

ENGINEERING MOVEMENT



War Horse has been a hit both at the National Theatre and at the New London Theatre, Drury Lane. By the summer of 2009 the horses had taken to the stage 300 times © Simon Annand

The award-winning theatre production *War Horse* is now on a West End run – after a sell-out season at the National Theatre. Michael Morpurgo's story and the 'believability' of the horse puppets have helped make it a stage hit. Adrian Kohler, one of the founders of Handspring Productions, created the horses and writes for *Ingenia* about the engineering behind *War Horse*.

The 2004 Handspring production *Tall Horse* was still playing at the Baxter Theatre in Cape Town when we had a visit from representatives of London's National Theatre. Associate Director Tom Morris and Executive Director Nick Starr came to see our show, based on the real-life journey of a giraffe from Africa to Paris in the 19th century and using a five metre tall puppet controlled by puppeteers on stilts. We began imagining that the 'Beautiful African' would be invited to play a season in London.

Three months of silence passed after Tom's visit to us in South Africa, then he phoned me at our base in Kalk Bay, Cape Town. He had found a novel that could possibly become a vehicle for puppets and he outlined the story of *War Horse* by Michael Morpurgo.

Albert, a boy on a farm, brings up a foal, Joey, that his drunken father bought by mistake. The First World War breaks out and the father sells the horse to the British Army. The horrors of the war are told from the horse's vantage point, including a cavalry charge

towards machine guns where Joey's rider is shot out of his saddle, after which the horse is taken by the German Army. Albert joins up under age and searches for his horse for the duration of the war. Miraculously, at the armistice, when both have been badly battered, they find each other.

My immediate response was positive: an epic love story with a happy ending where one of the leading characters is a puppet horse. We had made a good giraffe; surely a horse should be just as feasible?

EQUINE REQUIREMENTS

The horses would need to be larger than life-sized, able to contain two puppeteers and carry a rider on their backs, and, most importantly of all, move so realistically that the audience would immediately empathise with them and consider them to be just as engaging as the human actors beside them – if not more so.

Theatre with puppets in the UK has carried a stigma for many years. At European theatre festivals we would hear English

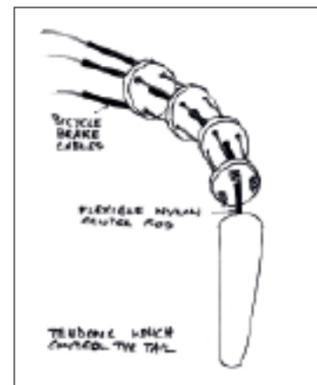
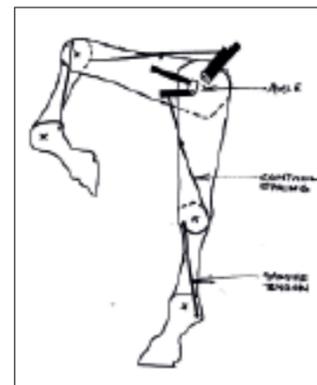
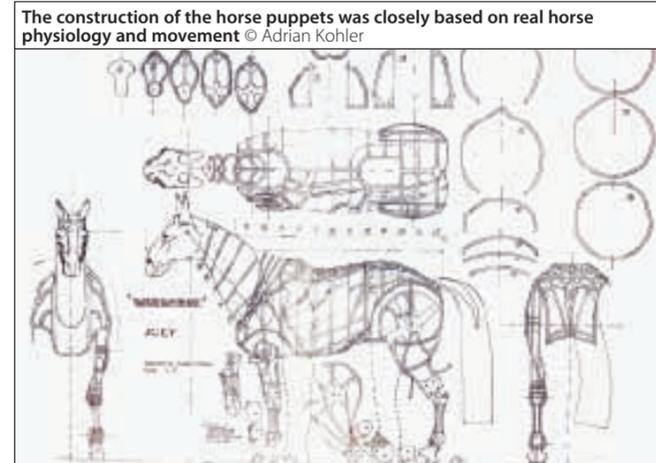
puppet companies complain that audiences at home were put off by the 'P' word. But Nick Hytner, with his adaptation of Philip Pullman's *His Dark Materials* and, of course, the effervescent puppetry of the *Lion King*, were starting to make puppets acceptable to a range of audiences.

A first workshop was held with a try-out writer and a group of actors. Among them was Toby Sedgwick, who would become the choreographer, and Mervyn Millar, who would recruit the many excellent puppeteers. Alan Edwards, from

the National Theatre's prop department, was seconded to us and together we made quick mock-ups of horse heads and necks out of torn cardboard and shredded newspaper. On a day when the Olivier stage was completely clear, we were able to take these and a complete life-sized cardboard horse body onto the vast round stage.

