**AUTOMATA**

**Earliest Days**

The notion of man-made man has exer­cised human ingenuity from far back into prehistory. There is evidence that, while developing language and tools and execut­ing cave paintings, prehistoric man was also malting models of himself, with movable limbs. In ancient Egypt, special jointed stat­ues of the gods were secretly manipulated by priests, so that they appeared to be mov­ing and speaking of their own accord. These manifestations of life *were* used to exercise power over underlings, and were the beginning of the link between automata and religious control through the ages.

The first recorded automata appeared in Egypt in the second or third century Be. The renowned engineers Ctesibius (who developed the rack and pinion movement and the self-regulating clock), Philo the Byzantian and Hero of Alexandria (285— 2221IC) all belonged to the Alexandrian School, along with other learned alumni, Euclid and Archimedes. It was Hero, one of Ctesibius' pupils, who recorded the work of his predecessors, and, indeed, his own inventions, expressing them in mechanical toms by making models. He used the mod­els to entertain his pupils, thereby teaching them about the physical laws that related to the workings of the models. The theorems devised by Hero of Alexandria that gov­erned these working models survive in his treatise on *pneurnarica.* Among other things, he built a machine called an *eaipile,* ro show the expansion of gas when heated and the

force of the gas escaping from various ori­fices. The lateral tubes (not shown in the illustration) were connected to a freely revolving platform that supported little fig­ures. The machine was simply a turntable driven by reaction.

The knowledge that the ancient Greeks possessed about gears, simple mecha­nisms, hydraulics and pneumatics formed the basis of mechanical science for later civilizations, reaching the Byzantine world after the fall of Rome (no 476). The Byzuntines drew upon the legacy, making water clocks that incorporated automata, and the inevitable war machines. They and the Muslim rulers revelled in the won­derful mechanical displays, which had now reached a high point of ingenuity. The accumulated knowledge travelled to the Arab world and, from the seventh century AD, Islamic artisans led the field, creating even more elaborate animated water clocks and ways of recording time.

The monumental clocks of the Arab world, incorporating spectacular automata, were far more advanced than the weight-driven clocks being used in Europe at the same time. However, by the fourteenth cen­tury, automata had begun to appear on colossal cathedral clocks in many European cities. The animated figures that struck the hours were called *jaquemartr,* or 'Jacks'. They were made of painted wrought iron, generally portrayed as a mechanically oper­ated man who used a hammer to strike the hours. Later, the striking of the halves and quaners was added, incorporating more automata. In addition to their striking

duties, the figures would also enact reli­gious or profane scenes, much to the amusement of the public and giving rise to mixed feelings on the part of the Church, which hoped that such displays would mostly inspire devotion.

During the Middle Ages, all mechanical science had been regarded with suspicion and was often confined with black magic. An awkward relationship had developed between the Church and the nutomatists. As the focus of learning moved away from the monasteries to the newly established universities, however, scientists were able to experiment more freely. Bavarian philoso­pher Alberms Magnus (e. 1200) was said to have constructed a mechanical man of brass who could speak, while Roger Bacon (1214-98), the English monk who has been called the father of experimental science, explored similar projects, undeterred by the teachings of the past. St Thomas Aquinas, a former pupil of Alberts Magnus, was one religious figure who clung to monastic bigotry; he smashed his former master's mechanical companion, denouncing it as the work of the devil. Alberts Magnus was devastated: 'Thus perishes the work of thirty years,' he lamented.

**A Golden Age**

In the sixteenth century, Hero of Alexan­dria's treatise on *pneumatic-a* was translated into Latin and subsequently into Italian and German. The writings and drawings were pounced upon by the Renaissance engineers, who constructed amazing water gardens complete with hydraulic automata. The gardens of Villa d'Este *and* Pratolino in Italy, for example, drew visitors from all over Europe, including Solomon de Caus (1570-1626), a French engineer who had studied the technical heritage of the ancient automatism. De Caus brought grottoes and mechanical hydraulic effects to Smart Eng­land. In the grottoes, articulated mythologi­cal statuary. - deities, satyrs and various other creatures - were constructed to play

practical jokes on hapless visitors, who were drenched in water, or covered in salt, or, even worse, soot! The mischievous humour was very 'Renaissance' but the mechanics **at** the heart of the constructions had clearly *been* handed down by the Ancient Greeks. Increasingly ingenious creations appeared, wind) were breathtaking in their mimicry of life.

Descartes and other philosophers of the Renaissance had played their part in dis­pelling prejudice and misconceptions about mechanical devices, but religious paranoia persisted even into the eighteenth century. A number of diehards continued to con­demn as pagan magic all mechanical things, especially those that bore an uncanny resemblance to life.

The most famous automatist of the eigh­teenth century was Jacques de Vaucanson (1709-82), a native of Grenoble in France. He entered training for the priesthood, but his stay at the college was short-lived; dur­ing his time there, he made some flying angel automata that were destroyed by the Jesuit priests for their 'heresy. De Vaucan­son took this as a cue to relieve himself of his vows, and went on to lead a rather wild life in Paris, working his way through a small fortune left to him by his father. After study­ing music, medicine and mechanics, de Vaucanson began to earn a living from exhibiting his automata. His most famous creation was a life-sized mechanical duck made of gilt brass, with flexible tubber tub­ing to simulate intestines. The duck not only looked like a duck and quacked like a duck but, on being fed corn, it also digested and produced droppings like a duck! In later life, de Vaucanson followed a more sober and distinguished path as Inspector of Mechanical Inventions at the Royal Acad­emy of Sciences, and achieved recognition as one of the most significant minds in the development of automata.

