This estimate gives the following prices per running foot for the various parts of the dam:

Navigable pass:	
Immovable part	$100 06
Movable part (trestles, needles, and accessories)	40 27
Total per running foot	140 33
Weir:	
Immovable part	70 88
Wickets and accessories	49 61
Foot-bridge	24 43
Total per running foot	144 92

These figures are not large, especially in view of the high lift of the dams to which these prices refer.

NAMUR, *June* 25, 1876.

THE METHOD OF MANEUVERING CHANOINE WICKETS.

By GEORGES LAVOLLÉE, *Engineer of Ponts-et-Chaussées, on duty in connection with the navigation of the Seine.*

The various maneuvers that must be performed at a movable dam on the Chanoine system are the following:

I. To raise a wicket which rests entirely on the floor.

II. To let down to the floor a wicket that is upright.

III. To maneuver a wicket while the dam is up so as thereby to regulate the level of the upper pool.

We will examine in succession into each of these operations, assuming that the various mechanisms of the wickets and of the apparatus are understood, although they may vary without causing any sensible change in the main operations to be performed.

I.—TO RAISE A WICKET.

This operation, which consists in raising a wicket that is lying on the floor, is performed by means of a windlass which is either placed on a maneuvering boat or on a foot-bridge constructed above the dam; in both cases the lockkeeper before beginning the operation must ascertain that the tripping-bar is in its proper place, *i. e.*, in the position for lowering the wickets; moreover he ought to work the tripping-bar to and fro so as to free its channel from sand or gravel that might be lodged between it and the floor.

A.—*By means of a windlass on a boat.*

The boat is placed at right angles to the current, the windlass being in the middle and a little aft, and at its bow is a leading-block.

Usually the boat is only fastened at the stern, but when the current is strong it should be fastened at both ends. It is held against the wickets already raised by means of an outrigger set according to the inclination of the wickets, and sufficiently immersed to press against the wickets either at or below the axis of rotation.

The leading-block must be in a line with the axis of the wicket to be raised.

The lockkeeper is provided with a boat-hook composed of an iron rod $1\frac{1}{8}$ inches in diameter and 8 feet long, fastened to a wooden handle 13 feet long and terminated by a hook, 2 feet above which there is a ring; to this ring is attached a rope about 50 feet long passing through the leading-block of the boat and winding around the drum of the windlass; it is with this boat-hook that the lockkeeper, standing at the bow of the boat, seizes the handle of the wicket. He casts the boat-hook, letting it slide through his hands in what he supposes to be the direction of the hollow of the wicket, so as to strike on the upper side of the handle. He holds the hook in such a manner that at the moment when the pole touches the handle of the wicket and is caught by it, he has only to turn the hook in order to engage the handle.

At this instant the lockkeeper orders the men at the windlass to turn, the wicket is pulled, the horse rises against the sill, and the prop finally presses against the hurter.

It is essential that while the wicket is being raised the boat-hooks should pull in the direction of the natural inclination of the wicket; if, on the other hand, the pull is too nearly vertical, the horse will stop before it touches the sill, and the foot of the prop before it reaches its hurter.

When this occurs there is nothing to be done but to move the boat further off; for that purpose one or two anchors are let go upstream, and the boat is moored to their cables. But when the bed of the river is sandy and the anchors slip, another method is resorted to. The wicket being as high as it will go, the windlass not being able to draw it any further, although the horse is not quite in place, the boat-hook holding the handle of the wicket is made fast to the boat; a second boat-hook is then taken and fastened to the rope of the windlas. With this the cap piece of the chase is seized, and the windlass being put in motion, the wicket is drawn directly forward, and the horse and prop assume their proper places.

It is important that the lockkeeper should thoroughly satisfy himself that the prop is against its hurter. To do this it is well to have a man below the dam in a skiff, who presses against the wicket a pole which he holds in his hand. The shock produced by the falling of the prop against its hurter becomes very sensible through the jar transmitted to the wicket, and thence to the pole pressing against it. Sometimes the lockkeeper trusts to his ear to catch the sound of the shock, but when there is a considerable depth of water and the current is strong this sound is often too feeble to be heard. The precaution which has just been indicated seems surer.

