AUTOMATA MAGAZINE

David Bowman's
Pulpo

2/5—Sep/Oct 2020

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EDITORIAL

Tools

by Marc Horovitz

Several friends and I have recently been discussing tools and workshops. I'm always interested in other people's work spaces and the tools they use to create their magic.

Some people have complete, high-tech workshops, filled with CNC (Computer Numeric Control) lathes, milling machines, routers, and laser cutters. They can work with wood or metal with equal ease. The nerve center of the shop is their computer, containing the software to run their machines.

At the opposite end of the spectrum are those who work primarily with hand tools, and not even many of those. A workbench, a coping saw, and a hand drill can produce surprisingly good automata.

My own shop is fairly complete, though not at all high tech. I actually have two workshops—one for wood in a separate structure, and a metal shop in the house. Outfitting these shops was done piecemeal over many years, up to the point that I felt like I had just about everything I required. In the woodshop, my primary tools include a standing drill press, a bandsaw, a table saw, and a radial-arm saw, all acquired secondhand. I use these for all sorts of jobs around the house, in addition to building automata.

The metal shop contains small- to medium-size lathes and milling machines, a bench drill, a belt sander, a bending brake, and a shear. My scrollsaw, one of the few new machines that I've acquired, also lives there. Everything in this shop is manually controlled—no computers. Plus, there are all of the necessary hand tools. As with the woodshop, I feel like I have just about everything for my needs.

People's attitude toward their tools, and to their craft in general, varies. For some, the tool is just a means to an end. It is used with little regard for the tool itself. When it's worn out or dull, it's discarded and replaced with a new one.

Others cherish their tools and care for them like children. For some people, the tools are as much their hobbies as anything.

Most of us seem to fall somewhere in between. Tools are made to do a job but they will give the best performance if reasonably cared for.

I mentioned CNC tools earlier. This is a relatively new way to use tools. In addition to knowing the tool and how it works, you must learn the computer software necessary to run the tool. This has generated philosophical discussions about how the part is actually being made. Is it the computer that is shaping the part, or the mind behind the design of the part? Does it take more skill to run a manually controlled machine or is that same skill just transferred to the cerebral sphere where the part is created?

And what about 3D printing? You can create components in three dimensions on a computer screen, then "print" them out in plastic using your own 3D printer, or send the computer file off to a professional printing house and get your piece back in a wide variety of different materials. Where does this method fit into the philosophical scheme of things?

I don't intend to get into controversial waters here I do, however, feel that it's important for automatists to think about these things and come to their own conclusions. Does the end justify the means? Is the final outcome the most important idea? Or does the manual skill necessary to bring something creative to life become part of the process? Your call.

NEWS

Translator and publisher wanted

Guido Accascina, author of the new Italian book, *Automi*, is looking for someone to translate the volume into English, and also for a possible English-language publisher for this definitive work. If you can help, or know anyone who can, please contact Guido: *guido@accascina.it*

WANT ADS

Wanted: I have neither the time nor the talent to build automata but would like to own a few. They need to be small, completely mechanical, and funny. Email descriptions, photos, and price to Warren: *wgreatbatch@easthillfdn.org*

Wanted: Book: *Paul Spooner*, published by Molen in Japan. Happy to pay shipping costs to the UK. Please contact Craig at *craiglonghurst@hotmail.com.*

EVENTS

Morris Museum: A Cache of Kinetic Art: Tiny Intricacies

March 13, 2020-January 10, 2021. Morris Museum, 6 Normandy Heights Road, Morristown NJ 07960.

Due to the recent four-month closure of the museum, the exhibition has been extended into 2021.

Contemporary mechanical works in *Tiny Intricacies* are designed to delight and surprise. Some employ traditional construction—wood, metal, and paint—others utilize electronic components. Pieces are installed alongside 19th-century novelty pieces from the Guinness Collection known as "precious smalls." They embody the spirited sense of imagination and curiosity of artists from the past and the present. Cost: free with admission. Info: Michele Marinelli, *mmarinelli@morrismuseum.org.* Website: *https://morrismuseum.org/*

Cabaret Mechanical Theatre (CMT) presents: **Mechanics Alive!**, ¡explora!, Albuquerque, New Mexico, USA. Through 2020. More info: *https://cabaret.co.uk/exhibitions/current/*

AutomataCon, hosted by the Morris Museum: May 21-23, 2021. *http://www.automatacon.org*.

CALL FOR ENTRIES

Morris Museum: A Cache of Kinetic Art: Timeless Movements. Originally intended to open in March 2021, this final *Cache* exhibition has been advanced one year, now scheduled to open in March 2022. The new submission deadline is Friday, Sept. 10, 2021. Check the website for new dates, updated prospectus, and entry forms. *A Cache of Kinetic Art* is a multi-year juried exhibition series showcasing contemporary automata and their inventive creators. Prospectus and entry forms for both exhibitions: *https://tinyurl.com/MMentries*. AM

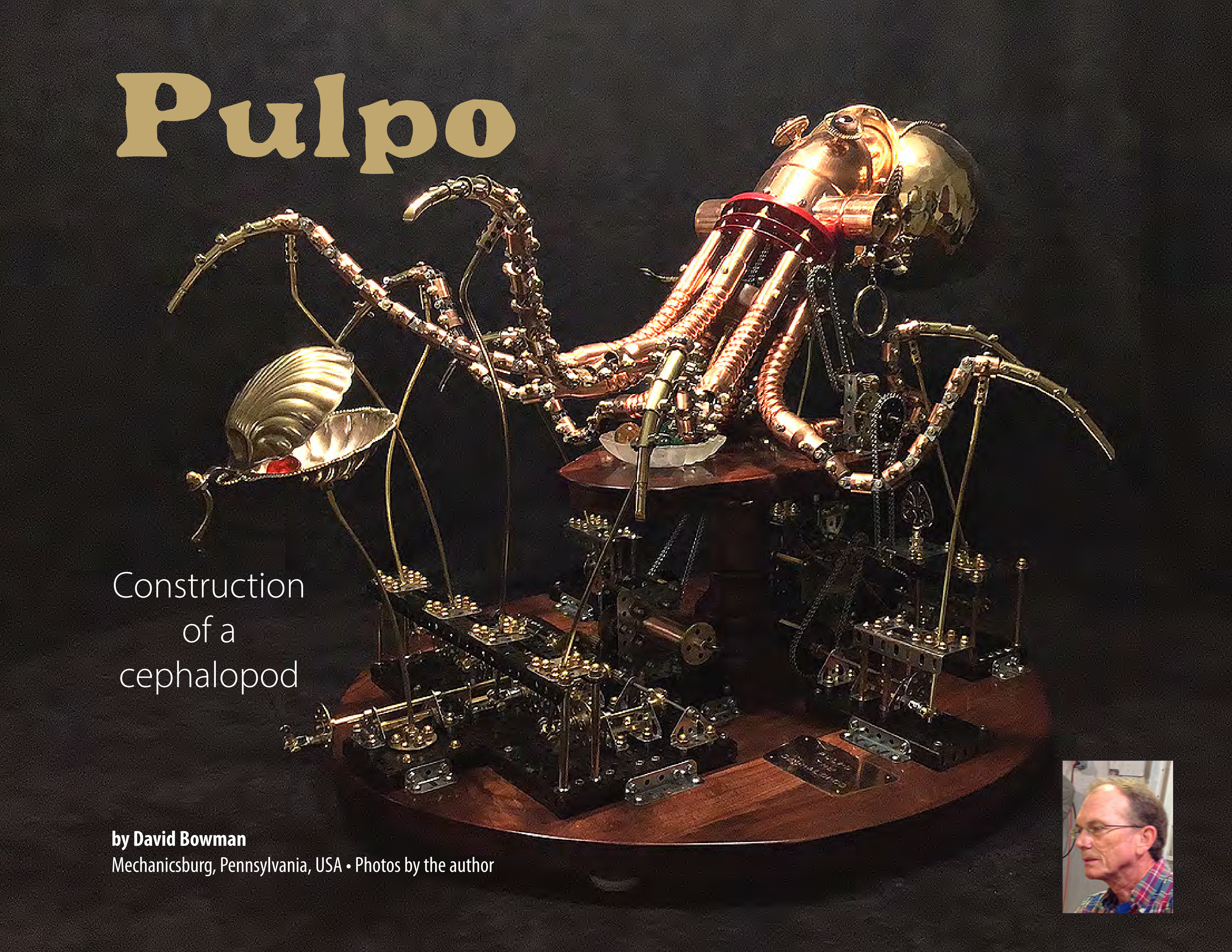
Follow *Automata Magazine*…

In the next issue of AUTOMATA MAGAZINE

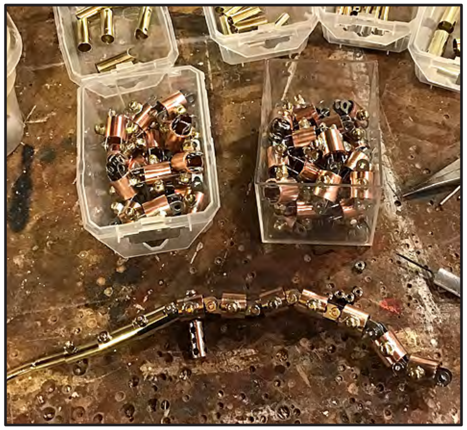
- **Pat Keck** discusses her beautiful and arresting automata
- **Guido Accascina** talks about his motivation and journey in writing his new book, *Automi*
- **Li Zhanlong** addresses the issue of repair of wooden automata
- **Andrew Alden** offers several ways of adding sound to your automata

Pulpo

Construction of a cephalopod



by David Bowman
Mechanicsburg, Pennsylvania, USA • Photos by the author

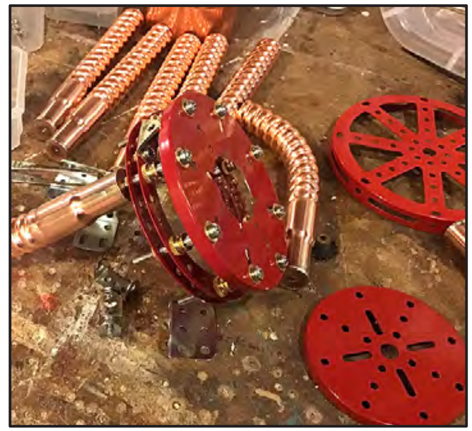


1. Plumbing parts and perforated metal strips, waiting to become tentacles.

2. Flexible-copper pipe for connecting tentacles to the body.

3. Canadian pennies soldered to brass nuts form the pipe ends.

4. Finished threaded pipe ends with the pennies in place.



5. Meccano parts are assembled to make the framework.

6. A brass vase and more plumbing parts were used to form the head.

In the summer of 2019, I displayed some of my automata at the Key City Steampunk Festival, in Gettysburg, Pennsylvania. This was my first foray into the steampunk culture, which I found enlightening. I met a lot of interesting people there and my kinetic sculptures felt right at home. But a lot of people kept asking, "Do you have an octopus?" As I did not, I thought to myself, How the heck would you make an animated octopus? After the show was over, the idea of making an octopus kept running through my mind. I slowly began accumulating materials that might become octopus parts. Finally it began.

The obvious starting point was to figure out the articulated tentacles. Short sections of copper pipe seemed to work well. I combined these with some perforated metal strips and brass tubing for the articulation (**photo 1**). Oh joy! Seven more to make.

Flexible copper hot-water-heater supply line was chosen to connect the moving tentacles to the octopus body (**photo 2**). I needed to create threads in the hollow top of the tubing so that it could be bolted to the body. After much trial and error, I found that Canadian copper pennies, with brass nuts soldered to them, provided the solution to that problem (**photos 3** and **4**).

The body came next. Disks, hubs, and rings from Meccano provided the required framework (**photo 5**). My dealer of vintage Meccano in England was about to have a really good sales month. Little did I know how many parts, pieces, gears, and sprockets this project would take.

Studying photos of live octopuses gave me some ideas for the head and mantle. An old brass vase and some plumbing joints would become the critical parts of the head (**photo 6**). Some grinding, filing, and soldering gave me the head and respiratory siphons (**photo 7**). The siphons would have to spin, so a drive mechanism was installed into the body and head unit (**photo 8**). Bolts for mounting the eyes were also positioned and installed (**photo 9**). The eyes are glass taxidermy fish eyes (**photo 10**).

I next had to connect the flexible-tubing upper legs to the body. A walnut disk mounted within the tops of the legs provided extra stability for them (**photo 11**). This thing was finally beginning to look like an octopus. I soldered a copper hemisphere to the flat bottom of the brass vase. A plethora of polishing was necessary to get the assembly to resemble a mantle (**photo 12**).

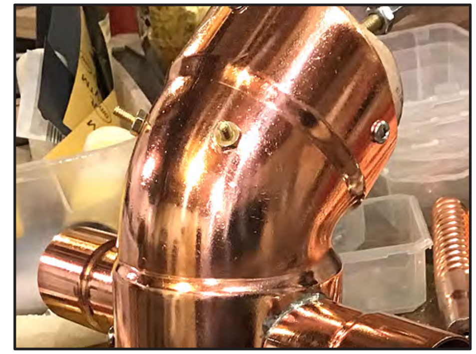
I used an internal threaded-rod device to attach the mantle. This, and making a pedestal, really began to bring the octopus to life. About this time, my niece from Peru stopped by. She told me the Spanish word for octopus was *pulpo*, so that became my octopus's name.

The four front articulated tentacles were attached next (**photo 13**). But how was I to make the legs move independently? After much trial and error (mostly error), I completed the drive train for the front legs (**photo 14**). The key was to use a different gear ratio for each leg, and this created the illusion of random movement.

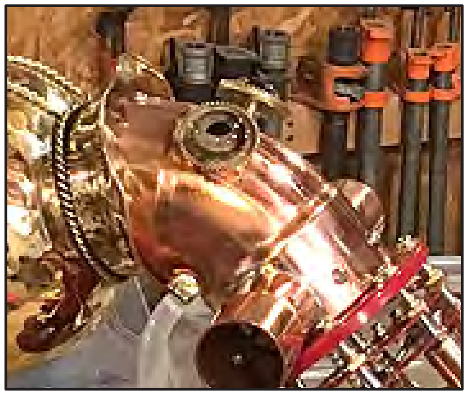
Since the octopus is an intelligent, inquisitive creature, *Pulpo* needed something to do. Trying to steal a red pearl from a clam seemed like a good problem-solv-

7. The head comes together.

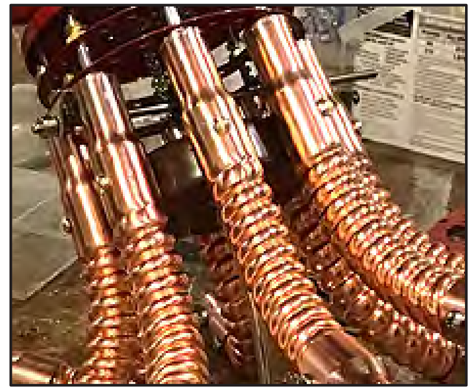
8. The drive mechanism for the siphons.



9. Bolts for the eyes are in place.



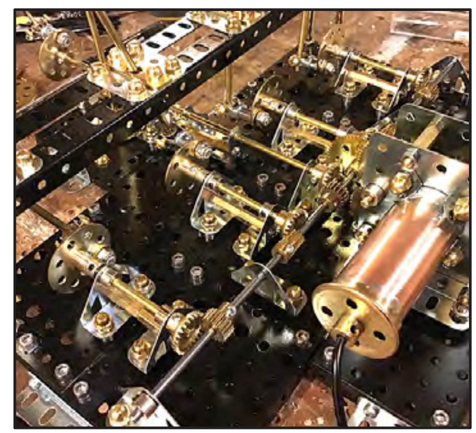
10. Eyes are taxidermy fish eyes.



11. A walnut disc helps support the legs.

12. The finished mantle, nicely polished.

13. Front tentacles have been attached.



14. Drive mechanism for the front legs.

ing activity (**photo 15**), I'm sure my wife won't notice that her clamshell soap dish is gone.

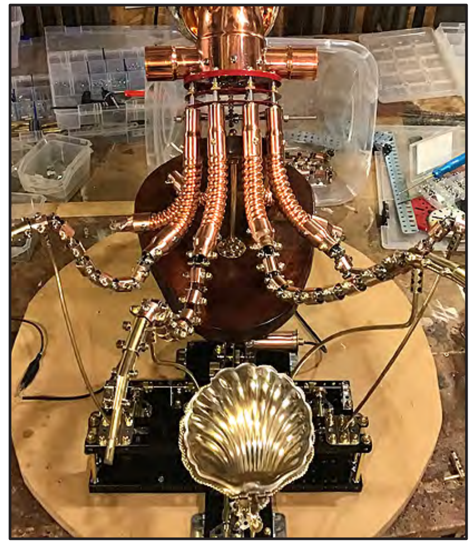
With the front assembly complete (**photo 16**), now was the time to move on to the rear four legs. A four-legged animal would have been much easier to make, and a fish even easier! But attaching the rear legs really made *Pulpo* look very octopus-ish (**photo 17**).

Sprockets needed to be introduced into the rear drive train, as the rear legs are not as linear as those in front (**photo 18**). The final mechanical issue to be solved was attaching the spinning siphons to the rear drive train (**photo 19**).

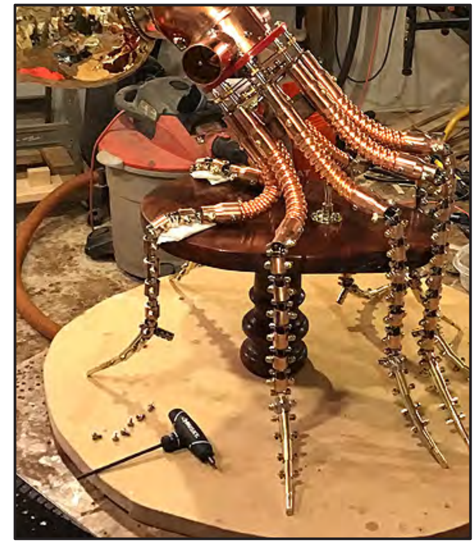
Pulpo was mounted on a walnut base and given a collection of shiny trinkets that she had collected from the bottom of the ocean (**photo 20**). She must now spend eternity trying to grab the red pearl from the stingy clam, who opens and closes its shell to prevent the pearl's theft.

