AUTOMATA MAGAZINE

Cecilia Schiller's
Il Mago

2/4—Jul/Aug 2020

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Editor and Publisher: Marc Horovitz
Copy Editor: Barbara Horovitz
Website: *http://www.automatamagazine.com*
E-mail: *automatamag@comcast.net*

EDITORIAL

The difficulties of making automata

by Marc Horovitz

I recently finished building an automaton. It took about three times longer than anticipated, which I suppose is better than the five times longer that it often takes. Over time, one tends to forget all of the pain and suffering that goes hand in hand with the excitement of coming up with a new idea and commencing construction.

I envy those who keep notebooks and journals, always sketching new ideas, jotting a word or two about mechanisms, or making notes about construction, materials, or finishes. These books become a valuable reference—something organic, growing not only in size but also in value. They become something that can be referred to over time for inspiration, problem solving, or just records of where one has been. These idea books often become works of art in themselves.

I've tried this approach periodically, usually after having seen someone else's idea book and having been inspired by it. I've found, however, that this just doesn't work for me. My brain doesn't work that way, for some reason. I can't seem to simply scribble ideas down, either in text or in drawings, when they come to me.

I have to work it out mentally—to visualize the piece—before proceeding. Then I start drawing the thing up, to scale, working out the mechanism as I go, but having a pretty clear idea in mind how I want it to work. I make corrections and changes along the way, allowing the original concept to morph just a little but not too much. I hold tenaciously to the original concept, no matter how bogged down I get in actually making it work as envisioned, even knowing full well at the beginning that there will have to be plenty of changes and modifications before I am finished, regardless of how precise my drawings were.

On the surface, some people seem perfectly capable of making a rough sketch or two, then setting out on the build, always coming up with perfection. I well know that this is not at all true but, nevertheless, that's the illusion. Unless you're involved in the process yourself, all you see is perhaps those early sketches and the magical leap to the final result. It just ain't so.

Once I got into the build on my latest piece, reality came back to me. Problem after problem reared its ugly head. The process always seemed to be two steps forward and one step back, except for those days when it was one step forward and two steps back. Actions had to be rethought, materials reexamined, and mechanisms redesigned.

Slowly the automaton began to emerge, somewhat altered but still pretty true to my original idea. Changes were made, new materials for a couple of parts were chosen, the mechanism was refined here and there to perform better, and in certain instances, the problem was solved simply by me altering my expectations a little and accepting the fact that no one but I would know the difference.

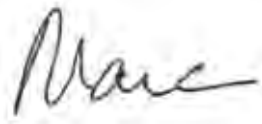
The whole process of automata building is a learning experience, one that pushes my personal envelope. Every time a problem arises, that's a chance to be creative, to problem solve. In the end, many of the solutions to the problems are better than my original design.

If you make automata yourself, you'll undoubtedly be familiar with everything I've said here. It just makes me feel better, having written this down.

— • —

I'd like to welcome Teun de Wijs to our family of regular contributors. In each issue, Teun will be writing about Lego automata, this following his well-received story in the March-April 2020 *AM*.

Also, a warm welcome back to Sarah Reast after her brief time-out from the last issue. AM



NEWS

Guido Accascina, founder of the Modern Automata Museum, in Italy, has authored a new book on the history of automata: *Automi*. The softbound book, in A5 format (148 x 210 mm; 5.8 x 8.3"), will have 328 pages, 418 color photos, and 135 illustrations. The volume, published in Italian, traces the history of automata and their makers, from the Ptolemaic dynasty of Egypt to the present day. Price: €25. Available from Amazon on July 10, 2020. For more information, contact *guido@accascina.it*.

Read about the Mystery of the Month on **Automata Magazine's Forum**: How does "Teddy the Artist" work? There has been much discussion in the forum regarding Teddy the Artist. How does he draw? What is the mechanism? Do you know the answer to this question? Here is a link to the thread: *https://tinyurl.com/TeddyTheArtist*. Consider participating in the forum. This online forum is provided to you at no charge and now has 53 members.

British automatist Ivan Morgan has created a clever video with his automata, related to the Coronavirus. You can see it here: *https://tinyurl.com/MorganCorona* Visit Ivan's website at *http://www.positivelycreative.co.uk/mechanicals.html*.

EVENTS

Morris Museum presents **A Cache of Kinetic Art: Tiny Intricacies**

March 13-August 16, 2020. Morris Museum, 6 Normandy Heights Road, Morristown NJ 07960.

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. More info: *http://www.automatacon.org*.

A FORUM FOR AUTOMATA CONVERSATION
AUTOMATA MAGAZINE
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We are pleased to provide the automata community with this free email-based online forum. Browse or participate to learn about and share the wide world of automata.

CALL FOR ENTRIES

Morris Museum—Timeless Movements: March 12-July 11, 2021. A multi-year juried exhibition series, *A Cache of Kinetic Art*, showcases contemporary automata and their inventive creators. Prospectus and entry forms for both exhibitions: *https://tinyurl.com/MMentries*.

In the next issue of
AUTOMATA MAGAZINE

- **David Bowman** constructs *Pulpo*, an amazing mechanical octopus
- **Eden Orion** talks about his history and the creation of the Cartomata Workshop in Israel
- We meet **Ivan Morgan**, an imaginative British automatist, and view some of his work
- **David Soulsby** takes us on a tour of automata clocks in the United Kingdom

Follow *Automata Magazine*…

Photo by Cy DeCosse

IL MAGO

The making of a magician: Part 1

by Cecilia Schiller

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

Paula DeCosse commissioned *Il Mago* as a surprise gift for her husband Cy, to commemorate his 90th birthday. Cy DeCosse is a celebrated artist in Minneapolis. He is a polymath and renaissance man. He's accomplished in painting and sculpture, an acclaimed photographer, and had successful careers in advertising and publishing. Additionally, he's a gifted flutist and, together with Paula, plays in a classical quintet.

LEFT: The magician simultaneously charms a snake, does card tricks, plays the flute, and more. This elaborate piece was a 90th birthday present.

Paula first contacted me by email, saying she was interested in commissioning a work for Cy, and she included a photo of one of his paintings—his self-portrait as a multiarmed Gumby-like figure performing magic tricks. Right away I thought, Wow, this would make a good automaton (**photo 1**)!

Paula told me that Cy, as a youngster, dreamed of becoming a magician. His mother had even sewn him a magician's cape when he was twelve. Although he never became a professional magician, he continued to create magic with his artwork, as I later discovered on a clandestine trip

to his studio with Paula while Cy was away. I was surprised, not only by the diversity of his work, but by the fact that we seemed to have kindred spirits. I recognized similarities in some of his sculptures to works I had already created and it appeared that we also shared an affinity for the whimsical. Paula wanted my piece to reflect the history of his storied career, and it wasn't hard to find inspiration.

Il Mago is full of references to Cy's artwork, life, and career. Here are some:

• **The magician** is right out of his self-portrait and is a reference to his multiple talents.

• **Roman-Greco building.** Cy's second home is Florence, Italy—his favorite place outside of Minneapolis.

• **The hypnotic wheel** is a reference to his career as an adman in the 60s and hypnotizes us with the allure of things like Pringles and Foaming Bubbles.

• **Military men** appear in a series of nonfunctional machine sculptures Cy built to later photograph (**photo 2**).

• **The egg and chicken** appear in several of Cy's sculptures and symbolize concept and realization. The roast chicken was a humorous addition to the automaton.

• **The lightbulb** is the *idea* and appears in Cy's painting *The Idea Brain* (**photo 3**).

• ***The Idea Brain*.** This was the painting that Cy painted while I was creating Il Mago (were we channeling each other?) and he exhibited it in a retrospective show, where I saw it. The painting

Photo by Cy DeCosse

LEFT: 1. *Il Mago*, by Cy DeCosse. This self-portrait of Cy as a multi-armed magician was the first image his wife Paula shared with the author, who was immediately inspired by it.

BELOW LEFT: 2. Cy made several machines to photograph, many with military men. This is the author's favorite. She copied the symbols on the dial and used them around her hypnotic wheel.

Photo by Cy DeCosse

ABOVE: 3. Cy painted *The Idea Brain* while Cecilia was creating *Il Mago*. She was amazed by it, and she used it as inspiration for the color scheme and the forced-perspective floor in the lower (gear housing) part of her automaton.

inspired the color scheme and the perspective tile floor for the lower-level, mechanical portion of the sculpture. This is appropriate, since these inner workings—the cams, gears, levers, and other mechanics—are, in a sense, the "brains" of the automaton.

• **The owl** is the mascot for Cy's businesses.

• **The skull** imagery appears in many of Cy's works but is also an image I embrace. And, because it makes a surprise appearance (**photo 4**), it refers to the fact that we are not always what we appear to be and that mortality is always just around the corner.

• **The card trick/bunny in the hat** appear in Cy's self-portrait.

• **The flute player.** It would have been easy to have the figure of the magician charm the snake with an oboe or clarinet (arms lifting straight up in front), but Cy actually plays the flute and Paula plays the oboe, so it was important to make that distinction. After several tries, I found a way to lift the flute into the correct position.

• **A snake** appears in Cy's self-portrait but also refers to his fearless nature and willingness to embrace difficulty.

4. The magician's scull emerges from the top of his head as he serenely plays his flute.

5. A preliminary cardboard prototype was made to work out the mechanism for raising the flute to the magician's mouth.

The design

After a few rough sketches to get my ideas outside of my head and onto paper, I began working in three dimensions. Anything is possible in two dimensions, but working in the round shows you right away where the difficulties lie.

I'm a huge advocate of working in cardboard. It's cheap (usually free) and can be easily worked. It's also a good material for getting a sense of scale and what size things need to be.

I cut a crude cardboard figure of the magician (**photo 5**), using hot glue to stick the parts together. Using this construction, I was able to figure out how the mechanism for playing the flute would work.

Having gained a certainty that I could build the magician with multiple arms, and a with rough sketch of my other ideas for the piece, I was ready for a meeting with Paula to get her approval for my concept. She was completely on board and supportive, so it was full steam ahead.

My method of working is to develop each mechanism individually, then figure out how they work together, based on the physical needs of each (size, speed, what it's connecting to, etc.). It's a giant three-dimensional puzzle with no box cover for reference. I used several different types of mechanisms in the creation of *Il Mago*.

Mechanisms

• **Crank drive.** The motor for *Il Mago* is the viewer. A hand crank initiates the action, turning an axle connected to two gears. One of those gears is the first in a series that slows the rotation and allows time for the other mechanisms to complete their movements. The other gear drives three other mechanisms: a ratchet for the marching military men, the card trick, and the bunny in the hat.

• **Multiple gears.** By using a series of small and large gears

6. The multitude of gears are in place on the painted, forced-perspective floor.

7. The snake rises from its basket via the action of the scissor arm, seen here. The author hand carved the snake's head.

8. The three-position Geneva mechanism, under construction. Above are hand-carved head and body parts.

(**photo 6**), I was able to reduce the speed of the mechanism from one turn of the crank/one revolution to twenty-four turns of the crank/one revolution.

• **Ratchet.** A ratchet moves the military men forward in a halting manner, giving the impression of marching. The nice thing about this mechanism is that, no matter which direction you crank, the rotation always travels in the same direction.

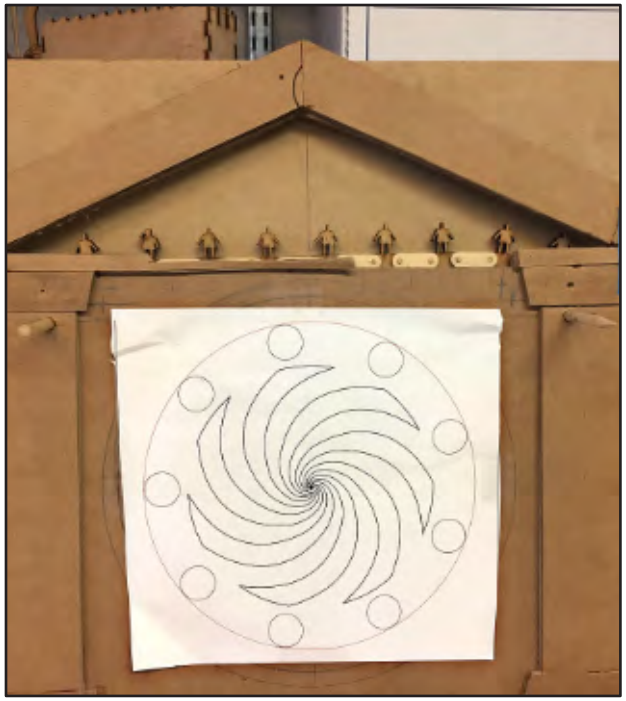
• **Pulley for the hypnotic wheel.** The hypnotic wheel, positioned in the edifice behind the magician, is turned by a pulley attached to the back of one of the other gears, allowing double duty. The wheel with the radial stripes painted on it rotates behind another similar, fixed striped wheel with the white spaces removed, creating a hypnotic effect as it rotates.

• **Snail cams.** I used snail cams to produce the action in the rabbit jumping and also the skull emerging from the head. You can see in the video how speed affects the resulting action.

• **Scissor arm.** The snake is raised with a scissor arm (**photo 7**). Two ends of the arm are attached to matching gears that rotate in opposite directions, thus raising the snake. The basket lid is attached to the same gear, so it opens at the correct time. Intermittent teeth on an accompanying large gear raise the snake only at the appropriate time.

• **Geneva mechanism.** I was excited to use a Geneva mechanism for the first time (**photo 8**). This mechanism has two rotating parts. One wheel has a single pin while the other has several slots into which the pin can slide. One slot is advanced each time the wheel with the pin makes a complete rotation.

My Geneva mechanism has three slots—one each for the egg, the chick, and the roast chicken. This mechanism operates in the understory, below the table, and it's connected to the table by a ladder chain. I had to create a way to tension the chain, in order to synch the rotations.



9. This cardboard prototype of the building was used to help determine its size and proportions. A drawing of the hypnotic wheel is in the middle of the structure. A rotating wheel with a similar black-and-white pattern will be mounted behind it. A line of small, laser-cut military men can be seen above.

10. The laser-cut wall, along with turned and carved columns, are in place. The wall needed to be as thin as possible (⅛") to allow for the hypnotic-wheel illusion and also to conceal the marching men while still allowing them to appear on the cornice. Columns were stuck together and turned as one piece, then separated into matching half columns.

11. The roof is made of basswood, for easy carving. The front portion of the hypnotic wheel and the frame around it have been painted.

• **Lever.** A lever operating on a rotating pin is used to do the card trick.

• **Cams and levers.** The magician's moving arms are all operated by a series of cams and levers. Cams are cut so as to displace the levers, which in turn pull strings that raise and lower the arms.

The backdrop

With the size of the magician more or less determined, I wanted to develop the backdrop for the piece—the Roman-Greco edifice (**photos 9-11**) with the hypnotic wheel and marching-soldier cornice. I traced the soldiers from photos of Cy's machines, with their small wax soldiers. I wanted the figures to be recognizable from his work. I added them to the links of the chain, and laser cut the links and accompanying gears. It worked!

To move them, I chose the ratchet mechanism. This created a halting, marching-like movement that would advance in one direction only.

I laid out my idea for the card trick with cardstock and fish line. I attached string to the cards, in the same way that fans are made, and that worked surprisingly well. I added a rotating cam to move a lever, and *voila*—the card trick! Luckily, I had a small deck of cards on hand. I laminated the cards in plastic, for durability, then made

some adjustments for the mechanism to accommodate the added thickness. That's the thing about making automata—any change you make, good or bad, will require adjustments to other parts.

As mentioned above, I really wanted to try out a Geneva mechanism, so the trick table (**photo 12**) with the egg/chick/roast chicken was just the thing. The egg-to-the-chick is a nice trick, but adding the roast chicken created the humor.

Three is the fewest possible number of lobes you can have on a Geneva mechanism (**photo 8**). The triangle shape (the rotating portion of the trick table) corresponds to those three lobes. Incidentally, the triangle shape gave me the greatest height for placing the egg/chick/roast chicken and still be able to rotate the tabletop without hitting the edges (**photo 13**).

I found equations online to lay out my Geneva mechanism, then laser-cut the parts for the greatest precision. Even then I found I had to make adjustments to the fit; any wiggle room can cause the parts to jam.

The Geneva mechanism is separate from the trick table, so I needed to find a way to connect them.

12. The trick table, with its hand-hammered copper dome. Each time the dome is lifted, one of three things magically change on the table.

13. The chick and the roast chicken are two of the things that magically change on the trick table via the Geneva mechanism.

I found a ladder chain at a clock-supply company and made two sprockets to match the chain's proportions. One sprocket is attached to the rotating triangular tabletop and the other to the Geneva mechanism. This worked well but it was difficult to line up the flat of each side of the triangle with the flat of the table. The addition of slots in the structure on either side of the chain, with bolts, nylon washers, and wing nuts allowed me to tension the chain and position the table top.

In the next issue of *Automata Magazine*, I'll describe how the different mechanisms interact, how the gearing was accomplished, how the automaton was finished, and more.

