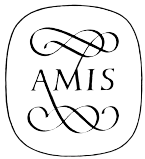
Journal of the American Musical Instrument Society

VOLUME XX • 1994



REPORT
Making a Bowed Keyboard Instrument*

AKIO OBUCHI

Introduction and Historical Background

THE EARLIEST KNOWN DESIGN for a bowed keyboard instrument is found in the 1488–89 notebooks of Leonardo da Vinci, whose sketches of a *viola organista* were discovered in 1967 by the art historian Ladislao Reti.[1] A four-string fretted keyboard instrument with a single wheel, the viola organista can be viewed as a link between the hurdy-gurdy and the *Geigenwerk*, which was invented in 1575 by Hans Haiden (or Hayden), a Nuremberg builder.[2] About 1625 the Spanish priest and harpsichord maker Fray Raymundo Truchado built an example of a similar instrument, which is preserved in the Mahillon collection of the Musée Instrumental (no. IV-21) in Brussels.[3]

Over the past 500 years a number of builders have made variants of bowed keyboard instruments and given them individual names. Although these instruments are now obsolete, several early examples do survive, and a few still function.[4] Among the various types, Carolyn W.

*This report is a revised version of a paper presented at the National Meeting of the American Musical Instrument Society in Nashville, Tennessee, 14 May 1993.

The author would like to express his thanks to Nicolas Meeùs of the Brussels Musée Instrumental for providing an opportunity to study Truchado's instrument and also to Tetsuo Sato of the library of the Kunitachi College of Music for his help in finding references. Gratitude is also due Dr. Edward L. Kottick and Carolyn W. Simons for their important suggestions and Dr. Martha Novak Clinkscale for her revision of the original text.

1. The drawings are located in the Biblioteca Nacional, Madrid. For a complete description of the *viola organista*, see Emanuel Winternitz, *Leonardo da Vinci as a Musician* (New Haven and London: Yale University Press, 1982), 137–67. Of particular interest is Leonardo's drawing (Biblioteca Nacional CA 218 rc.), reproduced as illus. 8.4.

2. See Michael Praetorius, *Syntagma musicum*, vol. 2: *De organographia*, trans. and ed. by D. Z. Crookes, Early Music Series, no. 7 (Oxford: Clarendon Press, 1986), 69.

3. See Ferdinand Joseph De Hen, "The Truchado Instrument: A Geigenwerk?" in *Keyboard Instruments: Studies in Keyboard Organology*, ed. Edwin M. Ripin (Edinburgh: Edinburgh University Press, 1971), 17. The date 1625 has been questioned by Karel Moens.

4. Among them are a *piano-quatuor* by Gustave Baudet, no. 23104 in the Württembergisches Landesmuseum in Stuttgart; and a *Streichklavier*, ca. 1800, in the Germanisches

Simons has distinguished three distinct groups: the *Geigenwerk*, which uses a system of wheels to activate the strings; the *Streichklavier*, which uses leather belts instead of friction wheels to sustain the strings' vibrations; and the *piano-quatuor*, which uses a friction drum instead of wheels.[5]

In the Geigenwerken by Haiden and Truchado, the wrest plank was located at the front, and the hitchpin plate was placed along the edge of the soundboard near the bentside and tail piece. The strings were positioned in a manner similar to those of the harpsichord and other keyboard instruments, i.e., straight back from the keyboard. A friction wheel was located under each of four (Truchado) or five (Haiden) groups of strings, while a small clearance was maintained between the wheel and each string in its group. When the keys were depressed, the strings of the notes selected were pulled down to touch the friction wheel, which in turn started their vibration. To prolong the sound, the player kept the wheels rotating with either a foot treadle or a manual crank mechanism. Unlike its close relatives, the harpsichord and clavichord, the Geigenwerk could then sustain its tone as long as the keys were depressed and its wheels remained in motion. By changing the rotation speed of the wheels, the player moderated the normal tension between them and the strings, thereby producing a limited range of dynamics.

