

THE ART OF MAKING VARIOUS KINDS OF GLUES.

By M. DUHAMEL DU MONCEAU,
of the Royal Academy of Sciences.

Translated by ARLEN HEGINBOTHAM
of the J. Paul Getty Museum.

M. DCC. LXXI.

Trans. MM. V.

THE ART OF MAKING VARIOUS KINDS OF GLUES.

By M. DUHAMEL DU MONCEAU,
of the Royal Academy of Sciences. *
M. DCC. LXXI.

IN GENERAL, the name *Glue* is given to the tough & sticky substances which are used to bind several things together, or to give firmness to certain fabrics. There are the soft ones, which can be employed in this state; others are dry, or more or less thick; but they must be able to be softened, & to be melted into liquors. Since in this state they are more or less sticky or viscous, one can apply them in thin layers on various bodies to which they adhere; when they are dry, the glue becomes hard, & it binds the bodies to each other so well which were coated with it, that they would break rather than separate.

According to this definition, several Cement species could be included among the Glues which are employed hot or cold. However we will not speak of them at present, because we will have occasion to discuss them in the description of different Arts which will put us in a position to better render their advantages comprehensible; thus we will limit ourselves to speaking about the substances which are known under the denomination of *Glue*; they differ from Cements in that they are, when they are employed, liquids & flowing, and that do not form a thickness; whereas Cements are thick enough to fill hollows, to form reliefs &c.

As several substances can produce the same effect, one distinguishes

* M.Benoit who has a very beautiful & very large Factory of Strong-glue, advantageously located in *Les Bordes*, in Corbeil, & who made very beautiful Glue there, more in the manner of England, than of Flanders, knowing that I proposed to record this Art in the manner of those which the Academy publishes, made a pleasure of showing me his Factory, & giving me all the explanations that I could to wish for.

various species of Glues, such as Flour-glue, Fish-glue, that which one names *Glove-glue*, and finally, that to which one gives the particular name of *Strong-glue*, because of its great tenacity.

This one, requiring particular preparation, is done in Factories. This is why we will speak about it initially, & in great detail, We will then say something of the other species of glues.

CHAPTER ONE.

On Strong-glue.

STRONG-GLUE is a dissolution in water of the membranous, cartilaginous & tendonous parts that are extracted from animals. That which is melted is then dried to make tablets which can be preserved for as long a time as wanted without spoiling, & whose transport is easier than if these substances were simply in the form of jelly.

The jellies of stag's horn, and those of calf's feet which are prepared in kitchens & pantries, would be strong-glue if they were desiccated; & the tablets which are used for making broths, are nothing other than strong-glue charged with juice, meat, & the extracts of various meats. This kind of glue which is extremely expensive, would be however less good than that which contains only the parts which are truly proper to be melted into jelly. All other substances, such as juices & the meat extracts, which being dissolved with the membranous & tendonous parts, make the tablets proper for good broths, would only worsen the glue that is intended for use in the various Arts. The fleshy & bloody parts spoil; the fats and the sinovia,¹ which are in the joints, should not be used in the composition of glue. Only the parts able to be melted into jelly are truly the essence of the glue: the others are foreign to it, & can only make it worse.

As for making use of Strong-glue, it should be dissolved & diluted in water, several Artisans & Manufacturers make their glue themselves; but they do not take pains to dry it & reduce it into tablets; they make use of it as soon as they have reduced it to the consistency of a more-or-less thick jelly, according to the use that they want to make of it. The Papermakers, Clothiers, & the Tempera-painters purchase clippings of skins or parchment which they boil in water, & then by putting some drops to cool on a plate, it solidifies into a slightly thick jelly, they use it in this state, & thus save the trouble of those who make

¹ The viscid albuminous fluid secreted in the interior of the joints, and in the sheaths of the tendons, and serving to lubricate them; also called *joint-oil* or *joint-water*. [Oxford English Dictionary, Second Edition, 1989]

strong-glue to dry it & reduce it into tablets; but it is necessary to be in a position to make use of these glues promptly, otherwise they are soon spoiled. Thus, there are those who engage in drying the glue, in factories, because when it is reduced in tablets, it can be preserved as long as one wants without deteriorating; & in addition it is much easier to transport.

The Painters, the Papermakers, Clothiers, & the other Craftsmen who make their glue themselves, would often find it advantageous to buy their glue in tablets; because Strong-glue is usually freer of adulterating foreign substances that damage the adhesive parts than the glues that Craftsmen make for their own uses. There are however reasons of economy or suitability which commit them to make their glues themselves.

Some claim that the glue in tablets is too strong, & that that they require something less perfect. It is perhaps a prejudice; because one is able to weaken the glue as much as one wants by extending it in water: in any event, one can consult what has been said of these various glues in *The Arts of the Papermaker*, of the Clothier &c; & for the benefit of those who do not have these Arts, we will say something of them later.

Many animal substances are suitable for making Strong-glue. Clippings of skin & leather, the feet, the skin of the heads & tails of several animals, even the bones, if one had the use of a Papin Digester² to dissolve them, they could provide glue.

I have not pursued the experiments on this point very far. However I did manage to make a glue with bones which was in truth quite dark, but which seemed to me very strong, & I believe that it would have been better if I had started by removing the marrow & grease, & by removing, by means of an acid, the earthy substance of the bones, so as to dissolve only the cartilaginous part; but there are indications that such preparations would have been dis-advantageous.

Among the substances which I have just mentioned, some make better glue than others. In general tanned leathers do not provide glue; leathers known as Hungarian or Harness-maker's leather which are treated with alum & tallow yield little, & of poor quality. In order to obtain glue, it is necessary, to prepare them specially.

New leathers give more glue, & of better quality than those which have been desiccated by long service. These substances, after much effort, return but little glue; I made a test of this in a cast iron pot, with a lid of the same metal closed tightly, so that the steam reverberated on the leather, yielding to some extent the same effect as Papin's machine; but I did not obtain any glue at all.

Chamois clippings treated with oil are worth absolutely nothing.

Hair does not melt at all into glue; blood, grease, the flesh can only spoil the goodness of the glue, or at least cause much waste. This is why

² The Papin Digester was the forebearer of the modern pressure cooker. See: Papin D. 1682. *La maniere d'amolir les os et de faire cuire toutes sortes de viandes en fort peu de temps, & a peu de frais, avec une description de la marmite, ses proprietes et ses usages*. [The manner of softening bones and cooking all sorts of meat in a very short time and at little expense, with a description of the pot, its properties and its uses.] Paris: E. Michallet.

those who purchase material to make glue, require that it be well degreased & clean, or otherwise expect a considerable waste which cannot be avoided.

Clippings & scrapings of parchment & vellum that are bought at the Parchment manufacturers & graders, make a good glue; but it would cost a great deal to manufacture; & it is the same for the clippings of skins purchased from Glovers & Tawers, the Skinners & the Furriers. The skins of hares, rabbits & beavers, which have been depilated by the Hatters, all these materials are quite good for making strong-glue; but they are mainly employed by the Tempera-painters, the Clothiers for gluing their warps, the Papermakers &c.

The makers of Strong-glue usually employ more common substances, such as leather clippings of oxen, calves, sheep, horses &c, which one calls *oreillons*; & the older and thinner these animals are, the stronger the glue is.

All the tendonous & aponeurotic³ parts that one calls *nerves*, make good glue. The feet, the tails of these animals can provide glue; but these substances cause much waste, because of the hair, the fat & the sinovia which are abundant in them. It is necessary to break down, degrease, and de-bone them; & in spite of all this, if only feet were employed, the glue would not be very strong, because of the quantity of sinovia which is in them.