The octopus has been my greatest challenge thus far. This project took about 250 hours and around $1,600 in materials. I think I will take a break from automata for a while, until the next idea starts to form in my head. AM

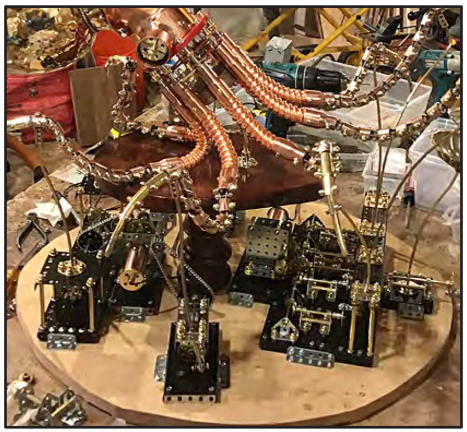
15. The red pearl in the clamshell. The hinged shell was being used as a soap dish.



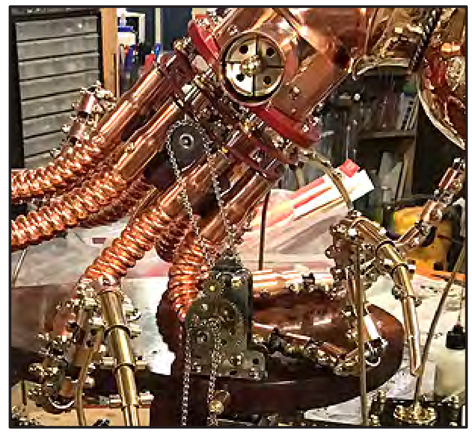
16. The front assembly is complete and the clamshell is in place.



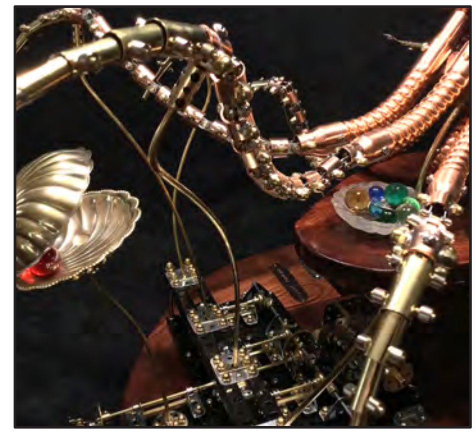
17. Attachment of the rear legs is beginning.



18. With the rear legs in place, their drive units are being installed.



19. Spinning respiratory siphons are attached to the rear drive train.



20. Mounted on her pedestal, *Pulpo* eternally tries for the red pearl.

I am not yet ready to post a video of *Pulpo* on YouTube. The last time I posted something this cool, somebody bought it right away. I want to hang onto *Pulpo* for a while. However, on my YouTube channel (*bowman woodcraft*) there is a video of *Calamari*, *Pulpo's* boyfriend (*https://tinyurl.com/Calamari2*), who has similar movement but is chasing a jellyfish instead of a clam.

The Cartonomata Workshop

Teaching automata in cardboard

by Eden Orion • Koranit, Misgav, Israel
Photos by the author

My Cartonomata Workshop is a web page through which I teach children (in Hebrew) how to build automata made out of cardboard. The name Cartonomata came from *carton*, which is a generic Hebrew name for cardboard, combined with the end of the word *automata*. In the following article I will explain how I arrived at the insights that helped me set up my Cartonomata activities and my website.

Early days

For as long as I can remember, I've been making things. In 1966, when I was four, my father brought me a construction set called Matador. In the box were wooden blocks of various sizes, along with

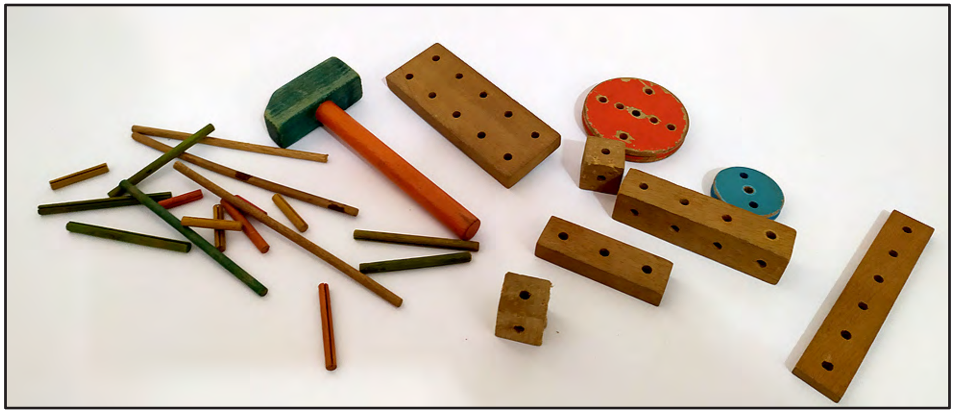


Three cardboard automata developed by the author for teaching simple automaton construction. *No-no Teddy* (left) was inspired by an Israeli children's story, the flying-bird automaton employs a paper origami crane, and *Happy Dog* is based on a Peter Markey design.

rods and hinges, in all kinds of colors (**photo 1**). The set also came with assembly plans for about twenty different models (**photo 2**), most of which contained features of machines—movable parts, changing forms, etc.

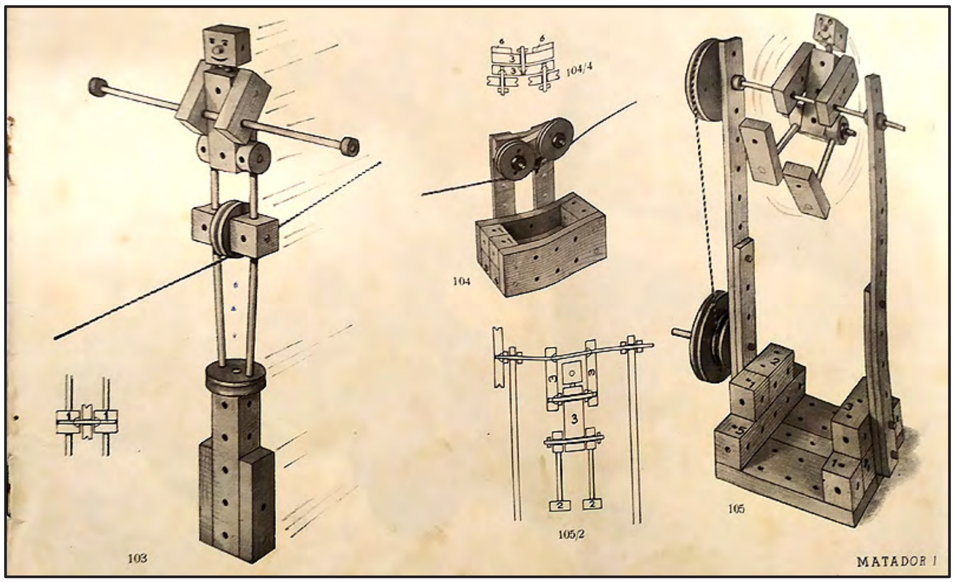
By the age of five, I was able to build simple transmissions with gears, get an acrobat doll to do stress exercises, and build a toy lathe and drill press. When I was six years old, I got my first Meccano set and switched to assembling mechanical models made of steel. Although I made all of the models suggested by the included plans, I preferred to build freely from my own imagination. The only limitation I encountered back then was that the shape of the parts often imposed certain constraints in construction.

In 1969 the first box of LEGO came to us. What I particularly liked there was that, beyond the pictures on the packaging, there were no plans and the construction was completely free, though still with some limitations and constraints due to the shapes of the pieces. I had a wonderful childhood and cherish my parents, who had spent a fortune to allow me these years of creativity.



ABOVE: 1. Parts from the Matador construction set the author had as a child.

BELOW: 2. Construction suggestions from the Matador set.



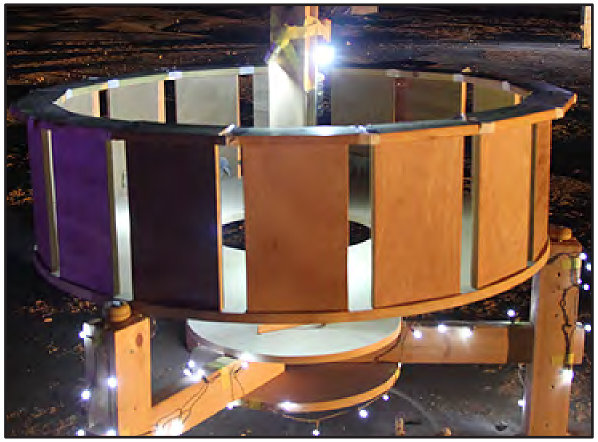
My love of building machine models from wood, metal, and plastic brought me to a professional high school, in 1977. Here, I learned to work with a real lathe, milling machine, and welder, and to build real machines. After five years of military service, I studied at the Technion—the Israel Institute of Technology. There, I chose to specialize in teaching science and technology.

After school

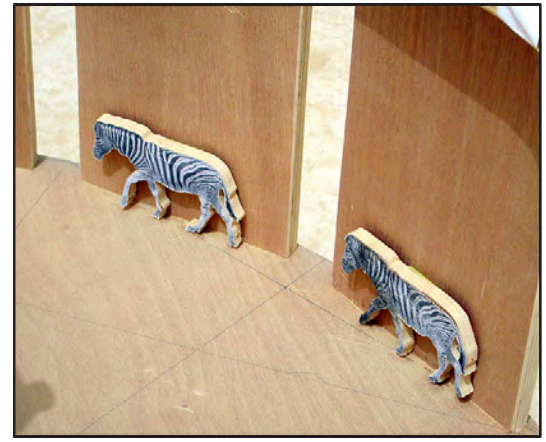
When I graduated from the Technion in 1990, I was offered the opportunity to work in one of the faculty research centers that dealt with teaching technology to children and young people. This was done by constructing machinery and control systems using LEGO. The venture was run in conjunction with MIT, the LEGO Company, and the Technion. These were wonderful years, in which I participated in writing seven books and conducting workshops for more than a thousand teachers and hundreds of students.

My wife and I started a family. Our two children received educations similar to the one that I experienced, as much as possible. They, too, liked to build with LEGO and K'Nex, but their greatest enthusiasm was for the things they designed themselves and built from found materials. LEGO had no chance, compared to the "sword" our son made from a tree branch, not to mention the tree house the children built from materials they found around the area where we live. They no longer touched construction sets.

At the same time, I studied for an art degree, which I received in



LEFT: 3. A zoetrope made for the 2014 Midburn event. The 3D zebras were cut from images extracted from a YouTube video. A strobe light flashed to correspond with the speed of the revolving zoetrope, which was turned by hand.



RIGHT 4. A closeup shot of the zoetrope zebras.

BELOW LEFT 5. A 6-meter-tall (19 feet) marionette made by the author for the 2016 Midburn event. Participants could pull handles that controlled the hands and feet, making the marionette dance.

BELOW RIGHT: 6. A large-scale kaleidoscope made for a Midburn Event.

2001. I was then able to share my knowledge and the experience of making art, as well as appreciating art in museums and public spaces, with the entire family. Today my son is an architect and my daughter is studying for an art degree in Berlin.

About ten years ago I went to the Eretz Israel Museum, in Ramat Aviv, Israel, to see an exhibition called *Machine Dance*. This was basically two parallel exhibitions: Cabaret Mechanical Theatre's *On the Wings of Imagination*—a colorful exhibition of about forty mechanical toys and machines—and Sharmanka Kinetic Theatre, a strange and magical performance without actors, the stars of which are the wonderful machines created by artist Eduard Bersudsky (see *Automata Magazine*, September-October 2019).

Burning Man

My visit to that show reignited the automata flame in me, but this time on a different scale. I became active then in Midburn, Israel's Burning Man community. For each of the events that took place, I built a large-scale mechanical installation or automaton. Examples included a zoetrope (**photos 3** and **4**), where the people could see 3D zebras running in a circle; a six-foot-tall marionette (**photo 5**); a giant kaleidoscope (**photo 6**); and more. My participation in Midburn enabled me to visit the great Burning Man event in Nevada, USA, in 2017, where I saw countless giant, crazy automata creations!

A year later I visited Nantes, France, as part of the Burning Man European Leadership Summit. There I met with the founders of Les Machines, who showed us the workshops in which they make the wonderful animals described in the January 2019 issue of *AM*.

When I finished serving as chairman of Midburn, I was once again free to do the things I loved—making in general, and especially automata. Some automata I made by following plans I found on the internet or from books (**photos 7-10**). These helped to improve my skills in working with small pieces of wood, some of which I colored. I enjoyed myself a lot.

Cartonomata Workshop

The regional school near our home has been participating in international robotics competitions for many years. Students in the high-school division have won numerous awards in local, national, and international competitions. In order to fund the robotics activity at the school, a fair for the whole family is held each year in early January. Within the fair are about ten different workshops for a variety of ages, with the aim of bringing children closer to the world of robotics.

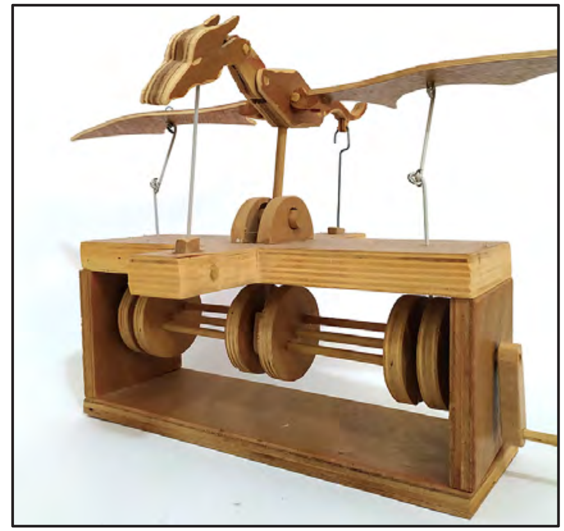
The fair organizers learned about my background and asked me to create a workshop for kids in grades three through six, where the kids could create something. They told me that there were already workshops for LEGO Technic, LEGO Robots, programming, drones, 3D printers, and more. "Give us a workshop we haven't had yet." I agreed and set out to plan what, in the end, came to be the Cartonomata Workshop. My design constraints were as follows:

• No budget—the materials should be free (or almost free).

• Kids don't have a lot of patience. They need to come out of a twenty-to-forty-minute workshop with something working.

• There would be about two hundred participants in four hours.

Cardboard was the ideal choice of material. I knew about it from my art studies and even saw quite a few pieces of art and furniture made of cardboard. It is accessible



ABOVE LEFT: 7. Lumberjacks, from the book *Folk Toys*, by Ken Folk.

ABOVE RIGHT: 8. The flying dragon was based on plans found at GrabCAD: *https://grabcad.com/library/flying-dragon-wooden-toy-1*

LEFT: 9. *Ladies Churning Butter* also came from Ken Folk's *Folk Toys*.

RIGHT: 10. *The Lion Tamer* is a Ron Fuller design, downloaded from the internet. The author made a 3D model in SketchUp, then made the actual one in wood.

to all and can be found in almost any home, behind any store, or in various recycling places. It can be used to create almost any shape and can be easily glued to almost anything. And it’s free.

• For hinges I chose long bamboo skewers (eighty pieces for $1); for hinge guides I used straws. Total expenditure: $6.

• For adhesive I used hot glue. The glue gun and glue sticks for two tables were about $20.

• Other tools included a craft knife, scissors, paper cutter, pencil, and a metal 30cm (12") ruler (**photo 11**) for six tables: $30.

• Materials for decorating the automata included eyes, pipe cleaners, colored paper, and more: $20.

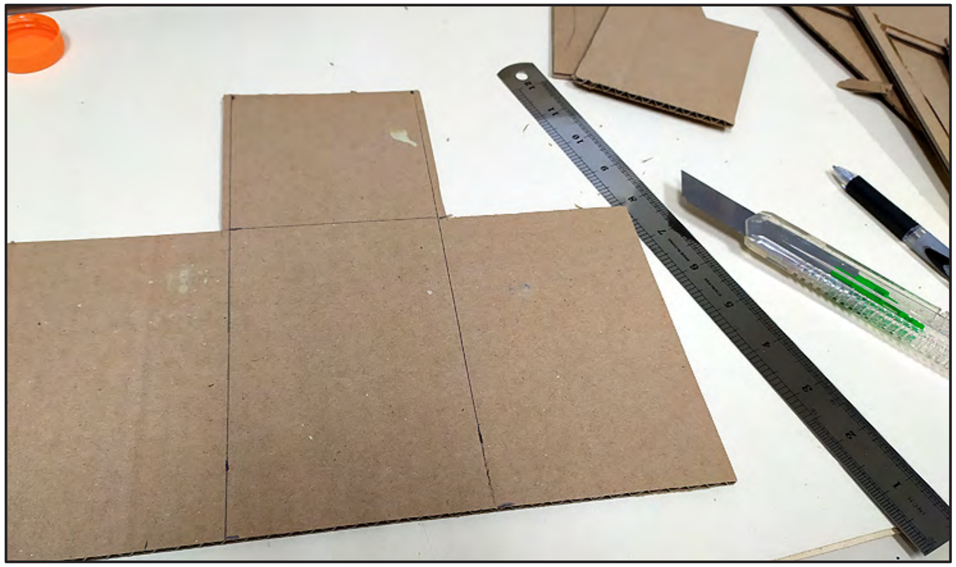
• Total cost of the workshop for 200 participants: less than $80.

For a couple of nights I cut out cardboard shapes for 200 kits. Each kit included enough pieces to make a box, three wheels, two “nuts,” and one handle. I made six different models of simple automata that could be built using the kit. I emphasized to the kids that they could design, build, and decorate the part above the mechanical apparatus (on top of the box) themselves, each according to their wishes.

About a week before the event, I met with four girls from the art department of the high school; they would serve as instructors at the workshop. For about an hour, I demonstrated the workflow to them, so everything would be ready for participants.

