Build of a medieval parchment manuscript

The creators of medieval parchment manuscripts had to struggle with the curling effect of parchment. A sheet of parchment tends to curl towards the hair side: `hair side ) flesh side`. To obtain a manageable manuscript, the manuscript block is required to be flat.

The solution they found is to place the sheets with alternating curvature: `( )`. In this way the sheets' curvature counteract each other and makes: `II`. A stack of sheets becomes flat and the manuscript could be handled now.

`( ) ( ) ( ) ( )` would result in `IIIIIIII`.

A similar effect could be achieved by placement in groups:

`( ( ( ( ^ ) ) ) )` would result in `IIII^IIII`.

An additional advantage of placing the sheets with alternating curvature was that when opening the manuscript, the left (verso) page and the right (recto) page would nicely show the same shade of parchment: `) (` or `( )`. Either the lighter flesh sides, or the darker hair sides would be opposite each other. When placed in groups, this situation would only occur for the middle 2 pages. Placement with alternating curvature and shade was applied everywhere, in Eastern as well as in Western Europe, and was first noticed by G.R. Gregory. He argued that this placement was indeed used for the esthetic reason of having the same shade of parchment on each pair of visible pages. Since that time this application is called the Rule of Gregory (Gregory 1885, 261-268) [1].

I pose the following rule: overcoming the curling behavior of parchment sheets was achieved by ordering the sheets with alternating curvature, either in pairs or in groups, causing the curvatures to push against each other that resulted in a flat manuscript that could be handled well. Having the same shade of parchment on each pair of visible pages is a side effect: an encore (gift of beauty.} The Rule of Gregory is the visible result of an underlying structural effect. This underlying structural effect reaches further than just two pages that have the same shade. It can also be achieved by two groups of opposite curvatures pushing in opposite directions, while having different shades of parchment visible when opening the manuscript. '(((^)))' results in `III ^ III`.

In the later Middle Ages parchment making had developed in such a way that it became more and more difficult to see the difference between the hair side and the flesh side with the naked eye. This removed the need to apply the esthetic Rule of Gregory largely, but didn't remove the need to resolve the curling behavior.

Malachi Beit-Arié wrote:

"It is obvious that despite the similarity of the two sides, the manuscripts' producers distinguished between them, as the arrangement of the bifolia in a quire and the method of ruling them demonstrate." *Oriental Manuscripts Studies: An introduction*, 2015, p. 209. [2]

In my view they distinguished the sides to note the curling. They could now arrange the folia with the alternating curling.

Besides the arrangements of the bifolia to overcome the curling, the method of scraping the hair side helps to fight against the curling.

Malachi Beit-Arié wrote in Comparative Oriental Manuscripts: An Introduction, 2015, p.209-210 [2]:

"It is evident that the parchmenting process aimed at reducing the difference between the two skins sides by scraping of both, so that the hair and the flesh sides would present a very similar or even identical appearance. Nevertheless, it seems that the scribes were well aware if which side was which, as they arranged the bifolia according to Gregory's Rule."

It is my view that with the scraping of the hair side you want to remove their compact layers that are not flexible and mostly cause the curling effect. The structural very similar sides can move more equally after scraping. Not the even appearance of the both sides was the aim of the manuscript makers but the reduction of the curling effect. They are not working according to Gregory's Rule, but they are working to overcome the curling when building the manuscripts.

Gregory has never mentioned the relation between his rule and the problem of parchment curvature. In this way the placement in groups of alternating curvature, in which only the middle two pages have the same shade when opening the manuscript, '(((((^)))))', is seen by him and others after him as just violating his rule, and not that with this placement the curvature effect can be mostly eliminated.

Professor Peter Gumbert wrote (Gumbert 2000, 86) [3]:

"I have come to the conclusion that at least until the ninth century skins were normally not divided into bifolia by folding, but by cutting out sections of the desired size in any way they would fit … ."
"This would seem to be confirmed by the fact that bridge marks or other indications of folding have never yet been observed in classical manuscripts, and that in Greek and Oriental manuscripts they appear to be rare, to say the least."

And Gumbert continues (Gumbert 2000, 87) [3]:

"The results of these observations would appear to be that folding was not an ancient practice; neither the classical codex nor the Oriental traditions which are its heirs seem to know it. And so Gregory's Rule, which really existed in antiquity, is not a consequence of folding, but of deliberate choice in arranging separate bifolia, for which another reason must be sought. Nor is the preference for quires of even bifolia numbers an effect of folding."

I pose that this other reason Gumbert mentions is to place the sheets such, that their curvatures are alternating in order to eliminate these and a flat manuscript is created that can be handled well. This conscious structural placement has one aim: to overcome the curling effect and not to make a good looking manuscript. Gregory's Rule as leading to good looking placements of sheets did not really exist in antiquity and also not in later times. It is a gift of beauty that hair side faced hair side and flesh side faced flesh side in the struggle to overcome the curling effect of parchment sheets.

It was professor Jos Hermans who identified the curling effect of parchment sheets as the underlying reason for placement of sheets with alternating curvature (in pairs or in groups), (Hermans and Pastoor 2002, 23-24) [4]:

"Een(…) kenmerk is dat de vleeszijde de neiging heeft iets bol te gaan staan, en de haarzijde juist hol. Ook in de Middeleeuwen wist men terdege dat deze verschillen bestonden; vandaar dat men meestal de haarzijden tegen de haarzijden legde, en bijgevolg de vleeszijden tegen de vleeszijde(n)".