The feet of oxen, formerly esteemed, are now looked on as one of the bad materials that can be employed, & especially since the Butchers have begun to carefully remove a tendonous part of them, called the *small nerve*, or the *shin nerve*, that they sell by weight, & rather dearly for the production of a kind of oakum which is useful for caulking the panels of carriages, or to make suspension straps for carriages. When the feet are thus stripped of this tendonous part, they produce only a mucilaginous substance which is not suitable for making good glue; & if anyone makes use of them, it is because of their low price. The tendonous materials that are bought to make glue, are thus priced in proportion to their cleanliness, which is to say, those which are fresh, quite clean, dust-free, without hair, without fat, and without flesh, must be chosen first. It is not that they cannot be cleansed of these useless or harmful materials; but the process is wasteful & requires much labour, because, as I said, the fatty, fleshy and bloody parts, & that which is unsavory, are heterogeneous materials which can be removed with washing, with soaking, or in the kettle, where they form either dregs which precipitate at the bottom, or a scum which rises to the surface, according to their weight. Thus it is necessary to employ time & labor to unburden the useful materials of these harmful substances,

³ Pertaining to aponeurosis, a white, shining, fibrous membrane, sometimes serving as the sheath of a muscle, sometimes forming the connection between a muscle and a tendon. [Oxford English Dictionary, Second Edition, 1989]

particularly of blood which is very susceptible to spoilage. Usually when one purchases the materials suitable for making glue, they are stripped of the hair & fur which covered them, considering that this fur is sold separately; but when it remains on the feet or the tails, they are not sought after to be used in the glue Factories. These materials are put in a slightly strong lime water, to depilate them before employing them to make glue: however any hair which remains does not cause damage, & will be found in the dregs, un-dissolved. The reason to get rid of it, is so that it does not fill the kettle unnecessarily, that it does not retain dirt and soil, & that it does not take away from the glue by soaking it up.

I saw employed at M. Benoît, the skins of hare, rabbit, & beaver depilated by the Hatters, to make beautiful glue in the English manner.

With regard to Hungarian leather which is put through alum & soaked with tallow, which we call Harness-maker's leather, this requires, as I said, particular preparation. It should be held longer in the lime water to remove tallow & salts; then it will provide quite good glue, but russet-red & in small quantity: thus to profit from it, it should be bought cheaply, especially when old & desiccated.

If one were to make glue entirely with the ears or nerves of cattle, it would be very good. Thus when the Tanners wanted to make glue, since they had the clippings of all the parts of the skins which were not suitable for good leather, they made excellent glue. But as these materials are too expensive to be marketable, the manufacturers mix them together with substances of various qualities to make a good commercial glue. They take, for example, 1000 pounds of clipping of sheep & calf skins, & 500 pounds of ox oreillons: the whole being well maintained, should provide 5 to 600 pounds of glue. I give this only as an example; because it is appropriate to vary the mixtures, according to the quality of the glue which one proposes to make, & the price of the various materials, of which some are more abundant in one Province than in another.

Each material is put to soak separately in small tanks A, Pl. I & II full of water; twenty four hours is sufficient for the fresh skins; it takes more time for those which are dry, & still more for old leathers. From time to time they are stirred up B, Pl. I, with the fork C, Pl. II, or the shovel D. When they are well infused with water, they are withdrawn from the tanks with this fork, or a hook E, & charged onto the grills F, Pl. I & II, which must be narrower at the bottom than at the top. In the large Factories, one makes them large & strong like Plate I. In the small Factories has, one keeps them light as in Plate II. These grills are made with bars or pins which are held in a strong structure of

cartwright's or joiner's work. The leathers are allowed to drain a little on the grills, then, when the Factory is, like that of Corbeil, established at the edge of a River, they are washed in the River, as we will explain; but many are denied this advantage, which nevertheless is very important to make beautiful glue.

Openwork cages *G 1, G 2 & G 3, Pl. II* are established on the river banks. These are formed by bars or pins which enter holes bored into a strong carpentry frame. The cage is assembled at the end of a counter-weighted framework *e*, & this pivoting frame, is assembled by means of two hooks *FF*, which are attached to the horizontal piece forming the cross bar at the center of the wooden structure. This base is shown at the edge of the River, similar to the carpentry framing of a door, as one sees it in the distance in Plate I, where the cages of which we speak are in two locations.

When the framework is vertical, as in *G 1 & G 2, Pl. II*, the cage into which the pieces of leather are put, soaks in the water of the river, as one sees in *G 1*. They are then stirred up & agitated in the water with a roller *H, Pl. I & II*, or a churner *I, Pl. II*, a kind of rake with large teeth. In the distance of Plate I, a man can be seen who stirs up the leathers in this kind of cage.

From time to time, the end of the counter-weighted frame is lowered to bring the cage out of the water, as one sees in *G 1, Pl. II*. The pieces of leathers leave the water, drain, & the dirty water runs off. When this water has drained away, the cage is re-immersed, as one sees it in *G 1 & G 2, Pl. II*; the leathers are stirred again, & this operation is repeated until leathers are cleaned, & the water runs clear. This operation can be seen in the distance in Plate I.

As the various leather species are washed separately, special attention is paid to the ears which usually retain dirt and soil more than other materials; The cage ends up being set, as represented in *G 3*, the pieces of leather are drawn from it with the churner *I Pl. II*; & the fork *C*; they are put on the grill *F Pl. I & II*, & carried in small iron-banded tanks *A*, of which there are a great number in the Factories. They are left there for twenty-four hours, & if it appears that they are still dirty, they are washed a second time, just as was done the first. As much water is needed to fill the tanks, it is raised with pumps *K Pl. I*, & led by means of channels *L* into the various tanks.

Usually leathers are put to soak in a rather weak lime water. This is advantageous, as they can be left a long time to become well infused with water; as they will never spoil as long as they are in the lime water, even if they remain there for two months. The water of the tanks is merely refreshed every

fifteen days with a bucket or two of new lime water, & from time to time the soaking leathers are turned over.

By this soaking, the fleshy & bloody parts are dissolved, and a kind of soap is made with the fat, & the skins are almost converted into parchment.

If one has materials which have hair, then after washing, they are put in a stronger lime water, which burns or detaches the hairs, at the same time that the lime in which the materials are left soaking, partly consumes, as we have just said, the blood, grease & flesh which can only lower the quality of the glue. In addition, I should note that if one covers a skin on the side of the flesh with a paste containing lime, the skin as it dries will soon become like parchment, & it is known that parchment is very suitable for making glue.

It has been said that to benefit from the skins which have been treated with alum & tallow, it is necessary to hold them longer than the others in a slightly strong lime water, & to wash them with more care, in order to carry away the salts & grease.

With regard to the materials which contain fat, blood, sinovia, fleshy parts, & hair, they are put in a strong lime water. They are withdrawn from this water being all white with lime, & are preserved dry in pits *M Pl. I*; as they will not spoil in this state, this work is done in the winter, & keeps them in heaps *N* under sheds until the spring, which is the season when they are used: they are then put to soak in small tanks full of clear water; three or four men stir them with a kind of roller *H*; they are washed in the River, & they are fit to be put in the kettle.

After having thus soaked the skins well, & after having carefully washed them, they are put for the last time on the grill *F*, mixing together all the various kinds of materials in the proportion considered suitable, & one carries them to the cages *G* to give them a final washing. Some then pass them under a press *P Pl. I & II*, to remove part of the water with which they are soaked, which would keep the glue from being made sufficiently thick.

Some put stones at the bottom of the copper kettle in which the glue is to be melted, to prevent the materials from sticking to it & burning. It is better to put a wood grid at the bottom of the kettle whose bars are two inches square, & this grid is surrounded by an iron circle which holds it together. A copper kettle which is placed on a masonry furnace *Q Pl. II* is filled to the very top.

Here the practice is not the same in the various Factories; some

claim that the water that the materials absorbed in soaking is more than sufficient, & than one should not add any more. Others add some, but in more or less quantity, according to the quality of the material, & think that one needs more for those which are hard & dry, than for those which, being fresh & tender, are swollen & charged with much water from soaking. I am sorry not to be able to say anything more precise on this point; because I believe that it is in the interest of the Manufacturer to employ rather precisely the quantity of water which is appropriate, especially since if one were to put too much, it would be necessary to keep the fire burning a long time to thicken the glue. In this case, one would consume more wood, & the glue would be more brown; if one were to put too little, the glue would be done before all the parts were melted: a portion of fibers suitable for glue would thus remain in the dregs, & it would be a loss for the Master of the Factory. However it seemed to me that a little more or less will do, & that with a little practice one will easily get it right, providing that one is warned that it is necessary to add less water to the materials which absorbed much with soaking, & which swelled considerably, than to those which are hard & dry. In order to know if it were important to employ much water, I took beautiful glove clippings; I put them to soak for twenty-four hours in clear water; after letting them drain a little, I put them in a cast iron pot, which had a lid also of cast iron, & which fit rather tightly; having initially put a small fire below, then a bit stronger, my clippings were almost entirely melted, & furnished me with a glue which thickened & dried promptly. I then boiled water; I threw in similar dry skins, they melted there; but I had quite some trouble to thicken them enough to make glue in tablets. I return to what is practiced in the Factories.

