

if they can be related to details of design and construction. Very little research of this nature has emerged so far.

As a result, we must admit that the desire to hear how historical music or instruments sound cannot be seriously justified in terms of increasing our objective knowledge of music history. That desire is mainly confined to developing a subjective relationship with that history.

In early times, music performers were the least respectable of music professionals. The most respectable were music theoreticians who explored the universality of the musical intervals in all aspects of our physical and spiritual existence. No-one thought of actually trying to hear what the music of the spheres sounded like. They were not concerned with themselves enjoying the sounds, but they enjoyed the idea that music was a unifying factor in understanding the world and the universe.

We can enjoy our objective knowledge of music history without being influenced by enjoying or not enjoying hearing what it really sounded like. Good history books don't include CDs. What is on offer from the modern early-music movement is not what it really sounded like, but interpretations thoroughly infused with modern professional performance practices, adapted for the enjoyment of modern audiences. It is rather like tourism, and makes the same compromises with authenticity.

What the music really sounded like is a very legitimate subject for music scholarship. The practitioners have so far been much more interested in having an impact on the musical public than in pursuing this subject objectively. Thus they make the practical compromise of assuming that modern performance aesthetics is essentially the same as that aesthetics centuries ago, deliberately ignoring clear evidence otherwise. Perhaps future generations will be more devoted to uncompromised historical scholarship than to perform a service to the contemporary public, and so will be able to study this subject properly. Till then, it seems to be appropriate to avoid the issue and just enjoy hearing the sounds we like and ignoring those we don't, and be careful about claiming that discovering what the original music sounded like is the purpose of our scholarship.

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Arnaut's *clavisimbalum* Mechanisms

## Introduction

Despite the fact that a facsimilie edition of Arnaut's treatise, with a translation of the Latin into French, has been available since 1932, there is relatively little literature on the four types of action which Arnaut describes as suitable for inclusion in the *clavisimbalum*. It is the second mechanism which has attracted least attention, but has been discussed by Clutton, Lester, Pollens, and Kaufmann.<sup>1</sup> I believe that Lester has described correctly all the essential details of actions 1, 3, and 4 (with photos of models of the action types), but as he says himself, action no. 2 is difficult to interpret. Clutton, Lester, and Le Cerf and Labande did not incorporate the spring in their description of the second action, so their solutions are incomplete. Pollens, whose book was devoted to the piano, concentrated his attention on the fourth mechanism (which is evidently of the striking type), thus his description, which correctly lists all the features of the second action, is extremely brief. There is, therefore, a useful purpose to be served in considering the second action in further detail.

## The text

Lester, and more recently Pollens, have translated the Latin into English, but I shall start with a fresh translation since there are several points of difficulty. I have intentionally used a literal translation to preserve the "telegraphic" style of the original and to avoid conveying a possibly misleading impression of a clear, unambiguous text. Thus, my text will be found to be vaguer in places than Le Cerf and Labande, Lester, and Pollens. Some of Arnaut's Latin is grammatically wrong and one must interpret his intended meaning from the context, but these faults are not serious enough to warrant detailed consideration here.

On fol 128r<sup>o</sup> Arnaut gives a drawing of the four types of action and describes them in notes alongside the sketches. My translation of the Latin text is as follows:<sup>2</sup>

<sup>1</sup>Le Cerf, G. and Labande, E.-R., *Les Traités d'Henri-Arnaut de Zwolle et de divers anonymes*, (Paris, 1932; reprint with comments by Lesure, F., *Documenta Musica*, 2nd series, IV, (Kassel, 1972)).  
<sup>2</sup>Clutton, C., 'Arnaut's MS', *Galpin Society Journal* 5 (1952), pp. 3-8. Lester, J., 'The Musical Mechanisms of Arnaut de Zwolle', *English Harpsichord Magazine* 3 (Oct 1982), pp. 35-41. Pollens, S., *The Early Pianoforte* (Cambridge, 1995), pp. 9-15. Kaufmann, K., and M., 'Le Clavecin d'Arnaut de Zwolle', *Bulletin du Groupe d'Acoustique Musicale* no. 54 (Feb 1971), p. II. Pollens and Kaufmann give no drawing of the action.

<sup>3</sup>fol 128 r<sup>o</sup> is reproduced full size as plate VI in Le Cerf and Labande. The Latin text appears on pp. 3-5.