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

Cecilia Schiller's recipe for creating automata

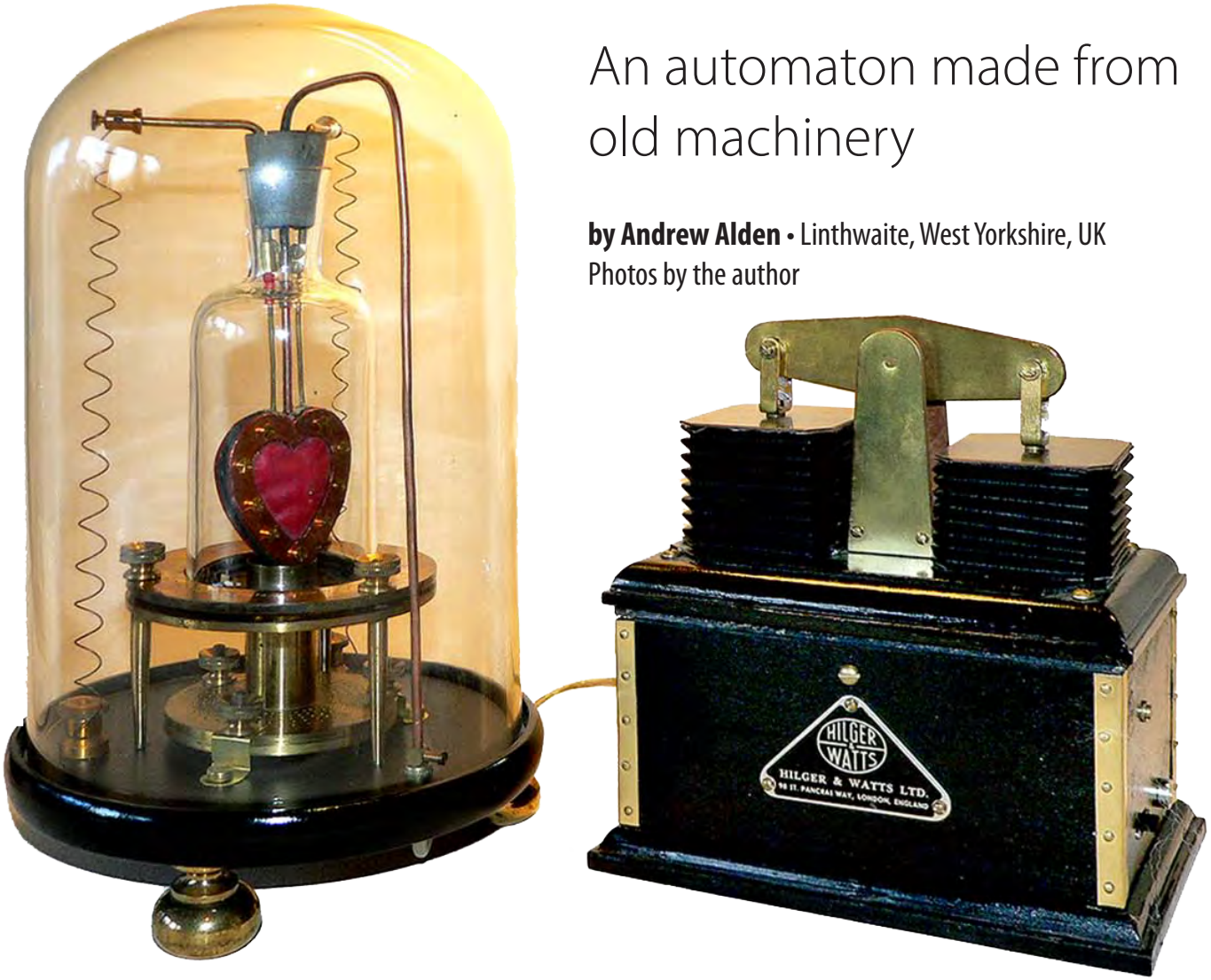
- A pinch of imagination
- A dose of patience
- And a whole lot of fearlessness

Once you begin, you can never be quite sure where you will come out, but it will be an interesting ride—guaranteed!

My Beating Heart

An automaton made from old machinery

by Andrew Alden • Linthwaite, West Yorkshire, UK
Photos by the author



Andrew Alden's *My Beating Heart* was made of found objects to look like something out of an old science-fiction film.

In my time I've seen some wonderful automata, both ancient and modern, and I've always been amazed by the skill and imagination of their makers and by the intricacies of the construction. However, it's easy to be overwhelmed by such ingenuity, especially when one's own abilities seem so lacking by comparison.

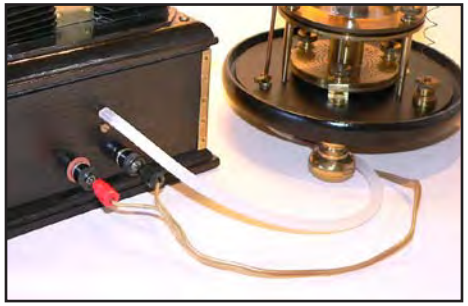
I've worked in science and engineering for years, but in my spare time I have also had a great interest in older technologies. I've spent many hours researching and repairing anything and everything obscure and obsolete, keeping the bits and pieces left over, just in case they might come in useful at some future date.

Building an automaton from scratch seemed overly daunting to me. However, I believed that one solution might be to begin with something already old and interesting that could be modified to work in a way never originally intended.

For the automaton described in this article, I started with the idea of making a Valentine's Day gift that looked like something built by Kenneth Strickfaden. He was a Hollywood special-effects wizard who made props for horror and science-fiction films, from 1931 right through to 1974's *Young Frankenstein*. Whatever I ended up building also had to be possible using the meager range of hand tools available to me.

My Beating Heart began life as a piece of industrial equipment originally used to test the flash point of fuels. This I bought at a local flea market for a few pounds. It incorporated two bell jars— one large and one small. I used the larger, outer bell jar to encase the entire heart apparatus. In the smaller bell jar, over its brass base, I suspended my mechanical heart.

1. A closeup of the heart, which pulsates disturbingly.



2. The pneumatic and electrical connections between the pump and the heart.

The heart

The heart (**photo 1**) consists of two heart-shaped pieces of red silicon rubber, spaced apart and clamped with nine brass nuts and bolts, to form an airtight cavity. A tube through the brass frame around the heart allows the air pressure inside the heart to be varied so that the rubber surfaces can be made to bulge out or be sucked in.

A pair of copper conductors connects to a small array of light-emitting diodes (LEDs) located inside the heart's cavity. More about these later. The connections for the air and LEDs extend out from beneath the base of the unit so that they can then be linked to the air pump (**photo 2**).

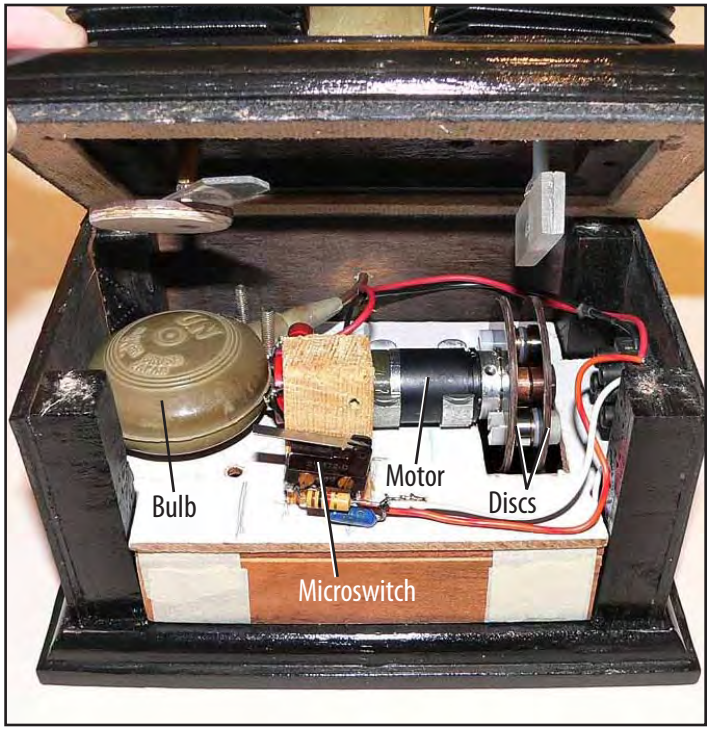
The air-pump unit

The air-pump unit is shown in **photo 3**. The key component in the separate air pump is a rubber bulb, originally part of a lens-blower brush. This is connected to the heart unit by a length of neoprene tubing. Pressing the bulb results in the heart surfaces bulging outward; releasing it allows the heart to return to its original flat profile.

The bulb is squeezed by the action of a pair of conjoined, rotating discs mounted on the shaft of a low speed, high torque, 12V DC motor that I salvaged from a large TV-camera lens (**photos 4** and **5**). Between the discs are carried a pair of ball races near the edges of the discs, spaced 180° apart, so that the assembly acts as a low friction, double-ended cam. The motor rotates at 15 rpm, so it activates the bulb once every two seconds. The sides of the disc also locate the plastic blade that acts as a cam follower.

The compression of the bulb is not direct, as I wanted something moving that could be seen from the outside—hence the beam-engine-style rocking-beam assembly seen in **photo 3**. As the cam pushes up on one side, the other side pushes down on the bulb.

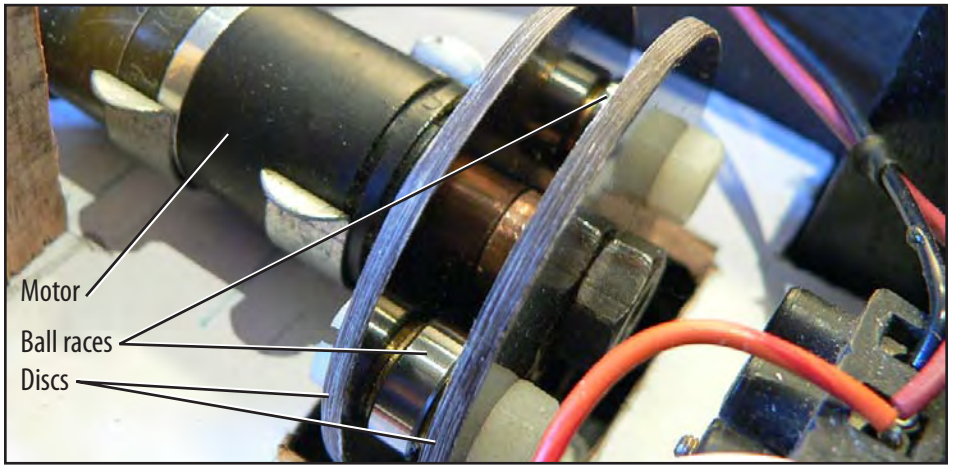
3. The air-pump unit. The bellows were made of a repurposed photographic lens extension.



4. Inside the pump housing. From left to right is the air bulb, the microswitch, the motor, and the discs.

The bellows are purely cosmetic, aping an early hospital operating-theater ventilator. These were salvaged from a set of extension bellows, originally used for close-up work on a 35mm still camera. The bellows were cut in half.

The cabinet housing the motor and air pump was made of wood out of my scrap box and an old wooden switch plate. The label on the front was taken from yet another piece of laboratory apparatus, its purpose unknown.



5. A close-up of the discs. Two ball races actuate the lever that powers the air pump, causing the pneumatic heart to beat.

Power for the motor comes from either a rechargeable 12V NiMH battery pack in the base of the cabinet or an external mains adaptor. The latter was a wise precaution, as the batteries seem to have a habit of going flat after they've been on the shelf for a while. They're usually dead when I come to show off one of my creations!

A microswitch on the downstroke to the rubber bulb is used to make the LEDs inside the heart light up as the heart swells. A 500-ohm dropper resistor is fitted in series to allow the LEDs to operate from the 12V supply.

Conclusions

Making this little automaton has been a positive experience for me. Completing something that started as a bit of a daft idea has given me a lot of confidence. The experience of playing with simple pneumatics was an added bonus, plus the machine does seem to be a pretty reliable performer.

Reactions from people who have seen it have been varied—everything from, "That is so creepy. I couldn't sleep with such a thing in the house!" to "Brilliant, but can you make me one that runs on clockwork?" Admittedly, that last comment came from a visiting lurk of Steampunks, so it was really not so surprising! There will definitely be more pneumatics in the next project, though.

To see a video of *My Beating Heart*, click ***here***.

GALLERY

The Haunted House

by Mike Palmer • Tarleton, West Lancashire, UK
Photo by the artist

The story. The old man, butler to Lord Trumpington-Spurt of Spurt Manor, has worked there for many years and is much past his prime. He usually drifts off to sleep after a bottle or two of His Lordship's cabriolet plonc blanc and a good ghost story. What happens afterwards is plain to see but he never sees anything, as it only happens when his back is turned. Many things go bump in the night.

The action. Doors begin to open and slam shut, the grandfather clock leans forward, its hands going backwards, and a huge spider descends from under the balcony. A ghoul appears from the cupboard under the stairs, surrounded by an eerie blue light. The old man is awakened by the commotion and sits up in bed, turning to his right. Just before he

is able to see what is happening, the ghoul disappears, doors cease to move, the clock rights itself, and the spider shoots back into its hiding place.

The man waits to make certain that he had only been dreaming. While he ponders, the action shifts to the front of the scene, again behind his back. The table begins to gyrate around the room, the chair revolves around the table, a phantom appears at the window, and the curtains blow into the room.

Finally, the old chap concludes that he has only been dreaming and settles back to sleep. By this time, the action at the front has stopped, too, so he sees nothing. Life is too silly to take seriously!

Watch a video of *The Haunted House*: *https://tinyurl.com/PalmerHauntedHouse*

What's so special about automata?

An art therapist's perspective

by Daisy Rubinstein
Littlehampton, UK
Photos by the author, except where noted

So far, despite years of longing and anticipation, I have made just one automaton—*Girl Power*. One reason for this is the intrusions of a busy work life. At present I have the privilege of working as an art psychotherapist. I work in a variety of settings, with children and adults, in schools and for charities, helping individuals and groups to explore their emotional and social world through making art.

My professional work has grown out of a curiosity about the innate creative drive within us all, an interest in how we each experience the creative process, and the intersubjectivity with which we approach the creative work of others. With that in mind, I aim to explore in this article the notion of creativity itself and how I believe automata provide a special experience of shared and interactive creativity to a world in desperate need of it.

I first caught the automata bug at the age of ten, when my dad took me to the Cabaret Mechanical Theatre, at that time in Covent Garden, London. I remember being fascinated by the exposed inner workings of these whimsical and mysterious toys in the dark cave of the exhibition there. I loved the variety, the humor (particularly any title puns) and the raw-wood finish of many of the pieces. To me the movements achieved seemed

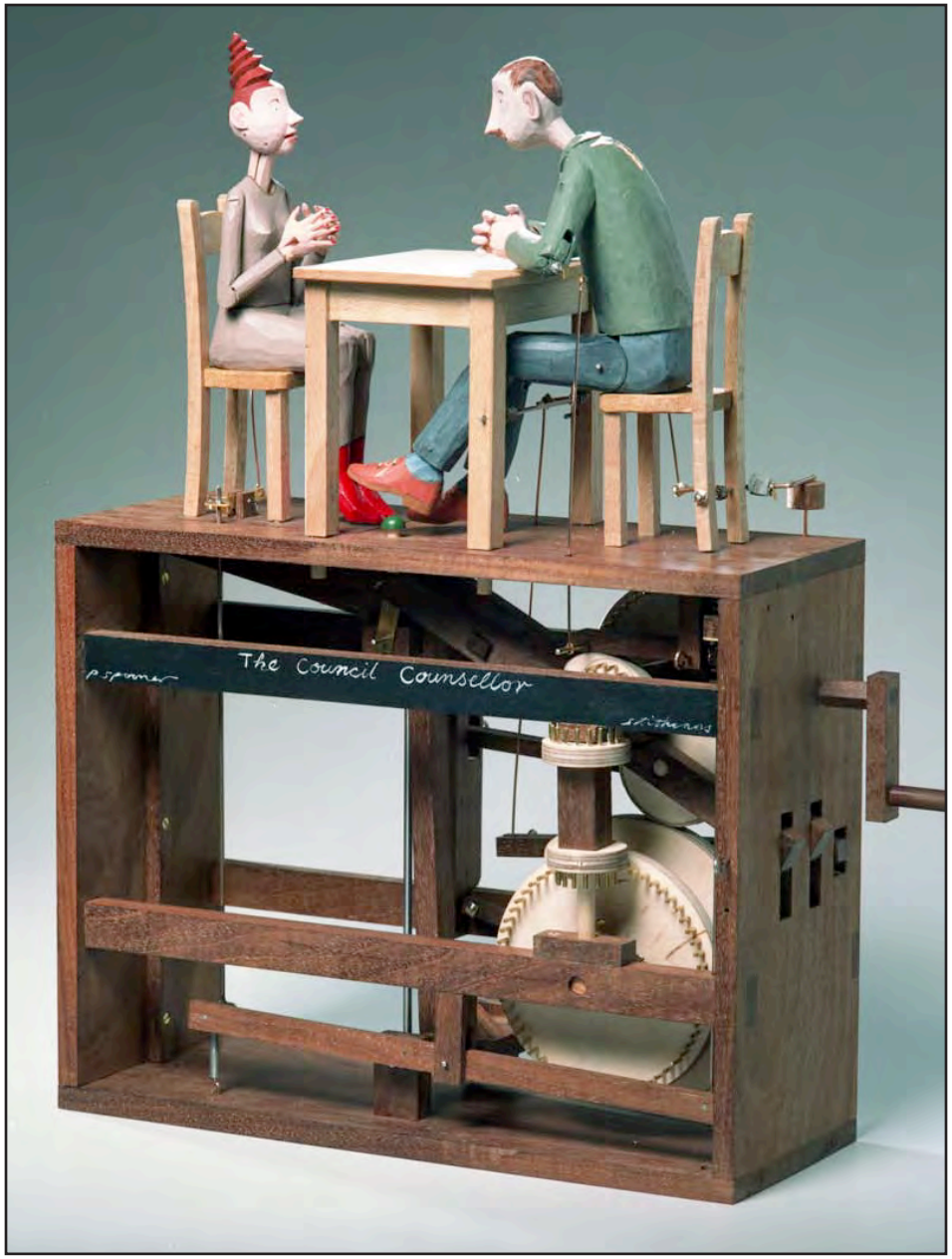
1. *Girl Power*, the author's first automaton.

impossible, and yet the "how" of these pieces was often right there—not hidden, obscured, or made esoteric. There was something mesmerizing about automata that seemed to me to be just as much about their creation as the finished product. The hand skills of making that were so evident in these works of art endowed them with an honesty and integrity other toys could never have.

What I wanted most was to make my own automata, but at ten years of age, I felt this to be entirely out of reach. My awareness of woodworking tools and making was already established, as my family had just moved into an ambitious house-renovation project, and a whole room on the ground floor was transformed into a workshop. I'm sure my parents would have helped me, but it was I who never chose to make a start. I was intimidated, afraid of failure, and deterred by what I felt sure would take much longer than I anticipated.

It would be years, even after three years studying contemporary craft at Falmouth University, before I would actually set the wheels in motion (automaton pun shamelessly intended).

What took me so long? I'm not sure if that's the right question. For me, I think the question might be, What inspires us to make art—or prevents us from making it?



