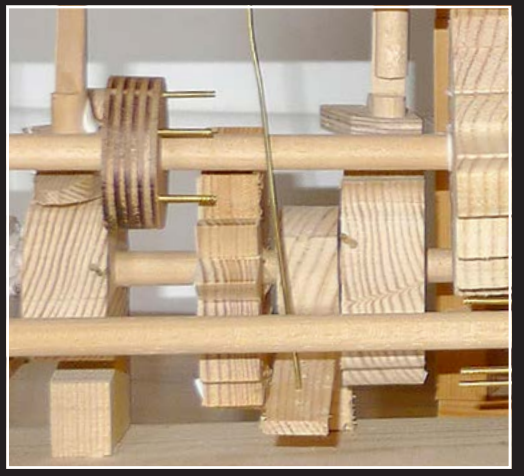
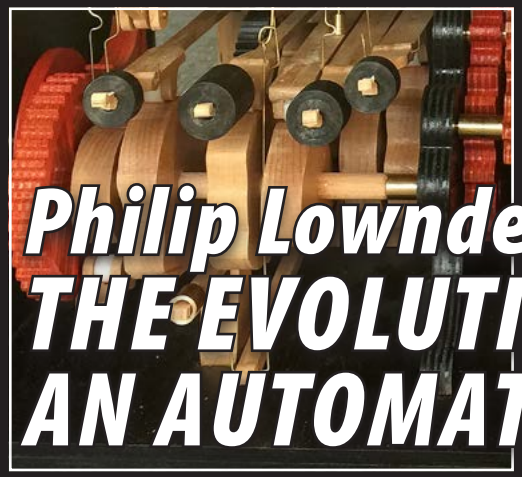
AUTOMATA MAGAZINE









Philip Lowndes: THE EVOLUTION OF AN AUTOMATIST

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Which comes first, the idea or the tool?

Evolution through technology

by Philip Lowndes • Hinxton, Essex, United Kingdom • Photos by the author

A maxim that I have picked up along the way is to never buy a gadget or tool unless it enables me to do something new. However, due to the amazing progress of technology, I have to say that this has not held me back and my workshop gets ever more crammed with tools.

My first realization of the value of using the appropriate tools came in the early 1980s. I had designed a Noah's Ark with cutout animals in the decks. Working with an Eclipse hand fretsaw (coping saw in the US), bought for me as a child by my grandfather, I spent a lot of time sanding the animal inserts because it was impossible to cut vertically well enough for the animals to fit easily in place.

This was, and still is, a successful design, and I was fortunate enough to win second prize in the 1986 *Practical Woodworking* magazine's toy-making competition, which had a surprisingly substantial cash prize. After much deliberation I invested this in a Hegner fretsaw (scrollsaw to many).

My toy making was transformed by my new-found ability to make perpendicular cuts. I went on to make and sell hundreds of Arks, with the help of part-time workers. I still sell the plans and an "heirloom" version to this day. Even now, people occasionally track me down and ask me to make replacements for lost parts so their grandchildren can play with it. This venture ceased abruptly when we moved as a family to Switzerland in 1990.

1. The author's early efforts. *In My Humble Opinion* is on right; *Shy* on left.

Roll on to the 2000s and a return to Cambridgeshire, where the urge to make things arose again. Toy making no longer seemed such an attractive pursuit. My family was growing up so there was no "internal market," and I didn't really fancy enduring the bureaucracy of the EU CE certification process for toys. I have always had a fascination with mechanical art and had dallied with automata along the way, so I decided that this would be

2. *In My Humble Opinion*, latest version.

3. A head cut on a manual copy/carving machine.

4. Turned-brass parts from the author's first lathe.

5. Proxxon's DH 40 thickness planer.

my new direction. This time I took it seriously.

Armed with my Hegner, a small bandsaw, a cheap belt sander, and an old electric drill in a stand attachment, I made a start. My first effort, seen on the right in **photo 1**, was cut from leftover pine wood and cardboard glued together with a glue gun. Control wires were made from flower-arrangement wire. "Paint" was done with a felt-tip pen. The result was dismal but it sort of worked, and the animation definitely added something. I was immensely pleased with it. I saved it for years but it slowly deteriorated, and I eventually binned it. It lives on, though, in my *In My Humble Opinion*, available today as a finished automaton (**photo 2**) and, in simpler form, as a downloadable plan on my website.