Modus iste forpicum est cum coram formato quasi ad formam trianguli, et in cauda habet duo foramina quorum superius habet pectiam unam latoniam rigidam sibi affixam per modum parve cathene, ad deprimendum e converso caput forpici post ictum. Foramen vero inferius habet quendam cethenam affixam clavi per quam clavis, ipsum forpiceum trahens, percussit cordam: et in isto modo oportet quod clavus sint longe et quod extendantur quasi usque ad A, et tunc etiam oportet quod ibi claves bituminentur simul, sicut fit in portativis, propter eorum longitudinem.

There is another section (following the description of the fourth action) where some additional detail is given about parts of the second and third actions, as follows<sup>4</sup>:

Nota quod isti ultimi duo modi forpicum situantur fixe in quodam asere secundum latitudinem ipsius pennae, ita quod quando deponitur asser, cum ipso immobiliter deponantur isti forpices, et in secundo modo forpicum resiliens est sursum per modum stricte laminae; sed in tertio modo resiliens fit de filo ferreo vel latonico, et ejus pes figuratur in asere prope pedem forpici, et ejus cauda transit retro caudam sub illa dupluciate in qua est foramen, ut e converso deprimat caput forpici.

## The Mechanism

Thus, the basic elements of the action can be understood (refer to the drawing below): playing the key pulls the player's end of the forpex down, thereby causes the "head" of the forpex to rise, which carries the "horn" [cornu] and sets the string in motion, probably by plucking it.

The word Arnaut uses to describe the first three mechanisms is *forpex* which is a corruption of *forfex*, meaning fire tongs; perhaps the pivoting part of the three mechanisms may have suggested fire tongs, more in an analogical way of thinking rather than in any literal sense. *Forpicum* is the genitive plural; *forpices*, nominative plural. It could be misleading to translate *forpex* as "jack" since this has a special connotation for us, knowing as we do about the 16th-century and later forms of plucking mechanisms, and "mechanism" is too vague. "Pivoting lever" would be the nearest correct translation for *forpex*, but

<sup>4</sup>this is also on fol 128r<sup>o</sup> and appears in Le Cerf and Labande's translation on p. 6.

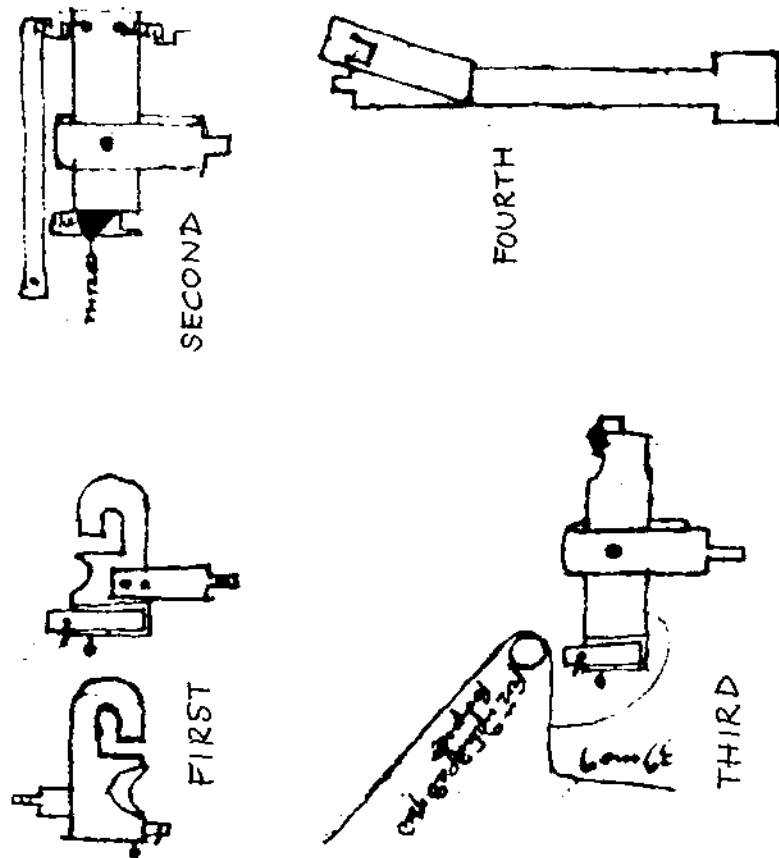
This system of *forpex* is with a "horn" [cornu] made more or less in the form of a triangle and in the end [of the lever] has two holes of which the upper one has a rigid piece of brass which is attached to it by means of a small chain in order to depress [the far end of the lever] and to turn the head of the *forpex* around after the pluck/strike. However the lower hole has a certain chain fixed to the key, by means of which, the key dragging the said *forpex* strikes the string; and in this system it is advantageous if the keys are long and those are extended almost as far as A, and then it is advantageous when the keys are glued [with bitumen] as one does in portatives on account of their length.