Initially a small fire is lit under the kettle to melt the materials little-by-little & without burning them. One increases this fire by degree, until the glue boils, & as the glue is close to done, some decrease the fire, claiming that it is necessary to let the glue finish without stirring up it: others, when a part of the skins are molten, stir & mix up the materials vigorously with a spatula *H*; which they repeat from time to time until the glue is done, which they recognize by filling an egg shell with it; it is ready, if, when it is cooled, the glue forms a rather thick jelly. When a part is melted, it is necessary to decrease the fire until that which is melted just barely boils, avoiding too big a fire; for it is to better to go slowly, than to rush anything. This operation usually lasts 12, 14 or 15 hours: when part of the goods is molten, a scum which contains cooked blood sometimes rises to the surface of the liquor: some remove it with skimmers; but one can spare oneself some work: these impurities will separate in

the tank or in the boxes. A small fire is maintained under the kettle so that the glue does nothing but simmer, & from time to time the materials are stirred up with a shovel which has a wood handle, so that the light materials which rise to the surface are driven into the melted glue & are melted themselves, & also so that those which fall to the bottom do not burn.

I believe that during the time when the glue is not stirred, it would be advantageous to cover the kettle with a straw lid braided with wicker, which is raised by means of a cord run through a pulley, when one wishes to stir the glue; by this means the steam is retained, this hot & wet vapor being very useful to speed the melting of the materials.

The place where the glue is cooked is a small closed building *R Pl. I*, in which the kettles are mounted similar to those *Q Pl. II*; & near each kettle, there is a small wooden tank, banded with iron straps *S, Pl. II*. If one puts a little melted glue on a plate or in an egg shell, and find that as it cools it takes on the required consistency, one may judge that it is time to empty the kettle. A long & square cage is placed on the tank covering the entire diameter of the tank. This cage is called a *Civiere*, because it is made of bars like the grill *F*. Long straw is put in the bottom of this grill; better still would be to use a hair cloth. The small tank must be very close to the kettle not only to transport the materials more easily to the grill, but also so that the heat of the furnace will prevent the glue from cooling, & it remains fluid.

When the materials which are to furnish the glue are thus melted, & the glue is cooked, after letting largest dregs precipitate out, the kettle is emptied with a large copper spoon *T*, which is called a *Cassin*; that which is spooned out is put in the grill which is placed on the small tank. This operation must be done promptly, & while the glue is extremely hot, so that the liquor is fluid. As it is important to keep the glue hot, not only so that it drains well from the dregs, but also so that it is purified by precipitation while it is in the tank, one must take care that the kettle & the tank are in a small tightly closed place, which is, in this manner, kept hot by the furnace; but still one covers the grill & the tank with a fabric doubled-over several times, in order to prevent it from cooling.

In order to not loose anything which might furnish glue, the dregs, which they name *the manure*, are left to drain in the grill for a long time.

Normally the dregs which one gets from the grill are put out to dry in the air, & when they are quite dry, they are used to maintain the fire under the

kettle, this results in a savings on wood, which one manufacturer told me runs to more than 1000 livres per year.

It is good that the liquor remains in the tank for some time to purify by precipitation, giving time for the foreign substances to precipitate to the bottom; for this one must close the doors & the windows of the shop where the kettles & the tanks are, so that cooling can happen slowly & the glue remains liquid, without which the impurities will not precipitate. One usually leaves the glue to purify thus by precipitation for three or four hours; if by holding the tank in a quite hot place, by means of a stove, one drew off the glue only at the end of six, eight or ten hours, it would be more beautiful; because the best purification is that which is done slowly.

When the glue is judged sufficiently purified, it is drawn off still hot from the tank, taken promptly & poured into troughs or boxes of wood *V Pl. II & III*, that have previously been well wetted, & in which water must always be kept, mainly so that the boards do not shrink, & the boxes are tight, so that the glue that one will put in them will not be lost; but they must be empty before putting the glue inside.

In this operation, some clear the glue with hair sieves, which usually are given an oval form, because it is more convenient to fill the boxes which are long & narrow; but this operation is not without disadvantage, & best is to clarify the glue by precipitation, as we have said.

The boxes *S* are well built of oak or fir wood; they are seven inches high, nine wide, & approximately three feet long. They must be an inch larger at the top than at the bottom.

The melted glue, clarified by precipitation, is thus poured into these boxes. Holes are bored in the tank, *S Pl. II*, at various heights, and wooden taps are added. The lowest is an inch & a half from the bottom, and highest is three & a half inches from the bottom. The liquor which comes from the highest tap, provides the most beautiful glue; & if one wants to have it very beautiful, one should not draw off all that can come from this tap, because at the end, a little grease would come through, floating on the glue, and giving it an unpleasant look. However, one draws off the liquor by the various taps as long as it runs clear; that which runs from the last tap, though not clear, is not less good. For if it precipitates dregs at the bottom of the box, these will be removed when it is cut into layers. The surplus which has dropped to the bottom of the tank, containing much glue, is put into the kettle with new material.

In spite of the care taken to purify the melted glue, one almost always finds

a little grease solidified on the surface of the glue that one has put in the boxes, & some dregs at the bottom; but these materials are cut off when the glue is cut into tablets.

The glue is left to cool & thicken for approximately twenty-four hours in the boxes that it was drained into from the tank, keeping them under a shed *A A Pl. I & III*, protected from the rain & the sun; as it loses of its moisture, it decreases by volume; & when it has become firm enough to be pulled from the boxes, it is approximately four inches thick. It is then taken from the boxes and cut into tablets, as we will explain.

Even though the boxes were kept wet, the glue adheres to them; thus to detach it from the wood, one takes large double-edged knives *X Pl. II*, soaked in water, & slides the blade between the glue & the boards of the boxes, taking care to wet this blade often. Thus does one manage to pass it all around the solidified glue which clings to the walls of the boxes.

When one has gone around the boxes with the knife, the glue from the boxes is cut with the same knife, into five pieces or parallelepipeds⁴ which are nearly seven inches in length, nine in width, & approximately four in thickness. To cut these pieces regularly, a small frame called a *mold* or *gauge Y Pl. II* is placed onto the glue, the longer side must be equal in length to the width of the box. The width of the mold must be such that it divides the length of the box into equal parts without fractions. Having placed this mold onto the hardened glue, the knife is run along one of the sides; but there is the question of removing these parallelepipeds of glue from the box. This is done with a wooden pallet which has a handle. The body of this pallet is precisely the width of the boxes, & as they are narrower at the bottom than at the top, the pallet is narrower at the end than it is near the handle; in a word, one makes it so that it fits the interior of the boxes exactly. This pallet is wet, & one slips it between the pieces which one wants to remove, introducing it into the slits that the knife made; one thus starts by putting the pallet in the slit which separates the first parallelepiped from the second, & sliding it under the glue, it is removed on this pallet. It is this piece of glue which is most difficult to remove; however one should never start with the pieces at the ends; one would seldom succeed there; but having removed one from the middle, the others are detached easily, because one can tilt the pallet to make it slip under the other pieces. Workmen who are well accustomed to this work, eschew this practice; because, as a point of support is needed to remove the pallet, one damages the parallelepiped next to the one being removed: thus they do without this pallet, & having poured a little water on the glue before slicing it with the knife, they have the artfulness to pull these

⁴ A 3-dimensional polyhedron with six parallelograms for faces. [Oxford English Dictionary, Second Edition, 1989]

pieces of glue from the boxes with their hands.

In order to draw the parallelepipeds from the boxes easily, it is important that the glue be neither too moist, nor too dry; if it be too moist, the pieces will break; if it be too firm, the glue will be so adherent to the box that it can not be separated, & one will have trouble cutting it into tablets, as we will discuss in a moment.

When a piece of glue is removed, it is carried on the same pallet & slipped onto a plank *Z*, *Pl. I*, which is approximately one inch in thickness, & at one end of which another rises perpendicularly; this one is used for a backstop, that is to say, one of the faces of the parallelepiped of glue is placed on the horizontal board, & one of its sides pushes against the vertical board; then the Workman *E*, *Pl. III* placing himself on the side of the vertical board, & holding with two hands a sort of saw *E*, *Pl. II*, whose frame *a* has, instead of a cord, a heavy iron wire *e d* held by a nut; moreover, instead of a normal cutting edge, there is a thin copper blade *a a*, which is enough to cut the glue; while placing this instrument in a horizontal position, the Workman holds it with two hands, draws it toward himself, & cuts the parallelepiped into horizontal sections, giving them the appropriate thickness. Usually one cuts off a thin slice from top, & from the bottom, the latter often containing contaminants which did not precipitate in the tank, & the former having congealed drops of grease which give an unpleasant look to the glue.