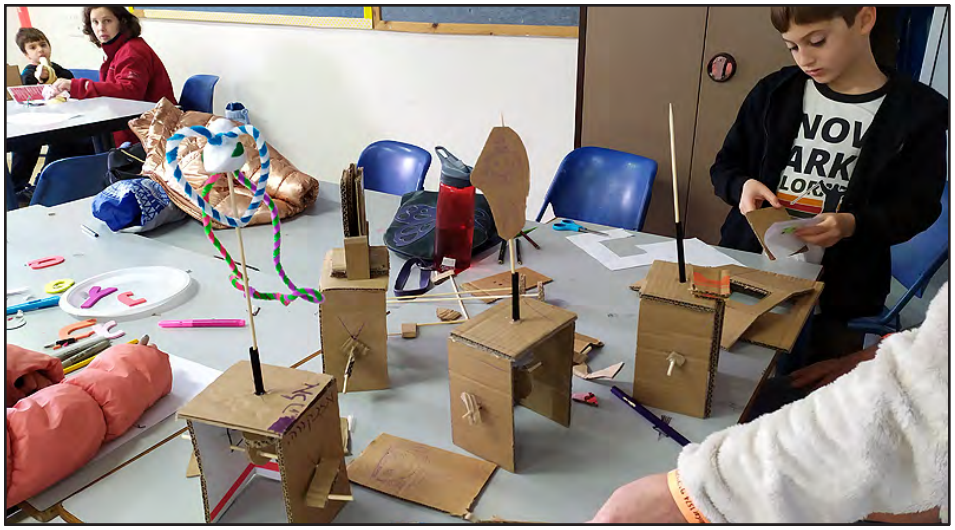
On the day of the workshop, we distributed the materials (**photo 12**) among the six classroom islands made of tables. On a screen, I showed automata videos from YouTube. We then waited for the event to open and the participants to come.

When the children started coming out of the workshop with their automata, we soon became the most successful workshop at the event—much more than the glittery LEGO workshops, 3D printers, and drones. The 200 kits I had



ABOVE: 11. Some of the necessary tools for making cardboard automata, as well as the layout for the basic automaton box.

BELOW: 12. Pre-made handles, rods, and wheels for the workshop, to reduce the amount of hot glue used.



13. A table at the workshop, with several automata, some finished and others still incomplete.

14. A happy grandfather with his granddaughter, who has just completed a merry-go-round.

made turned into lots of colorful automata that made kids smile, with glowing eyes (**photos 13-15**)! The best thank you I received was from the mother of one of the girls who attended the workshop. The next day, she told me that her daughter had put the rotating bird she had built on the shelf above her bed, and that there were not many things that received such an honor!

My next step was to move the activity to the national level. Since my day job is Webmaster at the University of Haifa, I decided to do this via the internet. My original plan was to shoot five to ten videos, describing the different aspects of cardboard-automaton making, and explaining three mechanical devices, so that viewers—especially children and young people—could build the automata by themselves using things found in almost any home. Special emphasis was placed on encouraging the children to create the different pieces themselves. Drawing wheels with a compass would help them to recognize concepts like diameter and radius, and how these dimensions influence the behavior of the machine they will build.

The website opening was scheduled for the end of August 2020—a time when there would be no kindergartens or schools in session in Israel, and some employment was needed for children. I also planned to have a concluding meeting at the end of the school holiday, in a central place in Tel Aviv, where we would hold an exhibition of children's work and have an opportunity to meet with their friends from different places in Israel.

Then came the coronavirus...

Israel, like most countries in the world, has been quarantined, and I have received requests to publish suggestions for things to help keep children and young people busy. I used my Passover (spring) vacation to quickly create a workshop web page, as well as nine videos. Footage for the videos was taken with my mobile phone and edited with iMovie software. What particularly gave me strength were the photos and videos sent by parents of the happy children who enjoyed the experience of making something real. I intend to create video subtitles and an overall translation to the workshop page so that kids from all over the world can also enjoy it. You can find links to the videos and website in the sidebar. AI

Eden Orion's videos (in Hebrew) can be viewed on his YouTube channel: *https://tinyurl.com/EdenOrion*

Visit the Cartonomata Workshop website (also in Hebrew): *https://bit.ly/2JOlOuP*

Il Mago was created as a 90th birthday present for Cy DeCosse.

IL MAGO

The making of a magician: Part 2

by Cecilia Schiller
St. Paul, Minnesota, USA • Photos by the author, except where noted

In the last issue, I discussed how *Il Mago* came about and how I approached the project and solved a lot of the initial problems. Here, I'll finish the story.

With all of the mechanisms for operating the moving parts in the scene determined, I now had to decide how to initiate the different movements and at what speeds. I wanted one crank to drive all the movement, which meant a series of intersecting gears on several axles that would drive the cams or levers associated with each movement (**photo 1**). Some mechanisms, like those actuating the flute playing, the snake, and the magic-table trick, had to be timed together. Others, like the jumping rabbit, the card trick, and the marching soldiers, could move at their own pace, as long as it was a reasonable, realistic speed.

I determined where the axels needed to be placed, then roughly calculated the gear ratios I needed. I used a series of gears to reduce the speed from 1:1 down to 24:1, which means that the viewer must rotate the crank handle twenty-four times in order to see a complete cycle. Since it takes three complete cycles to see all the tricks on the trick table, that means that the viewer must turn the crank seventy-two times before the whole story is revealed. I got it pretty close the first time but needed to adjust the placement of the axles so they did not interfere with the operation of the various cams.

Initially, I had intended to run several of the mechanisms using belts running from other gears or mechanisms, but I discovered that this created too much friction and the belts either slipped or bogged the gears down.

Another problem surfaced. Anything is possible in one's imagination, and indeed on paper, but in physical 3D reality I found that I had placed some mechanisms too close together and they jammed against each other. I solved this and the belt-slippage problem by extending some axles through the rear panel and adding a set of gears in back that runs the ratchet mechanism for the marching soldiers, as well as both the rabbit and the card tricks. These run continually and aren't part of the cycle evident with the magician's other arms.

1. Gears and axles have been placed on the floor of the automaton to help determine their proper location.

ABOVE: 2. The crank is made from orange-colored padauk to contrast with the lighter maple handle.

RIGHT: 3. The snake's basket is finished in Williamsburg Wax. The lid begins to open as the snake peeks out.

Finishing

Normally, I create all the different moving parts and figures first, then disassemble, paint/finish, and reassemble them. This generally results in the need for fine-tuning because the finish alters the way an automaton operates. *Il Mago* is so complex that I decided to finish it as I went. This worked really well because I was able to resolve problems as they appeared.

I like to use natural-wood colors in my palette, contrasting the wood colors to highlight parts, such as the crank of orange-colored padauk wood and the crank handle turned from hard maple (**photo 2**). Williamsburg Wax (available in woodworking stores) is an easy-to-use blend of beeswax and oil (just wipe it on and off), and it leaves a nice, natural finish without any buildup. I used it for axel supports, cams, levers, and the snake basket (**photo 3**). When I want more protection or a lustrous finish, I use an oil varnish, which I applied to the magic table (**photo 4**) and lower-level turned columns, both of which are cherry wood.

For color, I used acrylic paints—in this case, a brand called Jo Sonja, which I am fairly new to.

Unlike other acrylic paints I've used, these dry to a chalky appearance until you finish it with a clear coat. What I like is that it dries smoothly, without brush strokes, and the colors are opaque. However, you have to be careful not to smear the colors when you apply the clear coat.

I wanted the carving on the snake to stand out (**photo 5**) so I used a different approach. I dyed the wood yellow, then applied a dark stain, wiping most of it off but letting it stay in the carved recesses. Then I dry-brushed some metallic-gold sign paint over the surface to give it shimmering highlights.

The roof was painted in a similar manner (**photo 6**). First I painted all the tiles orange, then green, which I wiped off, then finally dry-brushed the metallic-gold paint to imitate a copper patina.

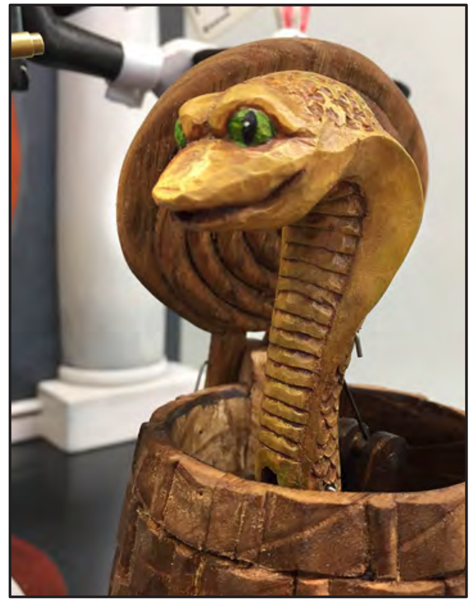
As I was puzzling out how to finish the understory where the gears are housed, I visited Cy DeCosse's retrospective art exhibition at his alma mater, the Minneapolis College of Art and Design (MCAD). I was surprised by a new painting of his, called *The Idea Brain* (see **photo 3** in Part 1). It was just what I was looking for and I used it as inspiration for the background painting of the understory and for carving the shape of the magician's head). It turned out that Cy had just finished the painting and, at the last moment, substituted it for another piece. It made me wonder again if we weren't somehow channeling one another's creative thoughts.

The presentation

Il Mago was a huge undertaking and I worked down to the wire to finish it on time, for Cy's birthday. His wife Paula and I were in communication in the days leading up to the event. I was to bring the piece to their house between 3:00 p.m. and 5:00 p.m. Early that afternoon I alerted Paula that it would be closer to 5:00. Ever patient, Paula suggested that I bring it around 6:30, after the magician they had hired was finished.

Il Mago was visually finished but not fully functional when I arrived at 6:30, so I told Paula I would prefer to be present at the unveiling to offer specific operational instructions. She invited me to sit with the family while she went to pour a glass of wine for me. As I sat down (somewhat disheveled and covered in saw-

4. The magic table, carved from cherry wood and finished in an oil varnish. The lid, which raises to reveal various things, is hand-formed copper.



5. The carved-wood snake was dyed yellow, then selectively stained. Gold paint in places provided shimmering highlights.

6. The roof was painted in orange and green, then wiped off, after which metallic gold was dry-brushed on to appear as a copper patina.

dust), the small group of family members looked at me with the obvious question, Who the heck is she?

"I heard it was your birthday, so I thought I would crash the party!" I told Cy, then added, "You don't know me but I feel as though I know you, so I think it's OK." That, of course, was a conversation starter and Paula arrived, wine in hand, and explained that I was the one who had created the surprise under the veil in the next room. After a little more friendly conversation we headed to the dining room and Cy ceremoniously unveiled *Il Mago*. Astonished, dumbfounded, and thrilled are fitting words for Cy's and his family's reactions. Even though *Il Mago* wasn't a hundred-percent functional, it was still impressive and joyously received.

Photo by Cy DeCosse

The finished *Il Mago*, as displayed in the home of Cy and Paula DeCosse. The automaton is framed by Cy's work, which served as inspiration for this piece.

I was invited to stay for dinner and happily accepted. The delightful, easy-going company made me feel like one of the family. I slept well that night and returned in the morning to retrieve *Il Mago*. I kept him for two months, while Cy and Paula spent time in Florence, Italy, so I had plenty of time to string the arms and fine tune the cams operating the magic table. *Il Mago* found his way back home just in time to celebrate Christmas with many family members and friends. AM

For videos of *Il Mago* doing his tricks, and also some in-progress and behind-the-scenes footage, click *here*.

About the artist

Cecilia Schiller has been creating crank-driven, interactive automata since 2009. Working mostly in wood, Cecilia uses power tools, hand carving, and laser cutting in combination, to fabricate the components for each piece. She then finishes each part by highlighting the natural wood tones or applying paints by hand, to produce colorful figures, scenes, and hypnotic gears. It all comes together in a visually stunning and mechanically mesmerizing automaton.

Before making automata, Cecilia honed her skill set over many years, fabricating puppets, masks, special effects, and scenery for theater. She studied traditional woodcarving in her hometown and traveled to Bali, Indonesia, where she learned traditional Balinese mask carving. She has no formal training in engineering; however, she scored highest in mechanical aptitude in her 9th-grade class!

Cecilia Schiller lives in St. Paul, Minnesota, and works from a studio that overlooks the Mississippi River. She is an award-winning wood sculptor and has been recognized for her work by being awarded several grants from the Minnesota State Arts Board, the Jerome Foundation, and the National Endowment for the Arts.

In addition to her custom work, Cecilia teaches classes and is launching a line of DIY automata kits called Cranky Heart Automata. Find out more by visiting *www.crankyheartautomata.com* or *www.ceciliaschiller.com*.

The Man from Somewhere near Geneva

A simple mechanism provides intermittent rotation

by Paul Spooner • Stithians, Cornwall, UK • Photos by the author

Alan Williams Photography

Hardly anybody needs to make a figure whose head turns through 360º in a number of stages. If you do, a Geneva mechanism might be your first choice. It's pretty, it's positive, and it's not too hard to make. It was necessary for my piece titled *The Man from Geneva*, but had I just wanted a head that could alternately face in four directions, an even simpler device is available.

This is a sort of escapement. A disc on the vertical head/neck shaft rests on the perimeter of another disc mounted on a horizontal shaft that is turned by the crank handle. Turning the crank handle causes the vertical shaft to turn and the head to rotate, as long as there is freedom of movement. To divide the movement into four 90º increments, four pins are set in the top of the driven disc, and a stop is set in the frame, to interrupt their path. The upper disc will turn until it is arrested by the stop. Cutting a flat on the driving disc allows the driven disc to duck under the

The Man from Geneva.

The Man from Somewhere near Geneva.

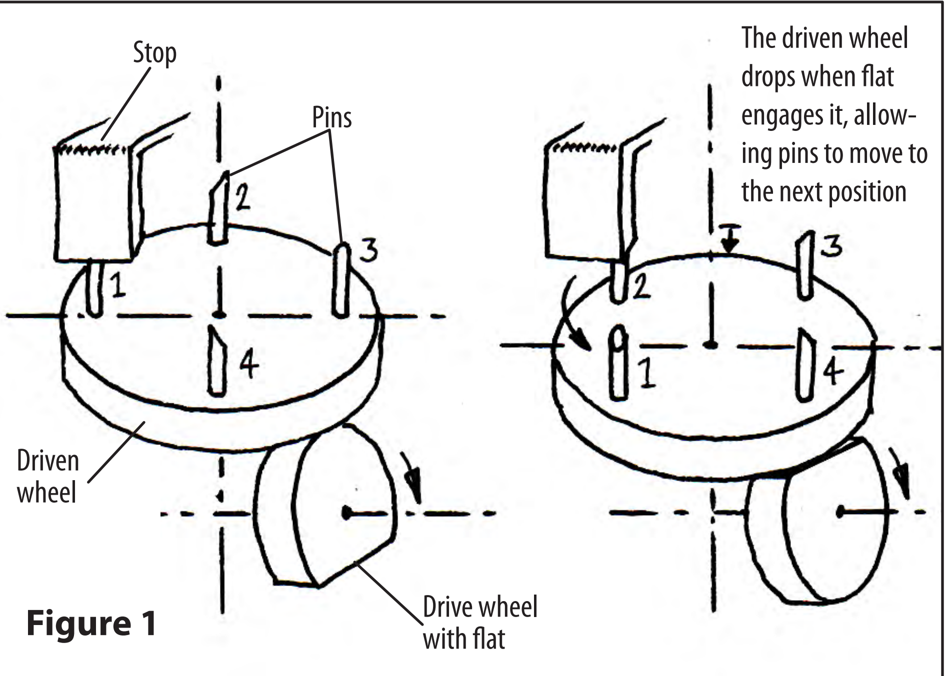
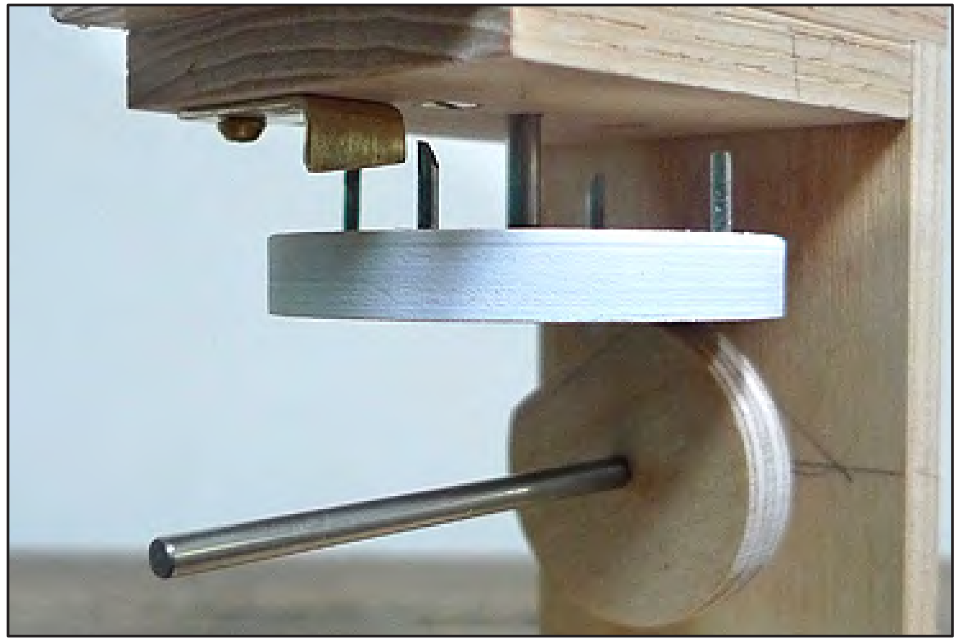


Figure 1



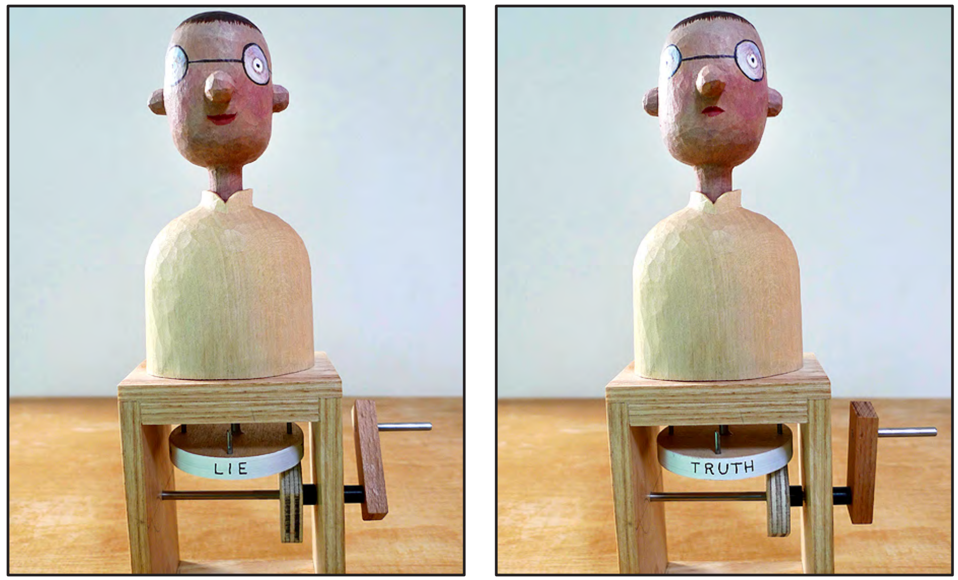
This cutaway of the mechanism shows all of the relevant parts.

stop, continue to turn until it's arrested by the next pin, then duck again when the flat on the driving disc allows it to.