Note that these last two sorts of *forpex* [i.e. the second and third types] are fixed firmly in a lathe which has the width of the entire action so that when one presses down this lathe [i.e. installs it] then at the same time the *forpex* is depressed [installed]. And in the second type of *forpex* the spring is above in the form of a narrow leaf spring, however in the third system the spring is made of iron wire or brass wire and that foot [of the spring] is fixed in the lathe beside the foot of the *forpex* and that end goes backwards through to the end [of the *forpex*] under the *dupluciate* [vertical fork] in which there is a hole, and turns around the head of the *forpex*, depressing it.

plucking mechanisms, and "mechanism" is too vague. "Pivoting lever" would be the nearest correct translation for *forpex*, but I have left it untranslated.

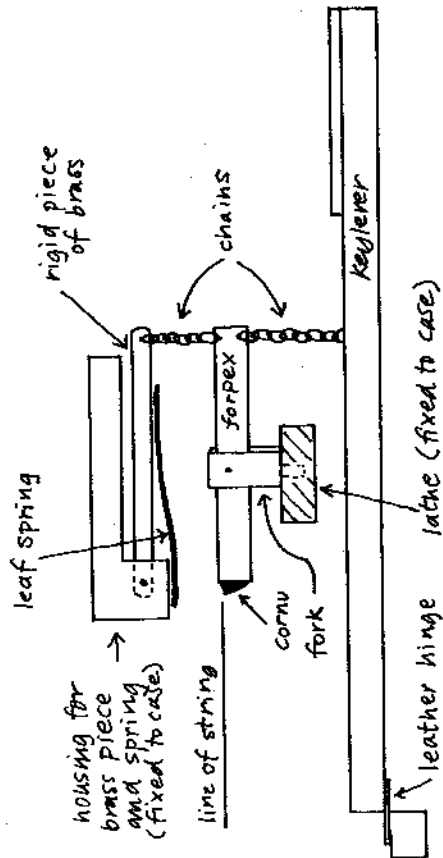
The second and third actions share one basic feature: a horizontal part is free to swing on an axle, which axle is held in a vertical forked part, the construction of which is apparently identical for both of these actions. Arnaut's sketches show this quite clearly, and the vertical part is made apparently with a sort of pointed "foot" which can be anchored. The Latin word for this vertical piece is *duplicitate*, literally "doubled"; this name, and the sketch, strongly suggest that this piece is made of sheet metal and folded over so as to hold the swinging part between its two sides. Pollens notes the resemblance of the *Kapsel* of Viennese piano actions to this part<sup>5</sup>.

Arnaut's sketches of the four actions



<sup>5</sup>Pollens, op. cit. p. 14.

Interpretation of Arnaut's second action



It is clear that there is a chain connected from the keylever to the "end [cauda] of the *forpex* [i.e. of the pivoting part]". It is also clear that at the same end there is another chain connecting the "end of the *forpex*" to a brass rod. It is apparent that the front of the keylever must pull the "end [nearest the player] of the *forpex*" down for any motion to be imparted. Given this, it follows that the vertical forked part (*duplicitate*) which holds the mechanism must be fixed to something immovable. This would have to be a rail attached to the case, and is only described by Arnaut in the second piece of text. The *duplicitate* cannot be fixed to the moving keylever, as Clutton has drawn it. We learn (in the second piece of text) that all the *duplicitate* are mounted on this lathes so that the pivoting *forpex* can all be removed in one operation. This description of the simple removal of the *forpices* neglects to mention that they are connected by chains to both the keylevers and the pieces of rigid brass/spring assembly. Thus, removal would require disconnection of all these parts from each other.