The practice of the Workmen means that they cut their tablets of glue very regularly, being guided simply by eye. Moreover as the glue is sold by the pound, precision in the width & the thickness of the tablets is rather insignificant; the Manufacturers simply try to make them not extremely thick, because the thinner they are, the more transparent the glue seems. With regard to the layers which one took from the top and bottom of the parallelepipeds, they are put back in the kettle with the other goods.

When the sheets are thus cut, they are carried to the drying room *A A*, which is a covered warehouse or shed, but whose sides are furnished only with curtains that are closed if needed, leaving, as much as possible, an unrestricted flow of air which dries the glue promptly without spoiling it.

Under this shed are posts *B B*, *Pl. III*, with long pegs, on which are placed frames of joiner's work, with nets nailed to them *C C*, *Pl. II & III*, which are similar to those of Fishermen. It is on these nets that the sheets of glue are placed to dry, as the Workman is doing *D D*, *Pl. III*: they are arranged close to each other to save space; but care is taken that they do not touch.

The curtains of the drying room are closed only when it rains, or when the sun can shine directly on the glue. It is obvious that if it rained on these tablets of glue which are just gelled, they would become deformed; but the sun is as much to fear: because if the sun's rays shone directly on them, 5 to 6 minutes would be enough to melt them & make them drip away into nothing.

Sometimes ten days are enough to dry the glue, & other times it takes more than fifteen. When the glue is put on the nets, it is firm enough not to pass through the mesh; but it is rather tender so that the strands are printed on its surface, which makes the diamonds that one sees on the tablets of glue *EE, Pl. II*: it is necessary to be attentive and to detach them from the nets and turn them over from time to time, without which they would stick so that one would be obliged to tear the nets to have the sheets of glue. Nevertheless, if this happens, the glue can be removed without tearing the nets, by wetting it a little on the underside with a sponge soaked with water.

When the glue is half-dry, the sheets are pierced at one end, to be able to tie them on a string, which is used to hang them in the stores, as seen in *FE, Pl. I*. When the tablets of glue are almost dry, one can give them a pleasing look, by wetting them a little, & rubbing them with a new linen. This operation gives them the polish & the transparency which is valued in English Glue.

Stormy weather turns the glue bad, not when it is in the kettle, but when it rests in the tank, or when it is in the troughs. In the drying room, stormy weather won't do anything more; the glue is only menaced by the rain & the sun. However if it were to be shocked by the frost, before it is dry, it would become gelatinous, & would loose its transparency, & though its quality would not be deteriorated, it would not be marketable anymore, it must be re-melted; thus when the frost comes, while the glue on the nets is still soft, it is necessary to carry the sheets to a place where the frost will not penetrate. One thus makes haste to carry those which are not dry to the cellar or to a storeroom, as well as the boxes in which the glue was put to cool. With regard to the small tanks, as they are beside the kettles in a small and confined place, there would have to be quite violent cold for the glue to be damaged there by the frost; but it can be said in general that times of great heat & of frost, are not favorable for glue making. The sheets of glue are preserved easily in storage, & the older glue is even more valued, because being drier, it brings more profit; but the Merchants try to hold it in a place which is neither extremely dry nor humid.

In a hot & dry place, it would lose weight, & this would result in a loss which would be prejudicial for them. If it were in a wet place,

it would be softened, & the Purchasers would refuse to take it; for the retailers focus their attention on this, they know well that they would suffer a considerable loss if they bought a glue which was not dry.

There are some who want the glue to be a little red, others value that which is light; but all desire that it not have obscure spots; it should not have an odor. The breaks must be shiny, as if it were a piece of ice. When using it, it should not accumulate dregs at the bottom of the vessel where it is melted, & as that sometimes happens, because it is burned, the attentive Workmen dissolve their glue in a bain-marie; but the best test is to put a piece of glue in water to soak for three or four days. It should swell greatly, but not dissolve, & afterwards be desiccated, without any loss of weight; this makes it known that it does not contain any sinovia nor meat juice, & that it is thus entirely a gelatinous substance.

The Carpenters make great use of strong-glue; the Saddlers make use of it for ribbing the panels of carriages. The Marquetry-makers & the Cabinetmakers choose the best & strongest glue with great care. Some claim that they make it more adherent to wood, by rubbing the parts which they want to glue with garlic. One can see in The Art of the Organ Builder the way of promptly melting the glue without spoiling it.

CHAPTER II

On the so-called Flanders-Glue.

THIS Glue does not differ from heavy Strong-glue in the way it is made; but as it is used only by the Tempera-painters, Cloth Manufacturers, & for other uses which do not require a very strong glue, & since its principal merit is to be fair & transparent, it is not made like the standard glue, known as *English-glue*, with nerves, ears & skin clippings from old animals, even those from hares, rabbits, & beavers, which would make it red, but with sheepskin clippings, lamb skins, or skins of other young animals. This is the situation in which sheep & calf's feet can be employed, which provide a delicate jelly; those of thin animals make the best: a portion of parchment clippings can only be advantageous to get a beautiful glue. It is necessary that these materials be washed carefully. One will do well to keep the glue in the small tank to purify for a longer time. But what contributes much to making it appear transparent,

is to make the sheets extremely thin. They have barely one twelfths-of-an-inch [une ligne] in thickness at the middle; their ordinary width is two inches, the length from 6 to 7.

To cut them into this small thickness, when one pulls a parallelepiped of this glue from a box, it is placed on one of its narrow sides in a cage or rack *G G Pl. I* & *II*, between two rows of brass wire which one keeps more or less widely spaced, according to the thickness of tablet desired, & the sheets are cut with the instrument *H H, Pl. II*, which resembles a saw with a blade which is extremely thin, & without teeth, with which one cuts the tablets to a very small thickness, which contributes to making them appear transparent, & of an amber color, because of the materials which were employed to make the glue.

For Joiners, Cabinetmakers, and Makers of Marquetry, this glue is not as good as the heavy type known as *English Glue*; but it is preferable for several Arts, & particularly for Painters. A too-strong glue would be prone to flake off; moreover Flanders glue does not diminish the vividness of the colors as much. However for white, one still gives preference to glove glue, which the Painters make for themselves.

CHAPTER III.

On Mouth-Glue.

MOUTH-GLUE is that which Draughtsmen use for assembling, extremely neatly, several sheets of paper, when they do not have ones large enough for their intentions. It is called *Mouth-glue*, because when one wants to make use of it, instead of melting it as with ordinary glue, a little piece is placed in the mouth, where it is left some time until it tenderizes to the point that it mixes with a little saliva, & is made extremely sticky. Before teaching how it is best used, I will describe the manner of making it.

Mouth-glue is nothing other than ordinary Strong-glue, except that one aromatizes it to remove the disagreeable and repellant taste which it would have naturally, & it is reduced into small cakes or tablets, to make it more convenient to use. One can do this with any species of strong-glue, even with glove-glue, of which we will speak; but it is better to make use of English-glue, because it is the firmest.

One can take, for example, 4 ounces; broken into small pieces: as usual

these are soaked for two or three days in a sufficient quantity of cold water, in a glazed earthenware pot: all the surplus water is then thrown out, so that none remains at all, & it is melted on a small fire. When it has become quite liquid, two ounces of ordinary sugar are put in, it is mixed bit by bit with the glue so that it melts; there are some who add a little lemon juice, which appears to be rather useless.

One takes a marble slab of approximately 15 inches square, or a wooden board of similar size; making a rim along the four sides with wax or a small candle, the surface of this mold is rubbed all over with a small piece of linen soaked well with good olive oil so that the mold is well coated; & having placed it level, all the glue is poured into it, without giving it time to cook any more. It is left four or five days or more on this mold, so that it takes on a consistency such that it can be removed without tearing. It will then be approximately one quarter of an inch [trois lignes] thick.

When it is time, this large plate of glue is removed: it is spread on a towel folded into four, placed on a table; the glue is covered with another towel also folded into four: the whole is weighted down with a board or the same mold. These linens initially remove all the oil which could still be on the glue, & above all they draw moisture out of it. A few hours afterwards, the towel on top is removed and dried before a fire, it is then put on the table and the glue placed on top: next the other towel is dried in the same way, and placed back on the glue: the whole is weighted again as it was the first time. This same operation is repeated three or four times per day for fifteen days: until the glue becomes firm enough to hold its own weight without bending; but it should not yet be breakable.