> (*"A (…) characteristic is that the flesh side tends to become slightly convex, while the hair side concave. In the Middle Ages these differences were widely known as well; this is why it was common to place the hair sides to the hair sides, and therefore the flesh sides to the flesh sides."*).

Although Hermans writes that Gregory had identified that sheets were ordered hair side to flesh side and vice versa, named the Rule of Gregory, he doesn't specifically mention that Gregory only described the appearance of the pages and did not describe the elimination of the curling behavior. Hermans also writes that the Rule is applied in the whole of Western Europe, (Hermans and Pastoor 2002, 25) [4]:

"maar … niet bij de insulaire handschriften. In Ierse en Angelsaksische handschriften werden nu juist de haarzijden op de vleeszijden gelegd, tot men in het midden van de katernen natuurlijk eenmaal de uitzondering aantreft".

> (*"but … not with insular scripts. In Irish and Anglo-Saxon scripts it were the hair sides that were placed to the flesh sides, leading to the exception being visible in the center of the manuscript".*)

"Leggen we een insulair handschrift open, dan vormt zich iets dat lijkt op 'een nest schalen' ".

> (*"When we open an insular script, something that looks like a "group of bowls" appears".*)

Professor Kwakkel from Vancouver mentioned (email 17 January 2019): "Na 1066 zullen Engelse kopiisten de Normandische norm hebben overgenomen."

> (*"After 1066 English copyists will have taken over the Norman standard").*

The placement in groups apparently doesn't eliminate the curling effect sufficiently well. The placement with alternating curvature in pairs became superior.

In this way when opening a manuscript, the sheets are flat. After some time, when the opened manuscript has been in contact with varying temperature and humidity (also from hands, breath, etc.) of the environment, we can observe the wonderful "memory" of parchment: the pages curl back to their original shape. And then we can see the difference between the concave hair side and convex flesh side. And furthermore, we can realize that with that we have uncovered the structural composition of the manuscript. The opposing curvatures of the sheets eliminate each other: the result is a flat manuscript that is easy to handle. The unwanted behavior of the parchment has been overcome. It also allows us to see irregularities in the composition of the manuscript, omissions, additions amongst others, that can give information about the contents and the history of the manuscript.

Franchois Déroche provides many examples in *Quires of a Codex* of special Islamic manuscripts that are composed of sheets with the same curvature. Parts of manuscripts of 6, 8, 10 or more sheets. For example '(((^)))'. He also discusses numerous irregularities in their composition. It appears

however that Francois Déroche did not notice the curling behavior of the sheets in his article *Quires of a Codex* (Déroche 2015) [5]. His drawings on page 73, 75, 80, 83, and pictures 19, 20, 22, 23, show the curvature of the flesh side and therefore the hair side going in the opposite direction: the flesh side concave instead of convex and the hair side convex instead of concave. In this way he misses the view of the underlying structural composition of the manuscript.

We can vary his formula of no 19, page 73
 F7H H8F F9H H10F/F11H H12F F13H H14F as:
  (   )   (   ) / (   )   (   )
or: '( ) ( ) / ( ) ( ) '

Concluding, Gregory looks at the appearance while I pose that looking at the underlying structural composition is not less critical. Arranging the sheets, single or in groups, with alternating curling can be the "another reason must be sought" as Peter Gumbert wrote. In general, we should not only have to look at the appearance of the parchment and the way the folia are arranged in a manuscript book, but we also need to inspect the skin to see just how much work was necessary to create a manuscript that was easy to handle with a minimum of curling.

As a note I wish to mention that we need parchment—dermatology as part of the codicology. I am delighted that the University of York has started research of the DNA of parchment which comes with fundamental results, identifying the animals, age, sex, races etc. of parchment. The next step is to look at methods that were used to modify the structure of the parchment such as scraping, shaving, bleaching, tanning, the use of enzymes, splitting etc. to know what is in the skin and what is happening in the skin.

1. Gregory, Caspar René, "Les Cahiers des manuscrits grecs," in: *Comptes rendus des séances de l' Académie des Inscriptions et Belles-Lettres, CRAI*, 29e anneé, n. 3, 1885, 261-268.

2. Beit-Arié, Malachi, *Comparative Oriental Manuscript Studies: an Introduction*, 2015, p. 209-210.

3. Gumbert, J.P. "Skins, Sheets and Quires." In *New directions in later medieval manuscript studies: essays from the 1998 Harvard conference*, edited by Derek Pearsall, 81-90. Suffolk, 2000, 86-87.

4. Hermans, Jos. M.M. , Pastoor, Aline, *De Oudheid in handen, Klassieke handschriften in de Provinsjale & Buma Bibliotheek fan Fryslân* (Leeuwarden: Provinsjale en Buma Bibliotheek fan Fryslan, 2002), 24-25.

5. Déroche, Francois, "The Quires of a Codex," in *Islamic Codicology: an introduction to the Study of Manuscripts in Arabic Script*, ed. Muhammad Isa Waley, Al-Furqan Islamic Heritage Foundation Publication no. 102 (London: Al Furqan Islamic Heritage Foundation, 2015), 73, 75, 80, 83.