Enthused, I sought to make improved versions. A huge technological change between the 1980s and the 2000s had been the introduction of affordable computers and that unfairly despised but truly incredible box of technology, the printer. While I previously made plywood templates in an attempt to achieve repeatability, I was now able to design on the computer, using graphics software, and print templates that I could stick on the wood as cutting guides.

With these templates, I could cut and sand to the line, creating more accurate parts. I was able to make pinwheel gears and cams more reliably using planed pine wood, and I developed several more advanced pieces using Geneva wheels and complex cam arrangements. These included *Quiet Contemplation of a Sandwich*, *Shy*, and *My Beautiful Hair*. Even though these pieces were rough around the edges, they had sufficient charm that people generously started buying them off my website.

I found that having people purchase my creations added a lot of satisfaction. It also stopped my shelves from filling up (at least with automata).

Making them was a struggle, though. When ordering from pictures on a website, customers expect to get what they have seen. While the paper templates worked fine for flat work and for blocking out carved work, it was still nigh on impossible to make identical heads, for example.

After struggling with this for a couple of years, I discovered some plans on the internet for making a copy carver. This was a large

6. The CNC router does good work but creates a lot of dust.

7. A dog, from *Sid Embraces Anarchism*, made in halves.

8. *Trip to the Doctor*, a complex automaton.

and brutal wooden contraption made from thick plywood, where an electric router on a parallelogram frame was manually guided by following a prototype with a pin. It was a horrible machine to operate, but within the blocks of flayed and thrashed wood that were created (**photo 3**) could be found consistent carvings, albeit after a superhuman application of abrasives.

Income from the sales financed a new direction—I purchased a small mill and lathe, both by Sherline. Small as they were, these were intimidating at first. It was difficult to believe that it was so easy to cut metal…well, brass, at least (**photo 4**). I soon found that cutting steel on these machines was just for heroes.

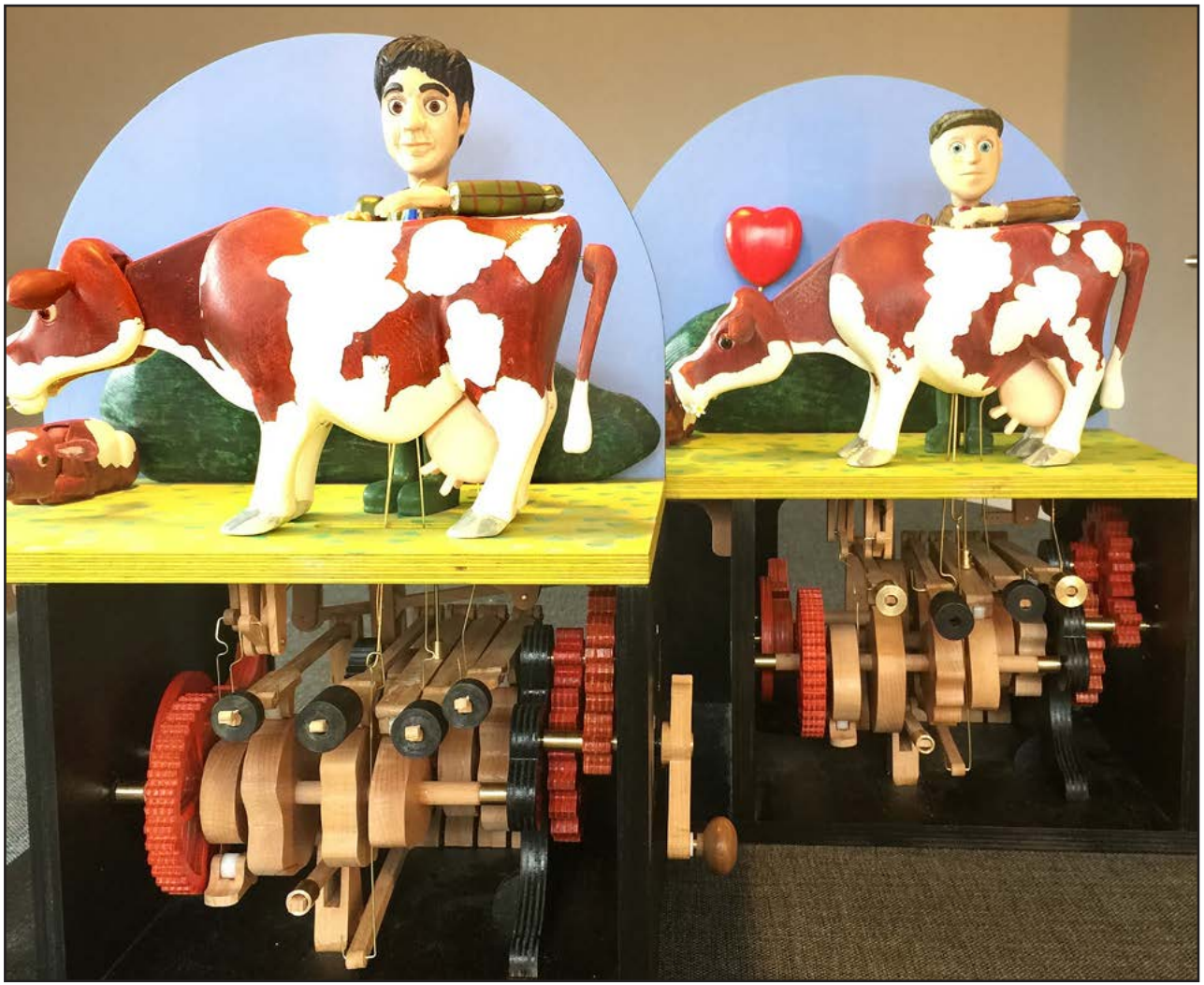
I could now make screw threads and cut brass weights. Before, I made counterweights from dense wood but they tended to be on the large size and were difficult to fit into the mechanisms. I don't use springs, relying on gravity. (My automata will be useless in space.)