The drawing in **figure 1** shows the action. On the left, the smaller driving wheel is trying to turn the bigger one but it's held up by the stop. In the second drawing, because the flat part of the driving wheel has allowed the big wheel to drop momentarily, pin 1 has ducked under the stop. As the driving wheel's circumference resumes, the big wheel is lifted again, but not before the friction between the two wheels has carried pin1 beyond the stop. Now pin 2 is held up until the flat on the driving wheel comes around again.

It's possible that, as the pin rises, it can strike the stop and jam. To reduce that possibility, both pins and stop are filed at an angle, to offer each other a very small area of potential contact.

This is a specialized mechanism, only fit for certain purposes, but I've found it useful sometimes. Of course, you can vary the number of stations by using a different number of pins. The photos here and on the next page show some examples. A



A Point of View. The head can be turned through 90º, so that what was a lie is now the truth, and vice versa.

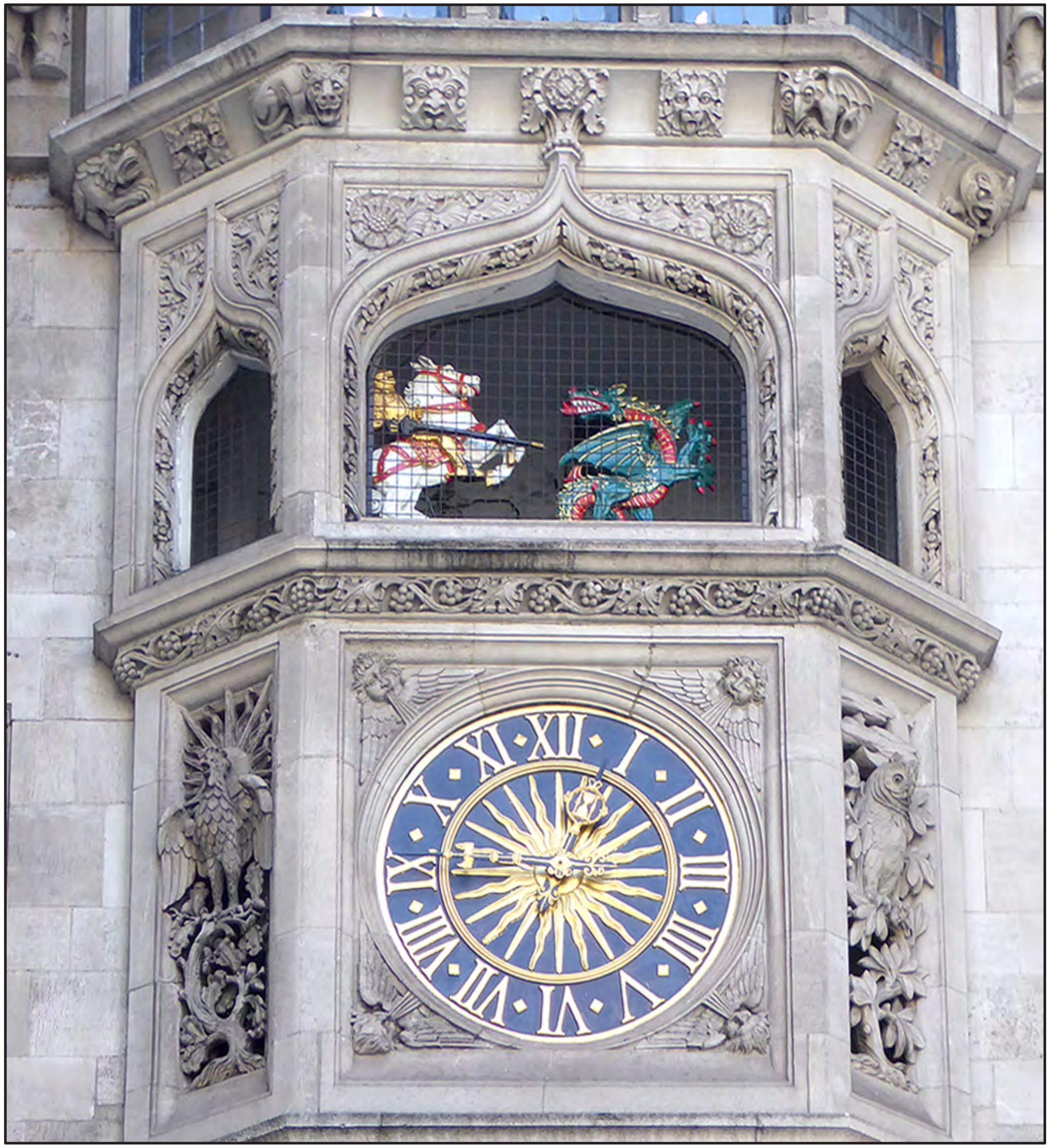
Good Cop, Bad Cop. Four sets of facial features take their turns.

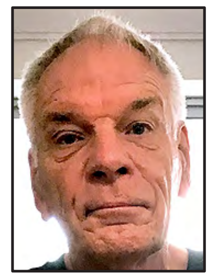
The Frog Princess. She is happy when she's had a fly.

Two Dogs that Meet on a Regular Basis. One dog rotates a quarter of a turn, while the other rotates a fifth of a turn, for each turn of the handle. They meet nose to nose every 20 turns.

Public automata clocks

A brief survey of clocks in the UK





by David Soulsby
Billingshurst, West Sussex, UK
Photos by the author

1. The Liberty clock, aka the George-and-the-Dragon clock (1925), near the Liberty store in London.

There are a number of ornamental clocks dotted around the UK that, when chiming the hour or quarters, kick off a series of automata representing figures or animals. As described in the March-April 2019 editorial of *Automata Magazine*, the lines between automata and kinetic sculpture are not clearly defined. I decided to visit several locations in the UK to find out more information about street clocks incorporating automata, and to observe them in action.

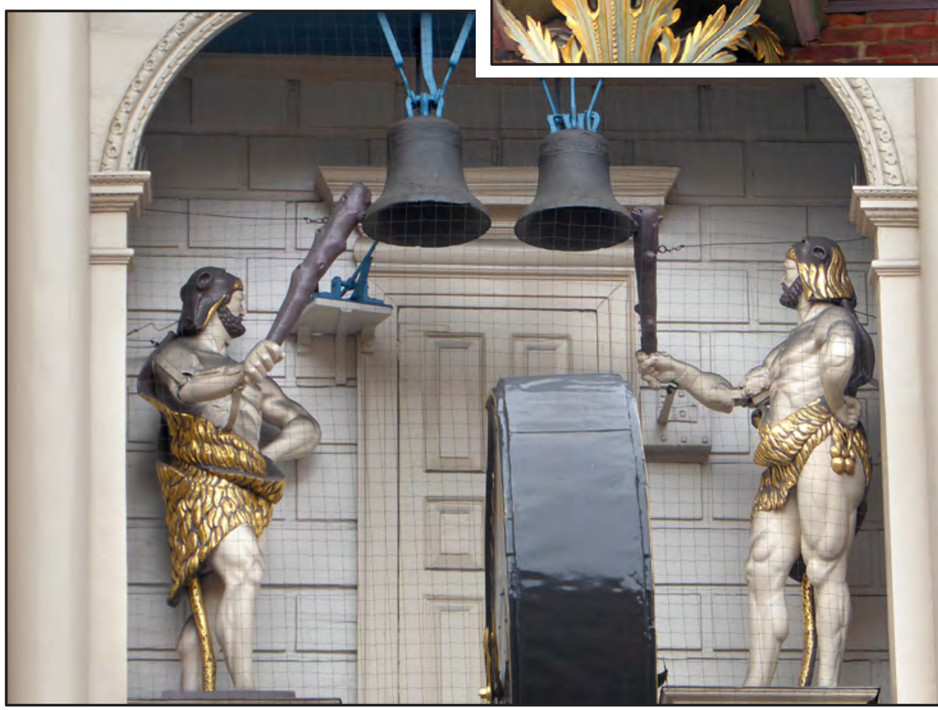
I began my journey in London, near Regent Street. Adjacent to the Liberty store there is an arch spanning Kingly Street that houses an ornate clock. Above the face of the clock are models of St. George and the legendary dragon (**photo 1**). The inscription below reads, "No minute gone comes ever back again / Take heed and see ye nothing do in vain." In 2010 the figures were refurbished. On the quarter hour, St. George chases the dragon several times across the window. On the hour, with the horseman's lance striking at each chime of the clock, the beast is slain.

Another clock featuring automata is less than a mile away from Liberty, outside the front entrance to the Fortnum & Mason store in Piccadilly. Fortnum's is the famous provider of luxury hampers and food. The clock was unveiled in 1964 and features 4'-tall (122cm) mannequins representing the store's namesakes. On the stroke of the hour, the clock chimes and Messrs. Fortnum and Mason emerge from doors on either side. One man carries a tray with a teapot and the other a candelabra. They turn to meet each other while music plays. Both figures nod their heads, inviting customers in for tea (**photo 2**).

In Fleet Street, also in London, is the Guild Church of St. Dunstan-in-the-West. Here, one of the oldest automata clocks is situated. It was built in 1671, only five years after the Great Fire of London. In an alcove above and behind the clock are carvings of two giants, possibly Gog and Magog, legendary guardians of the City of London. Every quarter hour, these automata figures strike the bells next to them with clubs, and they then turn their heads to look left and right along Fleet Street (**photo 3**).

In Basildon, Essex, the *Cat's Cradle Pussiwillow III* clock, built by Rowland Emett in 1981, is still

2. On the hour, Messrs. Fortnum and Mason emerge over the entrance to their store in Piccadilly, London.



3. The Giants of St. Dunstan's strike the bells with clubs, every quarter hour, at the Guild Church of St. Dunstan-in-the-West.

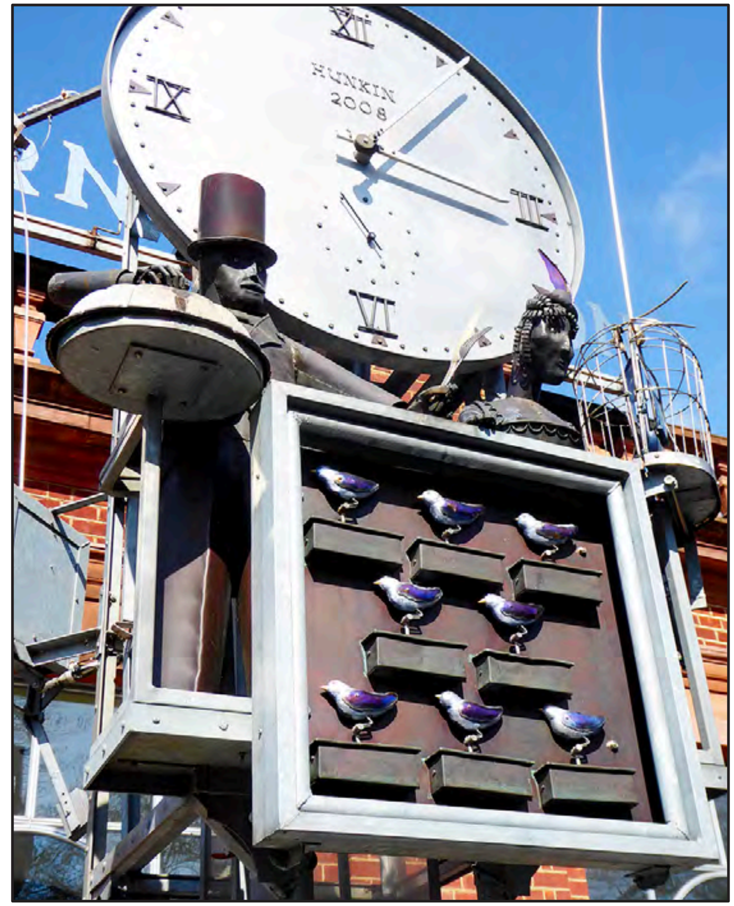
working in the Eastgate Shopping Centre. On the hour, every hour, the bell rings, the bicycle wheels begin turning, and a variety of figures move around the structure, telling the story of Edward Lear's *The Owl & the Pussycat* (**photos 4** and **5**). Emett was renowned for his whimsical machines. Although the majority of them are in the UK, examples can be seen in the Mid-America Science Museum, in Hot Springs, Arkansas, the Ontario Science Centre, in Toronto, Canada, as well as in the Museum of Science + Industry, in Chicago.

Emett was a great cartoonist, designer, and builder of "things." He is perhaps best known for the machines that he designed and constructed for the 1968 movie, *Chitty Chitty Bang Bang*, which featured his *Humbug Major Sweet Machine* and the *Little Dragon Carpet Sweeper*.

Located outside the Blackburn Pavilion (bird house) in the grounds of the London Zoo stands a rather splendid clock built by Tim Hunkin, in 2008. Tim is a self-confessed clock lover and has built several more around the UK that incorporate automata. Perhaps the most famous of these is the water clock at Southwold Pier, where two

4. Rowland Emett's *Cat's Cradle Pussiwillow III* clock in Basildon tells the story of Edward Lear's *The Owl and the Pussycat*.

5. A closer view of the owl and the pussycat.



6-8. Tim Hunkin's elaborate automaton clock at the London Zoo's Blackburn Pavilion. The man reveals a bird beneath the lid of his pan, while the woman opposite holds a bird in a cage. During the performance, birds vanish and appear, fly around, and pop out of the man's hat.

boys drop their trousers and pee, unsuccessfully, into a toilet bowl.

The one at the Blackburn Pavilion, to my mind, is superior because of the clever pneumatic engineering and the intricacies of the design and movement of the automata (**photos 6-8**). On either side of the base of the clock, toucans peck at the main pendulum to start the movement every thirty minutes. There are male and female figures above a display case of eight beautifully colored birds. The man, in a top hat, has a knife and fork in one hand, his other on the handle of a pan. The woman holds a cage containing a similarly colored bird. The man shakes his knife and fork and lifts the lid of the pan, where another bird is seen trembling inside.

The birds in the display case disappear, one by one, popping up at various places around the clock, including out of the man's top hat and on the woman's bodice. The man lifts the lid of the pan once more to reveal the bird. He then replaces it and, upon lifting it again, the bird has gone and is flying around the clock. The woman opens her birdcage and the bird flies out, wings flapping, and joins the other. The heads of the two figures twist back and forth, trying to watch the flight of the birds around the clock. The toucans at the base vanish, then reappear at the top of the clock, squawking. The birds in flight gradually slow down, one gliding back into the cage, which closes, and the other into a box adjacent to the meat pan. The toucans and the eight birds then return to their original positions.

The Swiss Centre, in London's Leicester Square, was opened in 1968 to showcase Swiss culture and promote tourism. It didn't meet expectations and was demolished in 2008. However, the Swiss glockenspiel and clock, which were popular with tourists, were retained and moved to nearby Swiss Court. Twenty-seven bells are struck by Swiss mannequins every hour, and the base rises to reveal eleven carved, animated figures and animals moving in a procession (**photo 9**).

In Gloucester, at the Cross, above the beautifully preserved Edwardian shop of G.A. Baker & Son, jewelers, is an interesting clock, built in 1904. There, five bells in the automata display are struck every quarter hour by life-size figures. The center bell is struck by Old Father Time, in the middle of the group and pulling on a rope. The other characters striking bells in front of them are from Ireland, England, Scotland, and Wales, respectively (**photo 10**).

Situated at the Regents Arcade, in nearby Cheltenham, is a much more modern clock, built in 1986

ABOVE: 9. The processional on the clock at Swiss Court in Leicester Square.

BELOW: 10. Old Father Time pulls the rope to ring the center bell above the shop of G.A. Baker & Son in Gloucester.

by Kit Williams (**photo 11**). He is the writer and illustrator of *Masquerade*, the 1979 picture book that contained clues to a golden jeweled hare he made and then buried somewhere in the UK (it was later discovered at Ampthill Park, in Bedfordshire).

11. Kit Williams's Wishing Fish Clock, at Regents Arcade, in Cheltenham, is one of his three public clocks.

The clock structure is 45' (13.7m) tall and thought to be the tallest mechanical clock in existence. It features a number of eclectic characters. There is a goose that appears to lay a never ending stream of golden eggs, and a family of mice that continually tries to escape a snake chasing them on the top. Suspended from the bottom of the clock is a large wooden fish that blows bubbles every half hour, to the tune of "I'm Forever Blowing Bubbles." The working and structural parts were built by Michael Harding, of the famous Sinclair-Harding, makers of fine clocks since 1967.

Moving on, fifty miles from the Cotswolds is an interesting clock located in the city of Coventry. This is based on the 13th-century legend of Lady Godiva, who rode naked on a white horse through the streets of Coventry to gain remission from the high taxation that her husband, the Earl of Leofric, had placed on the citizens. The clock, now on Broadgate Square, was originally in the old Market Hall Clock Tower, which dated from 1870. Following damage during WWII, the clock was moved to its present loaction (**photos 12** and **13**).