It should be noted that one can give the glue the thickness desired, by weighting it more or less; if it is weighted much, it becomes thinner, because it is prevented from contracting inwards; if it is weighted little, it becomes thicker, for the contrary reason; but it should be weighted, so that it doesn't shrink, & so that it stays straight & flat. If it were left to dry in the air without disturbing it at all, it would dry much more quickly; but the cakes would be extremely twisted, & would not be convenient for use. It is good if they are one twelfth-inch in thickness [une ligne], a quarter to a third of an inch in width [8 à 9 lignes], & approximately 3 inches in length.

Before the glue is dry enough to be breakable, it is cut to this aforesaid size with scissors; then all the cakes are arranged close together, without touching each other, putting them back between the linens which are dried from time to

time, & weighted. This operation is repeated until the glue is perfectly dry & breakable.

The Use of Mouth-Glue.

One starts by cutting quite straight and cleanly the edges of the two sheets of paper which one wants to join; this will be done easily, by means of a ruler & a knife point or a penknife. These two edges are placed over each other so that they overlap by approximately one or two twelfths-of-an-inch [lignes]. If the paper is quite strong & quite large, an edge is put on these two sheets, by putting a ruler on each one, and placing a weight on each end: attention must be paid that the edges of these sheets overlap equally along the entire length of the seam. For this, a point on each end is marked with a compass. Some strips of another paper are cut with a penknife & a ruler, & one of them is placed on the lower sheet along the edge of the upper sheet.

The whole being ready, one takes a cake of mouth-glue; the end is sliced thin, either with a knife or a coarse file; this end is put in the mouth; it is held between the teeth, so that it does not slip & that it does not escape; & when after having kept it thus in the mouth for 3 or 4 minutes, when one feels that the saliva touching the glue has become sticky & thick, one takes the cake, & passes it below the edge of the upper paper sheet, moving the glue from left to right, & right to left, over the length of approximately an inch & half. This operation must be done rather quickly, especially in summer. One starts in the middle of the seam: as soon as the glue is thus set, the paper band is removed, and another is placed over the top of the seam, & with a smoothing tool, or a wood or ivory knife, this paper tape is rubbed hard. There will then be section of an inch & half in length near the middle of the seam which will be glued. The same operation is performed at one end of the seam, at the edge of the paper sheets; then at the other other end; then in the middle of the first interval, then in the other; thus alternatively until the entire seam is completely glued. Some, to avoid creases, start at one end, & finish at the other.

There are several observations to make: 1°. to operate conveniently, one of the two paper sheets is placed on the table, laid out so that the edge to be cut with the ruler is opposite you, & the edge of the other sheet is turned in front of you, and placed over the first sheet. 2°. The seam will be cleaner if the face of the sheet to which the penknife was applied when the edge was cut is placed below, that is to say, face down on the table, & the upper sheet is placed in the same manner where it was cut, such that one puts the glue on the side opposite to the operation of the cut. The reason for this is that, while cutting

the edge of paper, the blade of the penknife forms a small bevel & a small imperceptible burr below, that can be used to make the seam less apparent & cleaner, by applying the glue to this side. 3°. The reason a paper strip is placed along the edge of the upper sheet, is so that when the glue is placed between the two sheets, the strip will prevent the lower sheet from being stained; which could not be avoided, if this strip were not covering the edge of the lower sheet. 4°. Care should be taken not to apply too much of the glue between the two sheets, so as not to stain the lower part. There are some who, for that purpose, put a paper strip below, along the entire length of the seam; this is better. 5°. It is necessary to take care, as soon as a piece is glued down, to shift the two paper sheets a little, because it happens sometimes that if one inserts a little too much glue between the edges of the two sheets, they become stuck to the table, or to the paper strip below. 6°. There are rather skillful draughtsmen, who remove half the thickness at the two edges of the paper sheets which they must stick together, half the thickness; to this effect, they run a pen knife along the edge of a ruler set two-twelfths-of-an-inch [deux lignes] inside the edge they cut before, & they cut only half-way through the paper, then they peel away a small band, splitting the paper in its thickness. They form thereby something like a rabbet. When they have performed the same operation on the edge of the other sheet, they place & glue one of these two rabbets on the other. By this means the seam is much cleaner, & is not thicker than the remainder of paper. But this operation can only be performed on strong paper. 7°. One is obliged to sharpen the end of a glue cake only the first time that it is used, the edge will always be retained. 8°. As soon as the glue has been applied between the sheets in one area, the glue should be placed back in the mouth, where it is prepared, while waiting, to glue the following area. It is not necessary to keep it in the mouth for several minutes, only when one is just beginning to glue; after this, it is always in use, without the need to wait. 9°. It is necessary to change the paper bands several times, as they become stained or moist, in order to glue more neatly. 10°. It should be observed that no saliva should be put on the glue when it is removed from the mouth, the seam would thereby be sullied.

I have made Mouth-Glue several times with Flanders-Glue, & I would describe here my procedure; but having found that of Dom Bedos to be more perfect, I felt I must give him preference.

CHAPTER IV*On Calf's Feet-Glue.*

WE said that one could include calf's feet in the glue known as *Flanders Glue*; but in this case they are not used alone: they are mixed with other materials, which give more consistency to this glue than it would have if the feet alone were employed. But whenever one needs a clear & transparent glue, & when it is not important that it have much strength, it can be made with only calf's feet. For this, the hair is removed with boiling water, as is done with a suckling pig; then the bones, and fat are detached, along with any sinovia which has a cloudy appearance. The remainder is then boiled in water, skimming off any froth that comes to the surface; & when the cooled broth takes the consistency of a thick jelly, the glue is strained through a linen cloth, & it is allowed to cool slowly, in order to degrease it as much as possible. When one wants to use it, it is warmed, paying attention to draw off the clear part, and not mix the good glue with the small amount of sediment that has precipitated at the bottom. This glue is transparent; but it does not have much strength, & it is not much used, because, as the calf's feet are employed in cooking, they would produce a very expensive glue.

CHAPTER V.

On Glove & Parchment-Glue.

GLOVE-GLUE is also a diminutive name for Strong-glue, & it does not have quite as much strength; it has, however more than that of calf's feet, & it is made with materials which cost much less. This is why the Tempera-painters, who do not need a very strong glue, make a great use of it, & for their whites they prefer it to Flanders-glue. Here is how it is done: one takes a pound & half of white glove skin clippings, that are bought at the Glover's & Skinner's; one must be sure that there is no chamois. Then twelve pints of water are boiled; when it is boiling well, the skin clippings are put in, & stirring from time to time with a stick, it is boiled until reduced by half; the liquor is then passed very hot through a linen cloth, into a new or clean earthenware pot. As the House-painters who make use of this glue, require

that it be sometimes more & sometimes less strong, they put some to cool on a plate; if they find it too strong, they add boiling water to it; if they find it too weak, they evaporate some part, or add clippings to it. Ordinarily they will boil the dregs in other water, to obtain a very weak glue which they employ for ceilings, or which they strengthen, by adding some new clippings to it.

Parchment-glue which is done with clippings or the erasures of parchment, or vellum, is done like glove-glue; it is stronger, but not as completely white.

The Gilders of burnished gold make great use of this glue, & glove-glue.

The Glue that the Clothiers use for their warp, & the Papermakers use as well, is approximately the same kind.

The Papermakers could themselves make use of Flanders-glue; but for the most part they make their glue for themselves. For this, they put the clippings of skins in an iron cage which is suspended in the middle of a kettle filled with boiling water: I say boiling, because for all the glues which are made with clippings of skin, it is better to put them in boiling water than to put them in cold water which is then brought to a boil. The best way to know if the glue has the degree of strength desired, is to put glue on some sheets of paper, dry them, & then apply one's tongue to it; if the saliva does not penetrate the paper, the glue has the appropriate degree of strength; some Roman alum is then added to it, & it is passed first through a hair sieve, and then through a cloth.

The Clothiers who do not need a very strong glue either, make it with skins of lambs, rabbits or hares.

When the glue is used without drying it in tablets, it is prone, as we said, to spoilage, when the weather is tempestuous. This accident may be prevented, if at the critical time, it is put on fire to cook it a little, taking care to skim off any scum which rises to the surface.

ARTICLE VI

On Fish-glue.

THIS Glue comes from Moscow; but writers on the subject do not agree on the fish species which provides it: almost all think that the Muscovites use the skin, the fins, the nervous & mucilaginous parts of various fish species; some say only

that the materials used do not include any bones, & that after having boiled the parts mentioned above to the consistency of a jelly, it is spread out into the thickness of a sheet of paper to make cakes or strings, such as one sees in the trade.

