

Le Bon Carron

Favoring one corner when forming a sheet of laid paper

Joseph de Lalande's "*The Art of Papermaking*," published in 1761, provides insights into the intricate methodology of 18th-century paper production. The passages concerning the "bon carron," a practice intended to make one corner thicker for enhanced wet strength, shed light on the meticulous attention to detail required in the forming, couching, and handling of the sheets. In papermaking, introducing subtle changes in production techniques determine the paper's final properties.

When making paper, a vatman and coucher form and couch a sheet every 12 to 25 seconds. Lalande tells us that within this choreography, the vatman and coucher tilt the mould towards the upper right-hand corner to create the bon carron corner. Lalande stresses the importance of this technique. This corner is the point of initial human contact when moist sheets, newly pressed, are most prone to damage. He suggests that the layer will destroy many sheets without implementing the bon carron.

This description sounds dubious at first glance. If the vatman attempts to directly distribute additional fibers to one corner during formation, it will be at the expense of the overall evenness of the sheet. The sheet will end up cloudy, too thin in the corner opposite the bon carron, or flawed in some other way. Assuming Lalande's description is accurate, what is a papermaker to think of this method?

We propose that tilting the mould as it drains (but after the pulp has been formed and settled into an even sheet) might create a corner containing more fines, left behind from the draining white water. White water contains a large number of fine fibers, fillers, and other suspended substances that could theoretically fortify that corner. If done successfully, the sheet would have a higher wet strength in that corner.

This theory of a reinforced corner seems plausible, but is it corroborated by experience? Would a simple tilt of the mould while draining create a corner with a greater caliper? Greater density?*

*The density can be calculated by dividing the grammage of paper (in grams per square meter or "gsm") by its caliper (usually in micrometers, occasionally in mils).

Joseph De Lalande, 1761
The Art of Papermaking

Translated into English by
RICHARD MACINTYRE ATKINSON, B.A.

The way in which Sheets are made

84. THE 'OUVRIER', OR VATMAN, who is also called *ouvreur* or *plongeur*, and who can be seen shown as A, Plate XI, installed in his niche, and in the cut-out of that kind of table which runs round the vat, holds a mould in both hands by its two sides, with the frame or deckle placed very precisely on the top of the mould, as if it were all of a piece; then, tilting it a little towards him, he dips it in the vat...

85. The 'Coucheur' or Coucher takes the mould from the bridge with his left hand; he lifts it gently, tilting it towards the corner of the '**bon carron**', in order to reinforce it (87); places it level once more and leans it against one or two pegs, which are set into the bridge on the edge of the vat; the bad side is supported by the bridge and the good side leans against the pegs of the ass or drainer;...