On the hour, the bell strikes, a door on the right opens, and Lady Godiva, with golden hair and seated on her white horse, travels across and disappears through the door on the left. While this is happening, a window above opens and out pops

12 and 13. Lady Godiva takes her famous ride every hour. As she passes, Peeping Tom takes a look. The figures were carved in wood, by sculptor Trevor Tennant. Mechanical elements were the work of City Architect Donald Gibson and apprentices from the local college.

the head of Peeping Tom, the only citizen to have watched the ride, as all others stayed away in respect for what she was doing. He has a peek and covers his eyes (the legend says that he was struck blind), then quickly moves back in. The window and doors then close until the following hour.

For the final entry in this short tour of automata clocks, I traveled to Edinburgh to view the Millennium Clock, in the National Museum of Scotland. Standing 33' (10m) high, it is in the shape of a medieval cathedral. According to the museum: "It marks the passing of time but is also a summary of the best and worst of the 20th century." Although the wood is new, the metal sections came from the Scottish scrapyards. At the center is a pendulum with a large convex mirror attached, in which you can see the crowd reflected, waiting in eager anticipation for the chiming of the clock (**photo 14**).

The tower is divided into four sections. At the bottom is the Crypt, full of wheels and chains, where an Egyptian monkey strains to turn the largest wheel, setting the others in train (**photo 15**). Above this is

LEFT: 14. The Millennium Clock, in the National Museum of Scotland, in Edinburgh. The awaiting crowd can be seen in the convex mirror that forms part of the pendulum. This tower was created by five master craftspeople: a furniture maker, a kinetic sculptor, a glass artist, a clockmaker, and an illustrator.

ABOVE: 15. The Egyptian monkey turns his wheel, setting the other wheels in motion.

the Nave, where all manner of figures, among them Hitler, Lenin, Einstein, and Chaplin, move around the pendulum. The next higher section is the Belfry, which houses the Requiem clock face and panels of colored glass. The Requiem is a circle of twelve carved figures representing the horror, pain, and suffering of victims of the past. The topmost section is the Spire, with a cross formed by a female figure carrying a dead man. They symbolize compassion and pity.

The automata that populate the clock were all carved and animated by Eduard Bersudsky, one of five builders of the clock. He was born in St. Petersburg in 1939 and is, sadly, now retired. A large selection of his amazing work can be seen in the Sharmanka Kinetic Theatre, in Glasgow (see *AM*, September-October 2019).

16. Twelve rotating stone figures in the Requiem represent horrors from the past: war, famine, slavery, and persecution.

At last, nearly three minutes late, to the accompaniment of Bach's powerful organ music, the various sections of the clock become illuminated in turn. Chaplin bangs his cane, Einstein plays the violin, and Lenin swings from side to side, with distorted statues of Hitler and Stalin looking on. A number of other moving models join in—an organ grinder, a dancer, a cyclist—all with the lights switching in synchronization with the music and movement. Everywhere wheels turn, chains rise and fall, and bells are rung. The tragic figures in the Requiem begin to slowly rotate, revealing the disturbing nature of the limestone carvings (**photo 16**). About them Bersudsky said, "To make it took eight weeks and all my previous life in Russia."

I managed to visit ten clocks, in streets or on public display around the UK, that range from automata to kinetic sculptures. From those with the simplest of operation to those with complex interactions of light and movement, they all act out a story through moving figures.

To be dogmatic and to try to draw a line between these mobile creations would surely detract from the enjoyment of watching mechanics and art in harmony. Doing so would certainly mean missing out on viewing examples of creativity and imagination that are moving, in an entirely different meaning of the word.

How I started making automata

A wood carver becomes an automatist

by Ivan Morgan • Lewes, East Sussex, UK • Photos by the author

A sampling of the author's automata.

It is interesting to read about how fellow automata makers began their work, as well as the other things they do, so I thought that I would share my story. When my children were young, I used to make lots of wooden toys for them, rather than buying plastic ones. These included an Action Man Jeep, a garage, a doll's house, a Sindy kitchen, and even a doll's pram.

When I retired from my office job, I set up a workshop. This was originally in my garage but now I have a nice shed/workshop. I started making all sorts of creative items from wood, including photo frames, pots, letter racks, and clocks—all unique and many quite quirky. I also joined a local wood-carving group called Bentley Wildlife Carvers and started carving birds and animals. Most of these are stylized and polished. Some are shown in **photo 1**.

In 1997 I visited Cabaret Mechanical Theatre, at Covent Garden, in London. There, I was inspired by the automata made by the great Paul Spooner, and I appreciated his humor. On the train journey home I thought of an idea for my own automaton. Within a fortnight I had made my *Secretary Bird* (**photo 2**), which I still have.

I continued making all sorts of things, but only the occasional automaton. However, within the next few years, I had made quite a few more. At an exhibition at my

1. Some of the author's carved birds, done in a variety of different woods.

2. *Secretary Bird*, the author's first automaton.

home, I sold several (at ridiculously low prices). I later concentrated more on building automata, making copies of some of the ones that I'd sold.

Making automata has now become my passion. I like to play on words in the titles of the models, so nearly all of my automata have an amusing and quirky name. Some have double meanings, like *Turkey Plucking*, *Nest-café*, and *Tug-a-Worm* (**photos 3-5**). My automata vary enormously, from extremely simple to quite complicated, but all are of a manageable size—usually no more than 15cm (6") wide, which makes storing the collection manageable. As I no longer part with any of my pieces, the collection is growing steadily and storage is becoming more of a problem!

I have made nearly two hundred automata now, including quite a few "mini-mechanicals," and currently have around sixty-five different ones in my collec-

ABOVE LEFT: 3. *Turkey Plucking*. The strings contained in the box below the turkey are actually plucked as the crank is turned.

ABOVE RIGHT: 4. *Nest-café*.

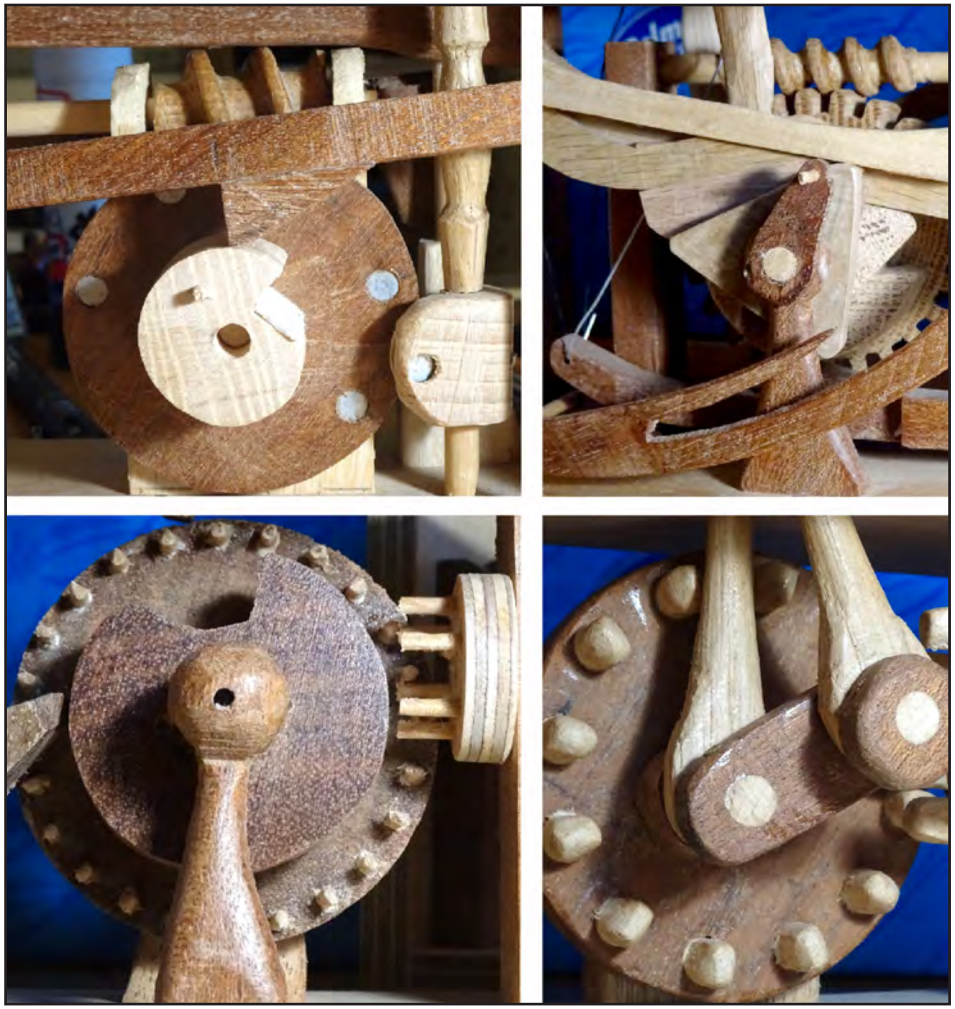
LEFT: 5. *Tug-a-Worm*. The bird and the mole struggle for control of the worm.

tion. All are hand cranked and are made mostly from offcuts of wood or pieces that I have salvaged from skips.

I prefer to leave my models unpainted, so I try to use contrasting woods, then polish them. Some models do need a bit of color. In those cases I use colored wood stain so that the grain of the wood still shows through.

The name is usually the starting point for an automaton. I then work out the mechanism that I think will be needed to get the model to perform the action. I usually do this in my "ideas book" or on the back of an envelope.

I then start carving the cogs and cams as I go along. There is no master plan—the model just evolves, step by step, until it performs as I had envisaged. There is a lot of trial and error involved, but I usually get there in the end. I hand carve all of the cogs, cams, and worm drives, often several times before I get them right, but that is all part of the learning process. Alas, a few automata have ended up in the "to finish" pile!



Some of the different mechanisms used by the author in his automata. Note the contrasting types and colors of exposed wood.

I use magnets in some of my models, especially my mini-mechanicals. I buy sets of Geomag, a construction toy comprised of magnetic rods and metal balls. Each rod contains two powerful 3mm x 6mm (⅛" x ¼") magnets. The balls are also useful for marble runs and that sort of thing.

I don't have a permanent exhibit, but in recent years I have had an annual open-house exhibition. I also show most of my work at the local annual Woodfair. It's great to see adults and children alike operating and enjoying the models, peering at the mechanisms to see how they all work. Some automata are charming because of their simplicity, while others are really intricate, and that makes them interesting, as well.

Designing and making the automata is most of the fun for me, but allowing other people to see them is also good. YouTube is brilliant for that. So far, I have had over 250,000 views of the videos I have posted there. AM

To see more of Ivan Morgan's work, visit his website at *www.positivelycreative.co.uk* and check out his YouTube channel: positivelycreative: *https://tinyurl.com/positivelycreative*.

The fuller

An animated model of an ancient process

by **Barry Falkner** • Otley, West Yorkshire, UK • Photos by the author, except where noted

Fuller and His Fulling Machine. As the fuller turns the crank, the beaters rise and fall, in the author's rendition of a fulling mill.

Several years ago, on a visit to the V&A Museum of Childhood in Bethnel Green, London, I saw a crude wooden toy based on a fuller working a fulling mill (**photo 1**). I took a couple of photos of it through the glass of the display cabinet, and these went into my photo library of interesting toys and automata. I found a similar example of this type of toy (**photos 2** and **3**), in the archive of Brocante de l'Orangerie, a French website dedicated to antique toys. Based on a handwritten note that came with the toy, it is believed to date from 1775.

My photos were ignored, until I rediscovered them in the autumn of 2019, when I was looking for

Photo courtesy of the V&A Museum of Childhood

1. The toy fulling mill in the V&A Museum of Childhood, in London.

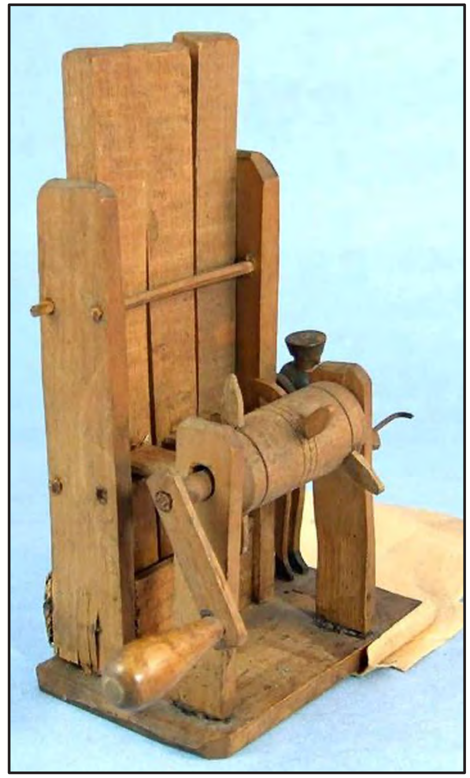


Photo courtesy of Brocante de l'Orangerie – Binetruy.org

Photo courtesy of Brocante de l'Orangerie – Binetruy.org

2., 3. This French toy fulling mill is thought to date from 1775.

something to make. A fulling mill looked like a good subject for an automaton and appeared to be relatively straightforward, mechanically. That would be a nice change.

Fulling was an age-old process in the making of woolen cloth. It involved cleansing the cloth and making it thicker. In earliest times, the worker, doing the job by treading on the fabric, was called a fuller (from the French word meaning "to tread"), a tucker, or a walker. All of these words have become common English surnames. The fulling process was mechanized in medieval times, usually being powered by a water mill (**figure 1**).

Figures 2-5 show my design drawings and 3D models. I made the frame from black 8.5mm ($\frac{5}{16}$") Valchromat, a type of colored MDF. This is a favorite material of mine, as it is easy to work and quite stable. **Photo 4** shows the