As soon as the man below the dam has felt the shock on the prop he notifies the lockkeeper, who orders the windlass to be stopped.

If no jar has been felt he endeavors by means of his boat-hook to get the prop into place opposite the hurter, either by sliding it along on the bed-plate or by lifting and putting it back in the slide, according as it has gone astray in the clear part of the hurter or has jumped over the guide-wall of the slide.

The preceding operations are all that are needed when the axis of rotation and the flutter-valves are so arranged that the wicket rights itself automatically under the action of the current; in this case it is only necessary to hold back the wicket so that it may not strike against the sill with violence.

When they are not thus arranged the pressure on the chase exceeds that on the breech, the excess increasing with the velocity of the current; it is then necessary to press down on the breech so as to help the wicket to right itself. Sometimes this pressure is not sufficient, and it becomes necessary simultaneously to pull on the chase, either by means of a boat-hook or with the help of a small windlass placed in the bow of the maneuvering boat.

Sometimes it happens, when a dam is being raised and there is only one wicket yet to be righted, that the current is so strong that neither men pulling on the chase nor a windlass can do the work. In such cases a screen is used, which rests against the adjacent wickets and extends down as far as the level of the axis of rotation; this screen stops the current, thereby lessening the load on the chase, whilst the pressure on the breech is not sensibly changed, and the wicket spontaneously rights itself.

B.—*By means of a windlass on a foot-bridge.*

The foot-bridge must first be raised; if it is supported by trestles of small dimensions, which may be handled by hand, the lockkeeper makes use of a boat-hook, of the necessary length, to the end of which a rope is fastened.

The lockkeeper throws the boat-hook towards the trestles which are lying down, and takes hold of the top of the one to be raised; his assistants then pull on the rope and assist him to raise the trestle. As soon as it is in a vertical position an assistant puts on the stopping-bar, then the two assembling bars, and then lays the floor plank as fast as the trestles are raised.

When the trestles are heavy it is necessary to use a windlass around which the rope of the boat-hook is wound; this windlass may be placed on that part of the foot-bridge already raised and made fast to the assembling-bars; however, when the current is not too strong, it appears easier and more convenient to put on a maneuvering boat moored at right angles to the current; the stern is pointed towards the still open portion of the dam, and the bow towards the shore whence the maneuver began; a leading-block is attached at the bow of the boat, and a snatch-block is fastened to the trestle last raised. The rope attached to the boat-hook passes first through the snatch-block, thence through the leading-block at the bow of the boat, and is finally wound around the drum of the windlass. The lockkeeper, standing at the stern of the boat, throws the boat-hook, seizes the top of the trestle to be raised, and orders the windlass men to wind in; the rest of the operation goes on as indicated above.

In all cases when the trestles are large it is better to use the boat-hook from a boat than from the top of a trestle, in order to lessen the length of the boat-hook.

As soon as the foot-bridge is raised the lockkeeper must place all the props against their hurters, which he can easily do by fastening the breech-chains of the wickets to the drum of the windlass and winding in on the latter.

An assistant, in a skiff below the dam, follows all the movements of the prop, and in case it gets out of line he puts it in place by means of a pole, as has already been described when a maneuvering boat is used.

When all the wickets are in place, that is to say, *on the swing*, the lockkeeper must immediately fasten the chase-chains in the chain-stops of the trestles, taking great care never to leave the wicket at its natural inclination, but to keep the chase 1 or 2 degrees above the horizontal; we shall see further on the necessity for this essential precaution.

To right a wicket, the windlass is placed immediately opposite, and the truck is fastened to the trestles by means of hooks; and for additional safety it is chained to the cap of the trestle.