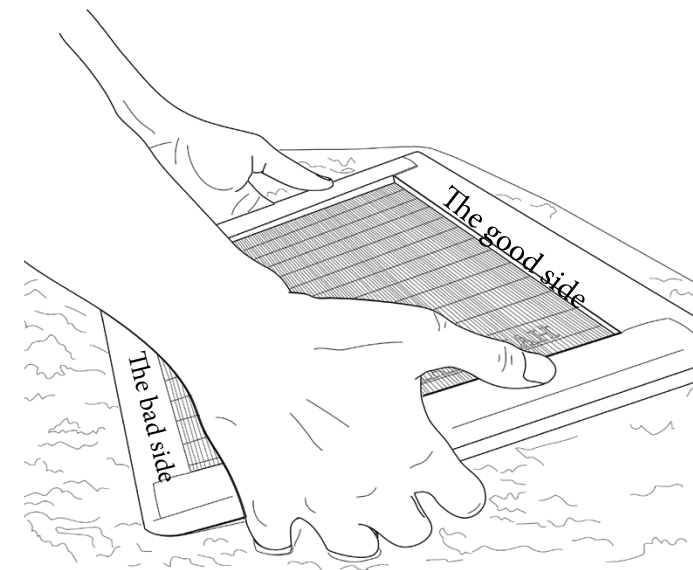
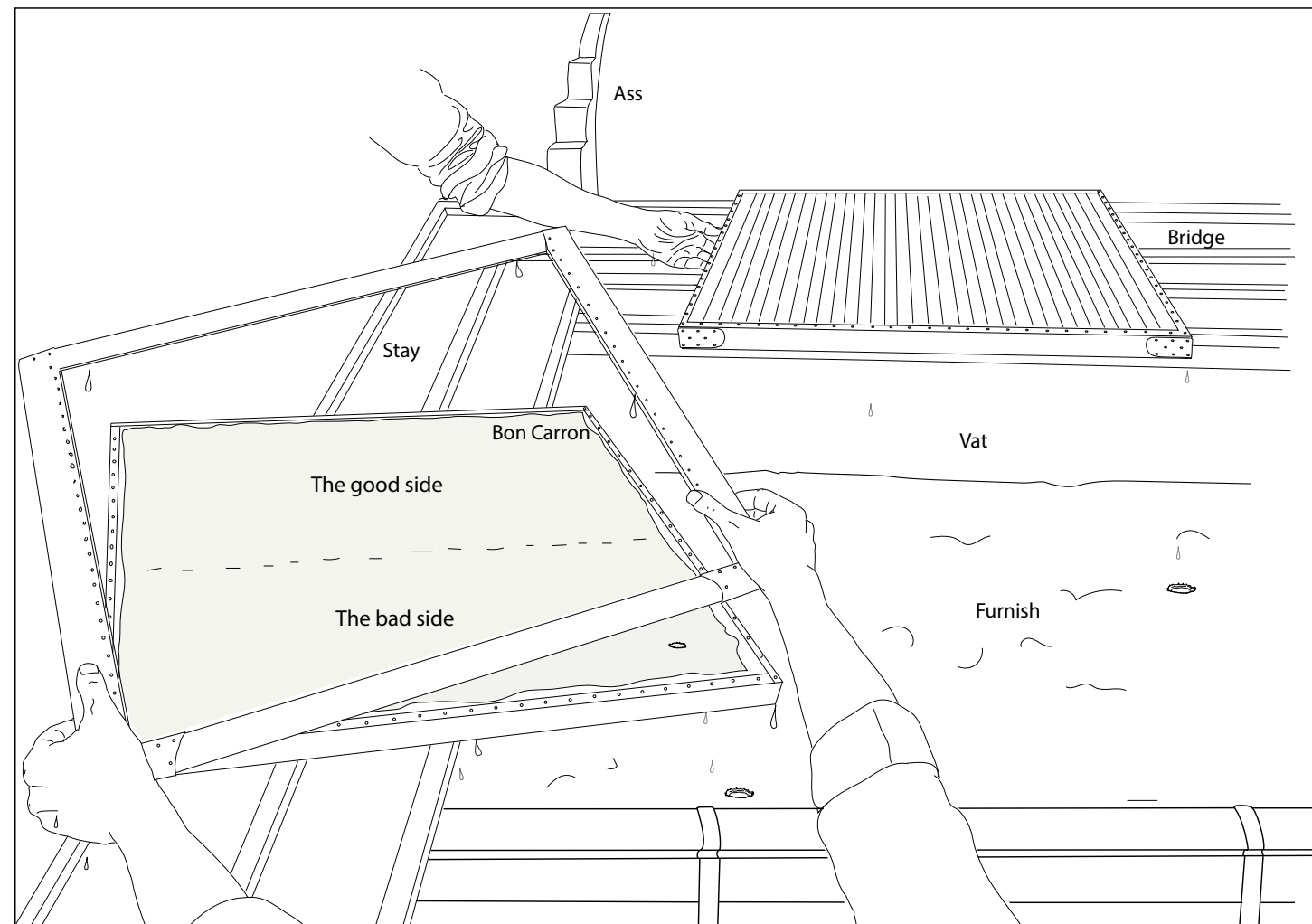
87. THE VATMAN must pay attention in spreading the stuff on the mould to reinforce the '**bon carron**', that is to say, the upper right hand corner between the good side and the hands, because it is always this corner which is pinched in lifting the sheets, or in laying them out; without taking this precaution a great many would break. If the vatman takes too much stuff when he dips his mould, if he does not spread it evenly, if he lets the water drain from it too quickly, if he knocks the mould against the ass, then in all these cases the stuff accumulates in certain parts of the mould which produces 'andouilles' in the paper, that is to say the paper is wild....

If the above questions can be answered in the affirmative, another question arises. In the ordinary course of paper-making, the mould is tilted on the “ass,” and whitewater drains towards the edge of the sheet closest to the vatman during forming. Is there a reason why these corners are not eligible to be a bon carron? Addressing this question first, we turn to Lalande, section 85: “[T]he *bad side* is supported by the bridge and the *good side* leans against the pegs of the ass or drainer;...” (emphasis added).

We contend that the bon carron must be on the “good side.” But why does Lalande label the top half of the mould the “good side” and the lower half the “bad side?”