I believe that one can make a Glue by the process which I have just described; because a very weak glue is made while boiling Eel skins in water; I have even made one with skins & fins of fish: this could have been employed like parchment-glue, if it had been used while it was a jelly. I even managed to reduce it into a tablet; but it was very brown, & extremely difficult to dissolve in water: perhaps with precautions which I did not take, one could make it less defective; because it is said that one finds a Fish-glue in England & Holland, truly not very perfect, that are sold in small booklets. I did not see any; but I can assure you that the best Fish-glue, is completely different from what one sees in the Writers who have tried to tell us where it comes from.

As I have seen much uncertainty regarding the manner of making the best Fish-glue that is brought to us from Russia, I requested M. Muller, then Secretary of the Imperial Academy of Petersburg & Correspondent of the Academy of Science of Paris, to agree to get an exact Report to me on the manner of making the Fish-glue which comes us from Russia. This dedicated & skillful Correspondent having agreed to answer my invitations, I am in a position to comment at length on an object which is interesting for the Arts as well as for Natural History.

Several fish provide glue; but the *Sturgeon*, & the fish named *Sterled*, give the most beautiful. After this comes the glue from a fish named *Sevrjougá*, & lastly *Belouga*; & though that of this last fish is most common, it is adulterated by mixing it with several other more common fish, & these make it not as good.

All these Fish-glues are contained in the bladder which is filled with air: however a considerable mass of it is found adhering to the bones of the back: because the majority of the fish, in which this substance is found, are bony: however the Sturgeon which provides the best, is counted as one of the cartilaginous fish.

The glue is thus found along the back, & attached to a cartilaginous part which is specific to the fish called *Acipenser*⁵.

The front of the belly is filled with eggs or caviar: when the eggs are taken out, the bladder is detached, and then the *vesiga*, or the substance which provides the glue; it is so adherent to the back, that one must take pains to detach it: the part of the bladder attached to this substance is white, the part which touches the eggs is black.

⁵ In current taxonomy, *Acipenser* is the genus to which the sturgeon belongs.

The air bladder is not divided into two, as in other fish; it has the shape of a cone, whose base is near the head of the fish, & points towards the tail. After having withdrawn this bladder from the fish, it is put in water to clean off the blood with which it is often soiled; if it is clear, it is not necessary to wash it.

The bladder is opened with a knife along its length, & one tries to separate the glue from the external skin which is brown. With regard to the interior membrane, it is so fine & so white that it is quite difficult to remove it.

The glue is then wrapped in a fabric; it is manipulated & kneaded with the fingers, until it becomes soft like a paste, this is formed into small flat masses, like cakes, which are pierced in the middle and threaded on a cord, in order to let them to dry.

One can save the trouble of kneading it; for this the pieces of glue are piled up in the sun, & covered with a wet fabric; the heat of the sun softens them so much that they can be rolled on a board with the hands to make cylinders, the ends of which are joined together, forming rings through which a cord is passed, to dry them in a moderately hot place, but in the shade, because the sun would make the glue blister.

Those who make glue to sell it, avoid drying it too much, in order to preserve more weight in it; however when it is not well dried it spoils, & it is prone to be eaten by mites.

It can be seen that beautiful glue is made entirely in the fish, it is only a matter of removing the membranes which wrap it, the blood which dirties it, & then to dry it so that it is not spoiled. However one makes in Russia a cooked fish glue, which, when it is good resembles yellow amber: it comes from *Gouriefgorodox*, a small city located on the *Yaix*. It is not an object of trade; however its hardness makes it resistant to any corruption: here is how it is prepared.

One binds the upper opening tightly, or the broad end of the bladder, with a sewing thread; the other end does not need to be bound, being naturally closed. The bladders are cooked until the glue which is inside becomes completely liquid. Some run this liquid glue into wood or stone molds, which are given various forms; others let the glue cool in the bladders, & then they remove the membranes which wrap it.

In Germany this glue is called, *Mouth-glue*, because having tenderized it in the mouth, it can be used to glue paper sheets together.

I saw one of these bladders from a Sturgeon at M. de Jussieu's which had been brought to him from Bengal by M. Anquetil; it was 10 or 11 inches

long, at least 3 wide, & more than one half-inch thick.

In Paris, we ate fresh *Scheid*, which had been fished in the Danube; it had a mass of glue along its back which was transparent, delicate & good to eat. M. de Regemorte, former First Commissar of War, had sent it to me from Strasbourg, from whence it was transported in water, and fed with fish.

One can also extract it from Cod, as I will explain while speaking about the catching of this fish.

Fish-glue, to be well conditioned, must be white, clear, semi-transparent, dry, & without odor.

To dissolve it, it is divided into small pieces, by beating it with a hammer, & then cutting it with scissors. In this state, it can be melted in water by keeping it over a gentle heat, & stirring it up from time to time; it dissolves more promptly in wine, & still better in brandy; which is quite different from Strong-glue, which does not dissolve at all in spirit of wine. The Cabinetmakers & the Fan-makers use it to attach small delicate parts; but it is too expensive to employ for rough works.

When it was less expensive, it was used to clarify wine; one half-ounce of this dissolved glue in two pints of water, is enough to clarify two half-queues or a barrel of wine, Orleans measure.

Small Images of various colors are made of fish-glue, which have in the middle a small cartouche in false gold, on which there are various printed subjects. These Images are brought from Germany, & the Commissioners ensure that they are sent to them from Hamburg & Nuremberg, I am unaware of how they are done; in the Economic Dictionary one can find, under the word *Image*, some procedures, to give various colors to this glue. *

Fish glue is still used to gloss fabrics of silk, & especially ribbons. The Gauze-workers use it a great deal as well.

Here as in England one makes black taffeta coated with Fish glue, to put on cuts & small wounds. A piece of clear black taffeta is stretched on a small frame, & with a fine brush, it is given several coats of Fish glue, dissolved in eau-de-vie as I will say hereafter. For the last layer, so that the taffeta will have a pleasant odor, the glue is mixed with a little Commander's balm [*baume de commandeur*]. New layers should be applied only when those which were applied first are completely dry,

These small plasters stick to the skin with difficulty; they should not be moistened on the side with the glue, but on the side of the taffeta. Sometimes,

* See the Note at the bottom of the following page.

when the wound bleeds, one is obliged to fix them on the wound with a strip of linen; but once they are attached, they hold until the taffeta wears out: one can even wash one's hands without the plasters being detached,

To make this Glue one needs 2 ounces of fish-glue, reduced as described before in small pieces, this is soaked in 8 ounces of water in a hot place, stirring frequently, & finished by boiling the liquor: a bottle of eau-de-vie is added to it: as the liquor boils, it is skimmed; & finally, it is passed through a linen cloth.

In old Dispensaries, Fish glue is recommended for making plasters: to dissolve it, they say that it should be beaten, left to soften in vinegar, & boiled, after which is added common water, a little slaked lime, & it is used as hot as possible.

Now Fish-glue is used in the *diachylon*⁶; I do not know to what other uses it can be put in Medicine.

One reads in the *Secrets of Lémery*, in-12. Volume IV, page 114, that to take an impression from a medal with fish glue, it is necessary to take the medal, of whatever metal it be, lead or tin, melted on a silver or gold medal, rub it with oil, then wipe it with a linen cloth so that it is just a little greasy; soak fish glue in a glazed or glass pot for three days, then boil it until it has approximately the consistency of the glue used for wood: next it should be passed through a linen cloth; then around the greased medal, an edging of greasy earth is made, approximately one finger thick: this cup is filled with hot fish glue; it is protected from dust by covering it with a sheet of paper: when the glue is well dry, it is detached little-by-little from the medal, whose impression it preserves. I have carried out this process rather successfully; but in order that the relief of the glue-medal is apparent, it is good to put it on a colored ground.*

* I have just said that, knowing the process of Lémery, I managed to take impressions of Medals, but I have never been able to learn how to make these small images from Germany that one gives as reward to children. Having not been able to gather anything more precise, I will put a Note here which I draw from the great Vocabulary of François, Volume 14, under the word *Image*.

Images or Medals are made with the fish glue. For this effect take fish glue that is quite clean & quite clear; break it with a hammer; wash it in clear & fresh water; then in tepid water; take a new pot; put it in this pot; let it soak there in water over night; then boil gently for one hour, until it thickens; it will be sufficient if it makes a drop on a nail. That done, have your molds ready; put a rim around them with a cord or with cotton to retain the glue; rub to them with honey; pour the glue in, until the mold is entirely covered with it; expose it to the sun, the glue will equalize & dry; when it is quite dry, the image will detach from the hollow by itself, it will be thin like paper, or the thickness of a medal, according to the quantity of glue used to cover the mold. The most delicate features will be retained & the image will be glossy. If one desires it to be colored, the water in which the glue is boiled is tinted, either with Brazil wood, Pernambouc, or with Avignon seed, India wood &c. The water must be only lightly tinted, & the glue should not be too thick; the image will come out all the more beautiful.