I also moved on from using wood-dowel axles rotating in wooden holes, to brass ferrules at the ends of the dowels rotating in Delrin engineering-plastic bushings inserted into the wood.

Slowly, tolerances were getting tighter, but the time taken to make parts was also beginning to stretch out. I was still relying on rickety pinwheel gears and having to use stock planks of planed pine for parts. The only exception was the carvings, where I used limewood cut into blocks before carving.

I wasn't satisfied with the results. The work was repetitive and, due to the loose tolerances, pieces needed a lot of fettling to make them work smoothly. They were not refined. All my work was represented by drawings on the computer that could be used as templates—my intellectual property. I made a hard-fought decision that resulted in me discarding all that went before and effectively starting again from scratch.

I invested in a Heiz CNC router. If the metal-working tools were intimidating, this one was positively scary—a machine seemingly with a mind of its own. So many mistakes to be made. I found at first that it went through milling bits like a machine gun goes through bullets. Too-fast cutting speeds, too-deep cuts, cutouts jumping up and jamming the bit. A learning curve soared above me. I also hadn't appreciated that a CNC router is like an aircraft carrier in that it can't function properly without a lot of support. More equipment was required.



9. *Cute Cow*—more complexity.

10. *Inca Llama* before painting.

11. *Inca Llama,* finished

Cutting shapes from birch plywood was straightforward, although it did require an investment in CAD/CAM software. The CAD (computer-aided design) is used to design the work, the CAM (computer-aided manufacturing) translates it into G code, which the computer controlling the router understands. I went with Vectric Carve Pro, which I have found to be excellent.

However, moving away from using plywood to softwoods I found to be less satisfactory, as it is difficult to get a clean cut with softwood. Here, at last, was the opportunity and need to start using hardwoods. I decided on beech for

12. *Tick Bird Visits the Museum*, with an open mechanism.

13. *Pigeons* with an American cherry mechanism.

14. *Lovebirds*, using a multiple cam, open mechanism.

the mechanisms due to its strength. However, beech is best bought from the woodyard in large, rough-sawn planks. I had to invest in a large bandsaw to saw it into lengths. For this I chose a Scheppach Basa 4.