As papermakers, we frequently observe that the edge of the sheet closest to the vatman during forming is thinner than the far edge. The immersion of a laid mould into a vat initiates a dynamic flow of pulp, akin to the aerodynamic principle observed when air moves over an

airplane wing. Furnish surges over the lead edge deckle, colliding with the laid screen at the mould’s fore-edge before dispersing across to the distal margin. During sheet formation, this pressure on the mould causes the screen to clog. The vatman periodically rinses off the tangled fibers by dipping the moulds in a vertical tub of water kept alongside the vat. Despite this, these forces are sufficient to create a thin fore-edge, even on a perfectly clean mould. The “bad side” of the sheet is, therefore, often the thinner half. Therefore, either corner of the “good side” would be the corner to choose for a bon carron.



Dipping the mould into the furnish

Test 1: using a 18” x 24” mould set

In our ongoing exploration of early Western European papermaking, Max Thill and I made small posts of 18” x 24” laid paper, using a mould set built by Britt Quinlan (24 laid lines per inch). We tilted the mould as we worked to see if it was possible to make a well-formed sheet with a reinforced bon carron corner. The furnish contained: linen, hemp, calcium, pigment, retention aid, and magnesium carbonate. Freeness: 280CSF

In a few cases, an attempt was made to thicken the bon carron during the vatman’s initial shaking, as opposed to during draining. As expected, this was detrimental to the even distribution of the furnish. Therefore, most of the sheets were formed normally. Once the fibers had settled on the mould, the vatman (and later the coucher) tilted the mould so the bon carron was low, directing the draining water to flow through that corner.

I believe the 18th-century papermakers chose the right-hand side because it is awkward for the coucher to lower the upper left corner. Although Max and I agree, the effort to incline the mould towards the good side seems awkward and disruptive of our standard workflow. We could get accustomed to this way of forming sheets, but thin writing paper is not often what we make, and the extra effort does not seem necessary when forming thicker sheets. When parting large, thin 20” x 30” sheets (see Tests 2 & 3) we could see an advantage to a bon carron. To lift larger sheets from the felt after pressing, we used a “slice,” a thin wooden stick that helps support the sheet, distributing the weight across the entire width of the sheet.

The Layer

93. *THE WORK OF THE LAYER* is to take the sheets from the felts which have been brought into close contact with them by the action of the press which they have just undergone. He takes his place, behind a kind of bench similar to that of the washerwomen of certain Provinces: it is called the ‘Selle’ or lay-stool ...

It is on this board that the layer, who is standing, places the sheets after detaching them from the felts; the ‘Vireur’ or felt-thrower begins by lifting one side of the felts with both hands, so that the coucher can detach the sheets that the press has, so to speak, stuck to them; and when he has taken them off, the felt-thrower picks up the felt, throws it to his left and forms a pile of felts which are placed on the felt-board so that the coucher may use them in the next post which is being made up at the same time. The felt-thrower is normally only an apprentice and his task is simple; but that of the layer demands skill and experience to avoid tearing the sheets as they are lifted from the felts; it is suitable only for people who have practised it from an early age and not for uneducated, inexperienced country-folk; so in small, out of the way mills, where one cannot choose the workmen, sometimes up to a third of the paper is spoilt, and almost always through some fault in this operation or in that of the drying-loft: it is therefore of some utility to examine in detail this operation and the great care it demands of the layer; we shall see that of the three vatmen it is he who must be the most skilful.

The layer pinches the corner of the sheet which is nearest to him, called the ‘*bon carron*’, between the thumb and index of the right hand; as soon as the corner of the sheet is about an inch above the felt, the layer takes hold of it with his left hand, lifts the sheet, at the same time slipping his right hand under the sheet about the middle and passing it to the other corner; and when approximately one third of the sheet is free he confidently lifts it off with both hands, and places it on the board; he puts it in position with two separate movements so that the air can escape, and he can avoid making blisters, wrinkles or folds.

There are workmen who put a felt on the pack as soon as it is two or three inches thick; most often it is when the layer has prepared half his pack that he covers it with two felts; he then presses it with both hands, as hard as possible, to flatten it working from the ‘hands’ to the ‘feet’ and, in the same way, along the sides; this half-pack becomes flatter, firmer and less inclined to slip. If, in spite of this precaution,

Instruction 87. (THE VATMAN)

In the forming and couching steps, Lalande describes the process used to make one specific corner slightly thicker than the other three corners—the bon carron (the upper right-hand corner when viewed from the vatman's point of view). Distributing the furnish while forming, favoring the bon carron, starts the process (Although easy to recommend, difficult in practice). Then, when the sheet is sufficiently drained (6 to 10 seconds), the mould is tilted to get a flow of white water draining through the bon carron.