⁶ An anti-inflammatory plaster containing mucilaginous substances. [Dictionnaire de L'Académie Française, 6th Edition (1832-5)]

ARTICLE VII.

On Flour-glue.

GOOD Glue is made with whole wheat flour: however it is claimed that it is stronger when rye flour is employed, & that it would be still better, if one were to use flour made from black wheat or buckwheat.

When one takes a slightly firm paste of whole wheat flour, & squeezes it continuously between the hands, under a small stream of water, keeping all the parts together so that the lump does not separate, it releases with this washing much white water, & it remains a ductile & elastic mass in the hands, which resembles a wet glove-skin; because it extends without tearing when a part is pulled between the fingers: it seems that by this operation the finest powder of the flour is withdrawn from the paste; & I am inclined to suspect that what remains in the hands after washing the paste, is formed of the portion of the grain, which the Bakers call *the Hulled grain*, which breaks with difficulty, & which remains in grains after the first grinding, like beaten rice, the more so as this hulled grain is a little transparent. I thus suspect that it is this hulled grain which provides the elastic part which remains in the hands when the paste is washed, that it is this part which is mainly used to give tenacity to flour-glue; according to this idea the finest powder which goes away while washing the paste, would be not very proper, by itself, for making good glue. To give some probability to this conjecture, I will note, 1°. that one cannot make good glue with the stray flour which the Millers collect in their mills with a feather duster, & this stray flour is a fine powder. 2°. that good glue is made with the starch taken in good part from hulled grain. 3°. that the elastic part taken from the washed paste, becomes very hard when it is dry: however I acknowledge that I could not dissolve the elastic substance in question perfectly in water.

In any event, to make good Flour-glue, it is necessary to start by forming a kind of soft paste in a kettle, by mixing the flour little-by-little with hot water, & stirring it up continuously with a wooden spoon, as if one wanted to make gruel: when it has thickened a bit, the kettle is put on the fire, & water is added in approximately equal amount to the volume of gruel. When it begins to steam, it must be stirred up continuously with the wooden spoon, & water should be added little-by-little as the glue thickens, because it must be well cooked: & more water is added than is evaporating, so that the glue is liquid. If it can be used while still hot, it can be extended much better than when it is cooled;

but by means of a small preparation, Playing card makers who need good glue, manage to extend it very well, even though it is cold: here is their method.

Into 40 parts of water are put 4 parts of good flour, sifted well, & a part & a half of starch; the whole in volume & not in weight.

The flour & the starch are diluted separately with tepid water by hand, until a clear gruel is made of it. These gruels are moved into a kettle where the water starts to boil; & the two gruels are stirred vigorously with the core of a broom, so that they are well mixed together; then the kettle is held at a simmer for 5 to 6 hours, until the glue takes on the smell of a well cooked gruel, & when one rubs some of the glue on his hands and presses them together, it is difficult to separate them. When it is in this state, one pours it in buckets *I L, Pl. I*, & as it cools it is stirred up with a spatula *H*; finally when it is cool, it is put little-by-little in a sieve of hair; & while turning it with a large brush of wild boar bristle, it is passed through the sieve. This operation makes it soft, & in a state to be used, even though cold.

The bars of sealing wax for letters are of true flour-glue, which has not fermented at all, and is dried between two iron plates.

Pure starch Glue is stronger than flour-glue; but it is also more expensive. The Quarrymen manage, by means of the mixture of these two substances, to make a good Glue which costs them less. I made a good glue for small works with starch & water lightly charged with gum Arabic.

One can also increase the strength of the Glue, by making it with starch & water, into which a little fish glue is dissolved.

It is roughly thus that the Hatters make the Glue which they call their *primer*. They put with 14 pounds of water 2 pounds of a gum called *of Paris*, a half-pound of gum Arabic, two pounds of good Strong-glue, & a half-pint of ox gall.

Gum Arabic by itself, melted in water, forms a liquor which sticks very neatly, & which is very easy to prepare: it is essential that there is not too much water, it must be slippery between the fingers; its defect when it is used alone, is that it is brittle. In the Merchants shops can be found both white & red; the latter which is cheaper, glues as well as the white, but not as neatly, & often some useless dregs settle out of it. The white gum is used by the Miniature Painters to give tenacity to their colors, without spoiling their vitality.

Gum Tragacanth which the Apothecaries use to make their pills can also enter into some formulations suitable for gluing.

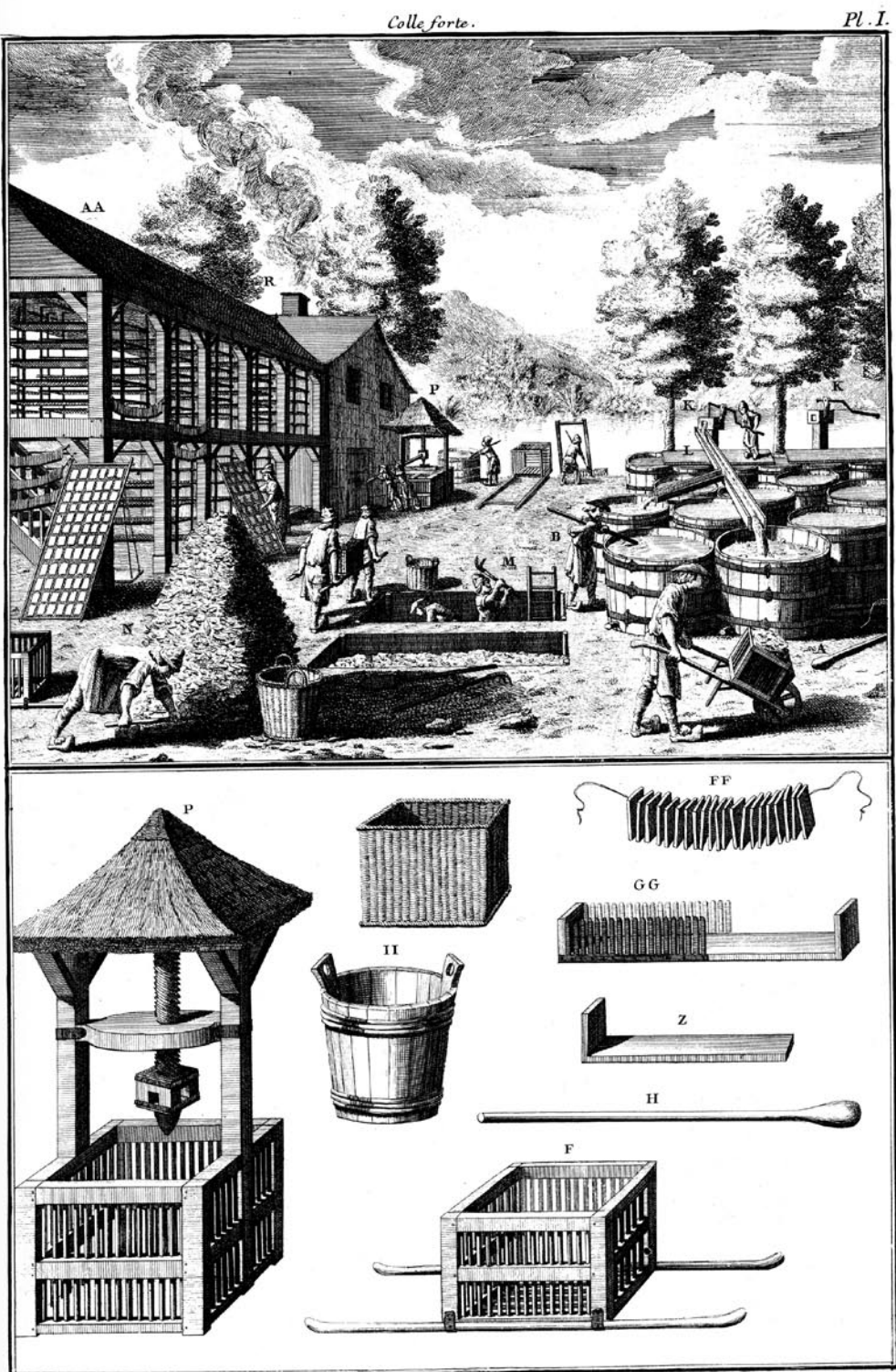
END.