Before the maneuver begins, the two chains are hanging in the chain-stops, on the lower uprights of the trestle. The breech-chain is now lifted from the stop, hauled taut, and wound backwards around the small drum of the windlass (the windlasses used on the dams of the Upper Seine are provided with two drums of different diameters but parallel axes, so arranged that they can be turned conjointly or separately). Attached to the large drum there is a piece of chain about 7 feet long, whose free end is provided with a device for holding chains, called a stopper. A link of the chase-chain is seized by this stopper, and then the crank of the windlass is turned. The breech-chain unwinds, whilst the chase-chain, without being taken out of the chain-stop of the trestle, is wound in, and the wicket straightens up into place.

The winding in backwards of the breech-chain of the windlass is a precaution which must never be neglected. The fact is that when a wicket is being righted, there comes a time when it has a strong tendency to right itself. At this moment the chase-chain which is transmitting the pull suddenly slackens; if the breech is not held back, the wicket swings with great velocity, and strikes the sill of the dam with a shock; this shock is injurious to the solidity of the structure. But there is a still greater danger to be feared. If the prop is not in place when the wicket automatically rights itself, or if the shock of the wicket against the sill is so great as to make the prop jump away from its hurter, the wicket, having lost its point of support, will quickly fall backwards; and the chase-chain, again tightened, will give to the windlass, by reason of its acquired velocity, a rotary motion impossible to check. The cranks fly out of the hands that are turning them, and if a man is leaning over the windlass he may be killed by the handles; such an accident has unfortunately occurred on the Yonne. It may be avoided by winding in backward the breech-chain, so that it will oppose the simultaneous unwinding of both chains, and by the lockkeeper taking care to keep clear of the revolutions of the cranks.

For the same reason, the chase-chain should not be taken out of the chain-stop on the trestles, in order that the shock may rather be sustained by the trestle than by the windlass.

It is also with a view to prevent the props from falling back on the floor that we have recommended that the wicket be held at an angle of 1 or 2 degrees with the horizontal, for in this position the prop has to sustain a thrust which prevents it from slipping out, and which it would not sustain were the wicket to lie parallel to the current in the position of equilibrium which it tends to assume.

If the fall is so great while a wicket is being maneuvered as to cause fears of the breakage of the windlass or of its fastenings to the trestle, it will be well to vary the inclination of the wicket little by little and successively, as we shall indicate further on in the directions for regulating the level of the upper pool.

II.—TO LOWER A WICKET.

When the dam is provided with a tripping-bar, the lockkeeper has only to turn the apparatus until all the wickets are lowered on the floor. Immediately after this operation the lockkeeper must move the tripping-bar back to its initial position in readiness for a repetition of the maneuver after the wickets have again been raised.

Should an accident happen to the pinion, should a foreign body be lodged between the floor and the tripping-bar and stop it from working, and, lastly, should the dam not be provided with a tripping-bar, then we must act directly on the prop in order to move it from its hurter.

If there is no foot-bridge the maneuvering boat is placed about 22 feet above the wickets to be lowered and parallel to the current. An assistant with the boat-hook used for raising the wickets (which we have already described) seizes the wicket by the chase and pulls it up-stream so as to take the pressure off the prop. Another assistant in a skiff, which is tied to the maneuvering boat, uses a boat-hook and a pole to displace the prop from its hurter.

When there is a foot-bridge the chase-chain is made fast to the drum of the windlass, and the wicket is slightly drawn up-stream, then the prop may be lifted out by means of a bent boat-hook handled from the foot-bridge, or by a pike-pole in the hands of a man in a skiff below the dam.

As soon as all the wickets are lowered on the floor the trestles of the foot-bridge are dropped. To do this the planks of the first bay are taken up and the claw-bar is placed between the first two trestles; then the two assembling-bars are removed, and thus the first trestle is isolated, and it falls on the floor when the claw-bar is taken out. The same maneuver is repeated on each successive trestle until the whole foot-bridge is taken down.

If the trestles are large they must not be allowed to fall too abruptly, but must be held back with a rope.