HEINI SCHNEEBELI, courtesy Cabaret Mechanical Theatre

Paul Spooner's *Council Counsellor*. The counsellor's foot is poised over a green button. After listening for a time while the client talks, he presses the button and the client and chair drop through the floor. In this instance, a manualized therapy treatment seems to be proving effective.

Perhaps this is the question on my mind because, since qualifying as an art therapist, I have been conducting weekly one-off art-therapy groups with adult professionals in a rehabilitation and recuperation center. The work life of those attending these groups has the potential to give rise to significant stress and traumatic experiences, which subsequently must be processed in order to maintain mental and emotional health and resilience. The groups are aimed at supporting beneficiaries in this process. However, I think it is fair to say that many of those in attendance have all but forgotten how it feels to make art, perhaps not having done so since their school days.

My job, in the two hours I spend with a group, is to facilitate an experience of "meaning making" through creativity. Meaning making, in this instance, refers to the psychodynamic process of allowing unconscious thoughts and feelings to emerge and to become known or explored. The use of art materials contributes to this process by providing a framework

through which to see our thoughts and feelings materialize, and to reflect on what arises with others.

Because the task of reflective art making is so unusual for group members, the groups often begin with a discussion around feelings of reticence. For example, we spend time discussing the mysterious characteristics of an artist. We think together about art that we respect, art that we find curious, high art, low art, outsider art, and finally our own art, which group members often feel should not be termed art at all.

Two things that I have learned through doing this are that "art" has come to be understood as a praise word and, as a result, creativity is not something most people feel entitled to. For thousands of years the human race has used visual means to solve and puzzle out problems, yet these days we've somehow come to feel inadequately skilled to do so, and feel that there is, in fact, a wrong way to make art. While many children might ask to "have a go" with art materials, we adults have usually learned to feel comfortable spending time only on things that we know we are good at. We want to feel that we don't need to ask for help or to troubleshoot—

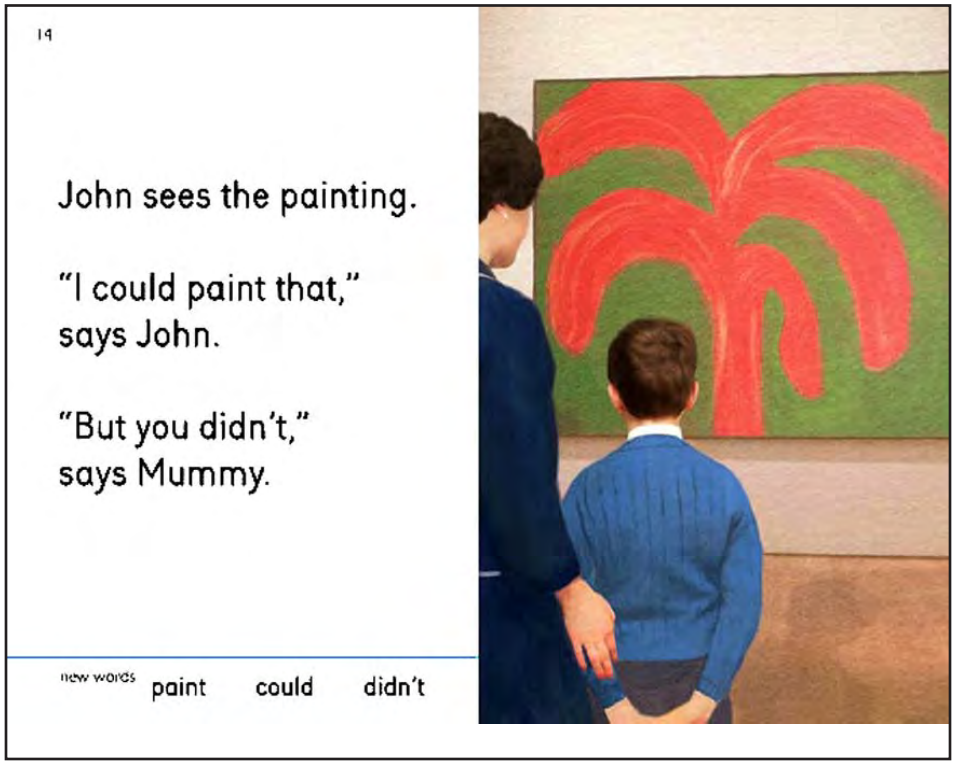


Image by MIRIAM ELIA, courtesy Dung Beetle Books

A page spread from Miriam Elia's Dung Beetle book, *We Go to the Gallery*. This book provides some valuable guidance on how to translate some of the most mysterious forms of art.

instead, that we have autonomy, that we won't look or feel silly, and that we won't have wasted anyone's time, including our own.

The truth is that working with materials exposes us to all of the above, to dead ends perhaps, to mess, and above all else, to a unique type of exposure. When we make art, we have a distinct sense of ownership and an awareness that no one else, irrespective of the endlessness of possibility in the universe, could have made this. All of these factors are likely to initially prove challenging and uncomfortable, but ultimately, perhaps thrilling.

I suspect that many of us don't even feel comfortable viewing artwork. We walk by a large canvas in a gallery and that piece may appear to be entirely sea green. A part of us might be suspicious, wondering if we could not have done this ourselves, but the price lets us know that we are mistaken, that our intelligence in this matter is lacking, and that there is, in fact, some great skill involved to which we are none the wiser. In this way we learn that art is something we don't understand, or that art is not for us.

Of course, as an art therapist, I believe hugely in the power of creativity. I believe that when we create our own emotional world, our *self*, if you like, is confirmed in a valuable and grounding way. Suddenly we are able to witness a part of that intrinsic us-ness externally, realized physically in the world we inhabit, as well as knowing it exists somewhere inside the dark unknown cosmos within our skulls. We are tethered in the world by what we create, be it a large dinner for our family or an artwork depicting a strange faceless cyclist.

Perhaps I am biased because I have always been encouraged in my creativity. I have been witness to making, although predominantly a making born out of necessity, almost all my life. My parents met at woodworking college, and with those skills were able to do a great deal of the work on the aforementioned renovation project themselves. In this way, I believe my first understanding of creativity was as a form of empowerment.

When I came across automata in Covent Garden, part of what struck me so deeply was the way the pieces reached out to me, never making me feel foolish or uninformed, but instead offering me an arm, a button, or a handle, and making me a part of bringing them to life. The art of automata is accessible to everyone by its very nature, yet its accessibility never lessens its impact.

I feel that one aspect of automata that resonates with people has to do with human capability and what we are able to do ourselves. This is something we are gradually losing sight of as technology advances. In a world increasingly blessed with intuitive technology and efficient, mechanized production, the process of carrying out tasks truly for ourselves becomes more and more extraordinary. These technological advances seem to mean that our choices appear to multiply but they actually shrink, while we slowly lose our natural sense of capability and freedom in the world. My sense is that this is a part of why automata delight us—we are reminded of the charm the human hand brings to creation.

Similarly, miniaturization is a source of fascination. It brings a vast, unknowable world into bite-size, manageable chunks of universality. We feel a satisfaction when either observing or creating for ourselves a miniature version, particularly of something familiar. A digestion seems to take place. The artist takes in something of our world, then mirrors or mimics it in miniature by hand, before offering it back again in its new iteration. Miniatures assume a charm, and in their tininess, we realise our affection and sentimentality for them.

Unlike adults, children will have a go at art and present their best work for publication. The author is unclear if this was her own work or that of a cousin, but the publication was a very limited run of one, for a 70th-birthday "magazine."

Snapshots of the world excite us, partly because of the way we are able to share recognition and perhaps feel less alone. I suspect this is why humor is such an intrinsic aspect of so many automata. It seems to me that humor is often implied, written into the subtlety of what is known and understood but unsaid. An intuitive understanding seems to pass between us when we laugh together. This is yet another way in which automata are connective and embrace the world around us reciprocally.

Automata is to art what stand-up comedy is to theater. Instead of reaching out to its audience, art can often alienate. Creativity is at its best when it shares itself, when it isn't too precious about its intention, when it emerges,

What resonates with us will appear to us to be art, wherever it is found. This is a photo of found art on the pavement in Amsterdam.

and, for reasons we aren't able to fully grasp, we recognise it like an old friend (or enemy)! The world of automata seems to combine nostalgia, familiarity, the implicit, timeless stories, and universal realities.

More than that, though, I believe automata help to hold open a door much too close to being closed—a door that leads us all not only toward play, but to a form of self-actualization we scarcely find time to entertain if we're not blessed with a natural gift for music or portraiture.

At the moment, I have two birdcages waiting to house my next automata projects. I also now have a partner, likely to hold me accountable to making the automata, as the cages occupy space in a not-all-that-spacious flat. I'm excited to make new pieces, but as it's been two years since I completed the last, the old nerves have crept back in. Here's hoping it's just like riding a bicycle (one last pun).

To see Daisy's *Girl Power* in motion, you can do so at *https://daisyroo.co.uk/2017/12/23/324/*

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Visit her art psychotherapy website at *www.daisyrubinstein.com*

Things the author is keeping, in case they want to become automata one day.

WALTER RUFFLER

Paper automatist: Part 2

by Ellen Rixford • New York, New York
Photos by Walter Ruffler,
except where noted

In the last issue of *AM*, Walter Ruffler discussed his background, how he got started with paper automata, and his process in developing an idea into a marketable product. Here he talks about philosophy, inspiration, exhibitions, and marketing.

* * * * *

Ellen: What is your philosophy concerning paper automata?

Walter: A mechanical paper sculpture not only has to work flawlessly but also has to contain a clever idea. It must build on the experience of the audience. The situation shown must be recognizable and should perhaps also stimulate thought and creativity—and a little humor.

One such model is Silent Night (**photo 1**), which shows a modern Santa Claus, who no longer brings presents with the reindeer sleigh but on a motorcycle. The structure of the base, the motorcycle and the rider, the mechanism (a crank slider), and the movement are like Off Road, but the story told is completely different. "Silent Night" is an old German Christmas carol, full of peace and quiet contemplation. The hustle and bustle of the loud, rattling, and smelly motorcycle is in sarcastic contrast to the

ELLEN RIXFORD

1. Stille Nacht, or Silent Night. Santa has upgraded his transportation.

actual meaning of Christmas. All sentimentality is destroyed; the commercial business seems to be the focus. So it says on the cover of the kit: "Times are changing, and a reindeer and sled are no longer viable in the global economy."

Ellen: How do you get your ideas?

Walter: There are many ways to get an idea for a paper machine—through one's own everyday life experiences, through suggestions from friends and acquaintances, through political events, historical topics, through orders and requests from customers, or just because one wants to try out a mechanism that one has designed. For instance, my model Sailing into the Wind (**photo 2**) resulted from sailing with friends in Holland.

My experience as a Member of Parliament in Bremen can be found in the model The Representative (**photo 3**). We sat a lot at the table in the plenary hall and had to listen to boring speeches that put us to sleep. In the end there was often a vote, the result of which had already been determined by the strongest party.

Everyone who has to work with computers knows the situation when the computer crashes or displays an "error" message. This has also happened to me, and I designed Chaos Computer (**photo 4**). On the cover it says: "As we all know too well, computer crashes create chaos for the user!" But here, the geek is surprised (to the point of being lifted off his chair) by a sweet message from his girlfriend!

I designed Wimbledon (**photo 5**) because I wanted to build a specific cam controller, so the mechanism was in the forefront of my thoughts. The cams are arranged so that the heads of three viewers move from left to right, and vice versa.

My model Egyptian Shaduf (**photo 6**) was created after a


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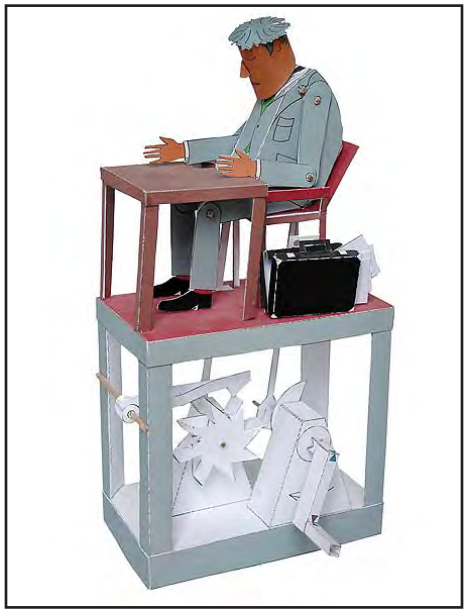
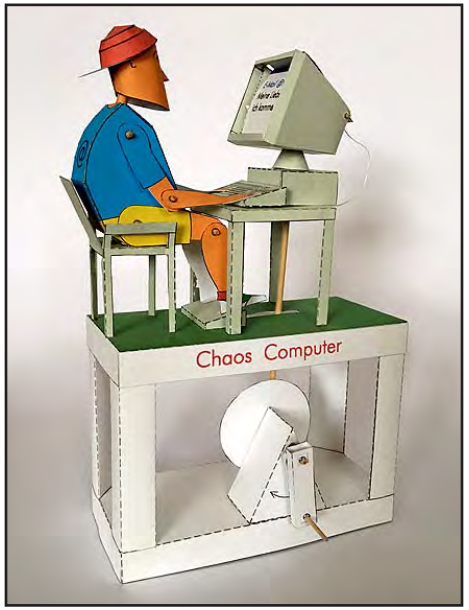
2. Sailing into the Wind.

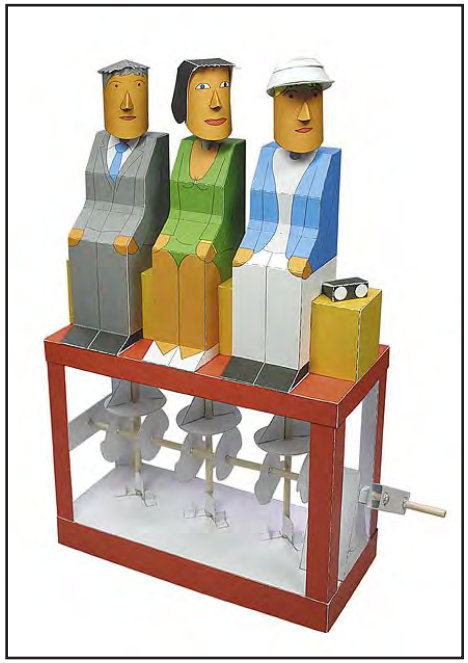


3. The Representative.

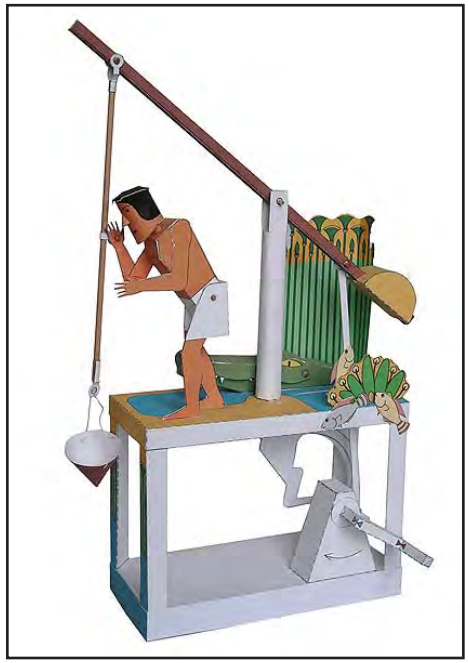


ELLEN RIXFORD

4. Chaos Computer.



5. Wimbledon.



6. Egyptian Shaduf.

vacation trip to Egypt. It shows a farmer, from the time of the pharaohs, who draws water from the Nile onto his higher field, with the help of a drawing well. In the background, a crocodile lurks in the reeds. The figure Egyptian Housewife (**photo 7**) is based on a child's toy from the time of the ancient pharaohs; it was then made of wood and was moved by pulling on a thread. It shows a farmer's wife, grinding grain.

I designed the imposing Fire Dragon (**photo 8**) because I love dragons as mythological creatures. The Red Knight (**photo 9**) is just another one of those.

7. Egyptian Housewife.

ELLEN RIXFORD

8. Fire Dragon.

9. Roland of Bremen is similar to the Red Knight.

Ellen: Are exhibitions an important part of selling your work? Do you promote your work in different ways? Which paths seem to be the most successful?

Walter: In addition to my own work, I have a collection of over 250 paper mechanical models by contemporary artists, and also historical models from the 19th century, since 1860. I also have a collection of pop-up cards and over 300 pop-up books. Using pieces from this pool, I design complete exhibitions that I lend to museums.

I have participated in many exhibitions around Germany and other places in Europe, since 2002. The first exhibitions came about by me approaching the respective museum directly. Later, one exhibition often led to another. Some museum inquiries came from my posts on my website.

To date, I have had nineteen solo exhibitions of my collection and fifteen exhibitions with other artists. In conjunction with these exhibitions, the museums sell my automata kits. The exhibitions are therefore a good marketing tool and good for sales.

If possible, I also offer workshops on paper mechanics as part of the exhibitions. Because it takes several hours to build a three-dimensional object, which is out of the question for a workshop, I designed a large number of pop-up cards that can be built in 15-20 minutes.

Up until a few years ago, an international cardboard-model-construction convention, with 200-300 participants, took place annually in the German Maritime Museum, in Bremerhaven, where I presented and sold my movable-paper objects. Every last weekend in April, there was an exhibition of finished models, sales tables for dealers, and lectures on different aspects of cardboard-model making. The focus was on ships, planes, and architectural models. At the 12th International Cardboard Model Building Meeting, in 2000, I exhibited some paper automata and gave a lecture: "Paper Machines: Mechanical Models out of Paper." Many more lectures followed.

Ellen: How do you sell your kits—through bookstores, artist agents, art exhibitions?

Walter: I knew Cabaret Mechanical Theatre (CMT), in London, with its wonderful web shop. In March of 2000 my wife Christina and I went to England to win CMT as a reseller. Unfortunately, it had recently moved out of its premises in Covent Garden, for financial reasons. We drove to England again a few months later and visited CMT's new location in the Kursaal, in Southend-on-Sea, at the mouth of the Thames. We showed them a fully assembled model of Off Road and some kits, and expressed our interest in working together. Some time later we received a message from Sue Jackson and Sarah Alexander that they would like to sell my paper automata kits via their internet shop. This started a good twelve-year collaboration. Since CMT is known worldwide, my kits have become known everywhere. Later, importers in the United States and Japan began selling my automata.