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STARTING GAIT

Back in Cape Town I built a working cardboard scale model of Joey. The anatomy of the horse's legs and those of the humans inside it would not correspond with each other as they had done with the giraffe in *Tall Horse* (where the puppeteer's legs, standing on stilts, became the giraffe legs). Now there would be eight legs under the horse and not four. But the hands of the puppeteers would be in close proximity to the puppet legs and therefore available for strong, hands-on manipulation, so the legs had the potential to be highly articulated.

The construction of the legs is very similar to an actual horse's. We had studied horse physiology and movement to get the curl of the hooves and legs as realistic as possible. The passive movement of the legs relies on 'tendons' (made of strong wire) on either side of each leg which are pulled and relaxed by levers controlled by

the front and back puppeteers, raising and lowering the leg and pulling them inward for a horse-like bend.

Of course horses move elegantly by placing their feet on the same spot towards the middle of their bodies. A rubber joint connecting the legs to the body allowed five degrees of movement, which gave the puppeteers the freedom to place the legs in an elegant, equine motion.

BACK TO FRONT

Over the next four months, a horse with the potential of being ridden started to take shape. For the spine, I enlisted the help of Mark Laubser, a specialist aluminium welder who normally builds boats. The two puppeteers inside would each strap on a backpack and above their heads the backpacks would be attached to this bridging spine, made strong enough to take a human rider and high enough to protect their heads.

The spine itself is similar to that of a real horse because it had to carry cables to control the flicking of the tail, while possessing a slight flexibility to arch realistically during the moments when the horse would rear up on its hind legs. Cables were run through discs all the way down the back, made of plywood to keep it lightweight.

The design of the tail movement also lay in understanding the anatomy of a real horse. The spine of a horse extends almost half way down its tail and that's why the animal can flick its tail so decisively. This 'spine tip' is highly flexible and controlled by several lateral tendons. We mimicked these with bicycle brake cables, which, when pulled by a lever at the back, would flick the tail up and down and side-to-side.

CATCHING THE BREATH

The breathing action of any puppet helps to create the illusion of life and while observing real horses breathing hard after physical exertion, the problem of representing this looked daunting. The rib cage of the animal expanded and contracted out sideways; even if I could hinge the rib cage at the spine on either side and develop a means of rhythmically manipulating it outwards and inwards, the payback would be minimal. Looking at the animal head-on you would see the movement but seen in profile it would be hardly noticeable. And our horses would be seen mainly in profile.

The solution proved to be very simple. As in a motorcar, the front legs would be joined

to each other by an axle. If this axle were not fixed but given the freedom to move up and down in a slot, the 'heart' manipulator, who is attached to the spine above by the backpack, would, with the front legs resting passively on the ground, be able to make the rib cage go up and down simply by bending and straightening their knees. The up-and-down replaces the more accurate side-to-side, but it is more effective because you can see it. No extra hand controls are needed. Just the knees.

EXPRESSIVE MOVEMENT

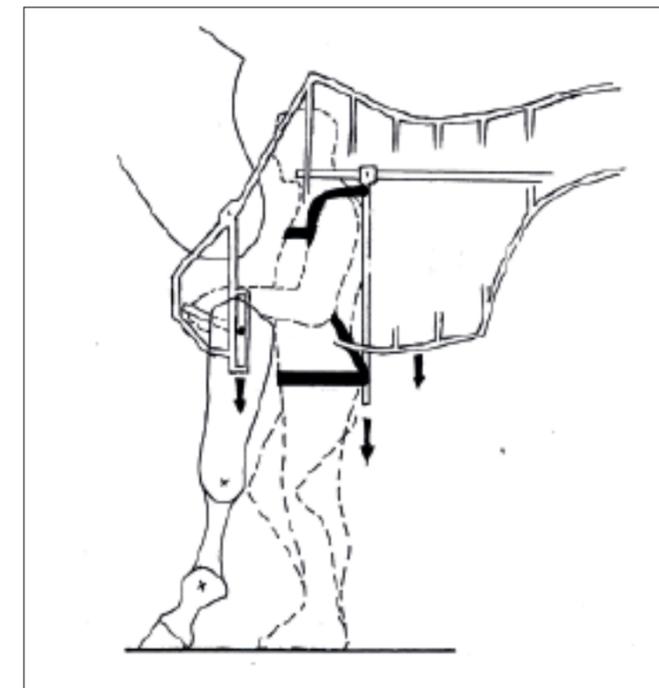
The ear movement would be the next major challenge. While it may seem a trivial aspect of the complex puppets these horses would become, the control and movement of the ears would lead to a major breakthrough for me – one that had taken me 25 years to find. The result would be crucial to the theatre piece. As theatre-goers have told me since, one of the moments they buy into the believability of the horses is when the ears swivel back when Joey panics.