Design and Description of a Newly Built Geigenwerk

Curious about the performance possibilities and general practicality of the Geigenwerk, the author recently designed and constructed an instrument based on historical examples. The frame of the new instrument was modeled after a typical seventeenth-century Flemish harpsichord. Made of poplar, the bottom is 12 mm thick, while the spine, cheek, side, and tail are all 14 mm. There are two soundboard ribs. The spruce soundboard is a nominal 3 mm thick but is 3.8 mm where the bridges are located; the edge below the hitchpin rail is only 2 mm thick. Four separate soundboard bridges cover the four-octave compass (C to c^3); each corresponds to a different wheel. The lower belly rail holds the

---

Nationalmuseum (MINe 257) in Nuremberg. The author wishes to express his gratitude to Carolyn W. Simons for sharing this information from her Ph.D. dissertation, forthcoming from the University of Iowa.

5. Carolyn W. Simons, "Some Nineteenth-Century Mechanically Bowed Keyboard Instruments in European Museums," a paper presented 15 May 1993 at the National Meeting of the American Musical Instrument Society in Nashville, Tennessee.

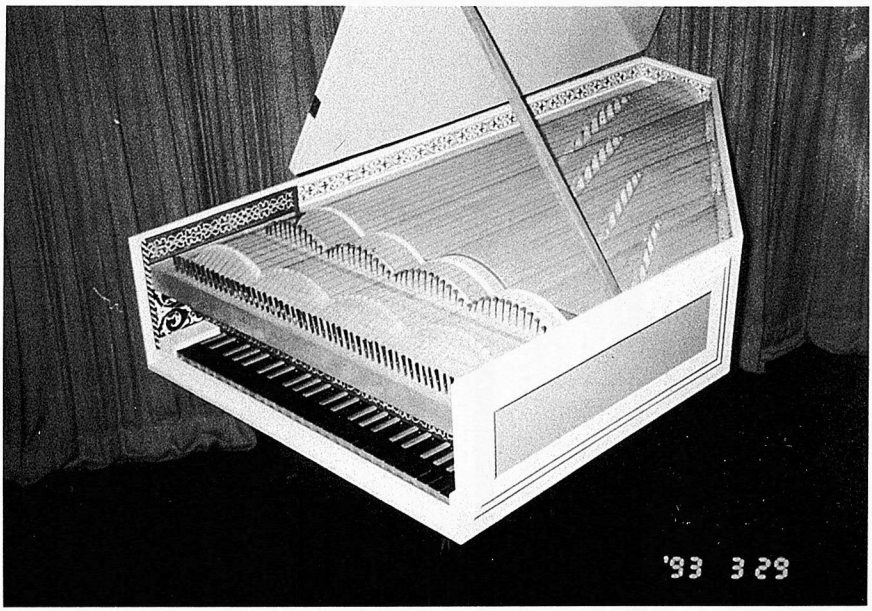


FIGURE 1. Geigenwerk by the author. Dimensions: 143 × 77.3 × 25.7 cm. Photo by the author.

bearings of the spindles for the four wheels, and the soundboard is glued to the upper belly rail. Since the upper and lower belly rails are separate, the sounds of the bearings attached to the lower will not be transmitted to the soundboard. The keyboard is located under the wrest plank. This is not in imitation of Truchado's instrument, but it seemed wise to locate the treadle closer to the player.

In Truchado's instrument a metal arm pulled the string down and effectively stopped any further tension from being applied to the string (fig. 2). The new Geigenwerk is more versatile; it has a clearance of about 1 mm between the strings and the rotating wheels in the rest (OFF) position (fig. 3). When the key is depressed, the pull-down arm draws the string down until it comes into contact with the rotating wheel, thus starting the sound. As the arm draws the string farther down to contact the back nut rail, fine adjustments of pitch, as well as vibrato and other expressive effects, are made possible.