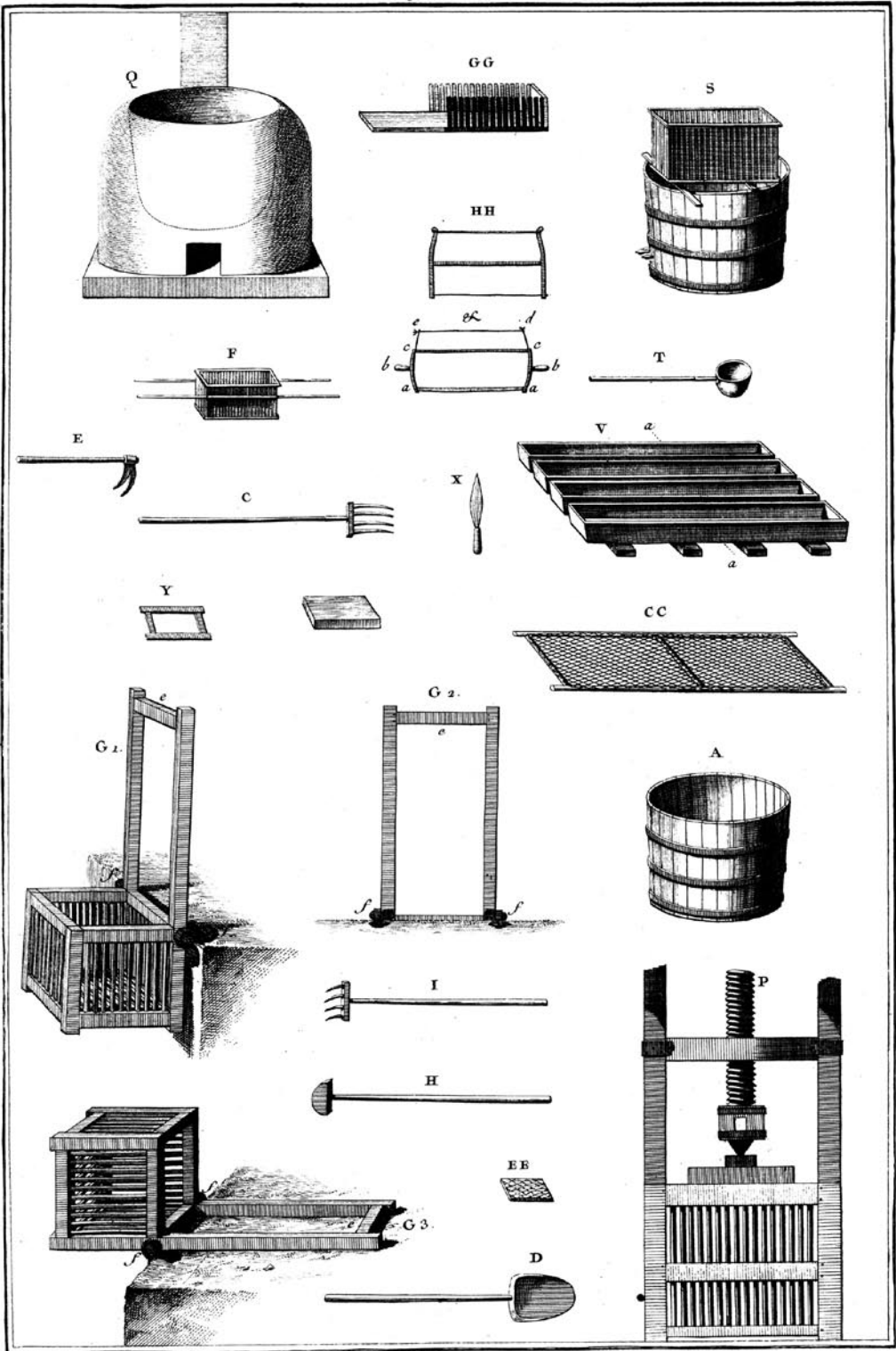
EXTRACT OF THE REGISTERS
OF THE ROYAL ACADEMY OF SCIENCES.

From February 6, 1771.

MESSRS MACQUER. & CADET, who had been named to examine the Description of *THE ART OF MAKING GLUE*, by M. DUHAMEL, having submitted their report, the Academy considered this Work to be worthy of printing; in witness whereof I signed this Certificate. In Paris, February 9, 1771.

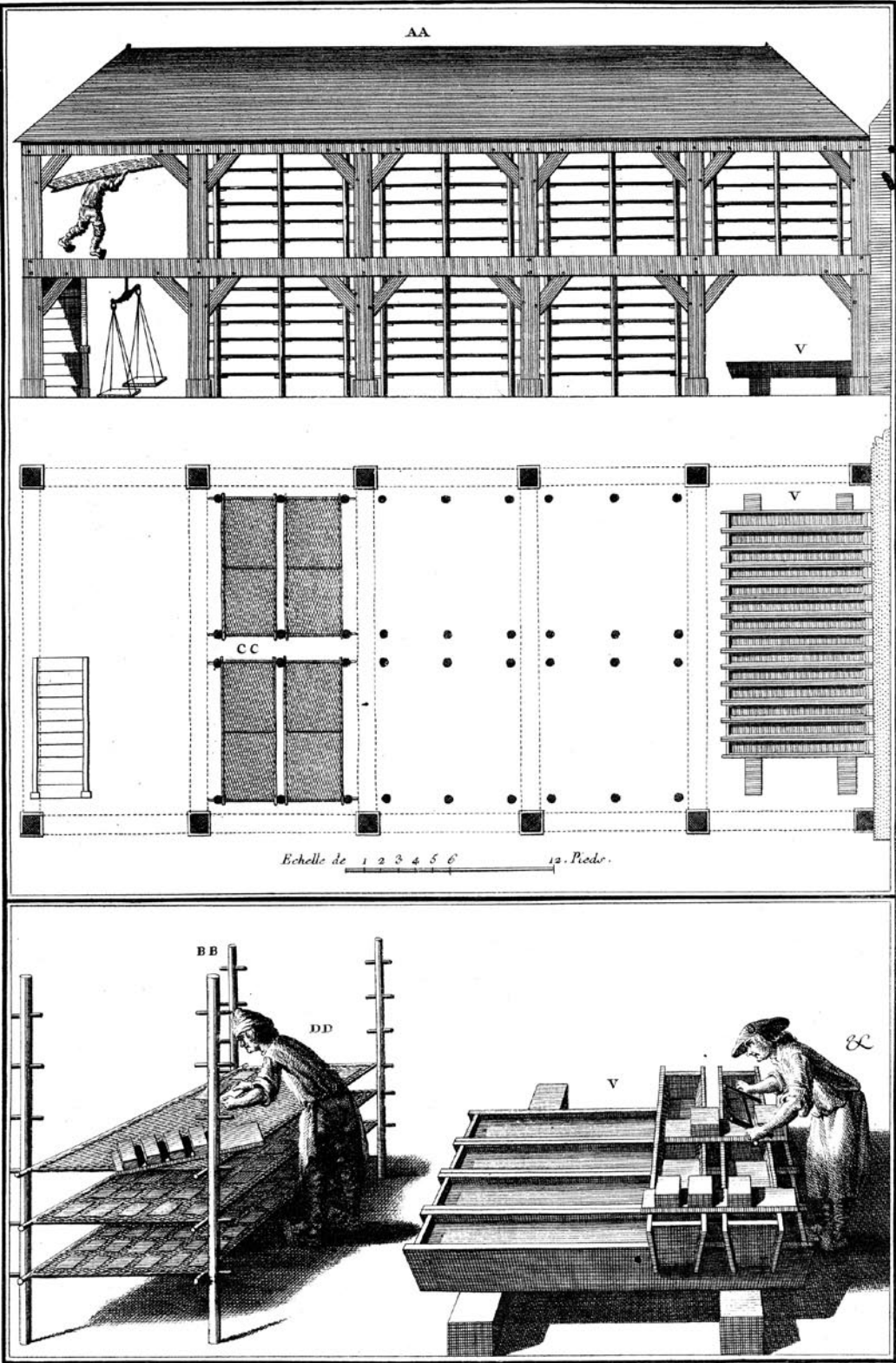
GRANDJEAN DE FOUCHY,
Eternal Secretary of the Royal Academy of Sciences.





Colle forte .

Pl. III.



Dessiné et Gravé par N. Rancornette .