Then the rough-sawn wood had to be planed to the correct thickness, as the CAD software needs an accurate thickness to be keyed in. I was using pieces less than 10mm thick (.40"), so I settled on a Proxxon DH 40. This machine has size limits 80mm wide and 40mm deep (3.15 x 1.57", respectively), but it is very accurate (**photo 5**).

It was not long, though, before I needed to plane wider and thicker wood so I bought a much bigger thicknesses planer which, surprisingly, cost the same as the small one. Then there is the dust that is thrown up by these machines (**photo 6**), so a dust-extraction unit was required, and so it goes. All this was just to cut in 2D.

The big advantage to having all of these tools was that parts could be reliably cut to a finished state. I make most parts in two halves to increase their strength and aid in making internal cutouts (**photo 7**). I also stopped using the clunky pinwheel gears and cut proper gears generated by software. Whereas before, I was working to tolerances of about one millimeter (.040"), I was now working to 0.1 mm (.004"). Parts now fit together and just work.

It wasn't long before 3D design and cutting caught my attention and answered my need for consistent carvings. Here, the big surprise was that brilliant 3D CAD software could be downloaded free. Blender is excellent. The learning curve seemed steep, but a few YouTube tutorials soon cracked it. Remember that "close enough" will do because the work

can be finished after the blank has been cut, so it is quite easy to get started.

Designing in 3D on the computer allows the generation of files for 3D printing, which is also a convenient way of checking the sizes and fit of parts. Just 10% in size difference can make a big difference to the look of a piece.

I soon completed files for my previous range of automata and started adding even more complex ones (**photo 8**). I was getting the occasional commission and, using computer design, I was able to design complex automata a little more economically in the knowledge that the files could be used to make similar pieces to amortize the time invested.

At that time, all of my automata were large, complex, and took a long time to make (**photo 9**). I wanted to experiment with smaller artwork. I was also attracted to simplification, and the new equipment was so accurate that it was possible to make automata with axles that are fixed only at one end.

I could dispense with the box that automata mechanisms usually live in, and expose all the works. My first design was *Inca Llama* (**photos 10** and **11**), inspired by a small statue that I saw in the Sainsbury Gallery in Norwich. This was soon followed by my take on William the Hippo, the ancient Egyptian artefact to be seen in the Metropolitan Museum: *Tickbird visits the Museum* (**photo 12**). These automata have single back plates with mechanisms on the front—a bit of showing off. The gears are internal, so the large driven gear is incorporated into the cam.

William the Hippo drove a new direction. I was attracted to the Egyptian artefact but

15. *Sparrow*, with different counterweight layout from the pigeons.

struggled at first on how to make it into an interesting automaton. Opening it's jaw was an option but would have ruined the aesthetics of the object. Then I thought of the tick birds seen on the backs of hippos in the wild. An internal mechanism and the curvature of William's back facilitated a realistic movement of the bird.

For some time, I had been looking at Roland Mdx40A prototyping machines, but they are a considerable investment. I was interested in the fine cutting that they enabled. I eventually discovered that these machines were popular in schools. They buy them, but then find they don't have time to use them, and they are sold cheaply on the second-hand market. I bought one on eBay for a sixth of the retail price and it only had 10 hours run time on it. These will cut with a bit as small as 1mm, enabling me to accurately cut small gears.

I had also started using American cherry wood, as it works well for both mechanisms and carvings. From here it was a small step to start designing small automata, with open designs and birds strutting back and forth. I started with single doves, then double doves, pigeons, and partridge (**photo 13**).

This was quite a collection of birds, which then led me into other, different bird automata in a similar scale; lovebirds (**photo 14**), sparrow (**photo 15**), and parrot. These make unusual gifts and have wider appeal than the automata-enthusiast market. They also have the advantage of being easy to ship, as compared with the larger pieces.

Since all of my designs are now on the computer, I am still able to faithfully recreate all of my automata, which keeps me busy. My profile on various social and commercial platforms also brings commissions that are leading me into new directions—but that is for another day.

LINKS

Philip Lowndes' website: *www.lowbot.co.uk*
Philip's YouTube channel: *https://www.youtube.com/woodenpersonality*