Arnaut tells us in the second piece of text translated above that the spring in the second system is mounted above the action. It is a significant omission that in their realisations of the action neither Clutton's diagram nor Lester's photo incorporate this spring. Le Cerf and Labande do not describe what the spring did in their action, if indeed it was incorporated.

However, the spring which is mentioned by Arnaut is above the action, and since it was a leaf spring it would either have borne down on the "head" of the mechanism in order to return the action

It appears from the sketch as if the non-chain end of the "piece of rigid brass" is furnished with some sort of axle. Given this clue we can see that the brass rod or lever was probably intended to swing up and down. The leaf spring would have to have borne upwards on this lever (at the chain end) to return it to its rest position, and thereby have pulled the keylever up.

It is possible, perhaps even probable, that the rigid piece of brass Arnaut has sketched is in fact the flat brass spring since there is no necessity to have a moving brass lever returned by a spring when the chain could be attached directly to the brass spring and achieve exactly the same result more simply. That the spring for the third action has been shown on the sketch might be confirmation of this interpretation, but my sketch of the action above shows a rigid piece of brass and the spring.

A box-like structure above the wrestplank, just as is apparently shown in some of the surviving representations, would be necessary to provide a point of anchorage for the pivoting end of the brass rod/lever and/or for anchoring the leaf spring. It is interesting to note that of the mechanisms described by Arnaut, only the second type requires any sort of rail above the plucking mechanism. I have shown a housing for the rigid piece of brass and spring. The action could be stopped by a pad between the rigid piece of brass and the housing, or by a pad between the keylever and latha. For simplicity I have omitted the wrestplank.

It now seems clear enough that this second system involves a rocking member [the *forpex*] similar to system three. The spring is essential to returning the system to rest, and it is evident that the player has to overcome the resistance of the spring in order that the action be put into motion. There would also be additional resistance of exciting the string; as a result, this system appears to have a fairly heavy action. One wonders why clanking chains were preferred to the rigid rods of a (potentially quieter) tracker action.

One detail Arnaut provides us with is obscure: it is said that it is advantageous if the keys are long, and the point A is suggested. The line A-Y is level with the cheek-bent-side corner and parallel to the case front. There is no advantage to having the keylevers this long if they merely pivot in the fashion of a normal harpsichord. The conclusion adopted by all the commentators that the keylevers are hinged at the far end (in the manner of portatives) seems correct; this view takes Arnaut's suggestion of "Claves bituminentur" to mean that leather or parchment hinges are glued at the far end of the keylever.

#### The excitation of the string

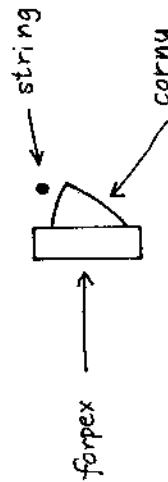
Arnaut does not distinguish in his descriptions of the actions whether the string is struck or plucked. He only describes the

<sup>4</sup>For example Bowles, E.A., 'A Checklist of Fifteenth-Century Representations of Stringed Keyboard Instruments', *Keyboard Instruments: Studies in Keyboard Organology 1500-1800*, ed. Ripin, E. M. (Edinburgh, 1971), plate 19.

setting in motion of the string for the second and third actions, and then he uses the verb "percuito", intending the sense of striking, even though the third action evidently has a plucking mechanism, similar to a modern tongue-mounted plectrum. Thus, Arnaut is unpecific or vague about the type of string excitation and his verbs of excitation cannot provide a reliable clue as to the nature of the action.

Nevertheless it is fairly clear that the second action involves plucking. It is not clear how we should understand cornu: either it was a triangular piece made of horn (as Kaufmann thought), or "horn" indicates the shape which was used<sup>7</sup>.

Since the description of the action gives few clues about the exact plucking operation, the sketch is open to interpretation. Actions 1-3 depicted by Arnaut are all viewed from the side; in effect from the bass end of the keyboard. Although they appear mostly like a cross section through the action, a certain amount of perspective has been included which clearly depicts the plectra in actions 1 and 3 and reveals the construction of the fork-like duplicitate. It would appear as if the cornu has been given the same perspective treatment as actions 1 and 3. If this is so, then the cornu (looking down the string towards the player, before plucking) would appear like this:



The form of the cornu as depicted by Arnaut enables it to pluck the string and then slide back past it after plucking, just as Le Cerf and Labande have already noted, and as my practical experiment confirms. This is the most straightforward interpretation and it is the view of all commentators that this is a plucking action.