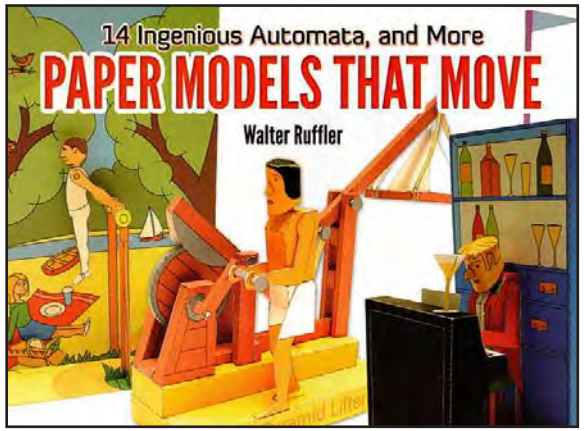
Early on, I got in touch with Scheuer & Strüver GmbH, in Hamburg, the largest mail-order model-construction company in Europe, who also became my customer for many years. And in cooperation with the Taiwanese company Evergreen International, I signed a license agreement that allows them to produce and sell mechanical wooden kits based on my designs.

My website, which Christina designed, is also very important. It contains a catalog of kits, my lectures, and a small gallery of paper mechanics, with history and objects by contemporary artists. An English version is available.

In 2003, my book *A Handbook of Paper Automata Mechanisms* was published by Tarquin Publications, in Stradbroke, England. The 48-page book included 26 pages of theory and five cut-out sheets of different mechanisms. In 2010, an extended version, with 106 pages, was published by the American publisher Dover, under the title *Paper Models that Move: 14 Ingenious Automata, and More* (**photo 10**).

My paper mechanics also became known through newspaper articles and local TV channels, especially in connection with my exhibitions. Some customers filmed their assembled models and showed them on YouTube. Articles in *Tu*—the magazine for technology in the classroom, by Falk Keuten, a German expert in kinetic art and ball tracks—also helped to make my creations known. Links on colleagues' websites are helpful. Reference has also been made to my paper machines in educational circles.

Another means of distribution was artisan markets in Bremen. And for several years I rented a booth at the Leipzig Book Fair.



10. Walter Ruffler's 2010 book, *Paper Models That Move*.

Ellen: Would you like to add anything else?

Walter: I was very happy about Guido Accascina's interest in my paper machines, which he shows in his Modern Automata Museum, in Montopoli di Sabina, near Rome (*www.modernautomatamuseum.com*). For exhibition, the machines were reinforced with wood and cardboard and equipped with small electric motors, so they could be set in motion by museum visitors.

In 2003, Guido also had the idea of an international exhibition of mechanical sculptures on the topic "Against the Idea of War." The background to this was the war of aggression against Iraq that had been wanted by the American president George W. Bush. Fourteen artists participated, including Aquio Nishida and Keisuke Saka from Japan; Paul Spooner, Keith Newstead, Peter Markey, Andy Hazell, and Malcolm Brook from England; Brian Gravestock from Canada; and Luca de Pascalis, Ivan Fodaro, Marina Gigli, Girovago e Rondella, and Guido Accascina from Italy. My wood sculpture *American Rodeo* shows a cowboy riding a falling bomb while a small music box plays the melody of Bob Dylan's song *Blowing in the Wind*. It was modeled after a scene from Stanley Kubrick's 1964 film, *Dr. Strangelove or How I Learned to Love the Bomb*.

Visit Walter Ruffler's website at *http://www.walterruffler.de*

SECURITY CONFERENCE

A Chinese automatist makes his debut

by Li Zhanlong
Shijiazhuang City, Hebei Province, China
Photos by the author

A few of the author's automata, produced in less than a year. Most of his learning came from the internet.

Many thanks to *Automata Magazine* for providing an opportunity for me to share my toy-making process. I am an automata maker from China. I belong to MJS Studio and am currently working full time to create and promote automata mechanical toys.

In early 2019, I discovered the automata of Harada Kazuaki on the internet, and I really liked them. After

that, I started collecting automata videos, watching them repeatedly and learning from them. I owe thanks also to Paul Spooner, whose work inspired me. By observing his automata, I gained a lot of mechanical knowledge, which I used in my later creations. I hope that Cabaret Mechanical Theatre will come to China many times, to bring the joy of automata to more people.

The production of automata requires learning how to use woodworking machinery, understanding the operating principles of machines, and also having a background in art and design. This is difficult for me, as I have not had professional training in these areas. But because of my obsession with automata, I took the first steps in learning to make them. In China, automata are something new. Few people are making this kind of toy, and no courses or books can be found online here. Under these conditions, I could only learn from watching the foreign videos.

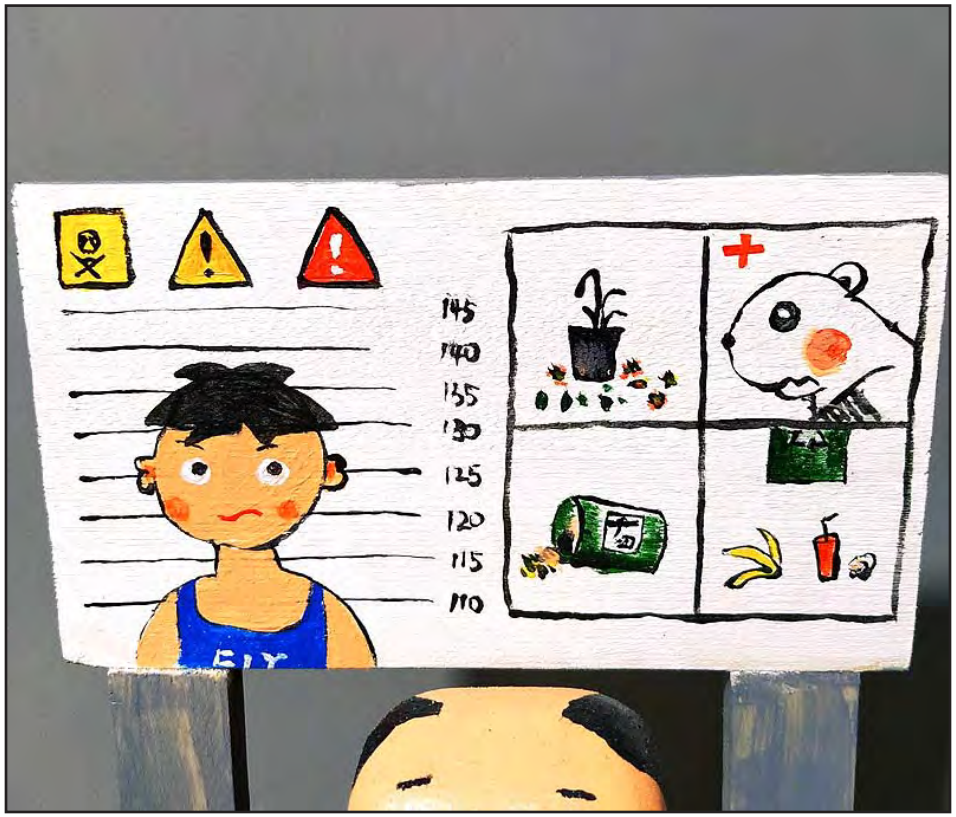
In more than eleven months of hard work, I made twenty-seven automata. In learning to make these, I have imitated while also innovated, hoping to put my theoretical knowledge into practice in the shortest possible time.

The following is about a piece of my earlier work. Although it looks rough and has many defects, I gained a lot of experience from building it, so I will share it with you.

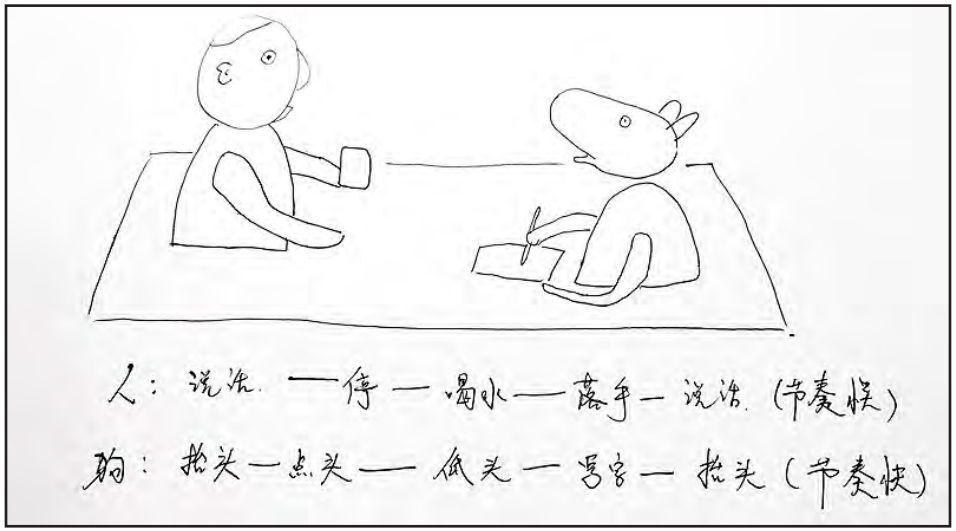
The title of the piece is *Security Conference* (**photo 1**). It describes the manager of a residential community meeting with a patrol dog. The purpose of the meeting is to prevent the bear children in the community from destroying everything (**photo 2**). Here is my production process.

First came the concept drawing (**photo 3**). When I was inspired

1. *Security Conference*. The dog is receiving his instructions from his manager.



2. A board above the manager's head graphically explains the goals.



3. The author's rough conceptual sketch of the project.

4. The manager explains the dog's tasks.

to do this piece, I drew the idea on paper and wrote down the actions and time sequence of each figure. The leader opens his mouth to talk (**photo 4**), and drink water (**photo 5**) after speaking for a while, while the patrol dog nods and takes notes (**photo 6**).

I built the mechanical part next. I used a lot of cams to make the figure speak and nod. A speed reducer was installed at the crank to ensure that the movement of the figures would be slow enough. I used two pulley sets to connect to the bodies of the human and the dog.

Then I started preparing the required materials. I made everything by hand with standard tools—no help from CNC ma-

5. He pauses for a drink…

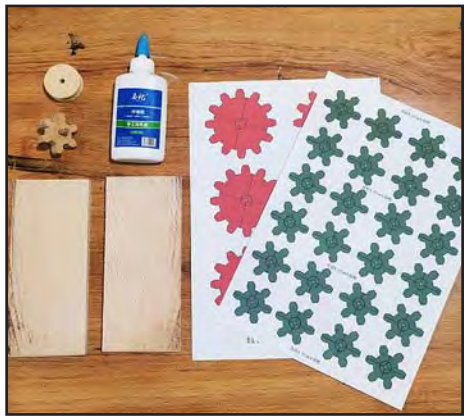
6. …while the dog takes notes.

7. Figures were carved and shaped from wood, with knives, a rotary tool, and sandpaper.

chine tools. The figures were made first (**photo 7**). Gears and cam parts were next (**photo 8**). I first pasted the gear drawing onto a wooden board. Then I drilled the spaces between the teeth with a bench drill and cut out the gear with a bandsaw.

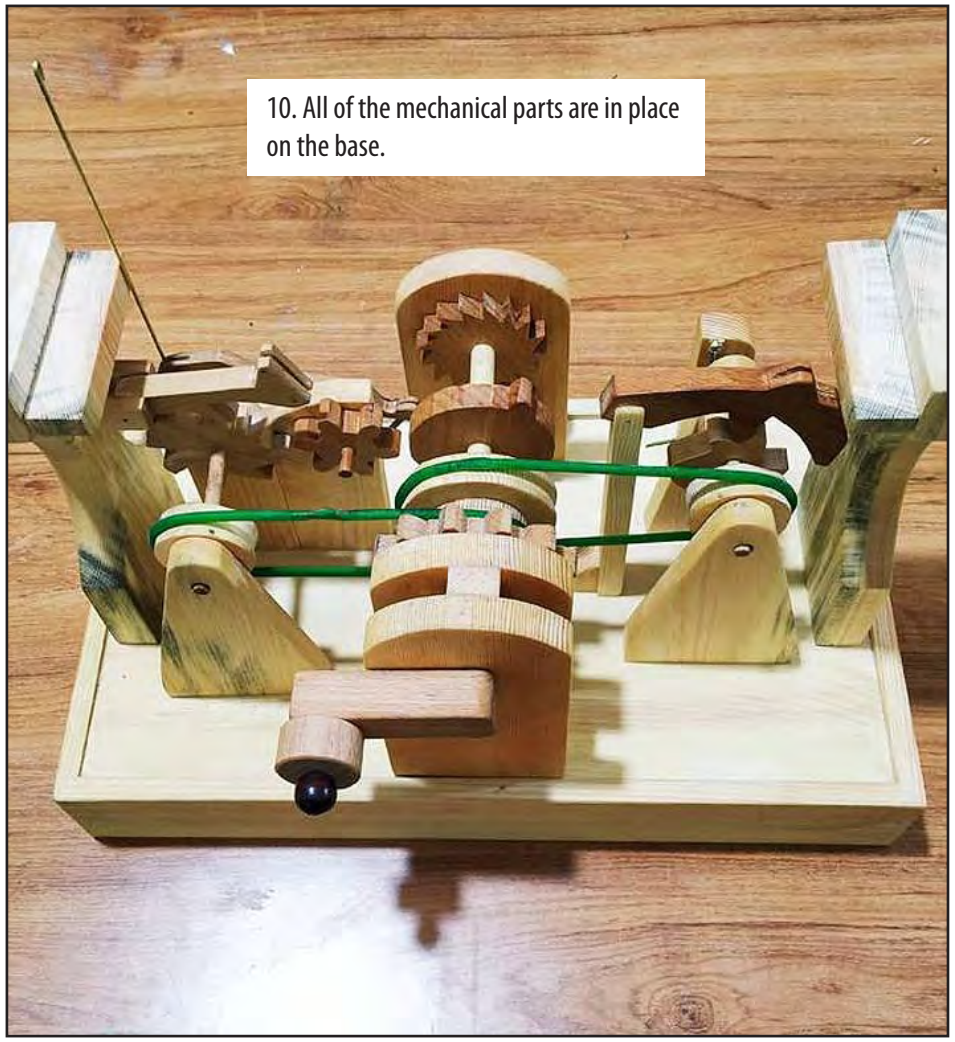
According to the planned structure, I made a base and frame (**photo 9**), logically arranging and simply fixing all of the mechanical parts in place (**photo 10**). Once I had assembled and debuged the mechanical part, I was ready to proceed to the next step.

I temporarily assembled the figures and the cover and put them in place. I debugged the unit until it ran smoothly, too (**photo 11**). Once this was done, I disassembled the figures and mechanical parts. I applied wood wax and oil to the mechanical parts and fixed them in place with glue. The figures were then painted (**photo 12**). The piece was finally assembled and all the parts were adjusted one last time. After the operation was smooth, remaining parts were glued in place and the work was complete.

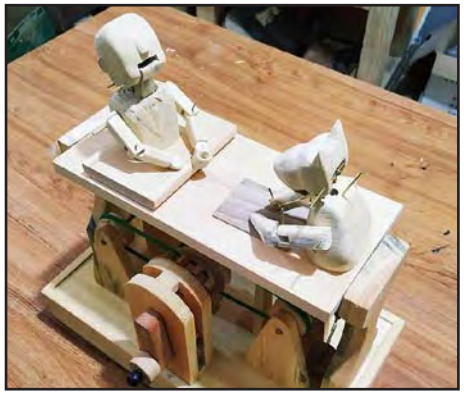


8. Gear patterns, glue, rough wood, and a finished gear.

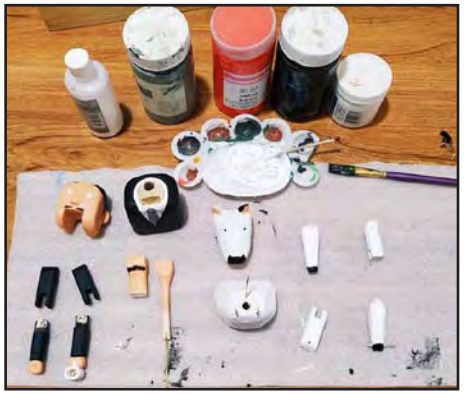
9. Wood for the base and frame.



10. All of the mechanical parts are in place on the base.



11. The nearly finished automaton was put together and debugged before final finishing and assembly.



12. When everything ran smoothly, the figures were disassembled and painted, and the remaining exposed-wood parts were finished.

Confessions of a part-time automatist

One man's journey

by Randall Rudd
San Antonio, Texas, USA • Photos by the author

First of all, why the name "automatist?" Nobody ever knows how to pronounce it, initially. Some never get it right. Then there's the problem of the plural being "automata," while the singular is "automaton." It's maddening. I tried calling them "performing sculpture" for a while, just to break up the monotony. But I've digressed before getting started.

History

I first learned about the phenomenon of automata while reading an in-flight airline magazine article about Paul Spooner when I was en route to London. Intrigued, I immediately visited Cabaret Mechanical Theatre in Covent Garden. There I met—and immediately befriended—contemporary-automata pioneers: Sue and Sarah Jackson, Keith Newstead, Gary Alexander, and others. They were a warm, fascinating, welcoming artistic group.

Paul Spooner's paper-automata books provided me with some early inspiration and experience in the mechanical, as well as the artistic and philosophical, aspects of this burgeoning art form. I was already halfway there, having built performing robots in high school. One was a mechanical Marc Antony delivering Caesar's funeral oration (until his arm fell off, anyway). Ultimately, I became a professional filmmaker/animation director and performer, ending up as a Creative Director at Paramount Pictures, in Hollywood.

An automaton—this brand-new, rediscovered art form—was the ideal synthesis of sculpture, comedy, performance, animation, and mechanics. I was hooked. As I

The Late Show. A terrified senior sits transfixed in fear, watching *Dracula* on his vintage black-and-white TV set. He gasps repeatedly and shovels popcorn into his mouth. Meanwhile, his wife pets her poodle and yawns.

began filling my home with pieces by Paul Spooner, Matt Smith, Peter Markey, and others, I could not help but jump in with reckless abandon. I started making my own automata, having gathered the look and technique from the early Spooner paper-automata books, *Spooner's Moving Animals* and *Museum of the Mind*.