III.—TO MANEUVER A WICKET SO AS TO REGULATE THE UPPER POOL.

When the dam is up the ordinary maneuvers consist in righting one or more swung-wickets in order to raise the level in the pool above, or in swinging one or more wickets in order to lower the level. These maneuvers are always performed by means of a windlass traveling on a foot-bridge.

A certain latitude should always be allowed to lockkeepers, as their methods of operating depend largely on circumstances and on individual peculiarities. There are, however, several principles from which they should not depart. Some of them have already been mentioned, but it is well to group them here. These instructions were given to the lockkeepers on the Upper Seine by Chief-Engineer Boulé.

In maneuvering a wicket the lockkeeper must always bear in mind that the prop may slip away from the hurter, and in that case, if the fall be great, the chain upon which he is pulling will experience an enormous tension, which is capable of breaking the windlass or the chains at a time when it is least expected.

In order to avoid accidents—

1st. Always keep clear of the circle of the windlass cranks.

2d. In swinging a wicket never let it pass the horizontal position. The chase must be kept at 1 or 2 degrees above this position by suitably fastening the chase-chain in the chain-stop of the trestle. The same precaution is indispensable when raising a wicket.

3d. When a wicket is maneuvered by means of a windlass, the dam being up, the inclination of this wicket must only be changed little by little and successively. The two chains (of the chase and the breech) must remain fastened in the chain-stops of the trestles, one of them having only a little slack, the other being necessarily taut. The taut chain must be acted upon by means of a piece of chain fastened to the windlass and terminated by a stopper, with which the wicket chain is held.

In this way only a small motion will be given to the wicket, and immediately afterward the chains will be lifted and fastened to the trestle by other links, and the operation will be repeated.

By taking this course the work will be slow and more fatiguing to the lockkeeper than a more expeditious method, but he avoids all danger, for if the prop slips out, or a crank should break, or a chain, or the ratchet, or the hook that fastens the windlass to the trestles, there will be but a slight movement, after which the shock will be transmitted to the chain-stops of the trestles.

PARIS, *May* 7, 1879.

DESCRIPTION OF A SYSTEM OF MOVABLE DAMS WITH ELEVATED BRIDGE AND DOUBLE WICKETS.

By M. PASQUEAU, *Engineer of Ponts-et-Chaussées.*

Chief Engineer Tavernier invented and fully elaborated a new kind of movable dam, based on the following principles:

Two iron bridges, each composed of 4 trusses, were placed on a series of piers, 46 feet high, measured from the floor of the dam. Webbed posts about 2 feet 8 inches wide and 46 feet long, made of 2 vertical beams of double T-iron 1 foot wide, were hinged to a series of axes placed under the lower bridge, and they could be raised into a horizontal position under the bottoms of the two bridges. Each webbed post supported a shutter 14 feet 9 inches high and 4 feet 11 inches wide, which was provided with rollers, by means of which it rolled on the angle-irons of the beam like a small wagon.

To close the dam the webbed posts were let down, and then the shutters were lowered by putting in motion endless chains placed for this purpose between the posts. The dam, with elevated bridge, occupied the whole width of the river, and when it was opened navigation passed under the bridges, which, for this reason, had to be raised to the height of 23 feet above navigable high-water.

The ruling idea of this system, which is entirely original, is very ingenious, and very favorable to the improvement of rivers that have a steep slope, for the reason that the dam, when open, leaves the sill without any parts that will prevent the free passage of gravel during floods.

The method bequeathed to us by M. Tavernier has, however, serious inconveniences, which will lead to certain failure if carried into practice without modification.

1st. The maintenance of a pool at a fixed level is managed at the bottom of the dam. This would give rise to currents along the bed of the river that no riprap work could withstand.

2d. The force necessary to raise a shutter against which a depth of water 14 feet 9 inches is pressing would be enormous in spite of the rollers, and the time required to open the dam would be considerable.