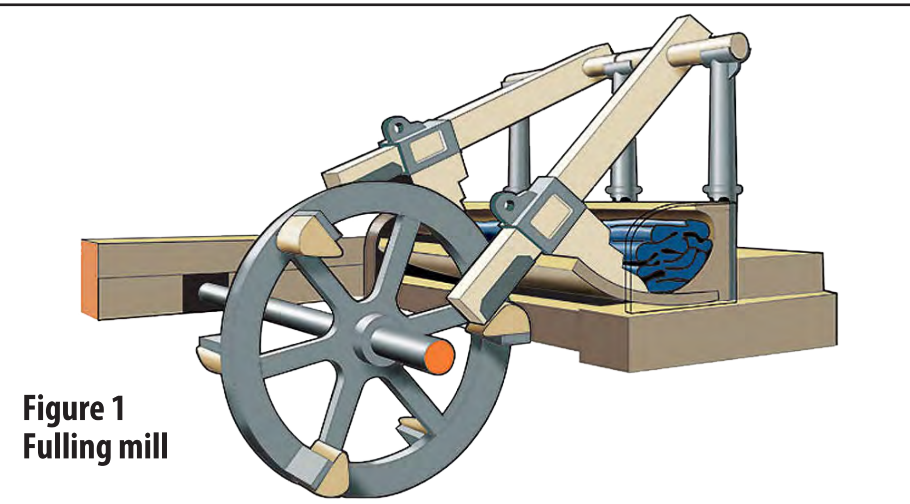


Figure 1
Fulling mill

Illustration courtesy of norfolkmills.co.uk

Figure 2

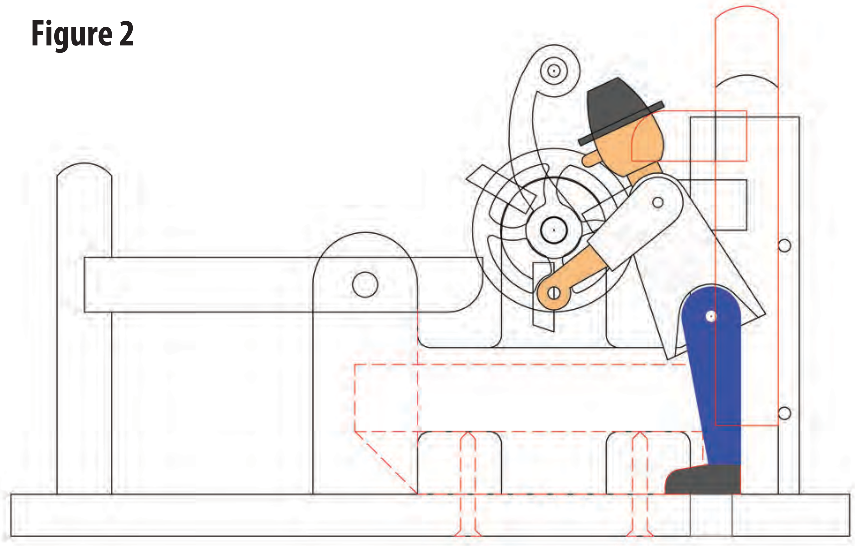


Figure 3

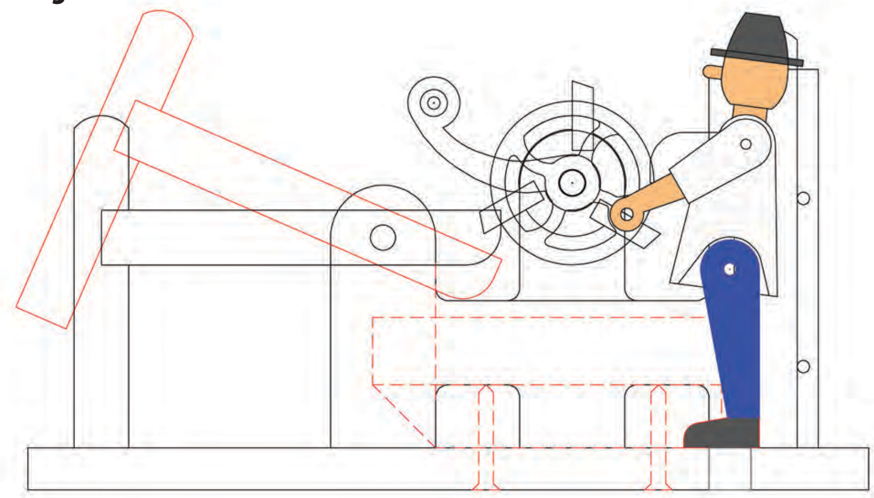


Figure 4

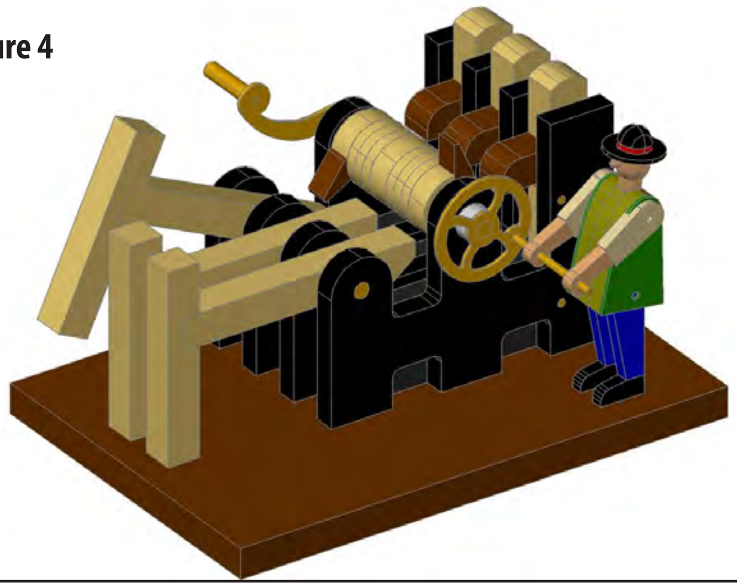
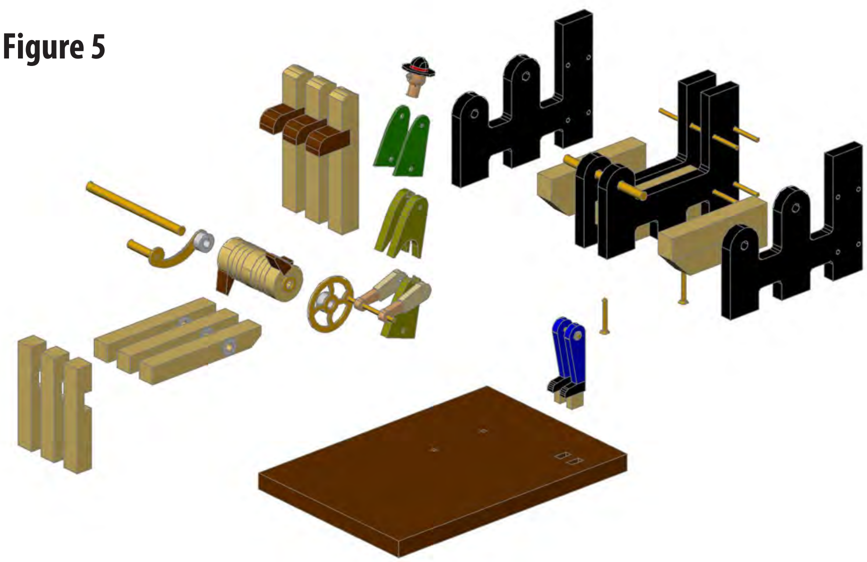
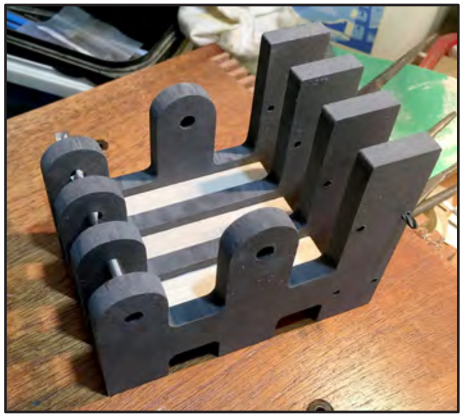


Figure 5



frame during construction.

Spacers are softwood. For the roller, I used birch-slab wheels—purchased from eBay—three 9.5mm diameter x 25mm (⅜" x 1") and six 4.5mm diameter x 25mm (³⁄₁₆" x 1"). The lifting pegs are mahogany, and the hammers are beechwood. The vertical lifters have mahogany inserts. Axles are 6mm (.236") and 6.5mm (.256") brass rods. The handle and wheel



LEFT: 4. The fulling mill's frame, made primarily of Valchromat. Spacers are softwood.

RIGHT: 5. The finished fulling mill. This is the side from which the observer cranks the machine.

BELOW LEFT: 6. The figure's body is made of plywood. His head came from a wooden doll.

are made from 1.5mm-thick (.059") brass sheet. These are soft soldered onto brass R/C-aircraft-wheel collets (again from eBay), with which they are attached to the brass rods. A view from the off side is shown in **photo 5**.

The figure's body (**photo 6**) is made of plywood, and the head is from a wooden peg doll from eBay. The base is 12mm (15⁄32") mahogany, rescued from an old microscope case. The fabric basket is a doll's-house accessory, found on eBay.

I used Humbrol acrylic, for the first time, to paint the figure. I found it to be perfect, being easy to use, fast drying, and quite resilient. There was no need for varnish. I stained the frame with black leather dye, which blended the Valchromat and softwood together. All parts, except for the painted figure, received a coat of beeswax polish.

The drumming action of the finished automaton is satisfying to me. I added felt pads to the underside of the hammers, as I got complaints that they were too noisy!

You can see a video of the author's *Fuller and His Fulling Machine* on YouTube: *https://tinyurl.com/BarrysFuller*

Brocante de l'Orangerie website: *https://tinyurl.com/OrangerieFuller*

LEGO AUTOMATA

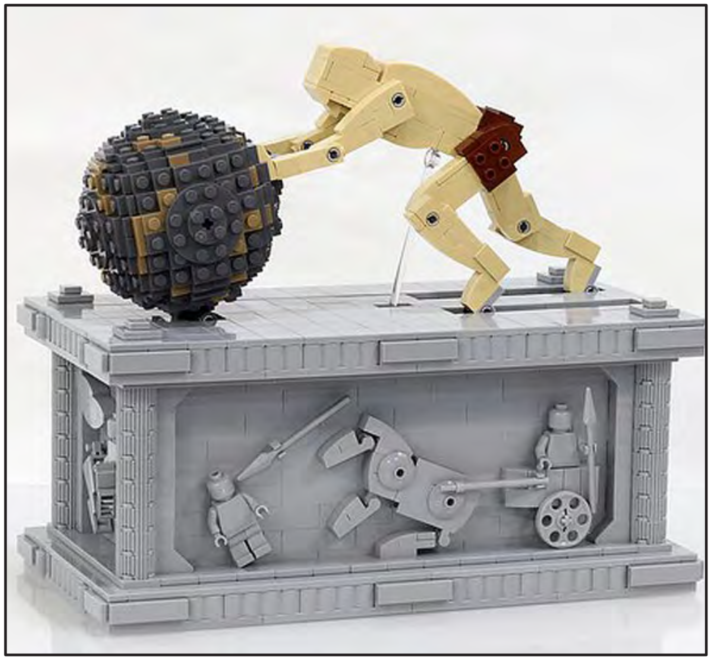
JK Brickworks

by Teun de Wijs • Amsterdam, The Netherlands • Photos courtesy of JK Brickworks

In the previous issue, I covered the rare occasions on which LEGO released official automata sets, and I lamented that there were so few of these. I'm glad to begin this column with a happy update. In May of this year, LEGO released a beautiful animated set featuring Harry Potter's owl, Hedwig (see the links section). This is definitely going on my Christmas list.

This was another small move in the right direction by LEGO. However, the AFOL (Adult Fan Of LEGO) community is where it's really happening, and any account of automata models by fan builders would have to start with JK Brickworks. JK is the shared moniker of Canadian LEGO- and real-life partners Jason Allemann and Kristal Dubois.

Kristal Dubois and Jason Allemann, in Denmark's prestigious LEGO House, where they were invited to display their models. This honor has been bestowed on only fifteen fan builders worldwide.



Sisyphus, one of Allemann's most famous models. In the Greek myth, the wicked king Sisyphus is cursed by Zeus for angering the gods and must roll a rock up a hill until the end of time. The movement of the legs is achieved by a Hoeckens linkage and the box is beautifully decorated with scenes from the myth.

Pursuit of Flight. This elegant model by Allemann could have been the first kinetic set for LEGO IDEAS. It reached 10,000 supporters easily but was unfortunately not approved by the LEGO jury. Luckily, instructions are available online, as are those for Star Wars- and Christmas-themed versions.

Jason Allemann

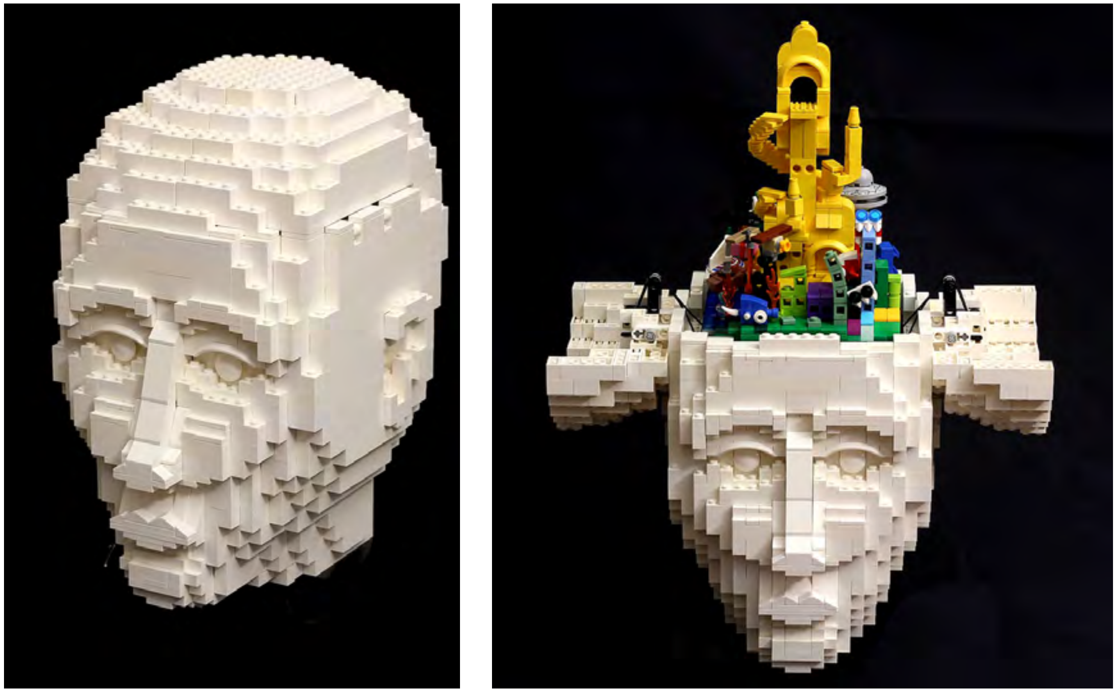
Allemann was already an established name among LEGO enthusiasts because of his amazing models, but his exposure skyrocketed when everyone's favorite Mythbuster, Adam Savage, showcased his beautiful automaton *Sisyphus*, in a video for *Tested.com* (see the links section). The video was seen by millions; Allemann's reputation as a master LEGO builder was cemented, and rightly so.

Allemann is a prolific artist, whose models are incredibly diverse. Be it a clock, a trebuchet, a mosaic-tile printer, an orrery, a combination safe, or a particle accelerator, Allemann has always pushed the boundaries of the brick. He is one of only three fan builders in the world to have had not one, but two of his designs—a marble maze and a pop-up book—produced as official sets through LEGO IDEAS. He has used his experience as a software developer by co-founding Fx Bricks, a company that produces LEGO-compatible "smart bricks" that can be programmed for sound, movement, and light effects in many different types of construction.

After rediscovering LEGO in his late twenties through Star Wars sets and LEGO MINDSTORMS (a groundbreaking line of programmable LEGO), Alleman applied his creativity to various styles of building. However, a video about Disney's computation design of mechanical characters, and the work of automata maker Dave Johnson (see the links section), inspired him to build his own kinetic models.

Allemann's automata stand out not only by their clean professional design and playfulness, but also because of his great attention to realistic movement and economy of mechanism. He is a perfectionist and his deceptively simple mechanisms are the result of many hours of prototyping. In his 2019 keynote presentation at BrickCon, he explained how his models go through various incarnations, and said that he keeps the whole series of prototypes intact to improve upon until the model reaches its optimal form.

(Text continued on page 41)



Inside the Mind of a LEGO Artist, the first in a series of three psychology-themed kinetic sculptures by Kristal Dubois. When the head is opened, a yellow castle tower telescopes out, surrounded by an intricate landscape of brightly colored, micro-built fantasy elements.

The Engineer, the second in Dubois's *Inside the Mind* series. The side of the head opens and a platform slides out, revealing spinning gears, pumping pistons, and even a light powered by a LEGO motor used as a generator.

Robot Dreams. A fairly large movement within the LEGO community specializes in Great Ball Contraptions (GBC)—modules that pass balls along in technically interesting ways and that can be linked together to form one big machine. Allemann's contribution packs a lot of personality by having different colorful robots happily doing the work.

Skating Penguin is based on the classic trammel of Archimedes, which Dubois discovered by accident and used to create this delightful model.

Kristal Dubois

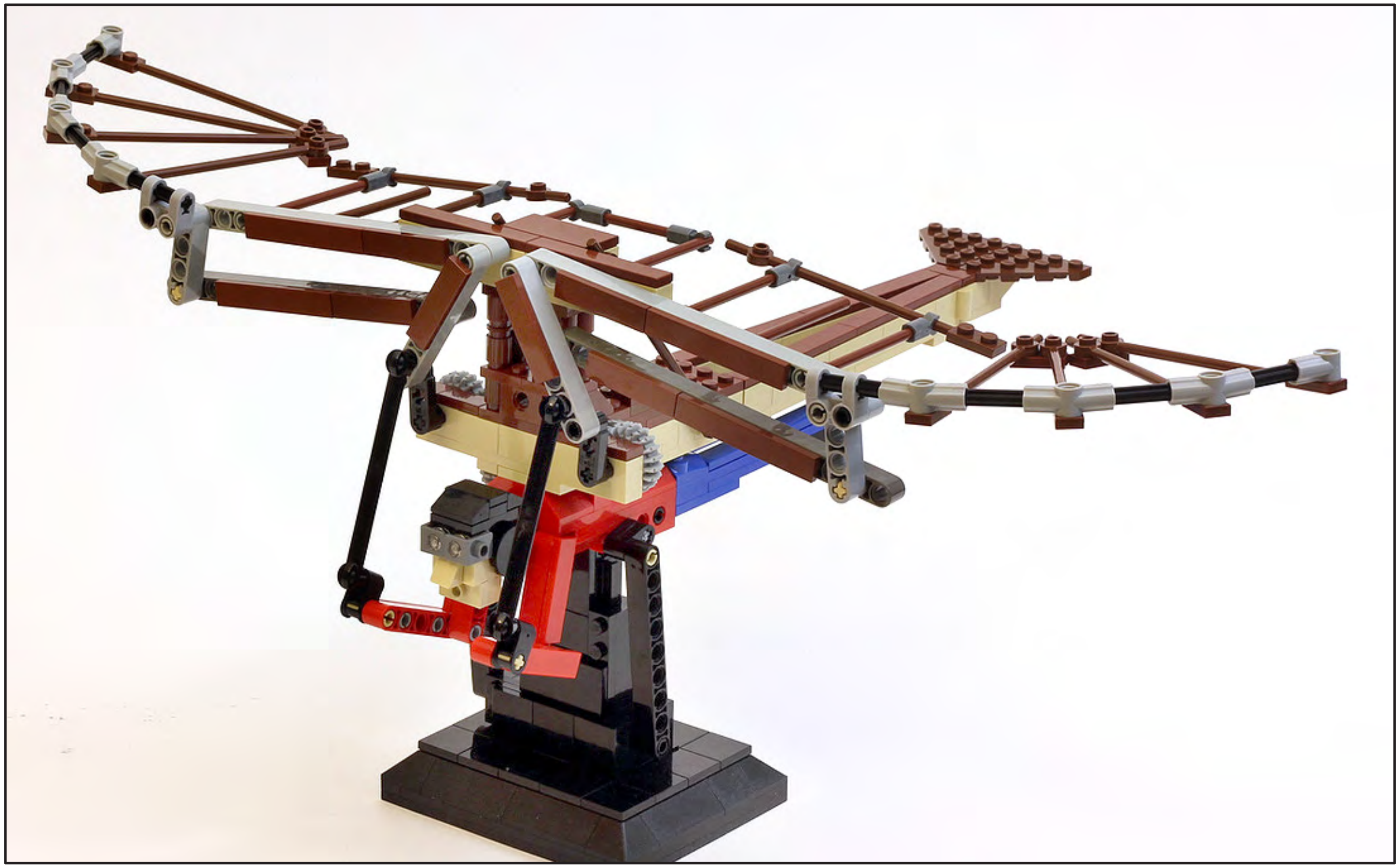
Unlike her partner, Dubois never played with LEGO as a child. She only started building after moving in with Allemann, but she discovered a definite talent for the brick and soon made up for lost time. Because of her busy life as a schoolteacher, Dubois may not be as prolific in her output as her partner, but her models are not to be underestimated. Her perfectionism is just as great as Allemann's and she truly has a style of her own. Besides their love for LEGO, Allemann and Dubois share a passion for the great outdoors. Her models are often inspired by nature but she also has a knack for out-of-the box thinking that leads her into unexplored creative territory; this sets her kinetic models apart from more traditional automata in both form and movement.

Prairie Dogs, one of JK Brickworks' latest models, is a collaboration between Allemann and Dubois. Curious prairie dogs peek out of their burrow. Each one has a different mechanism, which adds a lot of life to this cute model.

What must also be admired is the style, modesty, and charm with which the couple live up to their role as unofficial LEGO heroes. They are regulars at many LEGO events and are always happy to talk to fans. In many cases, JK Brickworks offers free online building instructions for the models, and every build is accompanied by a nicely produced

YouTube video that highlights the model and its inner workings.

Many of these videos feature Allemann only, but in recent times Dubois has joined him for some well-deserved time in the spotlight. Watching them demonstrate and listening to them explain the various mechanisms in their wonderful models is always a pleasure. I highly recommend that you explore their website and YouTube channel (see the links section). You'll be amazed and amused by this couple's imagination and skill. Enjoy! AJ



The Aviator. Allemann based this model on the iconic designs of Leonardo da Vinci. It makes excellent use of modern LEGO parts, and the stylish wing movement and brave-looking aviator would have made da Vinci proud.