Each wheel is a circular disc made of 9 mm plywood. Its edge was first covered with 1 mm felt, then with parchment coated with rosin. Each of the four wheels activates one octave of strings, and each has a pulley on a spindle driven by a treadle mechanism via belts. Both ends of the

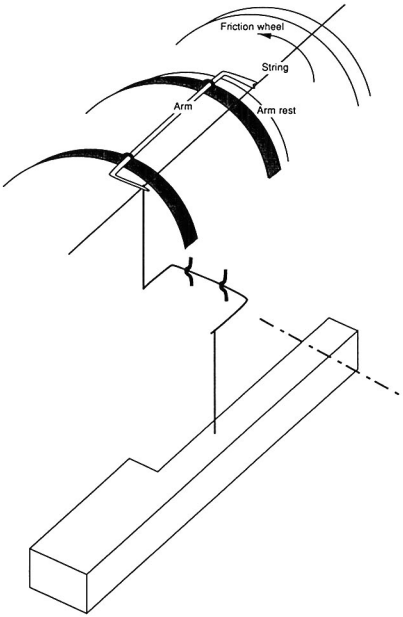


FIGURE 2. Geigenwerk by Fray Raymundo Truchado. Brussels, Musée Instrumental, no. IV-21. The mechanism for applying tension between the string and the friction wheel. When the key is depressed, the front end of the metal arm is pressed against the arm rest; no further pressure or tension is applied to the string. Drawing by the author.

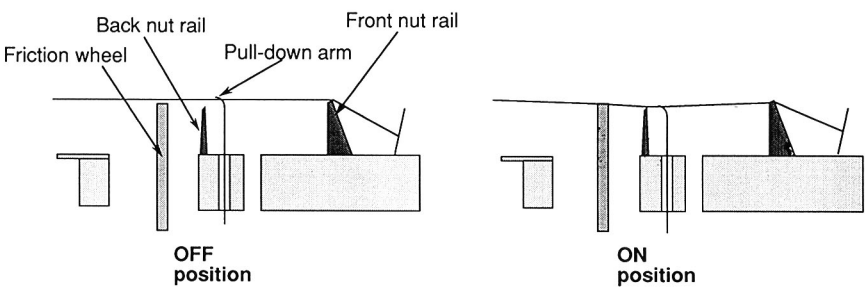


FIGURE 3. Geigenwerk by the author. Cross-section of the pull-down mechanism. The string first touches the friction wheel, then the back nut rail, providing a consistent tension. Drawing by the author.

spindle are supported by ball bearings. The four wheels turn at the same speed, although the wheels on Truchado's instrument turned at different speeds.

Copper-wound steel strings are used for the very lowest octave, brass for the next octave, and steel for the two treble octaves. The string gauges were determined by trial and error, but the goal was to achieve the best possible tone quality. Because of the difficulty of attaining a quick response, the string lengths of the lower notes are shorter than those on a harpsichord.

The tone of this new Geigenwerk is similar to that of a reed organ or a consort of viols. Fast passages, including trills, are playable in the upper three octaves but difficult to execute in the lowest octave. By varying finger pressure, the player can change both pitch and dynamic level of the sound. In principle the amount of change depends on the relative height of the nut rail, the length and tension of the string, and the density of the string materials; about forty to sixty cents can be adjusted by finger pressure for all tones. However, this adjustment appears too great for practical purposes; thus it is very difficult for the player to find the correct pitch as quickly as he should.

Conclusion

The unique capability of the Geigenwerk to sustain long tones and to adjust the pitch has been demonstrated anew. However, manipulation of dynamic levels without making pitch changes is extremely sensitive, and considerable skill on the part of the player is required to make such adjustments. There exists in the new instrument an uncomfortable difference in loudness between the notes located in the middle of a bridge and those at both its ends. A possible cause of this unevenness could be the convex shape of the bridges. Playing fast passages smoothly in the lowest octave, C to B, should, it seems, be as easy as in the higher octaves. The author-builder will continue his efforts to overcome these problems of dynamics and flexibility, as he further modifies this modern version of the Geigenwerk.[6]

6. For a discussion of the many experiments in making bowed keyboard instruments over the centuries, see Sibyl Marcuse, *A Survey of Musical Instruments* (New York: Harper & Row, 1975), 307–18; and for illustrations and a table of most of the known examples, see Curt Sachs, *Real-Lexikon der Musikinstrumente* (Berlin: Julius Bard, 1913; repr. New York: Dover Publications, Inc., 1975), 360–61.