3d. The iron of the bridges, which is distributed among eight trusses, and the iron of the beams, which is distributed among two uprights to the linear meter, are so divided that the bridges and the webbed posts would bend and twist in every direction, although they have cross-sections that are theoretically sufficient. The beams, which are isolated, and are 46 feet long and 1 foot wide, are notably incapable of supporting a heavy strain.

4th. The cost, notwithstanding the evident lack of strength, amounts to more than $750 per running foot, and would amount to at least $920 per running foot, if the different members were merely sufficiently strengthened to make it possible to use them.

SYSTEM PROPOSED.

In endeavoring to get rid of these inconveniences we have studied out a new system, which has been developed from the one which precedes, but which differs from it in the following points:

1st. The bridge, instead of spanning the whole width of the river, with a height of 46 feet under the trusses, only covers a part of this width, and has only a height of 33 feet under the trusses, which height is sufficient for the greatest floods. The rest of the width is closed by a weir, whose sill, placed $6\frac{1}{2}$ feet above that of the deep pass, is furnished with Chanoine wickets, or ordinary trestles and needles. Up to a depth of 13 feet on the lower sill, steam navigation finds 20 feet of head-room under the trusses over the deep pass, and at a greater depth it finds $6\frac{1}{2}$ feet of water on the weir, which is entirely uncovered.

This "division of the river into two passes," one being deep and spanned by a bridge, and the other at a high level but uncovered, has enabled us to make the beams 14 feet shorter, and to notably reduce the total cost by limiting to the deep pass the use of the more expensive system.

2d. The vertical webbed posts 46 feet long and 2 feet 8 inches wide are replaced by frames 13 feet $1\frac{1}{2}$ inches wide, divided into 3 sections by two intermediate uprights. This "grouping of the wickets" reduces by one-half the number of the beams, and transforms the webbed posts into veritable lift-bridges, which are strongly braced, and which can swing with the greatest regularity around the upper axes without swaying or transversal flexure of the beams. The dimensions adopted for the frames, and the spreading out of the ribs of the bridge, have enabled us to distribute uniformly the strains on the bridge, and to place the plumber-blocks on the cap pieces of the frames at the points of application of the two resultants of the strains developed by the four uprights.

The interval of 3 feet $7\frac{1}{2}$ inches between each pair of beams is closed by "two superposed swinging wickets." Each is provided with a chain, which is fastened to the middle of the breech-sill, and passes thence to chain nippers attached to the bridge, being guided by a pulley on the under side of the bridge. The chain of the lower wickets passes through a pulley with adjustable boxing, which is fastened to the upper wicket; the boxing is kept constantly normal to this chain by the pull of the chain of the upper wicket. In consequence of this arrangement the whole line of upper wickets can be opened in succession, and then the line of lower wickets can be opened when the fall has been lessened, or the pass can be closed by reversing the operation. An angle-iron fixed to the uprights prevents the wickets from swinging below the horizontal, and hence in order to close the wickets successively it is only necessary to let go the two chains in succession. The division of the whole height into two parts that can be opened separately does away with the danger of scour by keeping a cushion of water under the overflow caused by opening the upper wickets.

As the axis of rotation of each wicket can be brought very close to the center of pressure, but little power is required for maneuvering, and it can be done very rapidly. Moreover, it can all be done from the top of the bridge, even when the wickets are many meters under water, which is a very valuable advantage at La Mulatière, where the floods of the Rhone will always in a few hours drown out the dam from below before the discharge of the Saône is sufficient to permit the successive and partial opening of the deep pass.

4th. The uprights, the wickets, their chain, and the beams of the bridge form an "articulated parallelogram," whose upper side is horizontal and invariable. It follows from this that the wickets remain "horizontal" in all positions of the frame, when the latter is raised after the wickets are swung open. The wickets, therefore, always present their edges to the current, and they fall "spontaneously" into place on the frames when the latter are fully brought up against the under side of the bridge. In the project the parallelogram is somewhat distorted, in order to simplify the construction, and to give a slight depression to the breeches in order to guard against the accidental overturning of the wicket.