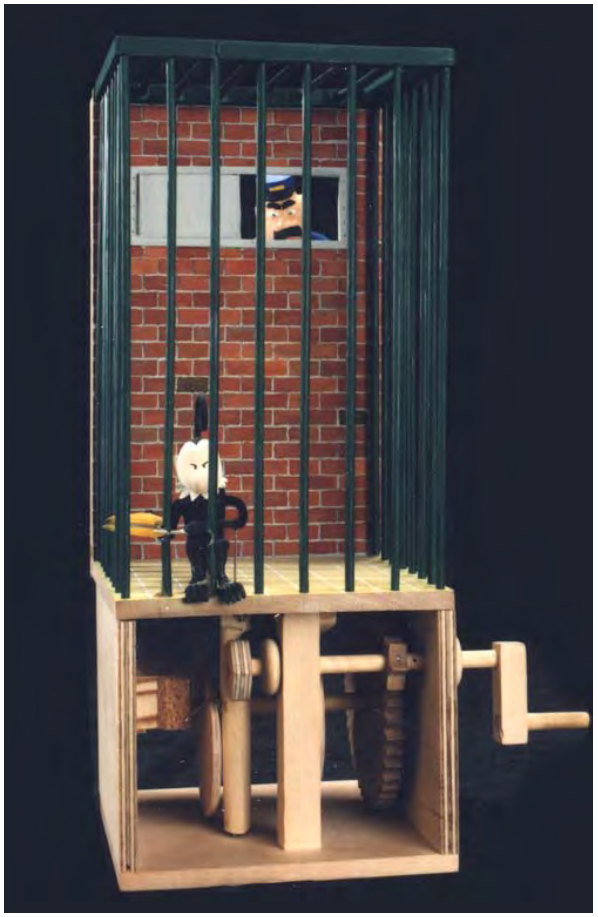
I was especially enthralled by Paul Spooner's and Matt Smith's philosophy and delightful senses of humor, wit, and whimsy. I caught on, eventually. It wasn't enough to simply add motion to a stationary object. The artist had a responsibility to provide entertainment value, tell a story, capture life, make a point, and do so with as much artistry and elegance as wood and brass would allow. The direct connection between creating animation for the screen and creating performing sculpture was easy and obvious. It was the same thing that I had been doing on-screen for decades, only much more difficult.

My early pieces were derivative, but as experience slowly settled in, I began to develop my own look, style, and subject matter. Here's an example of my work flow on any given automaton.

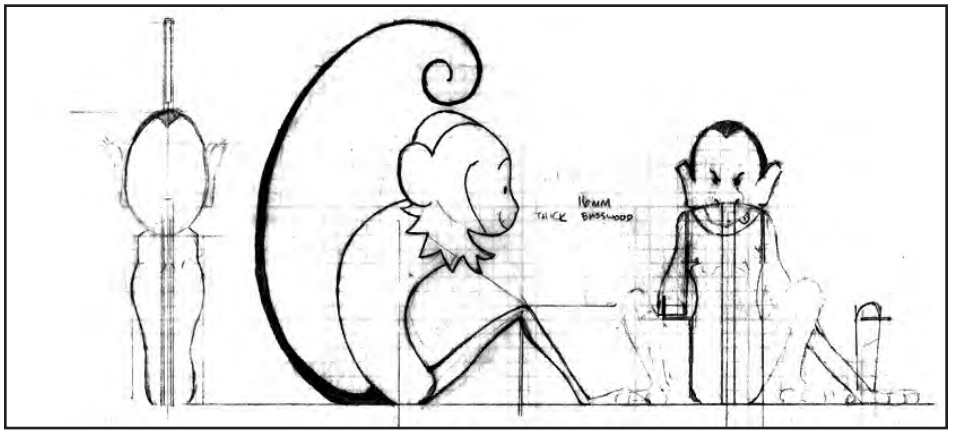
- Come up with an idea
- Draw it up
- Convert the drawing to graph paper
- Build a working paper model (optional)
- Transfer the design from graph paper to the top and sides of wood blocks
- Scrollsaw the rough shape
- Remove material (shave/trim/whittle/sculpt— usually with a Dremel tool—to final shape)
- Endless assemble-trial-revise-assemble-trial-revise routine, until perfection is achieved (this step can take minutes, hours, or weeks, depending on the complexity of the piece)
- Paint
- Final assembly
- Glue
- Final adjustments and paint touch up

Philosophy

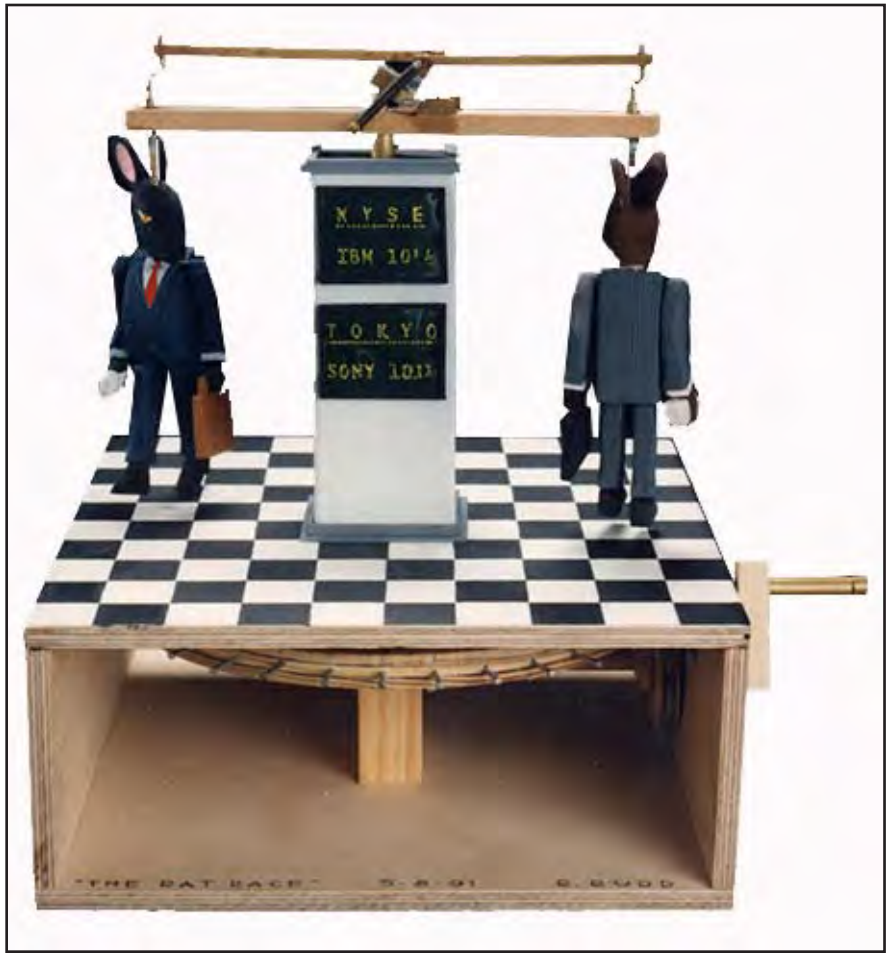
I eventually began creating automata pieces for museums and collectors. I learned the rude realities of the exhausting research and development involved in designing and building one-off automata vs. hard deadlines. But an even harder lesson was comparing the earning power of a lucrative film director vs. that of a paltry automatist. Eventu-



LEFT: ***Freedom at Hand.*** A study in deceit. A hapless, yet determined, capuchin monkey saws feverishly at his cage bars, occasionally pausing when the suspicious zookeeper checks up on him. Once the coast is clear, the monkey again slides his forbidden file out of his banana and returns to his nefarious task.



BELOW: An example of the author's precise preconstruction drawing on graph paper.



The Rat Race. Two nattily dressed rats, with briefcases in one hand and the *Wall Street Journal* in the other, race around frantically, as they study the stock-market readouts on the center column.

16 Cups of Coffee Later. . . . Through the simple turn of the crank, one can study, with startling clarity, the dramatic effect resulting from the consumption of 16 cups of caffeinated coffee on a normally nonaggressive gentleman.

ally, a tight, somewhat desperate deadline situation led to an unfortunate incident with a power saw that stopped my automata career in less than one-quarter second; stopped at least until my damaged finger regenerated its nerves and became usable again. After that, my hobby remained just that—a hobby. It was no less loved and appreciated, but from a slightly safer distance this time.

The first automata I attempted to create were mechanically fairly advanced, along the lines of later Paul Spooner pieces. One could say I started at the top. This was a big mistake, I suppose, but I had little interest in primitive automata that merely jerked up and down or spun around.

My background was animation, a word that comes from the Latin meaning "to give life." So, bringing life to inanimate wood and brass was always my goal. It was not to simply add motion. From the beginning I sought to com-

bine animation, direction, puppetry, sculpture, and mechanics, with performance/drama. Spooner's characters performed in real time, with spot-on appropriate pausing, and rhythm, often with the illusion of thought and motivation, and always with the element of sophisticated humor. This was exactly what I spent my "day job" doing— attempting to create convincing, natural 2D cell- and 3D CGI animation.

Even today, while I am appreciative of anyone who makes the effort to create automata, I am impressed more by the performance aspects than any other factor. Does the piece "stop time" and captivate? Or is it merely a piece of sculpture first and a performance piece a distant second? Simply adding motion, in my opinion, is not enough. Does just another twirling ballerina, hopping frog, flapping wing, or opening and closing mouth really advance the art?

Just as in music, there are those who play simply for the fun of it, and those who advance the art through creativity, invention, artistry, exceptional skill, and virtuosity. I have nothing against the former, but the latter push the envelope and evolve the art form. That's where my interest lies. Granted, growth in popularity has occurred. But in my opinion, I see few individuals involved in truly advancing the cause of contemporary automata as an art form.

These last two paragraphs are not intended to rile anyone. They are just some top-of-mind thoughts I've harbored as an automatist for over thirty-five years.

Beyond Repair. From this angle, it appears that poor Sigmund Freud is frantically scribbling, in between gasps and jaw drops, at his client's outrageous admissions. Upon further examination, we see that his wild-eyed, babbling patient is actually a ventriloquist, with his hand inside his dummy, exercising self-treatment.

The present

I still enjoy collecting, making, and promoting automata, just as I have enjoyed spreading the word, through interactive lectures for groups, conducting seminars, and designing museum exhibits. I have lately learned the power of automata through my grandchildren. Any visit with their grandfather means spending a good hour or so, cranking and discussing automata (at their insistence, not mine).

I've used automata in broadcast work, too. I tried for years to produce a definitive documentary on automata. National Geographic even approved a marvelous initial script, but last-second regime changes at the network scuttled what might have helped launch automata into the artistic mainstream.

Oh well. It may even be better that automatists are not yet rock stars. It keeps things pure. Only true artists participate in the world's most underappreciated, unknown art form. But, in a way, that rarity makes things all the sweeter—our little secret and all that.

LEGO AUTOMATA

A short history of LEGO and official LEGO automata

by Teun de Wijs • Amsterdam, Holland

LEGO Forma automaton, Koi, 2019, has a changeable plastic skin. This version is called Splash.

After writing about my own LEGO models (*AM*, March-April 2020), I was delighted when Marc Horovitz asked me to write a regular column to delve further into my favorite subject. Here goes!

Since I realize that not all of you readers are brickheads like me, I'd like to begin with a brief overview of the journey it took to make LEGO automata possible, and discuss the few official instances where the LEGO company ventured into the realm of automata.

The rise of LEGO is well documented and has been the subject of many documentaries (see the links sidebar). In short, it all began when Ole Kirk Christiansen, a Danish wooden-toy maker, took a

chance in 1932 and bought one of the first plastic-injection-molding machines. By 1949, the LEGO company (the name comes from the Danish phrase *leg godt*, meaning "play well") offered a full line of plastic toys, including a system of building blocks that was based on English toymaker Hilary Fisher Page's Kiddicraft Self-Locking Building Bricks (**photo 1**). LEGO's first bricks were called Automatic Binding Bricks, and they did not stick together so could only be stacked. However, Christiansen's son Godtfred realized their potential and, after years of testing, the snap-together LEGO bricks we know today were patented in 1958.

To make LEGO automata possible, one more ingredient was crucial: movement. Fortunately, LEGO did not remain static for long. Although Wikipedia would have us believe that LEGO gears were introduced in 1977, in fact, the first sets featuring gears (and even an electric motor) were released as early as 1964. Only two years later we saw LEGO's first official mechanized imitations of life (which is roughly how I define automata), in the form of a red owl with moving eyes, and a man pulling a lady in a rickshaw

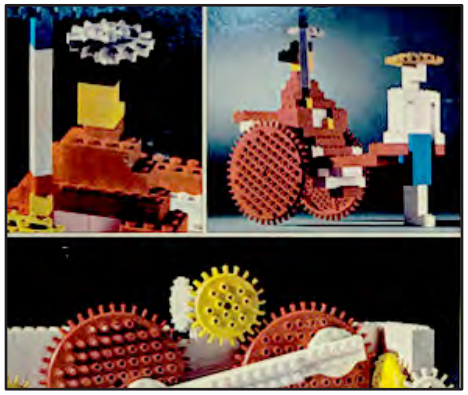
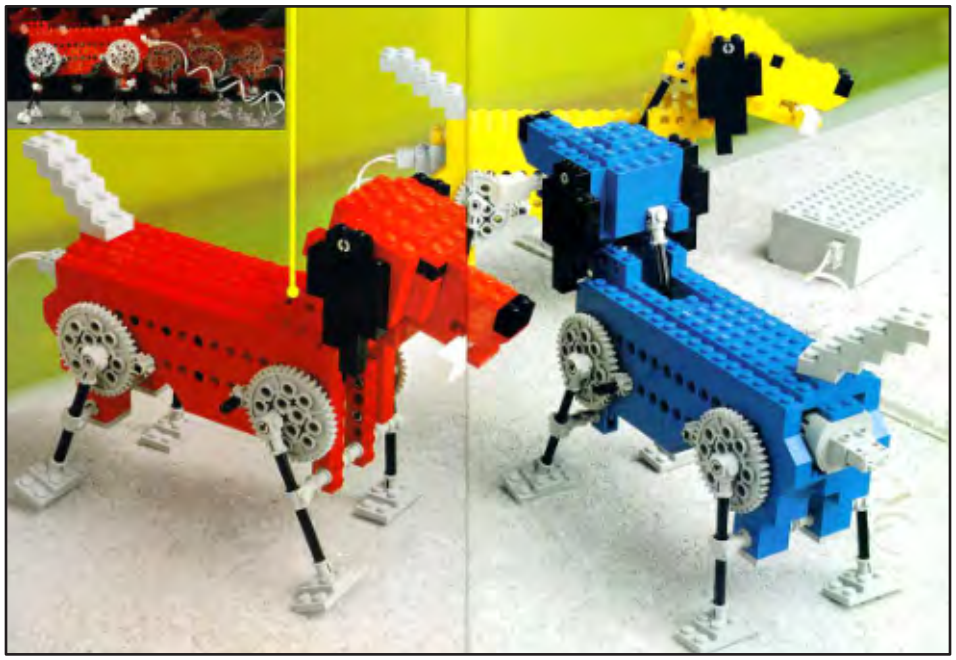


Photo: CHAS SAUNTER—www.HilaryPageToys.com



FAR LEFT: 1. **Kiddicraft Self-Locking Building Bricks, 1947.** LEGO based its system of bricks on this toy without formal permission. Not until 1981 did LEGO pay a small sum to the original company for the rights, and all mention of Page and Kiddicraft was removed from LEGO's published history.

LEFT: 2. **Rickshaw, 1966.** This set is extremely rare. The author has never seen the model in action. Evidently, from the box's picture (shown here), the lady twirls her large gear-umbrella as the wheels turn, pulling the rickshaw forward. One has to admire the creativity of the designers in building something so recognizable with only the crude LEGO bricks of the time.

BELOW LEFT: 3. **Dog, 1980.** The author still owns this *Ideas* book. This dog was probably the first LEGO automaton he ever built. The dog hops forward while its movement makes the ears swing and the tail wag freely. There's a video in the links section for those who'd like to see it in action.

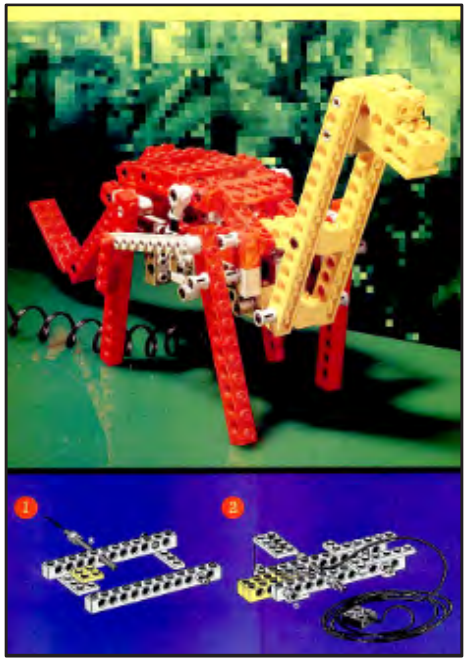
(**photo 2**); these were building suggestions on the box of the 1967 LEGO Discovery Set.

Children must not have responded well to building these types of things, because even though LEGO Technic (introduced in 1977) grew more and more sophisticated over time, LEGO's designers stuck firmly to cranes, trains, and automobiles for more than thirty-five years. In my research, I was able to find only two instances during this period where they mechanized models of living things, both of which appeared in LEGO Technic *Ideas* books. An issue from 1980 fea-

tured a rather cute hopping dog (**photo 3**), and an issue from 1991 contained a simple walking dinosaur (**photo 4**).

The wonderful *Ideas* booklets provided instructions to build the models, but the models were never sold as complete kits with all the necessary pieces. This changed in 2003, with the launch of an ingenious line called Inventor sets. Not only did these sets feature mechanized animals, like a rope-climbing monkey (**photo 5)** and a flying bird on a line (**photo 6**), but they were also quite versatile. Every set included multiple instructions on how to transform the basic model shown on the box into many others, including different moving insects, birds, fish, dogs, and even a drummer.