Even though the description of the cornu may be a little vague, Arnaut's sketch is well detailed: not only does the underside of the cornu have a sloping angle which is necessary for the return, but the upper surface has slight curve which ensures that the strings slides off sideways and is not simply pulled upwards and hangs on the cornu. This attention to detail suggests that Arnaut was drawing something he had observed, or at least, something the function of which had understood.

Apparently as a result of not seeing the perspective in Arnaut's sketch Lester understood the cornu to be pointing away from the player, with the result that he had to postulate a string running

<sup>7</sup>Kaufmann op. cit.

<sup>8</sup>Le Cerf and Labande, p. 4, note 2.

at 90° to the keylever, leading to consequent layout difficulties when a number of keys are incorporated. This hypothesis does not appear correct when we consider that Arnaut envisages that this second action can be fitted in the *clavisimbalum*, which has its strings running in the same direction as the keys.

Kaufmann suggested that the plectrum would pass by the string on account of its flexibility, which implies that it would pluck as strongly on the return stroke as on the initial, upward movement. He appears to have understood the triangle in a different plane, rotated through 90°, and this view does not appear correct<sup>3</sup>.

Clutton thought there was a means of avoiding a second pluck on the returning stroke, but his description of the *forpex* can be discarded since it is not consistent with all of Arnaut's information and neglects to incorporate the spring.

There is something drawn behind the *cornu* which looks a little like a tongue, but there is no axle, such as is drawn clearly in actions 1 and 3. Le Cerf and Labande's suggestion that this piece contains a damper is not entirely implausible, but it cannot be seen from the sketch how this would work. Le Cerf and Labande describe having constructed this mechanism, although their realisation is neither described in detail nor drawn. It is the only unresolved detail of this action that we cannot explain the purpose of the piece behind the *cornu*. Perhaps it was merely part of the mounting of the *cornu*?

It should not be overlooked that if this mechanism did have a damper, then it would be the only one of those described by Arnaut which did: it is a characteristic of the first three actions that after plucking the string was allowed to sound undamped.

Indeed, as practical experiment reveals, the subjective effect of a plectrum of the first or third type of action striking a still vibrating string is much louder than of the plectrum striking a non-vibrating string. In other words, it sounds much like a second pluck although in fact it is not. A plectrum of the second type of action produces a more substantial sound on the return stroke although it is more of the form of a "zing" which is produced (rather than a normal pluck) as the sloping underside of the plectrum rubs the string on passing it. Thus, this second action, if undamped, produces a more substantial sound on the return stroke than actions 1 and 3.

We can see that the advantage of the first or third type of action with a plectrum in a pivoting tongue lies in the speed of repetition and the reduction of action weight which is possible. The second action must be heavier since there is fair amount of friction which must be overcome when the *cornu* slides past the string. In addition the second action would have been heavy since the spring pressure which returns the action to rest has to be overcome by the player before even plucking the string.

<sup>3</sup>Kaufmann, op. cit.

#### Summary of the four actions described by Arnaut

Following the interpretation that the second action incorporates a plucking mechanism, we have two different types of action described by Arnaut: actions 1-3 are plucking mechanisms, action 4 is a striking mechanism.

Actions 1 and 3: are plucking mechanisms with a plectrum held in a pivoting tongue. The plectrum material is not specified, but could have been, at least occasionally, metal. Metal plectra were found in the 1619 Johann Mayer harpsichord and Kaufmann writes that metal plectra were used (at some time) in the Royal College of Music *clavicitherium*<sup>10</sup>.

Action 2: describes a plectrum action with a distinctly audible sound on the return stroke. The sound of the upward pluck using a rigid horn plectrum is slightly rounder (more like a leather plectrum) than that given by bird quill.

Action 4: is evidently a hammered dulcimer action without check or damping of the string. A metal peg (like a clavichord tangent) strikes the string.

It is characteristic of all these actions that there is no damping, which has obvious consequences for performance style.

<sup>10</sup>Carolinum Augusteum, Salzburg. Private communication from Kurt Wittmayer. Kaufmann op. cit. p. 11, note 4.