The vatman tilting an 18" x 24" mould draining white water through the bon carron corner.

Instruction 85. (THE COUCHER)

The coucher continues the reinforcement by again tilting the mould to drain white water through the bon carron. After one or two seconds (in this somewhat awkward position), the coucher reverses the incline of the mould and raises the low edge, "the good side", and leans the mould on the ass (good side up). The coucher takes a moment to throw a felt, turns back to the mould, and couches the sheet. Fines in the white water are likely deposited in the bon carron corner as the furnish drains through the bon carron corner.



Coucher (Max Thill) takes the mould from the vatman (once the deckle is removed) and then tilts the mould to continue the bon carron draining.

Next the coucher reverses the incline and rests the mould on the ass, throws a felt on the post, then couches the sheet.



Joseph De Lalande, 1761

the pack still shows signs of slipping, he takes a well soaked cloth, and squeezes it so that water flows between the back-board and the pack; this water prevents the pack from slipping.

The layer must take care, from time to time, to fan the sides of the pack, especially the 'hands' and that of the 'bon carron', or top right hand corner, so that he may take hold of the sheets more delicately when he wishes to part them.

If the coucher works too fast and the layer is rushed, he does not spread the sheets exactly on top of one another; the 'carrons' are not accurately aligned; so it happens that the size-parters, in taking hold of the corner of the first sheet to part it, weaken the corner of the sheet which is below; this breaks when it is lifted which gives rise to a 'pied de chevre', that is to say a corner up or slightly torn which can sometimes be repaired only at the expense of creating a seam, and in that case the sheet is classed under 'chantonné, or slightly defective, when it is taken to the salle.

94. *The pack, that is to say the board covered with the sheets of paper together with their felts, is then taken to a small press on the other side, as can be seen under L, Plate XI, which is called the 'Pressette' or little vat-press; there what little water may remain is squeezed out, but with moderation, gently and in several stages, since otherwise there would be the risk of cutting the paper.*

This small press gives body to the paper, and renders the texture more uniform by effacing the laid lines...



Parting a sheet from a felt lifting from the bon carron corner

In Paragraph 93, the role of the layer is highlighted, emphasizing the skill and experience necessary to detach the sheets from the felts without tearing or damaging the corners. The layer's delicate handling of the sheets (pinching the 'bon carron,' positioning, and stacking during the first and second pressing) while avoiding tears and wrinkles underscores the craftsmanship of papermaking.

The results: Test 1

Following Lalande's instructions, we couched, pressed, and air-dried ten 18 x 24-inch sheets with an average weight of 90.1 GSM (the approximate weight of writing paper). We had no trouble handling the sheets and tore no corners. In the paper-making process, corners tear most often when handling thinner sheets, especially cotton linter-content sheets. Thicker (>100GSM) linen and hemp fiber sheets do not present tearing hazards.

In nine of the ten sheets made during these tests, the designated bon carron corners were thicker than the other corners. On average, the bon carron corner was 17.3% thicker than the average of the other three corners, as documented in the accompanying spreadsheet. However, due to initial difficulties with the technique and unfamiliarity with the tilting process, one sheet was deemed "out of range" and consequently excluded from the final analysis.

Test 2 & 3: using a 20" x 30" mould set

Our second post was made using a 20" x 30" laid paper mould set (built by Serge Pirard) consisting of two moulds and one deckle with two different coverings. The furnish was very similar to our first test: linen, hemp, calcium, iron oxide pigment, retention aid, and magnesium carbonate. Freeness: 280CSF. One laid screen has 22 laid lines per inch and the other 26 to the inch. While forming and couching ± 90GSM sheets with this mould set, we did find the 26 laid lines to the inch performed better when making the thin writing paper for this study.

The findings of this modest investigation support the hypothesis that the intentional redirection of drainage to the corner of the sheet may thicken it,



Motorized micrometer measuring the corners in mils (1/1000 of an inch)

by depositing fines present in the white-water. Additional measurements, such as density measurements for each individual corner, would add further credence to this hypothesis.

If the creation of a bon carron was standard practice in France circa 1761, a survey of historical sheets would likely reveal examples of this feature. Full sheets would be required, but measurements of the corners should show variations in caliper and density. If a bon carron can be identified, its location could be cross referenced with other indicators of sidedness (see [which publication?] for a discussion of sidedness).