Links

JK Brickworks official
https://jkbrickworks.com/
https://www.youtube.com/user/truedimensions
https://www.facebook.com/JKBrickworks
https://www.instagram.com/jasonallemann/

Fx Brick
https://www.fxbricks.com/pfxbrick/

Support JK Brickworks
https://jkbrickworks.com/supportus/

Adam Savage builds *Sisyphus*
https://www.youtube.com/watch?v=U46Yo_6z_F4

Dave Johnson
https://www.youtube.com/user/djohnson16mindspring/featured

Disney Computational Design of Mechanical Characters
https://www.youtube.com/watch?v=DfznnKUwywQ

New Hedwig automaton set by LEGO
https://www.lego.com/en-nl/product/hedwig-75979

Building Blocks

Linkages and motion: Part 2

by Paul Giles • Sun City Center, Florida, USA • Drawings by Marc Horovitz

The proper arrangement of linked systems can provide movements that cams or gears can never duplicate. The best example of links and pins outperforming other mechanical devices just might come from the medical field. **Figure 1** is a six-bar diagram of a prosthetic knee. These links would be lighter, more durable, and more comfortable than an equivalent cam or gear system. Linkage systems can also be easier to build.

Linkage systems can provide a little fun and some new looks to your automata, so maybe you should ask yourself if you can make a link system do some specific things. Many of the motion examples shown in Part 1 of this article could be repeated with cams, but those were just linkage building blocks. Remember, a cam can easily grow into a complicated profile, and the more complex it looks, the more difficult it may be to construct and operate properly, without a resulting bouncy, erratic motion.

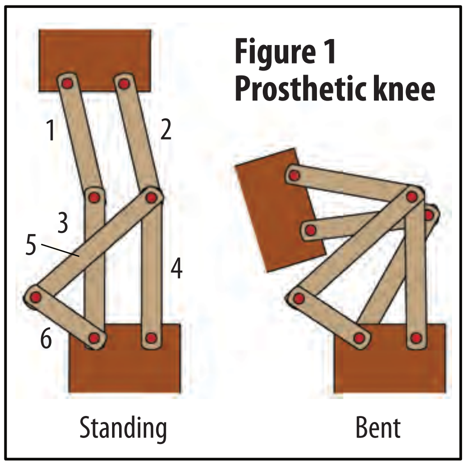


Figure 1 Prosthetic knee

In many automata projects, a straight-line motion comes in handy, yet there are times when a simple slider just won't work. Have you ever wanted some of your project's action to be above the base, or even above the primary focus? Think of a determined bear reaching into a hive full of honey, while a persistent bee buzzes the thieving bear's head. The bee needs to move across empty space. You can make that motion happen if you begin with a pair of scissors. Just add a few more blades (links) and watch that bee fly (**figure 2**).

This scissoring mechanism also gives an added benefit. If those links are a bit thin, and if that bee

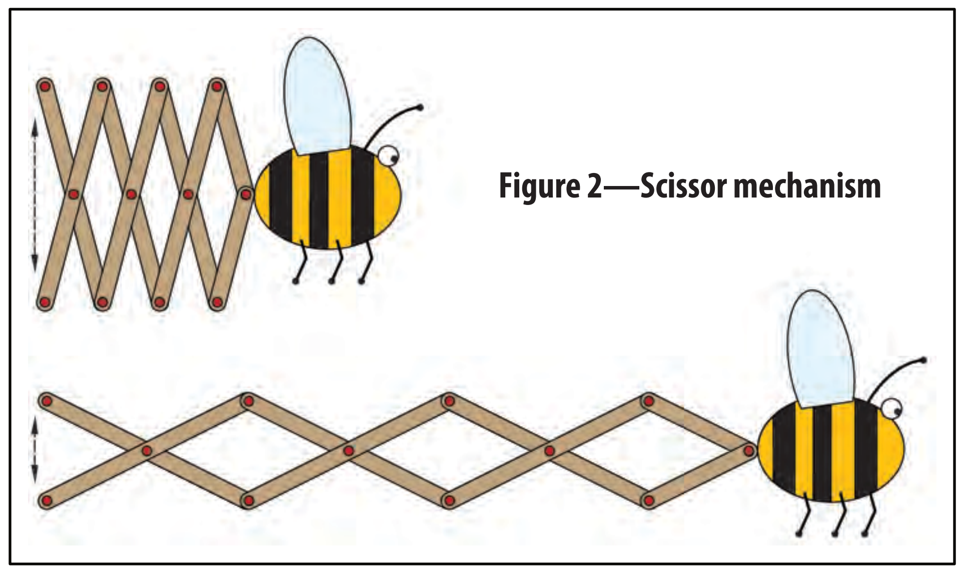


Figure 2—Scissor mechanism

has perhaps been eating a little too much of its honey, then as it flies out to the bear, it will naturally drop a little when it leaves the hive. Two motions with only one mechanism have been created.

This scissors mechanism can also be used for a very different purpose. This time think of a dog sneaking up on an unsuspecting cat. At the last moment the cat senses trouble and streaks away.

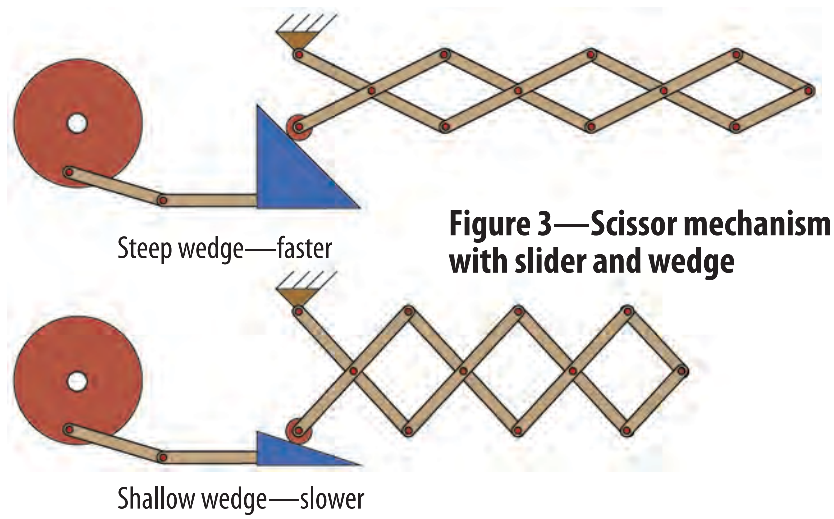


Figure 3—Scissor mechanism with slider and wedge

The simple slider I mentioned earlier will work well for the dog. If you add a wedge to the arm of the slider, as the dog gets close to the cat, the wedge will engage the free end of the scissoring mechanism. The further the mechanism closes, the faster the cat will flee (**figure 3**). The simple slider and the new tool are combined to create two different speeds. And that speed difference is adjustable—just change the angle of the wedge.

A linkage system can often do more than one good thing. However, it may also do things that you don't want if you are not careful. Look back at a previous example of moving two objects in equal-but-opposite directions (**figure 4**). If you take those same three links but pin them differently, the center point of the middle link will now move in a straight line (**figure 5**).

A nice feature of this straight-line movement is that its path can be forced in any direction that you choose simply by adjusting the two anchor points (**figure 6**). But this newfound freedom of motion comes with a bit of a cost. If you are not careful in controlling the amount of movement, the path will turn into a figure eight (**figure 7**). Fortunately, it's easy to control this and all other linkage motions. Instead of giving the input a rotating motion, change it to an oscillating back-and-forth path. The simple slider is fast becoming a

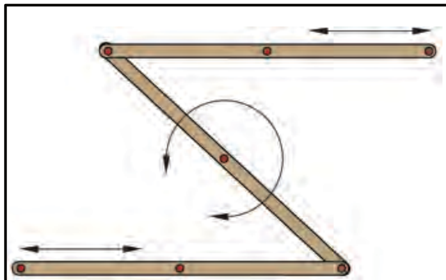


Figure 4
Opposite-direction motion

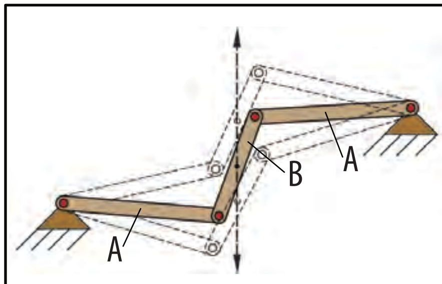


Figure 5
Vertical straight-line motion

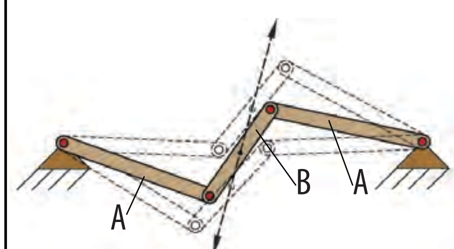


Figure 6
Straight-line motion, adjusted anchor points

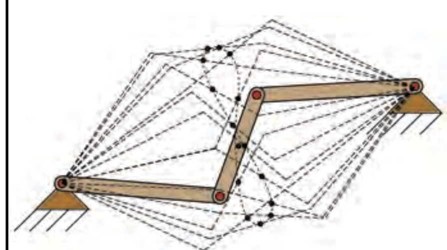


Figure 7
Path in a figure 8

workhorse (**figure 8**). Using a slider this way is one of the easiest tools available for changing rotary motion into a controlled linear path. All that must be done with a slider to control the reciprocating action of the following linkage assembly is to lengthen or shorten the arms (**figure 9**).

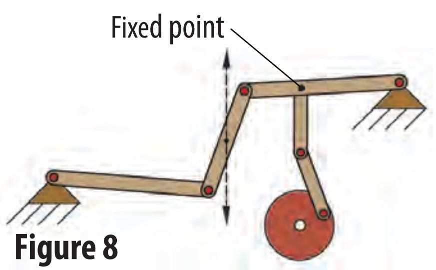


Figure 8
Straight-line motion, controlled by slider

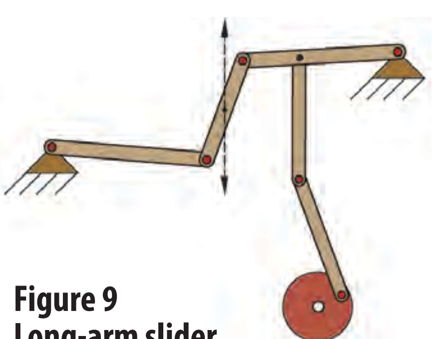
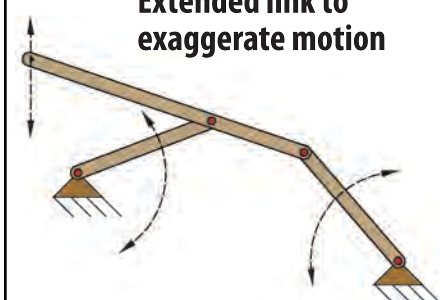


Figure 9
Long-arm slider

There is another reason to control the full motion of your link systems. Without using a lot of complicated math, almost every link system that can be devised will have one or more critical points where stuff just doesn't work. For instance, two links can bind or a lot of stress can be created on a pin or an anchor. It's even possible to create tiny, unintended loops in the motion. In the worst case, too much motion can cause the linkage systems to lock and break. To fix this in an automaton, it may be necessary to adjust the lengths of the links or slightly move the pins around.

Back to straight-line motions. There are many link arrangements that can produce a straight line. They all have their uses. When the dog has finished chasing the cat, she's off to the park to play with the butterflies. How can you capture that trip to the park with your own automata feature? A slider can give the motion but it will also give the appearance of restricting the dog's freedom. This time the motion will be outside of our focus on the dog. Levers are better than the slider for this, but if the pup wants to jump really high, then this arrangement becomes too long and the motion becomes too fast to be natural. The three links shown in **figure 10** once again shift their anchor points and produce a higher, less jerky motion that we want in her leaps.

Figure 10
Extended link to exaggerate motion



There is no real limit to the number of pins, anchors, and links that you can design. We are working our way now toward a seven-bar link system that will astound your friends and family with your automata skills. But first you must understand why some linkage systems can get so complicated.

Many promising link designs just need a little more stability. We don't want to see too many sagging-bee movements. To get rid of that droop, you can create a series of links that will provide the same rigid body as a solid object but with much less weight. These are often simple triangles, as found in a building's construction, where they are called trusses (**figure 11**).

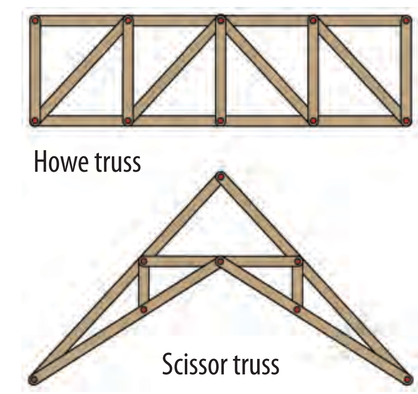
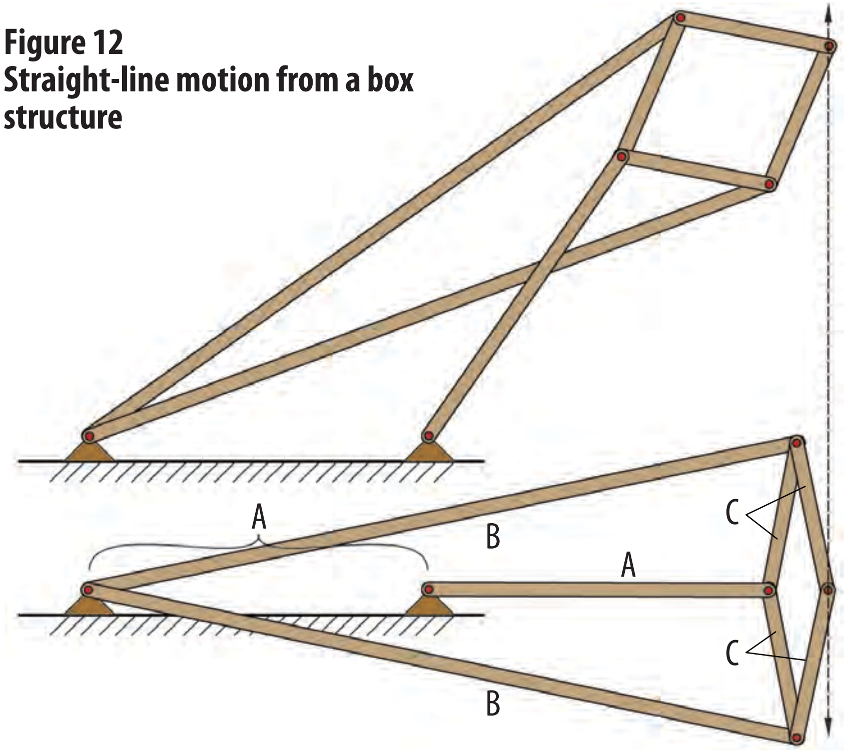


Figure 11—Trusses

Keeping everything rigid is why the next example of straight-line motion has so many links (**figure12**). This assembly is also one of few that will allow a full circular motion at the input point while

Figure 12
Straight-line motion from a box structure



still describing a back-and-forth straight path.

The four short links are equally sized and create a box. They also have flexible connections. The two long links that are anchored on the left will sometimes push and sometimes pull on the opposite corners of the box. An outside input will move the link that is pinned to the right anchor. This last link must equal the distance between the two anchors. As this link moves in its circle around the anchor point, it will also push or tug on its own corner of the box. The remaining corner of the box will describe the straight line as it moves. (Remember, too, that a system this complicated must have some depth so that all of the parts are free to move past each other.) As that box is pushed around every which way, that free corner will move in and out, exactly as wanted. The larger you make these parts, the longer the straight line will be.

GALLERY

Beth and Seth

by Nancy Hart
Orleans, Massachusetts, USA
Photos by the author

Beth finished her shower first , then inadvertently locked her husband in the shower stall. He hollered for her but she had gone to the other side of the house and was playing her flute in the garden, so didn't hear him.

Seth waves his arms, and Beth's head and flute move up and down, pulled by strings. The mechanism, inside the house, is activated by pushing down the lever on the side of the house.

To see videos of Beth and Seth, click *here*.

Get Moving

Tea Time

by Kim Booth • Berlin, Germany • Photos by the author

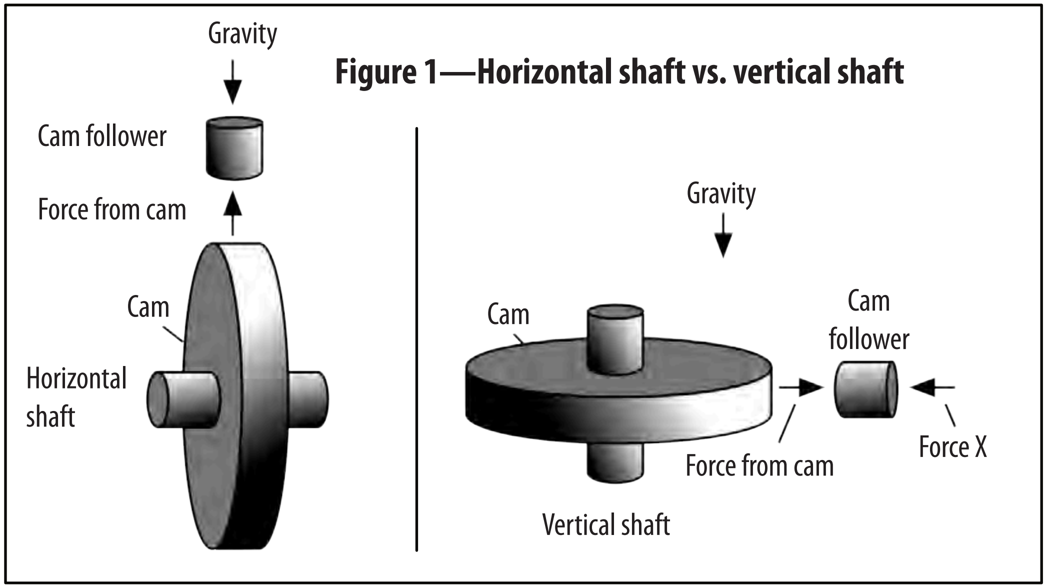
As an Englishman in Berlin, I am naturally a staunch defender of English culture. Being so, I aim to sell the benefits of teatime to the pagan Germans, who much prefer coffee! When two chatty friends get together, the benefit of having to drink tea is that, while one is drinking their delicious tea, the other can chat, and vice versa. The more vivacious the chat the better, so wagging heads and hair and dangling earrings are a must (**photo 1**).