The Inventor line was terminated after only one year and just four sets, however. This was perhaps due to poor marketing, or the fact that not all models were mechanically sound and they were rather crude. Nothing resembling the kind of automata featured in this magazine was produced until quite recently. For this to happen, LEGO first needed to find a new target audience.



ABOVE LEFT: 4. **Dinosaur, 1991.** This model looks well engineered in its use of relatively few parts. Perhaps the subject matter is fitting, as LEGO automata became extinct for nearly thirty years after this.

ABOVE: 5. **Monkey, Inventor set, 2003.** Each set in the ingenious Inventor line had a frivolous name, such as Wild Wind-up and Motor Movers, which featured a climbing monkey on the box. Each set offered many more kinetic animal and humanoid possibilities.

LEFT: 6. **Bird, Inventor set, 2003.** Impressively, even the Inventor line's smallest set, Motion Madness, included instructions for turning this blue bird into a unicyclist, a snail, a grasshopper, a horse, and a few other things, with only 243 pieces.

A new audience

There have always been grownups interested in LEGO, but as the system evolved to include materials that allowed unprecedented detail and functionality, more and more adult builders embraced it as a creative outlet. The internet was the perfect medium to share their models. The worldwide community of AFOLs (Adult Fans of LEGO) flourished as never before, and LEGO was smart enough to realize the market potential of adult builders.

Not far into the new millennium, the LEGO company started releasing more intricate sets, specifically aimed at their adult fanbase. At the same time, LEGO drew inspiration from the work and interests of adult builders.

And while LEGO automata makers are by no means a large portion of the fan community, their work apparently gained enough exposure for the LEGO company to take notice and explore this territory once again. In 2019, we finally saw the release of not just one, but two sophisticated, official LEGO automaton sets. The first of these was a charming set of Chinese dragon dancers, released for the Chinese New Year (**photo 7**).

7. **Dragon Dance, 2019.** Regrettably, this attractive set was only sold in China and is rapidly becoming a sought-after collector's item. Sets can still be found online for €100-€200. When the automaton's crank is turned, the minifigures holding the dragon jump up and down in sequence, making their dragon "fly" through the air in a wavelike motion.

LEGO Forma

The second set, released under the LEGO Forma name, was even more interesting, because it held promise. LEGO Forma started life in 2018 as a crowdfunding project by LEGO on *indiegogo.com*. Not because they desperately needed funds—LEGO made more than five billion euros in 2019 alone—but as a way of determining if buyers would be interested in a line of LEGO automata, marketed as anti-stress toys for adults. The financial mark of the crowdfunding project was quickly reached, and in February, 2019 the first LEGO Forma set was unveiled—a rather stylish swimming Koi (**photo 8**).

Sadly, these wonderful experiments were just as short lived as their predecessors. The Dragon Dance set saw only limited release in China and never made it overseas. In December of 2019, LEGO announced that the proposed Forma line would be discontinued after its first and only model. The koi sold relatively well, but the feedback of builders demanding more customization options was apparently enough for LEGO to pull the plug.

So here ends this brief history of official LEGO automata. Let's keep our fingers crossed that the LEGO company doesn't keep us waiting another fifteen or thirty years for the next automaton set. In the meantime, for more automata, we must look to the amazing world of LEGO fan builders and their work, and that is where I will be taking you in the next issue.

8. **Koi, 2019**, was the first and only model produced in LEGO's proposed Forma line. When the handle is cranked, the fish swims with an elegant motion. The skin was changeable, and three other varieties—including a shark skin, line-drawn white skin for self-coloring, and the skin shown in the lead photo—could be purchased separately.

Web links

LEGO history

- Wikipedia: *https://en.wikipedia.org/wiki/Lego*
- LEGO's own history pages: *https://www.lego.com/en-us/lego-history*
- *The LEGO Story* (animation): *https://www.youtube.com/watch?v=NdDU_BBJW9Y*
- *A LEGO Brickumentary*: *https://www.imdb.com/title/tt3214286/*

Instructions

- *1980 LEGO Expert Builder Idea Book* (includes hopping dog): *http://bricks.argz.com/ins/8888-1*
- *1991 LEGO Designers Idea Book* (includes walking dinosaur): *http://bricks.argz.com/ins/8891-1*

More links

- 1980 Hopping dog in action: *https://www.youtube.com/watch?v=tUEjb_ys4Fo*
- 2003 Inventor sets *https://brickset.com/sets/theme-Creator/subtheme-Inventor-Set*
- 2019 LEGO Forma in action: *https://www.youtube.com/watch?v=r1zjYGXiE2w*
- Hilary Page Toys: *https://www.hilarypagetoys.com/*

Building Blocks

Linkages and motion: Part 1

by Paul Giles •Sun City Center, Florida, USA
Photo by the author, drawings by Marc Horovitz

Cams and levers, pulleys, and gears may fill our heads as we begin to think about building our next automaton. All too often it's easy to skip right over the pins that hold things in place, as well as the rods used to join everything together. No fun there, you might think. Wrong! When you marry these rods and pins, an amazing universe of new and unimagined movements will open.

In their simplest form, those connected rods and pins do little more than create a bicycle chain. Unless the links and pins are wrapped around a sprocket, they won't do much more than wriggle around. But all that's needed to create some magic is to hold something down. When either a pin or a bar is forced to stay in place, what's made is what engineers call a linkage. One bar and (for now) two pins will provide the first link. Start thinking of those pins as hinges because something will move around them.

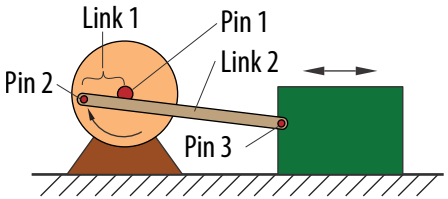


Figure 1
Creating back-and-forth motion

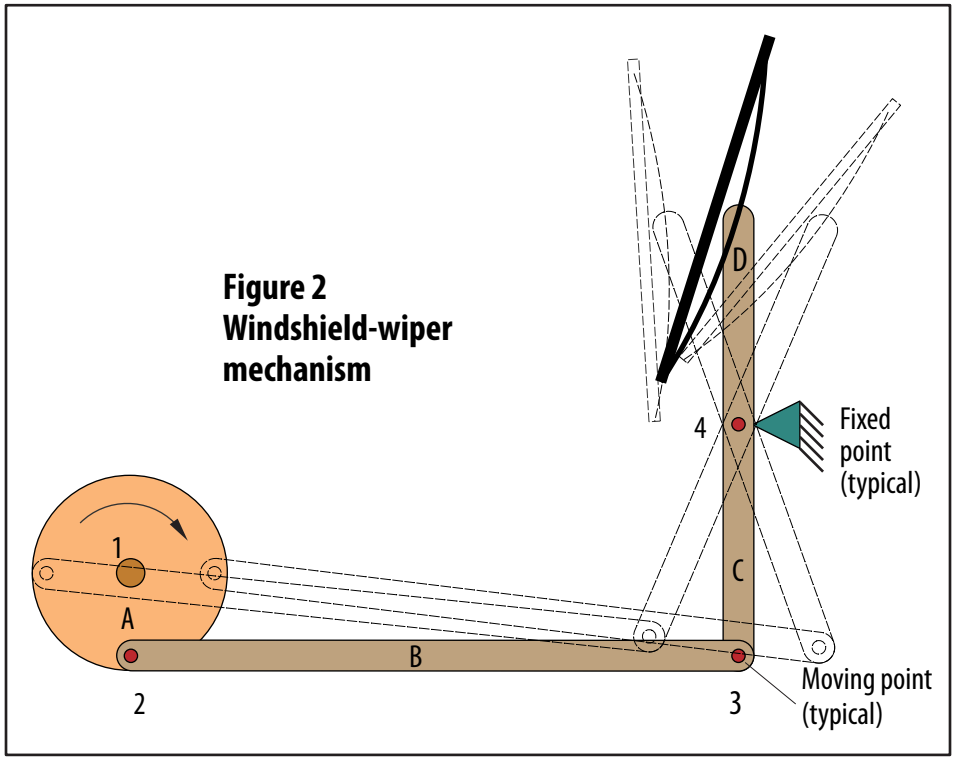
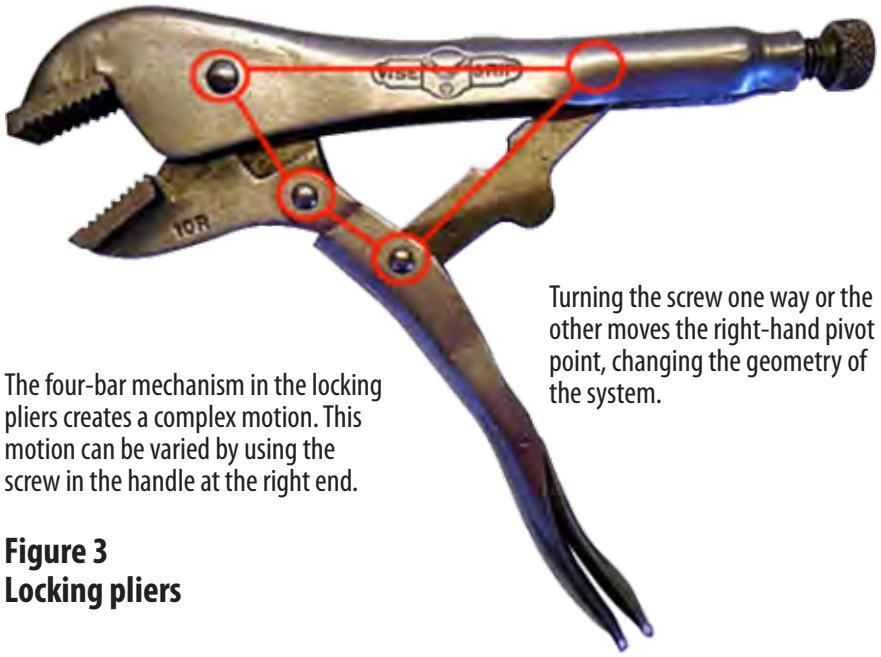


Figure 2
Windshield-wiper mechanism

The simplest linkages—linkage systems—you will likely see in your projects will have just a pair of links and three pins, one of the pins being shared by the two links. Use this when you want to turn rotating motion into a back-and-forth, reciprocating motion (**figure 1**).

You'll need to add more links before you can really create wonders in your projects. Here are just two examples of four-bar linkages from everyday life. The first one (**figure 2**) synchronizes the wiper blades on our automobiles. If you look closely, you can count four pins or hinges plus four bars or links. The leftmost pin (1) is where you could connect a power source. In the automobile, that would be just a small electric motor that would create an oscillating motion. You can also see that the last pin (4) is anchored to the chassis. Between the motor pin and the anchor pin, all four links are forced to pivot.

The shape of the links can be changed. A link doesn't have to



Turning the screw one way or the other moves the right-hand pivot point, changing the geometry of the system.

The four-bar mechanism in the locking pliers creates a complex motion. This motion can be varied by using the screw in the handle at the right end.

Figure 3
Locking pliers

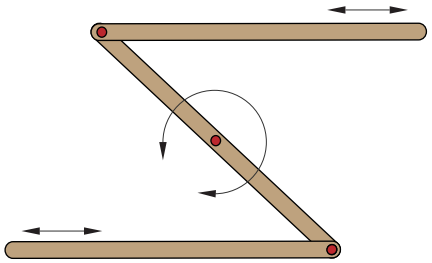
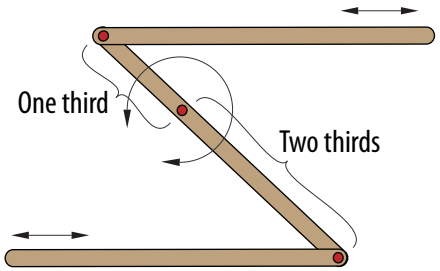


Figure 4
Creating opposing linear motion

look like a stick man. Many of us have locking pliers at home (**figure 3**). You can see where the four links and the four pins are. You will also see the links changing shape.



The lower bar will move twice as far as the upper one

Figure 5
Creating unequal opposing motion

The top link extends beyond its two pins this time. On the right side of this link is half of the handle. The left end takes a different shape and becomes the top half of the jaws. The lower jaw is the next link. Notice that this link is roughly triangular in shape.

Adding extensions and changing the shapes of the links is the secret behind creating intricate movements. There are some extra pieces on those locking pliers—pieces like the threaded rod and the spring. They work outside of the pliers' four-bar linkage, enhancing the tool by allowing us to change the jaw-opening width or easing the opening of those clamped jaws.

Like the bars, which don't need to be long and thin, neither must the pins attach only at the ends. If your automaton's components need to move two objects away from each other, then back, you might want to include the three-bar, three-pin linkage shown in **figure 4**. There you will see that the second pin is at the center of the middle bar. Imagine some gears in the background turning that middle pin and forcing the reciprocating motion of the two objects.

You don't want the two objects traveling the same distance? Perhaps you're thinking of a couple arguing and they're not quite ready to make up. That's easy—just change the location of the center pin. If you move that pin from a fifty/fifty split to a one-third/two-thirds spacing on the center rod (**figure 5**), you suddenly make one of your two people move twice as far, back and forth as the other.

You're not limited to moving in opposite directions, either. Replace the center rod with a triangle and move each of the other rods to a different point on the triangle (**figure 6**). If you now rotate the trian-

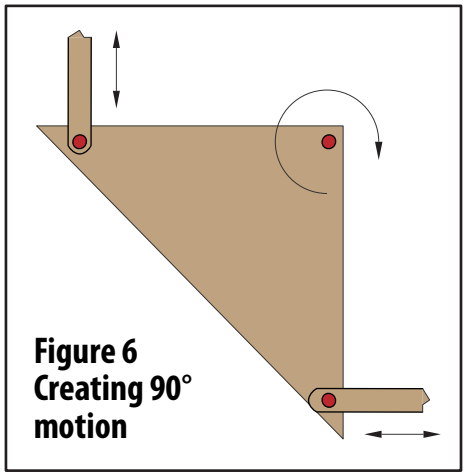


Figure 6
Creating 90° motion

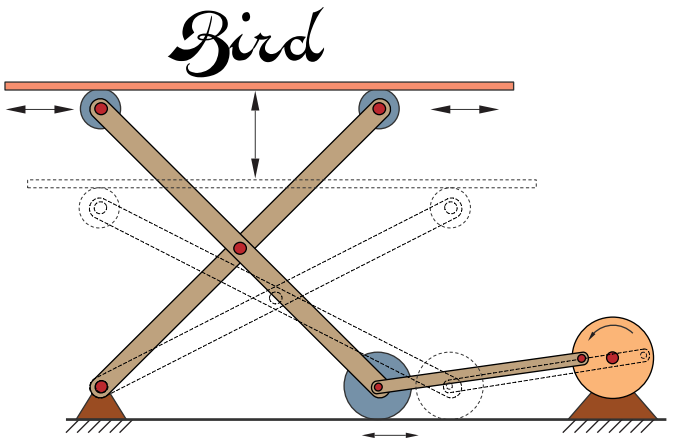


Figure 7
The scissor lift provides vertical motion

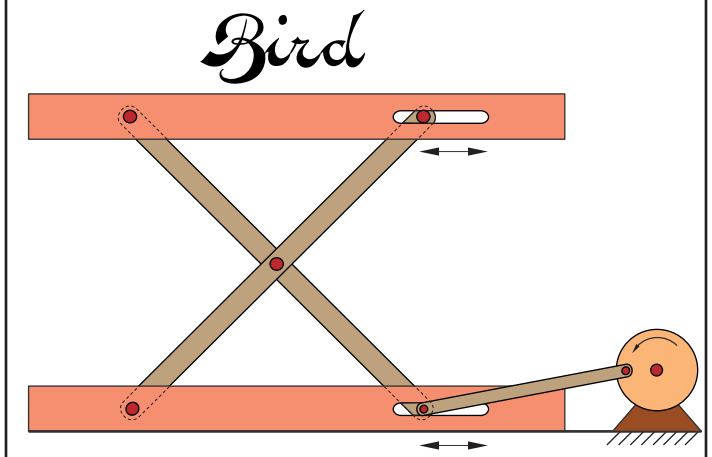


Figure 8
A more secure arrangement

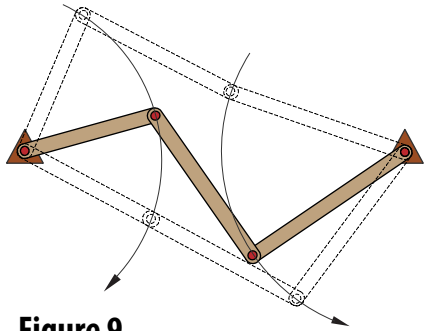


Figure 9
Three-bar linkage

gle around the point without a rod, the motions of the rods are at right angles to each other. This is commonly known as a bell crank.

For up-and-down motion, think about a frustrated bird-watcher, moving her binoculars back and forth to her left, when to her right a majestic specimen occasionally rises from the bushes to look and laugh at her. The device in **figure 7** is one way to lift the bird up and down. At the left of the figure are two rods and a pin joining them in the middle. At the end of one rod is a fixed pin, while there are sliding or rolling pins at all of the other rod ends. The fixed pin holds everything in place, while the three moving pins allows the bird to be raised from the bushes. On the right side of the drawing is an example of combining two different linkage systems, using the very first example of a reciprocating motion to power the bird.

The bird isn't very secure atop its perch in the last example. That's easy to fix by simply combining the loose perch with the two sliding pins below it. That will turn the shaky top piece into a more secure, connected rod (**figure 8**). The fixed point was replaced and two channels for the sliders were added, making the bird more secure atop his improved perch.

Let's look at moving more than one object using one more simple linkage arrangement. This is a great alternative to using a lot of gears to give your project some synchronized movement. Consider two teens ending their first date and nervously looking forward to their first kiss. Can you imagine them half leaning in but nervously shifting left, then right? Only three bars are needed to make this work. There will be two anchored pins, one at either end, plus two interior mobile pins (**figure 9**). Just attach one of the two mobile pins to each young lover's foot.

Never overlook these little bars and pins. They may not look as impressive as several gears spinning around, but when combined into a linkage system, the plain-looking bars and pins can do some fun things for your projects, often with far less effort than cutting lots of gear teeth.