20" x 30" laid paper mould tilted to the bon carron

Test 1:

Caliper (microns) 18" x 24" paper 24 laid lines to the inch						Good and bad side refer to the top and bottom of the sheet (see page 2)	
Corners viewed from felt side		The good side		The bad side			
Sheet	GSM	Bon Carron	Upper Left	Lower left	Lower right		
1	96.2	264.0	228.0	252.0	244.8		
2	89.3	249.6	220.8	208.8	208.8		
3	112.3	324.0	264.0	211.2	271.2		
4	85.0	237.6	208.8	223.2	223.2		
5	84.3	252.0	228.0	206.4	208.8		
6	80.0	247.2	218.4	196.8	218.4		
7	80.8	216.0	213.6	204.0	199.2		
8	75.0	156.0	144.0	124.8	127.2		
9	108.0	300.0	220.8	204.0	264.0		
Total	810.9	2246.4	1946.4	1831.2	1965.6		
Average GSM	90.1	Average Caliper	249.6	216.3	203.5	218.4	
Caliper thickness color code thick (red) to thinnest (blue)	1	Average of non-bon carron corners		212.7 microns			
	2	Average density of non-bon carron corners		0.42 density			
	3	Average density of bon carron corner		0.36 density			
	4	17.3%	Bon Carron % thicker than the other corners				

Test 2:

Caliper (microns) 20" x 30" paper 22 laid lines to the inch						Good and bad side refer to the top and bottom of the sheet (see page 2)	
Corners viewed from felt side		The good side		The bad side			
Sheet #	GSM	Bon Carron	Upper Left	Lower left	Lower right		
1	99.3	324.0	240.0	216.0	199.2		
2	74.8	276.0	228.0	184.8	204.0		
3	110	292.8	235.2	199.2	201.6		
4	90.1	196.8	259.2	216.0	144.0		
5	98.5	276.0	240.0	220.8	204.0		
6	102.9	307.2	240.0	192.0	228.0		
7	100	271.2	247.2	216.0	192.0		
8	87	244.8	244.8	180.0	158.4		
9		0.0	0.0	0.0	0.0		
Total	762.6	2188.8	1934.4	1624.8	1531.2		
Average GSM	95.3	Average Caliper	243.2	214.9	180.5	170.1	
Caliper thickness color code thick (red) to thinnest (blue)	1	Average of non-bon carron corners		188.5 microns			
	2	Average density of non-bon carron corners		0.51 density			
	3	Average density of bon carron corner		0.39 density			
	4	29.0%	Bon Carron % thicker than the other corners				

Caliper (microns) 20" x 30" paper 26 laid lines to the inch		Good and bad side refer to the top and bottom of the sheet (see page 2)				
Corners viewed from felt side		The good side		The bad side		
Sheet	GSM	Bon Carron	Upper Left	Lower left	Lower right	
1	100.5	360.0	204.0	180.0	201.6	
2	93.5	300.0	276.0	204.0	144.0	
3	104	268.8	228.0	204.0	252.0	
4	102.9	273.6	240.0	192.0	192.0	
5	93.7	261.6	204.0	192.0	211.2	
6	88.4	261.6	168.0	148.8	180.0	
7	93.2	252.0	252.0	180.0	180.0	
8	113	333.6	288.0	216.0	252.0	
9	96.7	252.0	240.0	204.0	184.8	
Total	885.9	2563.2	2100.0	1720.8	1797.6	
Average GSM	98.4	Average Caliper	284.8	233.3	191.2	199.7
Caliper thickness color code	1	Average of non-bon carron corners		208.1	microns	
thick (red)	2	Average density of non-bon carron corners		0.47	density	
to thinnest (blue)	3	Average density of bon carron corner		0.35	density	
	4	36.9%	Bon Carron % thicker than the other corners			

A 'carron' is a square block of wood. So the phrase "en l'inclinant sur le coin du bon carron" I take to mean "inclining it [the mould] on the corner of the appropriate carron" - i.e., the square-block best suited to the size & shape of the mould; the word "bon" in "le bon carron" means "the right block, the correct block."

— Translation: Jonathan Beck

A R T D E F A I R E L E P A P I E R .

Par M. DE LA LANDE.