1. Dangly earrings are a must.

The technical brief

I like the idea of cams controlling things, but as I live in a small flat, I see a drawback in the size of the base needed to accommodate cams that revolve around a horizontal axis. I wondered whether

Two ladies have a congenial chat over a cup of tea.



2. This dog bears a striking resemblance to its owner, as dogs often do.

3. The spider revolves with the rotating table, unbeknownst to those above.

arranging the cams to turn around a vertical axis was feasible and whether the resulting base would be more compact. **Figure 1** shows the two options. At first sight, the vertical-axis option looks distinctly flatter.

With a horizontal shaft, as the cam turns, the cam follower is pressed onto it by gravity. As the edge of the cam moves up or down, the follower moves with it (follows it). With a vertical axis, gravity stubbornly remains a vertical force, so some other force (X) is needed to keep the follower in contact with the cam. It does mean, however, that several followers could share the same cam with a "phase" difference, depending upon how far apart they are, angularly speaking.

Force X could be a spring or it could be a weight attached to a piece of suitably routed string pulling the follower against the cam, thus bending gravity to the required angle. The direction of rotation of the handle should be left up to the user, so the cams need to be bidirectional. And the base should be as open as possible so that the works can be easily seen.

Additional ideas that came while building

The shaft for the cams became the column supporting the table. As the cams are in the center of the base and the two figures are seated toward the rear, the empty space at the front begged for something to fill it. Each of the friends now has space for their dogs which, as we know, always look startlingly similar to their owners (**photo 2**).

The rotating table seemed to make no contribution to the narrative of the piece, so I almost stopped it. But then I thought that it would make a splendid carousel for someone small enough to enjoy it, so that's what it became—a tiny subplot within the bigger story (**photo 3**).

Gears, cams, and followers

The cams would turn in the horizontal plane around a vertical axis, but the crank for users to turn would rotate in a vertical plane, around a horizontal axis. Pinwheel gears seemed like a good idea. I used a small one with eight pins for the crank and a large one with thirty-six pins to drive the cams (**photos 4** and **5**).

For a smoother motion, I folded a piece of sandpaper into a V-shape and chamfered the tops of two of the pins at a time in the large wheel (after I took these photos). This step was not necessary for the small wheel.

Each figure has two moving parts—the mouth and the arm that lifts the teacup. As good friends, the figures take turns speaking. When not speaking, they take the opportunity to have a slurp of tea. I decided to use just two cams. Each figure is driven by the same two cams but with a 180° offset. While one figure is chatting, the other one is slurping, and vice versa.

In **photo 6**, the upper, sort of egg-shaped cam is responsible for lifting the arms. The lower cam opens the mouths. When not chatting (the wavy bit on the cam), the mouth is held open to await a slurp of tea. Note that there are no abrupt steps in the shapes of the cams, in order to make sure that they will work in either direction.

4. The two pinwheel gears, one eight tooth and the other thirty-six.

5. Pinwheel gears engaging. The arm cam is above, the mouth cam below.

6. The two cams. The top one controls the arms while the other operates the mouths. Each cam works both figures.

7. Two cam-follower levers. They pivot on the left and the followers are in the middle. The device at the right drives a mechanism to change the motion's direction.

There are four cam followers, each mounted on a lever that is pivoted at the front of the base—two for the lower cam and two for the upper cam. In **photo 7** you can see the pivot at the left, the follower in the middle (with a plastic ring to cut down friction), and the additional part at the right, which will drive the mechanism mounted on the rear wall of the mechanism's box. On the base, shown in **photo 8**, are two followers, with small springs to keep them in contact with the cams.

As the lever to which the follower is attached moves, it in turn moves a small mechanism that has the effect of changing a horizontal motion into a vertical one. As the lever moves out, it turns a triangular-ish piece of wood—a bell crank—around its axis at the bottom (**photo 9**). This mechanism is repeated four times, for the four followers. The row of small holes in the sides of the pieces are to receive the vertical brass rods that move the model. Unsure as to how much movement would be needed, I could thus choose a hole and shorten or lengthen the movement, through trial and error.

The tea drinkers

Each figure is assembled on a piece of 8mm (5⁄16") dowel that is fixed vertically to her seat. This means that the figures are adjustable. I left the knee hinged on a piece of 3mm (1⁄8") dowel until I was happy with the pose, then I glued it in place. Half of a 40mm (1½") wooden ball serves nicely as hips (**photo 10**). A whole wooden ball makes a good torso. One of the arms is hinged to the body to lift the tea cup. The other arm is fixed to carefully hold the saucer (**photo 11**). A few wooden eggs, balls, and other shapes serve as the head and hairdo (**photo 12**).

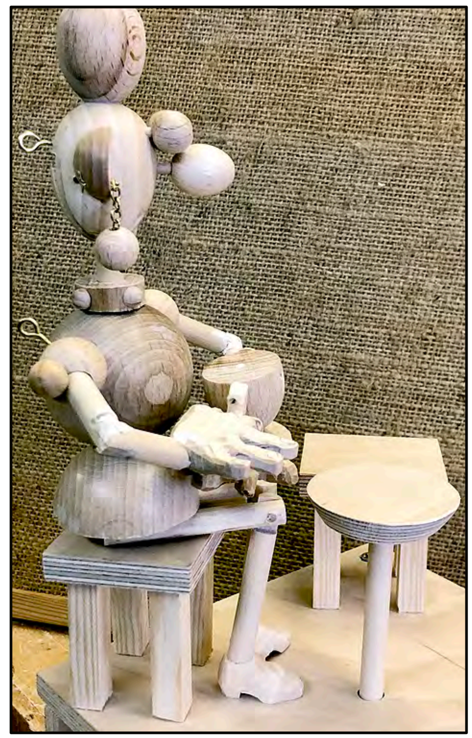
The jaw is fixed to the 8mm dowel and the head is hinged onto the jaw (**photo 13**). This

8. Two cam-followers mounted on the base. The other two will be above.

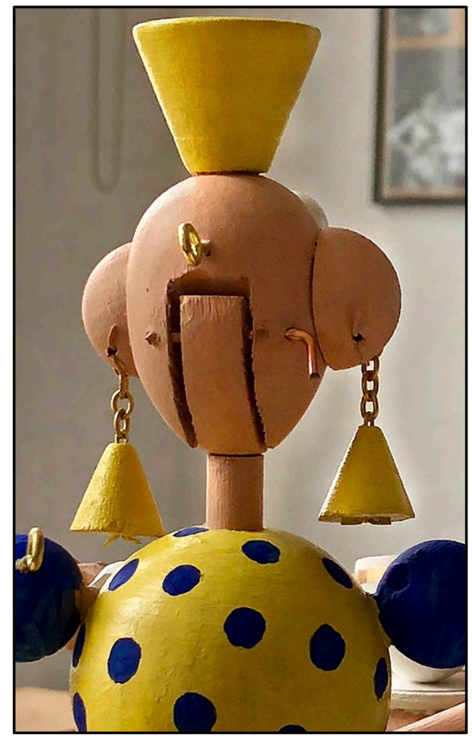
9. A bell crank, driven by the cam-follower, changes the direction of motion.

10. Half of a 40mm wooden ball forms the hips.

11. Bodies are formed from various other wooden shapes.



12. A completed figure, with hairdo and jewelry, awaiting paint.



13. The head is hinged to the fixed jaw for maximum waggle.

means that the whole head moves when the figure is speaking/drinking tea, causing the earrings to swing about most satisfactorily. Eyes and nose were removable for easier painting before being glued into place.

The hands are carved from limewood, with the smallest finger slightly lifted (**photo 14**). When the arm lifts, the protruding pinkie then makes that elegant gesture so typical of polished tea drinkers. Of course the teacup must stay horizontal to make sure that nothing gets spilled. It's hinged on a bit of brass rod, its weight keeping it level. The heads and teacups are controlled by brass rods, actuated by the cams (**photo 15**).

ABOVE: 14. Woodwedge teacups are carefully hinged near the top via their handles. The cups' weight keeps them level as the ladies alternately raise them to sip their tea.

RIGHT: 15. This left-side shot illustrates the entire mechanism: the large gear turning the cams above and below, the cam followers engaging the bell cranks to change the direction of motion, and the brass rods from the bell cranks controlling the figures' actions.

Lessons learned

I ended up with quite a compact base, so it was worthwhile turning the cams sideways. Precision seems to be more important in this type of setup, however, so I had to take great pains to keep the two cams parallel to one another, as well as to the box. The spacing between the two pinwheels also had to be just right, for smooth operation. Fortunately, I could adjust that a bit by changing the thickness of the washer underneath the cam assembly.

When I was almost done, I decided to use what I had intended to be collars for the figures as waists instead. Happily, that just meant changing the order of the bits stacked on the 8mm dowel. The figures look much more stylish like that.

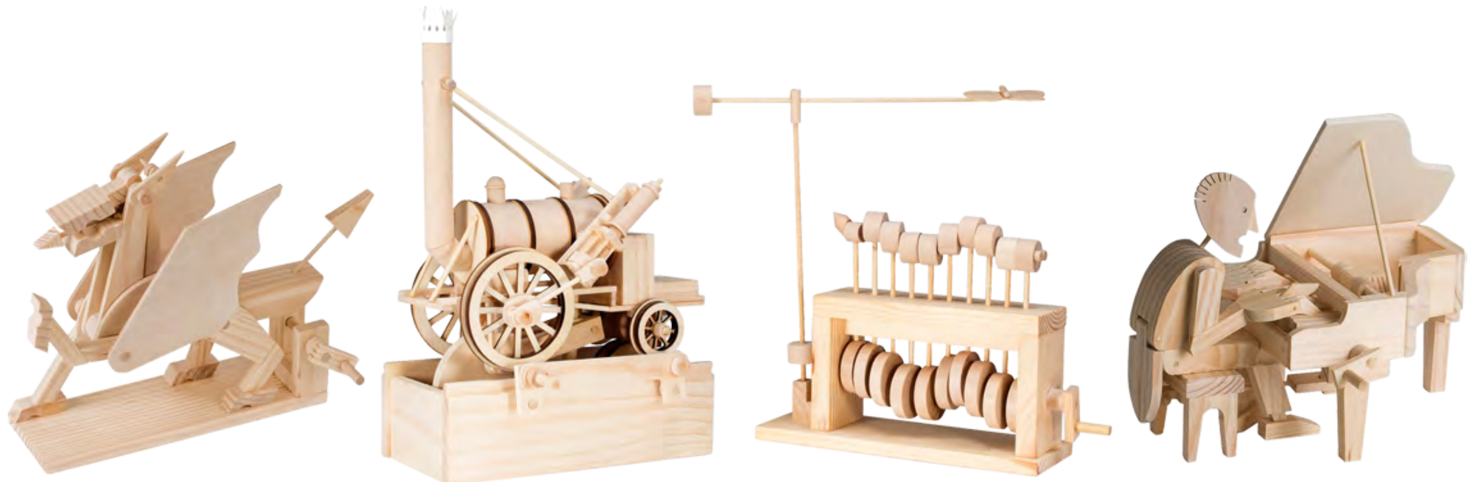
When testing the movement, I decided that the figures' mouths chattered too quickly, so I made a new cam from 3mm plywood to slow things down a bit. I resisted gluing parts together for as long as possible, to keep my options open. That was a delicate balancing act. While things were not fixed, the precision wobbled and pieces occasionally tumbled all over the place and had to be carefully collected. Once pieces are glued, though, it can be difficult to take things apart again, to change this and that.

Join the tea party in full swing at *https://tinyurl.com/KimsTeaTime*

AUTOMATA FOR BEGINNERS

Timberkits—where it all began

by Sarah Reast • Llanbrynmair, Wales, UK • Photos by the author



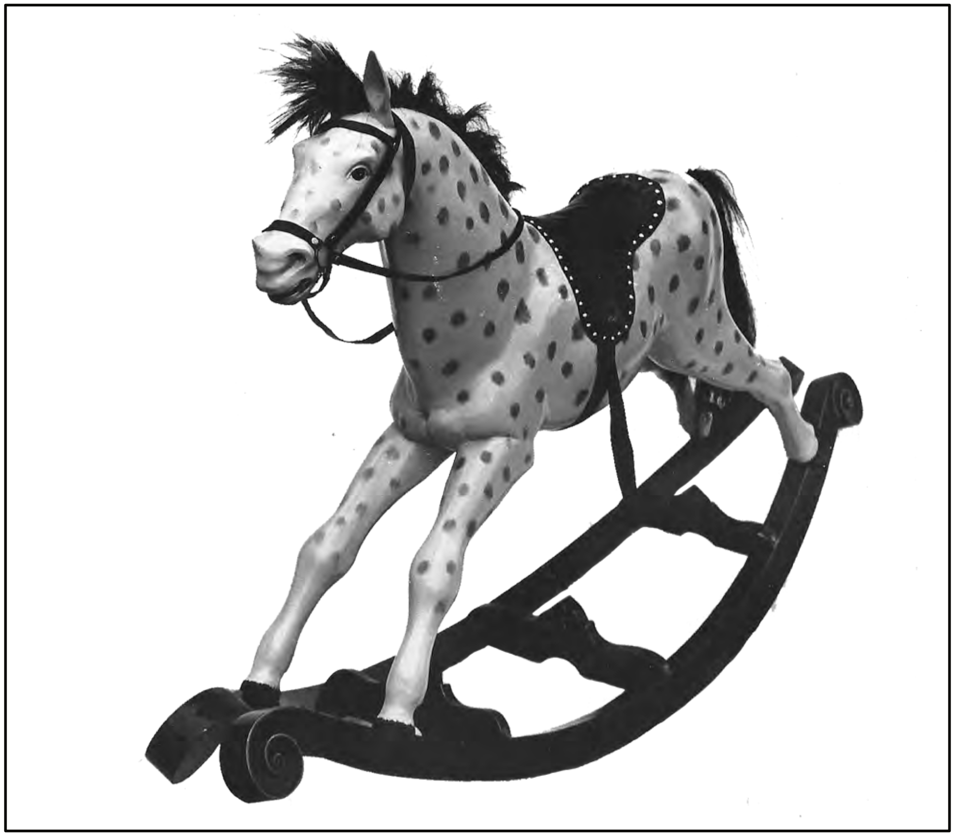
A small sampling of the many different Timberkits that are currently produced by the company.

Just for a change, I thought I might tell you a little of the Timberkits story before going back to building things. My parents, Eric and Alison Williamson, were fine-art painters—essentially your archetypal drop-out-of-the-rat-race hippies doing the self-sufficiency thing on a Welsh mountainside. This included knitting their own furniture, as well as eating nothing but kale and mutton all winter, and bingeing on wild fruits all summer, with the resultant tummy upsets.

Dad had always carved, too. My grandmother used to find the soap fashioned into swans, cathedrals, and armadillos. This must have been a source of both pride and frustration for her, soap having been rationed in postwar years.

When I was seven, Dad made me a marionette for my birthday. I thought it was beautiful. Mum made the sumptuous clothes and I loved the braid and velvet. At that time, Dad was making and selling magnificent rocking horses: laminated, carved, and customized. My sister and I were never allowed near them!

Making marionettes seemed like a great way of using all of the scrap wood leftover from the horses. Soon the production of these became the mainstay of their output. Marionettes sold well but shops kept ringing my parents to complain about the strings tangling, which, you will appreciate, is a difficult thing to resolve over the phone. My parents decided to



ABOVE: One of Eric Williamson's custom-made, hand-carved rocking horses.

RIGHT: Marionettes made by Eric and Alison Williamson.

set about creating puppets without strings. Hence, automata.

Dad got quite carried away and his automata got bigger, more complex, and less financially viable with every commission. His mechanisms incorporated bits of vacuum cleaners, record players, and mangles (remember those?), so it would be impossible to find spare parts for future repairs. The carving became more and more elaborate, too.

My friends at school had parents who were teachers, nurses, farmers, and ordinary things. I was mortified by having to explain what my parents did, only because it was sort of impossible.

Mad Hatter, by Eric Williamson.

Evil Weevil, inspired by Peter Markey.

A happy maker with his *Ocean Motion* automaton.

With her family the brink of bankruptcy, Mum put her foot down and insisted Dad get sensible, so how about making small kits of simple models for others to try? Her life had always been overshadowed by his genius while she tried to do the boring stuff, like pay bills.

As it happened, automata designer Peter Markey lived next door. Timberkits was originally inspired by his ideas, which were indeed much simpler and lent themselves to batch production and, later, mass manufacture. Over the years, designs came from different sources and now have a myriad of origins.

The more disciplined approach of preparing designs for production and dealing with wholesale trade made better use of my parents' combined skills, and a viable business was born. Now I could tell my friends that Mum and Dad ran a business making wooden toys, which at least sounded real.

My parents set up their own factory here in mid-Wales, but manufacturing was gradually transferred to China. There, we have had a long relationship with a small, family-run factory whose workers have a wealth of skill and patience for our unusual products.

Timberkits in its current form has been running since 1993. I took over in 2012 and Mum and Dad have retired, although Dad still has design input. My background is in theater design—sets and costumes—so I at least had the project-management skills in a creative industry.

The challenge of designing automata as kits for mass production and sale is quite different from making one-offs. We are one of few companies that makes automata commercially. These things are usually made individually and are in the province of private collections. Automata making tends to be an esoteric pursuit, but I want children in schools to make them, and I want to see our automata engaging elderly folk stuck at home, mums and dads and their kids, and all sorts of other people—people who may never step foot into an art gallery. The reward is in seeing them holding up their finished pieces and saying, "Look! I made it work!"

Timberkits has endured, and does so because it is timeless. It has weathered all sorts of market trends because it has never really been part of any. I like to think that the unique world of automata takes us away from other earthly concerns, and once captivated, you are forever hooked.

Contacting Sarah

If you have questions or comments for Sarah Reast, you can write to her in care of *Automata Magazine*: automatamag@comcast.net. Just put "Message for Sarah" in the subject line.

Sarah is the designer and director of Timberkits Ltd., which creates wooden mechanical models sold in kit form. To learn more about her company, visit https://www.timberkits.com/.

The End