Still, we've only just begun to explore the marvels that await. Adding more bars, more pins, changing shapes, and sometimes combining these new tools with gears will give us even more building blocks. Next time, we'll look at straight-line motions and elliptical paths, and we'll create exact replicas of our movements for several objects.

Get Moving

Yolanda, the Yoga Queen

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

Yolanda takes care to keep her plaits tidy, by using white-cotton ribbons, which of course match her snow-white ruff and socks.

Fitness is a big deal in Berlin, with fitness centers popping up everywhere like mushrooms. However, you don't have to become a member of one of these joints to stay fit, as Yolanda the Yoga Queen can show us.

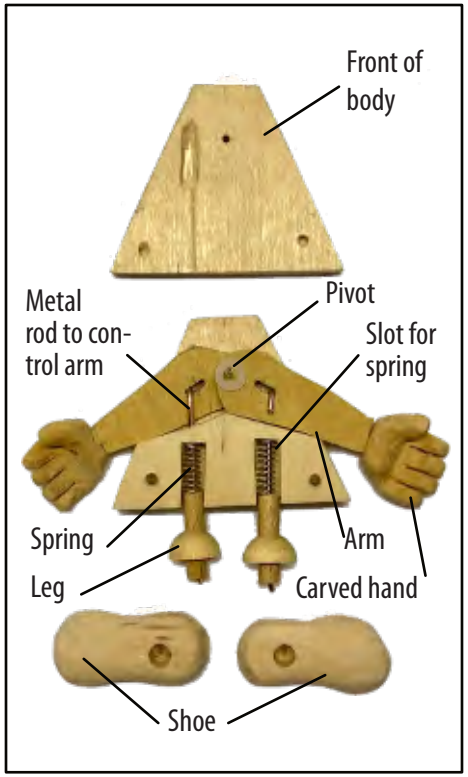
Yolanda is a moving example of the ancient art of wooden yoga. Her wooden-yoga skills are so advanced that she has mastered the technically demanding eyebrow twitch, even accomplishing the plait swing with simultaneous neck stretch, first recorded eons ago in the darkest depths of the forests surrounding Berlin. As a master of her craft, she is entitled to wear the initiate's navy-blue frock, with its matching conical headpiece.

Inspiration

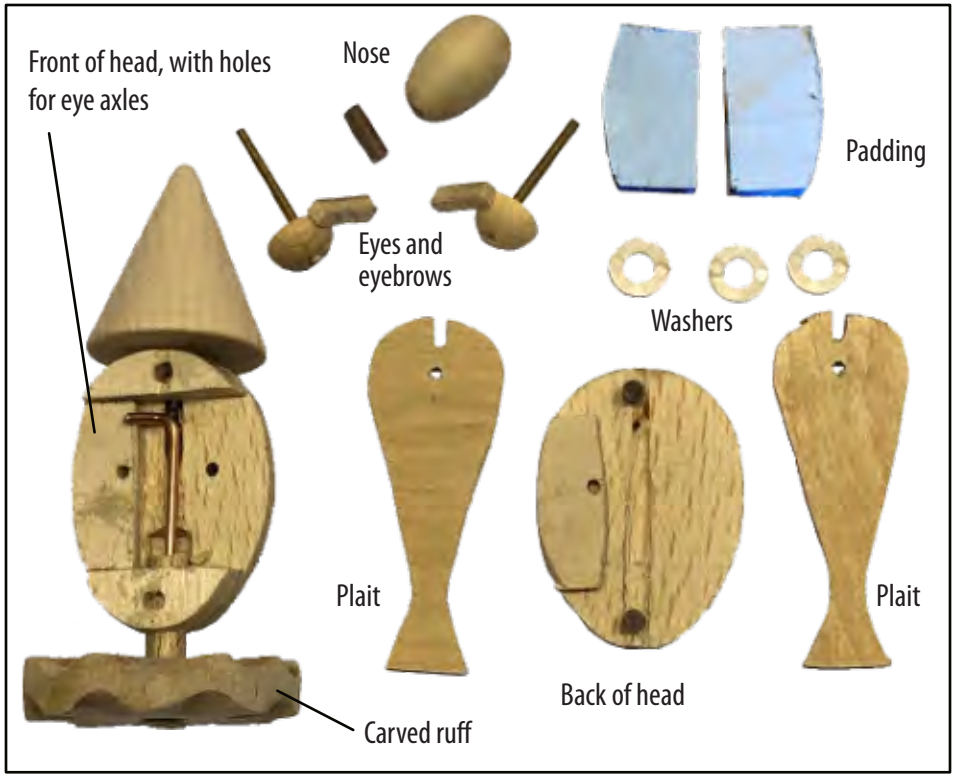
A friend gave me an A4-size card with a figure to be cut out, called "Gymnastics with Sister Adelheid." You can see it halfway down the page at *http://www.edition8x8.info/bastelbogen/bastelbogen.html*. I had a lot of fun making this paper automaton. When you move Adelheid's substantial body up and down, her arms wave up and down in a most fetching manner! Adelheid was created by Martin Graf, a brilliant artist with a great sense of humor. His website is in German but the images and animated GIFs speak for themselves, so it's a great source of inspiration.

The nurse who looked after ten-year-old me was called Yolanda and I loved her dearly. Her name

also sounds nice with Yoga, so that was that. I decided to change the movement so that when Yolanda's body is pressed down, her arms go up. Trendy girls in Berlin favor long hair at the moment, so I thought that long plaits would be nice for her, and maybe they could move up and down, too. While considering how to do this I thought, Well let's move her eyebrows, too.



1. Yolanda's body parts.



2 . Yolanda's head parts.

Body, arms, and legs

I used three sheets of 6mm (¼") plywood sandwiched together for her almost-triangular body. For her arms I used 2mm (5⁄64") plywood, with carved-basswood hands and shoes. Her legs are 6mm beech dowel, with 1.6mm (1⁄16") metal rods to move her arms (**photo 1**).

In the middle piece of the three-layer sandwich, there are slots in the plywood to accommodate the legs and the springs that push them down. This middle piece has an angled top on which the arms rest. Three small nylon washers help the arms to move freely. I cut grooves in the outer pieces of the sandwich to provide space for the bent metal rods to move up and down.

This arrangement means that, when you push down on the body, the leg springs compress and the metal rods move up into the body, thus lifting the arms. Each leg has its own spring, so you can choose to place one of Yolanda's feet onto a raised platform, leaving the other foot floating free in the air. If you then push down on the body, only one arm will lift. Since the ruff is fixed to the body, you can also push down on the ruff.

Head

I cut a beechwood egg into two halves as the basis for Yolanda's head. I chose a smaller egg for her nose, two hemispheres for her eyes, and a cone for her hat. I used 2mm plywood for her plaits and carved a basswood ruff to hold her 6mm-dowel neck (**photo 2**).

To help you understand how things move, **figure 1** shows just the plaits. These move up and down on the same metal rods to which Yolanda's eyes (and eyebrows) are attached. As the metal rod from the neck moves up and down, it moves the plaits up and down. The plaits are fixed to their axle rods with epoxy, so these rods rotate as the plaits are moved. The eyes, on the outside,

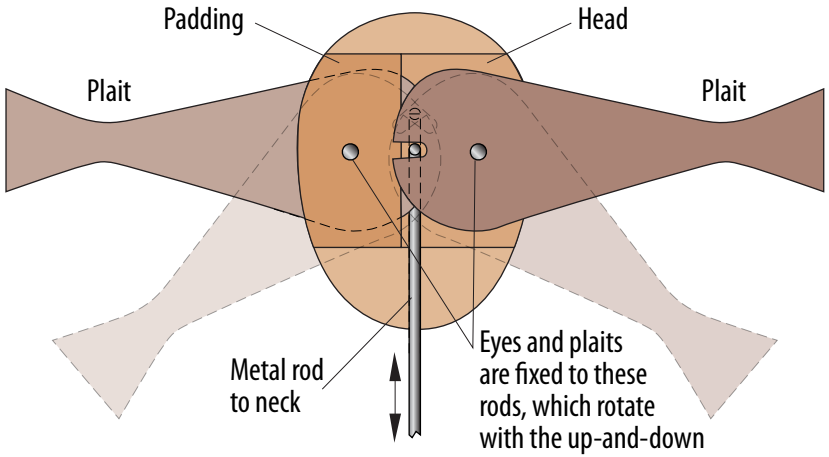


Figure 1

are fixed to the other end of the same axle rods, so they also turn as the plaits move. A short video showing the movements can be seen at *https://www.youtube.com/watch?v=pejNGatJAyQ*.

Because the plaits overlap inside the head, I added padding on each half of the egg to keep the plaits properly offset and to fill what would otherwise be an unsightly gap. This padding meant that one eye needed a metal axle rod that is longer by the thickness of the padding. A plastic washer beneath each plait keeps it moving freely.

3. Sometimes Yolanda gets a bit cross. Well, she's only human, isn't she?

Moving the plaits and eyebrows

The ruff is glued to the top of the body and the neck is glued to the ruff. The neck can move within the head, thus moving the metal rod up and down. There is no spring used here—friction can hold the head on the neck in any position that you choose.

To lift Yolanda's plaits, you have to pull her head upwards, "stretching" her neck. To lower her plaits, press her head down. Her hat is a good place to hold because your fingers are then clear of her eyebrows. As each plait lifts, its metal rod turns, rotating Yolanda's eyes.

Yolanda's eyebrows are glued to the tops of her eyes and move with them. As her plaits lift, her eyebrows tilt and Yolanda seems to frown (**photo 3**). As her plaits go down, her eyebrows relax and she appears calmer. You don't really notice that her eyes are rotating—her eyebrows grab your attention and give her this variable expression.

Once you have set her expression, you can then use the ruff to press her body down and lift her arms, without changing her expression. If you choose, you can press down on her hat, in which case her expression will first relax and she will then lift her arms. If that's all a bit complicated to understand, watch this video of Yolanda in action at *https://www.youtube.com/watch?v=7b1OuLkBtCY*, and that should help.

AUTOMATA FOR BEGINNERS

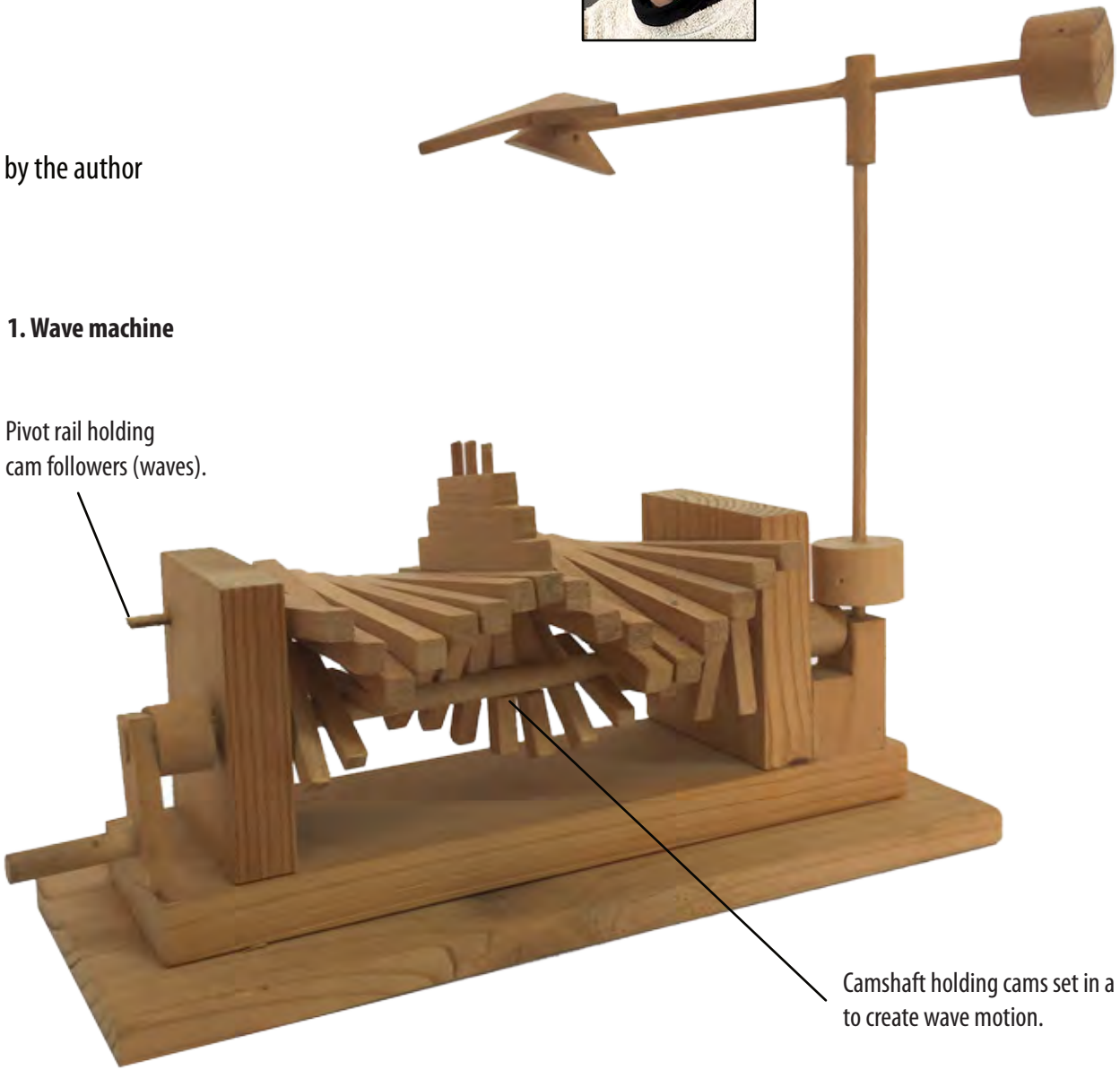
Wiggling

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

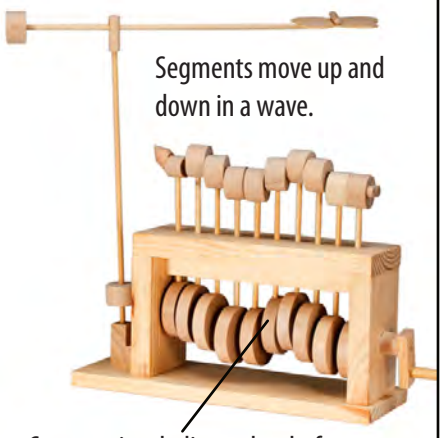
In this issue I'm going to talk about wiggling actions. As with all automata, our quest is to give inanimate objects organic movement, and the sinuous wiggle of a serpent or tail is a common challenge. I make a distinction here between wiggling motion and that created by wave machines. The wave machine has a pivot rail for each wave and a camshaft to move the wave (**photo 1**), so cannot be used for a shape like a tail.

There are three approaches that can be used alone or in combination. These are: creating a wiggle with limited control, creating a completely controlled wiggle, or creating the illusion of a wiggle. In all cases, the wiggle must have lots of sections that are linked or must give the illusion of being linked. Think of the bones in a

1. Wave machine



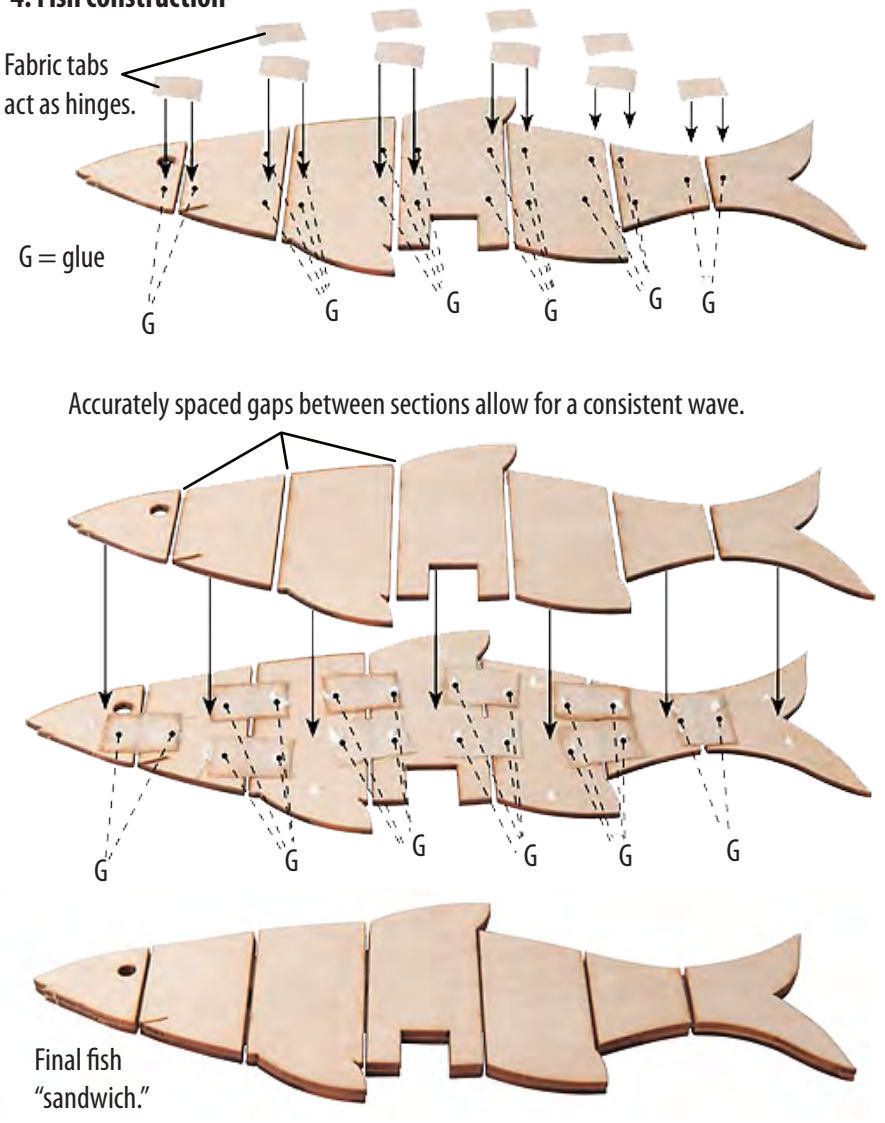
2. Caterpillar



3. Fish

The fish's body waves back and forth, either languidly or energetically, depending on the speed of the crank.

