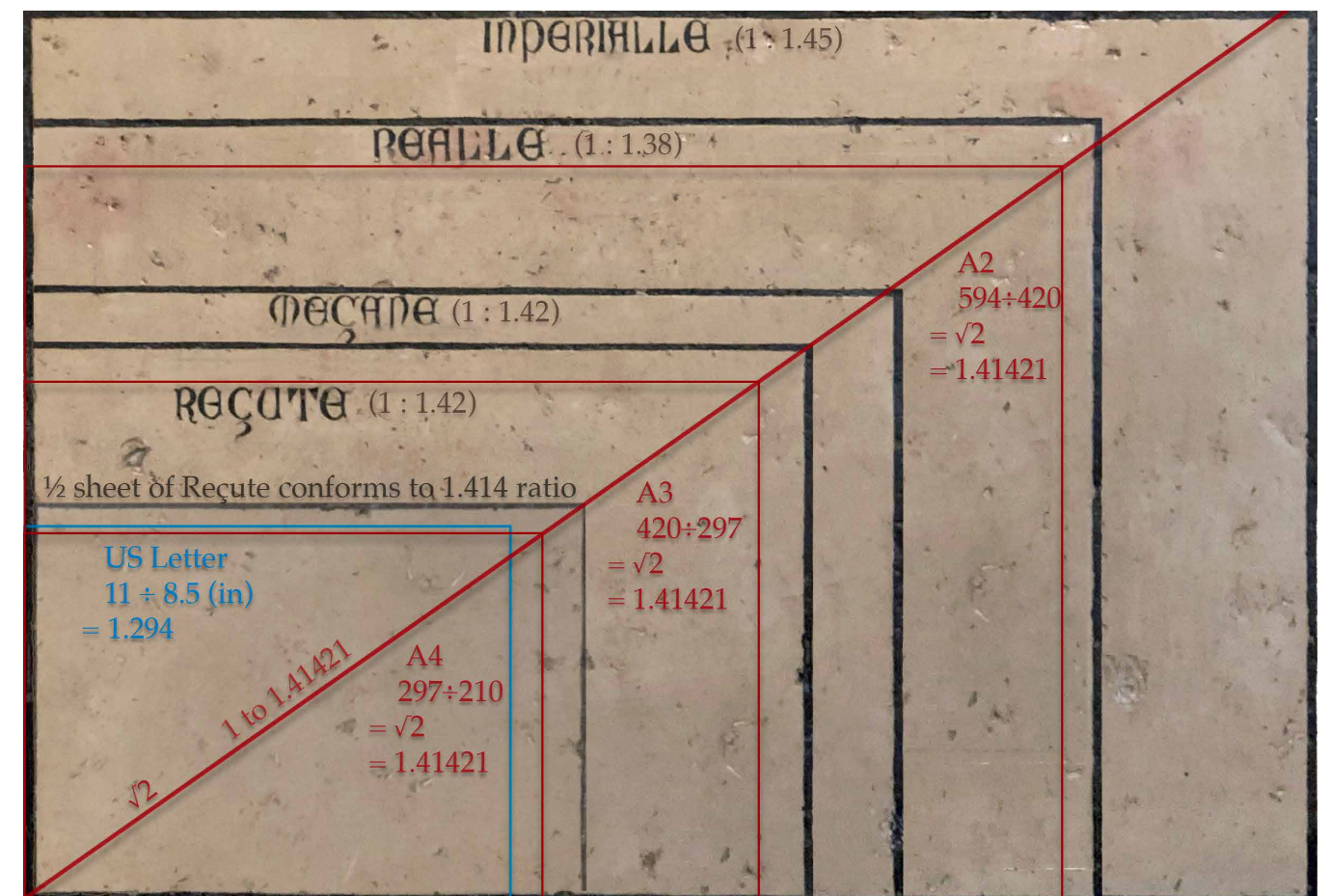
[...]The sheet-proportions set out on the Bologna stone therefore are not innovative; indeed it would be surprising if they were. They reflect a much older status quo, established by the handwritten Medieval book on parchment, which the city's legislators faced with the new medium are rendering official.



The rectangle based on the square-root of two seems to go back to well before the beginning of the Western book [...] It is a moot point as to whether the Medieval Italian parchment workers, who passed this precious snippet of knowledge on to the papermakers, were aware of all the geometry, since in cutting up an animal skin, this particular rectangle produces the least wastage. However, they knew enough to understand the principle and to construct their rectangles accordingly. (Harris, "The Shape of Paper," Institut d'histoire du livre)

Tim Barrett writes that the sizes codified on the Bologna stone may have originated with Arab papermakers previously active in the Mediterranean area, citing Josef von Karabacek's 1887 endnotes on Arab paper dimensions, which list a range of 10th to 15th-century sizes whose ratios are quite similar to those seen here. Going back further, it is likely that these dimensions were inherited from medieval parchment workers, who handed down their methods for maximizing surface area of an animal skin to papermakers. In both cases we find an intriguing consistency in the geometric ratio at hand – a ratio so consistent that

Barrett says J. Peter Gumbert calls it "invariant" in manuscript book studies. Whether we compare the four medieval sheet dimensions on the stone to an animal skin or to Arab paper dimensions and their eventual progeny (such as the ubiquitous A4), the basic trend is that standard sheet sizes fold according to the 1.4142 ($\sqrt{2}$) ratio. It is no accident that the ratio of standard sheet dimensions hews to 1.4142 ($\sqrt{2}$). **With such a ratio of length to width, a sheet folded in half is the same format as the full sheet – no matter how many times it is folded in half, the format remains the same.**



A rearrangement of the four Medieval paper sizes on the Bologna Stone comparing the Medieval paper sizes to a 1 : 1.41421 ratio and to modern A2, A3 and A4 paper sizes. Shown in blue is the rather awkward-looking and ill-fitting US Letter dimension.

In other words, according to this ratio, the sheet can be doubled or halved and the relationship between the sides will remain invariant – a principle preserved in most contemporary paper sizes, e.g. A4. (In the subsequent family tree of paper, the 8 ½ x 11 inch American Letter format, with its ratio of 1.294, is the most frustrating exception.) •

Bibliography:

Tim Barrett: "Paper Through Time: Chronological Plots" <http://paper.lib.uiowa.edu/chron.php>

Neil Harris: "The Shape of Paper" <http://ihl.enssib.fr/en/paper-and-watermarks-as-bibliographical-evidence/the-shape-of-paper>

Outer/inner frame		Dimensions		Ratio
Imperial [inperialle]	mm	500.00	x 725.00	1.45
Bologna Stone	in.	19.69	x 28.54	
Royal [realle]	mm	440.00	x 608.00	1.38
Bologna Stone	in.	17.32	x 23.94	
Median [meçane]	mm	345.00	x 490.00	1.42
Bologna Stone	in.	13.58	x 19.29	
Super-chancery	mm	330.00	x 460.00	1.39
	in.	12.99	x 18.11	
Chancery [reçute]	mm	310.00	x 440.00	1.42
Bologna Stone	in.	12.20	x 17.32	
Half-median	mm	250.00	x 350.00	1.40
	in.	9.84	x 13.78	
Damascus (1339)	mm	620.00	x 880.00	1.42
(Arab paper size)	in.	24.41	x 34.65	
Lambskin/goatskin	mm	533.00	x 762.00	1.43
	in.	20.98	x 30.00	

Matches in Italian (1389) and Arab (10th-15th c.) paper sizes; data courtesy of Tim Barrett



The Bologna Stone (center) as it appears today in the lapidarium of the Museo Civico Medievale, Bologna, Italy



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