5th. The two independent eight-truss bridges of the Tavernier system are replaced by a single bridge with "three trusses." This arrangement permits a concentration of the total weight of iron, a reduction of the lengths of the piers, and it secures a greater resistance to torsion by permitting the use of strong vertical bracing. Bottom horizontal bracing is inserted between the two lower trusses, consisting of solid web posts 20 inches wide, and diagonals of the same type. They form, in connection with the lower chords of the vertical trusses, a strong "horizontal truss," capable of resisting very considerable pressures in the horizontal direction of the thrust of the water.

6th. The axis of rotation is placed not under the axis of the bridge, but in a lateral position on the down-stream side, which enables us to resist the torsional effort by opposing the moment of the thrust of the water to the moment of the weight of the uprights, or, in other words, by causing the resultant of the forces that act on the bridge to pass near the center of figure of the transverse section. Moreover, this arrangement reduces the length of the piers, and the volume of the part of the dam that must be lifted.

7th. The uprights, instead of being vertical, as in the Tavernier system, are inclined, with the double object of increasing the stability of the floor of the pass and of permitting the uprights to arrive at the hurters without shock and by their own weight, in spite of the resistance due to the weight of the maneuvering chains. The continuous sill of the Tavernier system has been replaced by isolated hurters of cast iron, in order to stop the sanding of the sill, and to provide more fully for the passage of gravel in rivers with steep slopes.

8th. The maximum stress on the iron does not exceed at any point 8,500 pounds per square inch. The force to be applied to the cranks does not exceed 44 pounds per man.

9th. A preliminary estimate and a detailed estimate, made with all the care required for a definite plan, show that the cost for two deep passes, giving a total clear opening of 184 feet, does not exceed $85,500, in which is included $12,630 for contingencies.

The total cost per running foot does not, therefore, exceed $465, which is only one-half of the $930 per running foot which would be the cost of the plan of Chief Engineer Tavernier.

In order to open the dam the upper wickets of the deep pass are opened first, then the ordinary Chanoine wickets of the high pass, then the lower wickets of the deep pass, and lastly the frames are raised up to the under side of the bridge. In order to effect a closing the frames are first lowered, keeping the upper and lower wickets open. The ordinary wickets of the high pass are then raised, and lastly the lower and the upper wickets of the deep pass are shut by successively easing off on their maneuvering chains. We thus always maneuver under light pressures the parts whose dimensions are relatively weak.

This new system of movable dam has the following advantages:

1st. The sill is completely free for the passage of gravel during floods, a very valuable property in the improvement of rivers with steep slopes.

2d. The height of the pool above the sill, which, in the accompanying drawings, has already been placed at 14 feet 9 inches, can easily be increased to 19 feet 8 inches; and yet the wickets need only have a height of 10 feet, like those which are now in successful operation on a great number of dams.

3d. All the maneuvers can be effected from the top of an insubmersible bridge, which is a very useful advantage for dams at mouths of rivers or near confluents which, like the Mulatière Dam, are exposed to be constantly drowned out from below during high tides or floods of the main river.

4th. It can be opened and closed in a few hours by omitting to raise the frames, a maneuver which will very seldom be necessary.

5th. The construction is easy, for all the parts can be put together outside of the coffer-dams.

6th. Repairs and examinations are both simple and inexpensive, for they can be made during high-water and entirely in the open air.

7th. Dead animals and other foul floating matter can, as in the Chanoine system, pass freely over the dam in the overflowing current, which always runs over the wickets, whether they are open or shut. This property is an indispensable one at La Mulatière in order to assure the necessary sanitary conditions in the harbor of Lyons.

8th. The line of the tops of the wickets forms, as in the Chanoine system, a surface overflow that within certain limits automatically regulates the level of the pool.

9th. The upper wickets can be rendered automatic by a suitable lowering of their axes, as has been done with the Chanoine wickets on the weirs of the Upper Seine, which swing spontaneously when the pool rises much above its normal level.