Automata in human form became known as 'androids'. Produced by de Vaucanson, and other masters such as Jacques-Droz,



Leschot and Niaillardet, these figures per­fectly repnxluced the human movements of drawing, writing or playing an instrument. The pieces were jewels of complex mechan­ical invention, requiring long and painstak­ing work, and auromatitils would complete relatively few pieces in a lifetime. Their main purpose was to imitate life by mechan­ical moans; only today's robots could match their ingenuity, but nothing could match their style.

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Following a series of naval victories dur­ing the Napoleonic wars. thousands of French prisoners filled British prisons. The skilled craftsmen, watchmakers, clockmak­ers and jewellers among them would snp­pkment their meagre rations by selling their own work in the inison's market. Materials were limited, but there were plenty of bones from the cookhouse, which explains why so many of the pieces were tiny and white (although many were painted). Guillotines were popular subjects, as were domestic and trading activities, such as spinning, cobbling and knife-grinding. The delicacy of the wheels that drove some of models must have involved painstaking cutting work, but time was hardly at a premium for these

craftsmen of quality. Some escapees man­aged to cam enough from their work to buy a passage back to France.

As the industrial age dawned, the French seemed reluctant to surrender their artistic traditions to new technolosoy. During the second part of the nineteenth century, however, trains and steamships had an enormous effect on travel and communica­tions, and the establishment of tot **new** department stores affected the automata and mechanical toys industry. Artist-crafts­men were taken by surprise at the speed of developments, and totally unprepared for the surge in demand.

The day of the expensive 'one.olF automaton seas gone. lines came down as production lines were developed to make numbers of identical pieces, supplying a middle class who had prospered in the improved financial climate, and liked to display the mechanical marvels in their drawing rooms. The growing popularity of automata allowed inventors to exercise their ingenuity and flights of fancy, profit.. ing from modem economical methods of manufacture that none the less allowed them to retain some of the quality of a hand-made product. As the automata industry grew, so did competition. Innova­tion **was** all that mattered in the nese, com­petitive market, and wholesale plagiarism was rife. The tiniest new detail would per­suade a buyer to choose one automaton over another. So fierce was the rivalry between firms that many eschewed regis­tering parents to protect their inventions, preferring to guard their originality by constant change rather than relying on time-consuming legislation.

Some wonderful new effects were intro. &teed in a Golden Age that lasted from the mid- 1800s to the beginning of the First World War. leading makers such as Bontems, Lamben, Fhalibois. Remo, Rootlet et Decamps, Theroude and Vichy influenced and were influenced by each other's creations.

The nineteenth-century automatist w•as a clockmaker by training who, with his own expertise and that of craftsmen and artisans skilled in turning, drilling and cut­ting, oversaw the assembly of all the diverse components that made up a piece. The making process began with the mod­elling of a clay or **was** figure from which a mould was made to form the head, body and limbs. The working mechanism and musical movement were inserted in the completed body before the finishing touches were added by painters, seam­stresses and hairdressers.

These automata were usually displayed in the children's section in exhibitions, but they were not for children. In spite of cheaper production methods, costs in­creased as they became increasingly soph­isticated and more lifelike. Many aimed to reflect Parisian society of the day, cap­turing the essence of performances by famous entertainers, clowns, acrobats and music hall stars. Just **as** they mirrored the society that created them, so were they subject **to** changing fashions. Around the 1890s they were thrust into a new• role, on public display in department store win­dows, extolling the virtues of the store's products by their gestures. They became larger, in order to attract shoppers, and the musical accompaniment was dis­pensed with as it could not *be* heard from the other side of a window. The commer­cial automaton came to outshine its domestic counterpart, and what was once the xclusive property of the well-to-do now became available to all.

**Decline**

By the end of the First World War, electrical automata replaced the clockwork models in the elaborate window displays. Clockwork could only run for several minutes, but the action on an electrical piece could run on an ever repeating cycle until the power was snitched off. Demand for clockwork auto­mata diminished and they fell into decline.

In a fast-developing world it became in­creasingly difficult to find skilled craftsmen and engineers to build them.

The decline was accelerated when US importation laws placed an embargo *on* French toys coming into the USA. To beat the legislation, certain French firms sent foramen from their workshops to **set** up on the other side of the Atlantic, but automata were, it seemed, destined to disappear. During the First World War, France itself banned exportation of toys and this brought production to a virtual halt.

After the horrors of the conflict, the public was in no mood **to** return **to** pre­war luxuries, as automata were perceived to be. As the twentieth century settled into the Jam Age, with its new amusements ­the gramophone, the wireless and moving pictures - the extinction of automata was virtually complete. Only mechanical toys, which were in certain cases scaled-down versions of their superior relations, contin­ued to flourish. They had a mass appeal, were affordable and in tune with the times, and they endure today.

**MECHANICAL TOYS**

'The main factors distinguishing mechani­cal toys from automata are running time and the number of cams. Automata were programmed to execute a series of compli­cated movements within a time span. The duration and complexity of the cycle dis­tinguished them from the simpler mechan­ical toys.

**Origins**

France was supreme in the manufacture of automata in the nineteenth century, but it was makers in Germany, the centre of tin­plate production, who produced the finest mechanical toys before the First World War. Production quality was high, with manufac­turers such as Bing, Carette (an expatriate Frenchman), Lehmann and Marklin show­ing meticulous attention to detail.