4. Fish construction



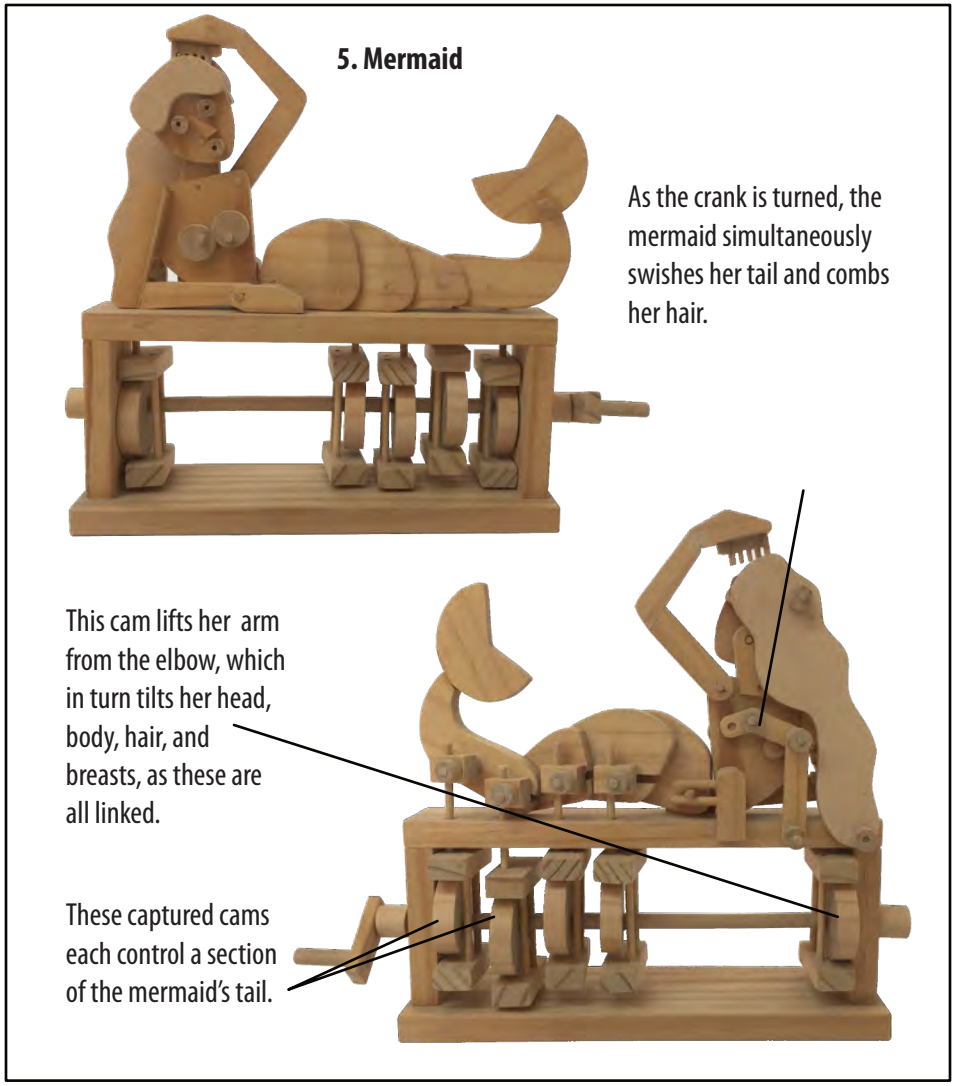
spine and all the possible tissue connections between them.

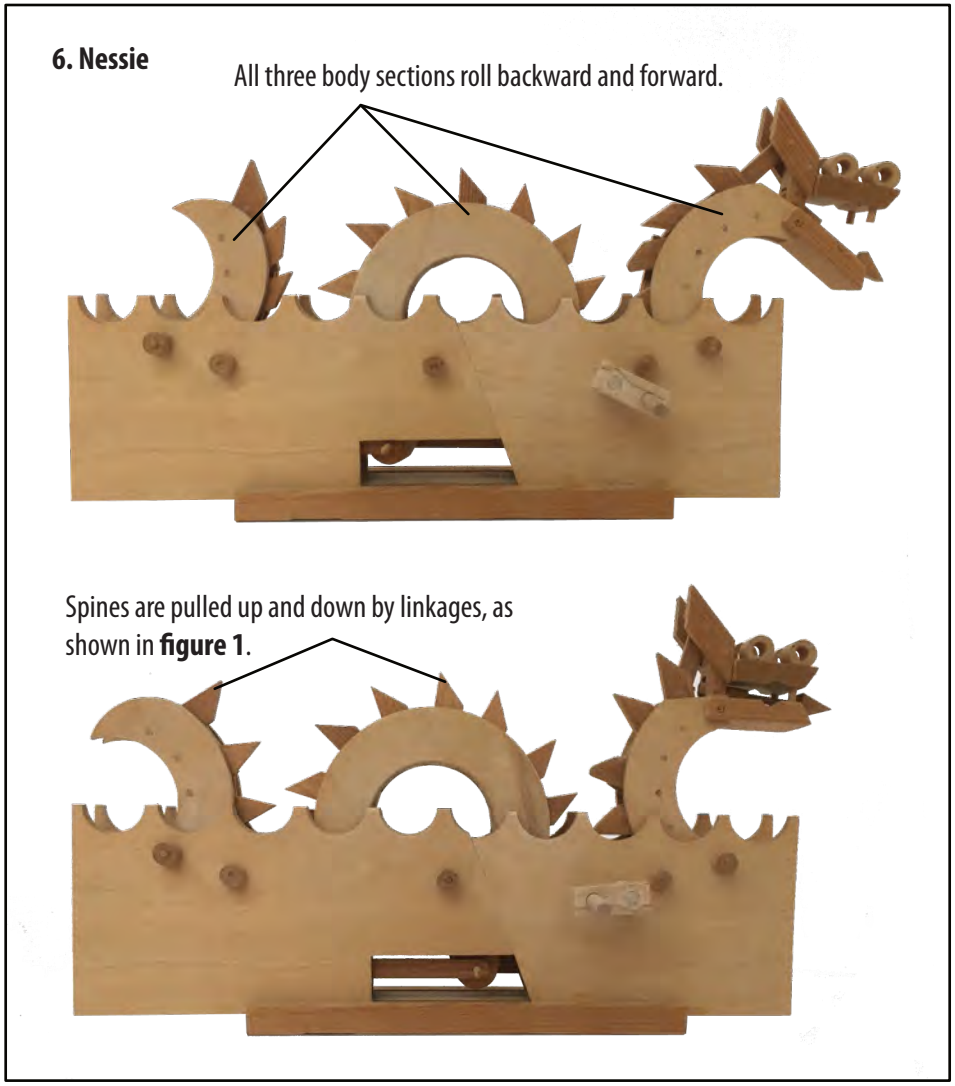
Here are some examples of wiggles with limited control. The Caterpillar (**photo 2**) relies entirely on gravity and smooth, friction-free movement. There have to be enough sections to create the illusion of a wiggle. The more sections there are, the smoother the movement will appear to be.

All moving parts here have been rounded, smoothed, and waxed. The model won't work if it is held at an angle. If the handle is turned too quickly, the bounce of each part may interrupt the intended effect or it might add a welcome energy. The point is that the upward push of each peg and the effect of gravity are the only controls there are with this mechanism.

The Fish (**photo 3**) relies on soft fabric hinges, which can move as far as the thickness of the wood sections will allow them to, and relies on the driving force of the side-to-side movement of the vertical shaft. This is a reasonably close imitation of a spine—the combination of soft and hard tissue—but it relies on the oscillating throw of the driving force to let natural physics do the rest.

This arrangement is prey to many variables. It has to operate standing vertically; otherwise, gravity will just make it flop to one side. The joints have to be secure and accurately spaced (**photo 4**). Otherwise, you will get an erratic movement and the speed at which it goes will affect the smoothness of the wave. If too fast, it will just thrash from side to side, and if too slow, it will not gather enough mo-



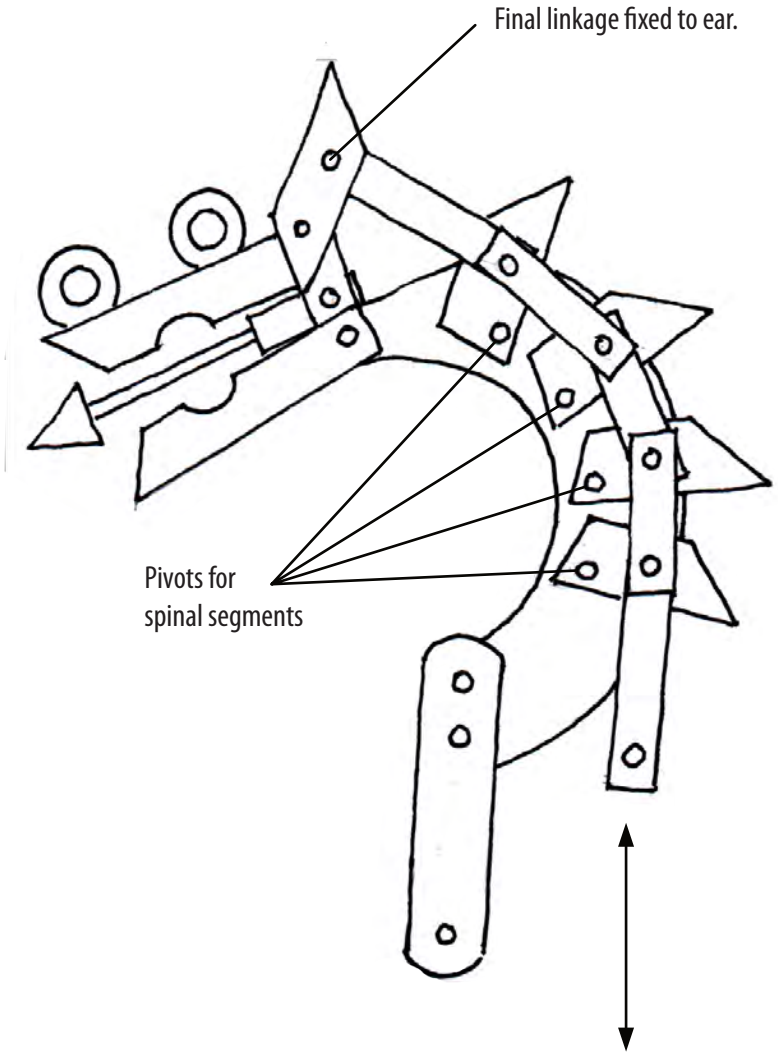


mentum to create a good wave. Timberkits has also made snake versions of this model. The longer it is, the more dramatic the effect, but the harder it is to keep the variables under control.

To introduce more control, you have to link the sections together and drive it by a mechanism that doesn't have to worry about gravity. In **photo 5**, the Mermaid's head, hair, and body are linked so that when one of these wiggles, the others do too. The tail is in sections that are also all linked, controlled by captured cams below. Every bit of the movement is controlled so nothing is left to chance. This solution is prey to lots of problems centered around accurate alignment and friction. However, when it is working well, it provides a satisfyingly coordinated movement over the whole model. It is not affected by gravity, so it can work at any angle.

Nessie (Loch Ness Monster—**photo 6**) doesn't actually wiggle

Figure 1—Nessie diagram



Linkages are pulled down and pushed up by a caged cam beneath Nessie, which articulates the spinal segments. Because the final linkage is fixed to the ear, the extremity of the push and the pull moves the head and the entire neck section backward and forward.

properly but its spines do give the illusion of movement. Each spine is linked to the next and driven from a single point (**figure 1**). As the arches of the body roll backward and forward, the spines are pulled one way or the other.

Mechanisms with less control have more dramatic movements but can be unreliable. The more controlled mechanisms have tighter movement and are more reliable. We have many more examples of wiggle mechanisms here at Timberkits HQ and I am fascinated by the endless quest for the perfect wiggle in the automata world. I hope this has at least given you some ideas to try.

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/*.

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And don't forget our Gallery. To be included, please send photos and descriptions of your projects.

automatamag@comcast.net

REVIEWS

Goofy Bird
Laser-cut wooden automaton kit
Cranky Heart Automata
106 West Water Street, Ste. 400
St. Paul MN 55107 USA
Price: $65 (introductory, $55)
Website: *https://CrankyHeartAutomata.com/*

Cranky Heart Automata is a new company started by Cecilia Schiller, a well-known automatist. There are three kits currently available, as of this writing. Goofy Bird was sent for review, arriving in a plain-white cardboard box.

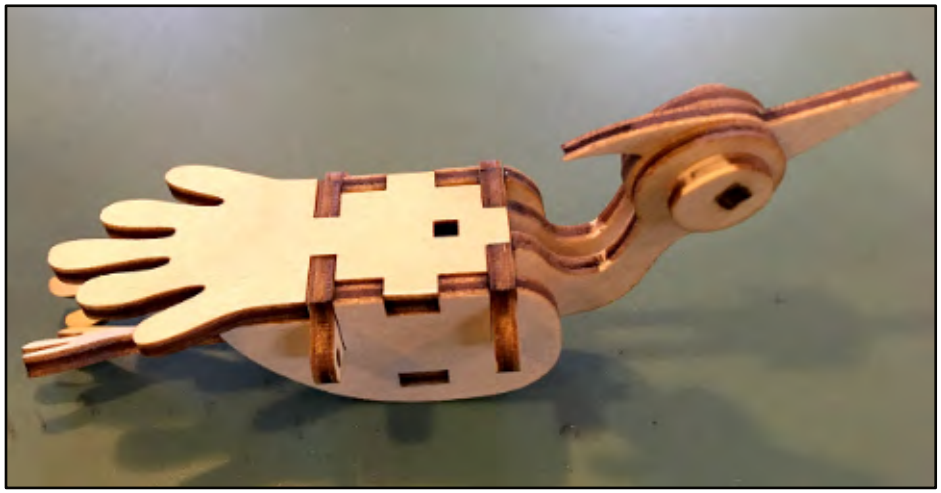
Inside the box, I found the kit packed in an orange paper envelope. In the envelope were three large, ⅛"-thick (3mm), high-quality birch plywood panels (called pages) plus a small, ⅛"- and a small, ¼"-thick (6mm) piece. These pages contained most of the kit's parts, all neatly laser cut.

Also included were small envelopes containing toothpicks for hinge pins, a piece of dowel for the automaton's crank handle, and a little block of paraffin wax to be used as a lubricant. A small piece of sandpaper was also included.

A single black-and-white sheet illustrated all of the panels, showing the names of the parts on each, and providing a little additional information.

The actual instructions were in the form of a four-page booklet. The first page included a list of the kit's contents and a short list of additional things that you may need—a small hammer, a matte knife, and some wood glue.

Notes are provided on the first page of the booklet for those who wish to color the wood. A photo of an attractively painted bird shows what could be done. I



chose to leave our review sample unpainted so that you can see what it looks like as-supplied.

The builder is admonished, in large red letters, to "Read all instructions before you begin!" I second that. While the instructions are clear and unambiguous, it is definitely a good idea to know where you're going with the project before commencing.

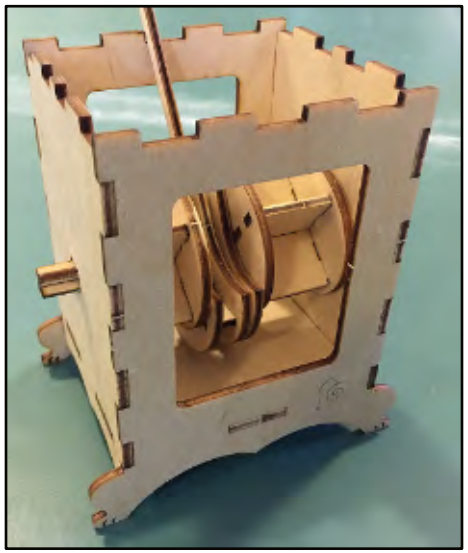
Instructions are mainly pictorial, with brief notes augmenting the photos. The kit goes together in three basic assemblies: the bird, the mechanism, and the cabinet. As mentioned above, the instructions are clear and logical, and the photos, though small, are of good quality.

Parts came cleanly away from their pages. Components were initially held in place by tiny tabs of wood that are easily snapped to release the part. This leaves very small burrs, which I sanded off with the supplied sandpaper. This step isn't necessary for the machine to function properly, but if you're as compulsive as I am, it's mandatory.

The builder is told that the automaton can be built without glue. I've built laser-cut kits before so was a little skeptical of this claim. However, I found it largely to be true. The parts are well engineered and accurately cut. Where parts need to fit tightly together, they must actually be pressed together, sometimes tapped with the aid of a small hammer. I used a small tack hammer that I had. A larger hammer could be used with care.

There were some assemblies that initially seemed to go together quite loosely. One of these was the lift mechanism. I was concerned about this but proceeded with the instructions. I found that all of the loose assemblies were ultimately held securely in place by other parts—another example of good engineering.

Where moving parts mate with others, you are instructed to lubricate certain edges by rubbing wax on them. This I did, discovering that it worked well.



Following the instructions, I found that the kit went together well. I experienced no trouble in its assembly and used glue in only a very few places. These included gluing the crank handle on as well as a couple of retaining washers.

I took construction slowly and carefully. In just over an hour I had a finished, working automaton. The cabinet holding the mechanism is 3¼" (8.25cm) wide x 3" (7.62cm) deep x 4½" (11.43cm) high. Total height, including the bird, is nearly 12" (30.48cm). The wingspan is 8" (20.32cm).

The mechanism is relatively simple but there's a lot of action. When you turn the crank, the bird not only flaps its wings, but its body moves forward and back as well. Plus there's the additional action of a rotating heart on the side of the cabinet opposite the crank.

This kit is well designed, well engineered, and well produced. Instructions are good, and assembly is easy and straightforward. The end result is amusing and satisfying. Action is smooth and the finished product is surprisingly solid and durable. Even if you have never touched an automaton, this kit should present no problems for you. More experienced builders will find assembling the kit enjoyable and relaxing. Recommended.

—M. Horovitz A1.

The End