10th. In rivers of small discharge this dam can be made as water-tight as may be desired by providing the right-hand upright of each frame with a joint-cover of plate iron which will rest on the left-hand upright of the adjoining frame, and by making a similar arrangement for the joints between the wickets and the frames, a combination that cannot be used with ordinary Chanoine wickets on account of the movements which must be made by them.

11th. The overflow caused by the opening of the upper wickets is received on a mattress of water 8 feet deep, this being the height of the lower wickets, and the water that flows over these wickets when they are open has a tendency to neutralize the force of the horizontal discharge from under them. The amount of scour below the dam will, therefore, be relatively very small.

12th. The discharge due to the opening of the upper wickets causes the mass of water to take the direction of the channel, and it tends to prevent deposits of sand in this channel during the times when the dam is up.

Our system, in brief, is a weir with Chanoine wickets placed on top of a movable sill of the same height, and which with its sill can disappear at any moment in order to give an opening of double depth, which provides for the passage of gravel by having a fixed sill perfectly free from any obstruction. Consequently this system has the benefit of all the new advantages of the Tavernier system, of some special advantages which have been indicated above, and of all those of the Chanoine system, which latter have been practically demonstrated by important constructions on the Seine, the Marne, the Yonne, the Saône, the Meuse, and other rivers.

In the project above described, some have criticised the lateral strain which seems to be caused by the method of connecting the uprights with the bridge, and the permanent tension on the chains of the wickets when the latter are open. These objections have little weight, as we could demonstrate by going into details that are incompatible with this brief description. However, in order to reply to them, we have worked out a modification which has not yet been lithographed. The downstream girder of the bridge, instead of being single, is formed of two twin girders with a common wall-plate. The plumber-blocks are shaped like the keyed heads of connecting-rods, and they are fastened under the bottom of the bridge by means of very wide shoes, with the view of regaining in part the considerable resistance which our original arrangement offered to the horizontal pressure of the water. The wickets, instead of being stopped when they attain the horizontal, continue to swing until they arrive at the angle of 15°, which arrangement guarantees the full swing, and stops the tension on the breech-chains. The righting of the wickets in this case is not spontaneous, and is effected by pushing from the top of the bridge on the breech with a boat-hook, or by pulling on a chain attached to the chase. During the movement of the frames the wickets remain at rest on their angle-iron stops, maintaining a constant angle with the uprights. A wide surface is exposed to the current, but the resulting pressure, having always a vertical component from below upwards, has the effect of facilitating and not of hindering the raising of the frames. The cost is increased, without, however, exceeding $492 per linear foot of free opening, in which is included the cost of the piers and the abutments.

Lastly, the objection has been raised that, as the regulation of the level of the pool is obtained by wholly throwing down one or more wickets, it is not practicable to regulate this level with exactness. This objection is valueless at Lyons, where the pool is not bordered by meadows at the level of the water surface, but by insubmersible quays, rising to an elevation more than 26 feet higher. Furthermore, the objection is not sound, because the level of the pool can be regulated as exactly as may be wished by combining the total lowering of one or several upper wickets with suitable maneuvers of the needles of the weir (which forms part of the dam, and is 328 feet long), or by keeping the upper wickets on a partial swing, as is done without any inconvenience with the chained wickets of the weirs on the Upper Seine.

LYONS, *May* 15, 1877.

THE CURTAIN-DAM OF M. CAMÉRÉ, INGÉNIEUR DES PONTS-ET-CHAUSSÉES.

[Translated from a French newspaper.]

CIVIL ENGINEERING AT THE UNIVERSAL EXPOSITION.—THE DIFFERENT KINDS OF DAMS FOR HIGH LIFTS.—THE APPARATUS OF M. CAMÉRÉ APPLIED TO THE DAM AT POSES.

It has been officially decided that the draught of water in our rivers shall be increased. But, as this journal has pointed out, this result can only be obtained on the Seine below Paris by the use of dams.

On the other hand, the methods of making dams hitherto in use will