85. *Le Coucheur* prend la forme sur le trapan de cuve avec la main gauche; il la souleve doucement, en l'inclinant sur le coin du bon carron, afin de le renforcer (art. 87); ensuite il la redresse, la forme & l'appuie contre un ou deux petits bâtons marqués 7 & 8, qui sont implantés sur le trapan dans la bordure de la cuve; la mauvaise rive porte sur le trapan, & la bonne rive appuie contre les chevilles de l'égouttoir; la forme reste dans cet état l'espace de deux ou trois secondes de temps pour s'égoutter dans la cuve, pendant que le coucheur étend un feutre; aussitôt le Coucheur prend la forme, & la couche ou renverse sur le feutre. On distingue deux manières de coucher: Coucher à la Suisse, c'est renverser la forme & la poser à la fois toute entière, en sorte qu'au même moment elle porte & appuie par-tout: cette méthode expose le Coucheur à faire beaucoup de papier cassé. Coucher à la Française, c'est appuyer la forme sur le feutre d'abord sur la bonne rive, ensuite par gradation & lentement sur les autres parties, pour détacher successivement toutes les portions de la feuille & les appliquer sur le feutre; la feuille s'y attache en effet, à cause de son velu, & abandonne la forme qui est un corps plus lisse; le Coucheur relève la forme, en commençant par la bonne rive; il la rend au Plongeur aussi nette qu'avant qu'elle eût été plongée, & il trouve sur le trapan de cuve une seconde feuille à coucher qui a été formée pendant qu'il couchoit la première, & qu'il relève en passant, avant que d'étendre le feutre. Ainsi l'on voit, qu'au moyen de deux formes qui sont toujours en mouvement, il n'y a point de temps perdu: pendant qu'une forme se plonge, l'autre se

couche ; quand le Plongeur passe une forme au Coucheur , il en reçoit une autre qui est vuide , sur laquelle il pose la couverture qu'il retire de dessus la premiere, & il plonge de nouveau.

Les opérations que nous venons de décrire, sont si promptes, qu'il se forme sept à huit feuilles par minute dans les grandeurs moyennes de papier ; telle que la *Couronne* ; en sorte qu'un Ouvrier peut faire huit rames dans sa journée : il seroit sûrement utile d'aller plus lentement ; le papier en seroit mieux fait : on verra dans les réglemens qu'on a été obligé de défendre aux Ouvriers d'excéder la quantité d'ouvrage qui est usitée , ou de la faire toute pendant la seule matinée , de peur que l'abus ne devînt encore plus grand ; on verra aussi à la suite du tarif , la quantité qu'un Ouvrier doit faire dans un jour des différentes sortes de papier.

86. Les feutres ou langes dont nous avons parlé , art. 79 , & qui doivent séparer chaque feuille de papier , sont placés sur la mule à côté du Coucheur ; il étend d'abord un feutre sur le trapan pour coucher la premiere feuille ; sur cette feuille un feutre , & ainsi alternativement ; comme il faut plus de temps à l'Ouvrier pour faire une feuille , qu'il n'en faut au Coucheur pour l'appliquer sur le feutre , celui-ci a le temps , dès qu'il a remis sa forme sur le trapan de cuve , & qu'il a redressé la forme suivante , de prendre un des feutres que le Leveur ou son apprentif lui fournit en les plaçant sur la mule , & de l'étendre proprement sur la feuille qu'il vient de coucher ; après quoi il se retourne , prend la seconde forme qu'il avoit redressée & appuyée contre les bâtons de l'égouttoir , & il la couche à son tour.

Des fautes que les Ouvriers de cuve peuvent commettre.

87. L'OUVREUR doit avoir l'attention en distribuant la matiere sur sa forme , de renforcer le *bon carron* , c'est-à-dire , le coin de la feuille qui est en haut sur la droite entre la bonne rive & les mains , parce que c'est toujours ce coin que l'on pince en levant les feuilles , ou en les étendant ; sans cette précaution il s'en casseroit beaucoup. Si l'Ouvreur enleve trop de matiere avec sa forme , s'il ne l'étend pas également , s'il laisse échapper l'eau trop promptement, s'il frappe de sa forme contre l'égouttoir , dans tous ces cas la matiere s'accumule dans certains endroits de la forme , ce qui produit des *andouilles* dans le papier.

Lorsqu'il laisse endormir la matiere sur la forme , & qu'il ne la distribue pas assez tôt , il se forme une feuille *châtagnée* , c'est-à-dire , semée de parties d'inégale épaisseur ; quand la cuve est trop chaude on *enverge* toujours mal , & l'on ne peut gueres éviter ces inégalités , parce que l'eau s'évapore trop vite de dessus la forme.

Un Ouvreur peut laisser *revercher* la feuille , c'est-à-dire , refluer trop la

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