For the horses' ears to give life to the puppets, they had



to move through at least 180 degrees, pointing forward they show interest, pointing backwards they indicate fear or alarm, and to the side they show attentiveness. The solution came to me early one morning: mount the ears on short vertical axles, around which would be wound a cable, with a spring to pull the axle back into place and rewind the string. The manipulating finger may only pull through 90 degrees, but the shorter circumference of the axle would give double that for the ear.

This was my 'Eureka' moment. This ear movement, I've since discovered, is a very old watch-making piece of technology.



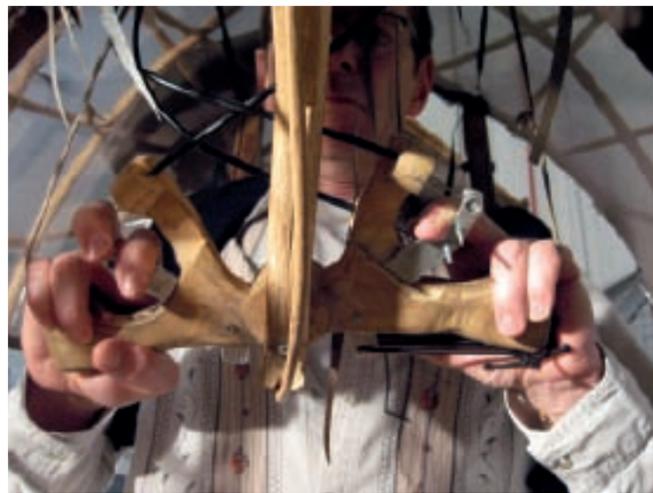
The puppeteer 'breathes' for the horse by bending his legs. The front legs rest on the ground whilst the chest is operated by the backpack attached to the puppeteer's shoulders and trunk. The front leg axle moves in a slot mounted on the horse's body frame © Adrian Kohler

THREE HORSE POWER

The head and neck controls were next. I had been aiming for the horse to be manipulated by two people as personnel numbers in any production need to be kept down. In a piece with many horses, the cast of puppeteers would increase by the number of manipulators in each horse. I built a 'steering wheel', a rocking bar with levers in it (see below), and positioned it at the base of the neck. It contained control levers that, connected with brake cables, controlled the ears and could raise the head up.

The rocking bar attached to lateral draw-strings, which could curve the neck from side to side. However, by attempting to control the horse with only two manipulators there was a drawback: the head could only be operated when the front legs weren't being manipulated. When the horse stopped walking, the puppeteer switched from the leg controls to those of the head.

It became clear from the start that the horse would need to be a three-puppeteer figure. The head had to remain alive while the horse was in motion,



"Clever puppetry and inspired engineering by the Handspring Puppet Company has taken the rough and ready representation of horses in theatre to a new level. Joey, Tophorn and two other equine stars are no longer mere Dobbins played by blokes inside baggy sheets. Rather, they are handsome steeds exhibiting realistic emotions and behaviours.

"To those of us who admire the beauty and movement of horses, the onstage performance of the models in *War Horse* is inspirational and nearly always accurate. Indeed, the cane, metal and fabric structures that house the puppeteers are probably inspired by Leonardo da Vinci's sketches of horse movement."

Dr Roger Mugford, *The Sunday Telegraph*

so I attached an external control rod to the neck just behind the head, and from then on a third manipulator worked the head and neck from the outside. This rendered obsolete the rocking bar 'steering wheel' though it was used for the four 'legless' horses that fill out the cavalry charges. All of its controls would now be incorporated into a control box on the new neck rod for Joey and Tophorn – the second fully animated puppet horse character.

The horses were now almost fully functional and could be shipped to the UK. They were, however, completely untested.

A month later, back at the National Theatre Studio in London, my Handspring partner Basil Jones and I unpacked the horse with the whole of the next *War Horse* workshop gathered in front. A team of puppeteers had been assembled to test them but we had also requested beefy, strong acrobats because the horse operators would also have to support a rider on their backs. The group was a mixture of these and puppeteers of a more normal physique.

In order for the heads of the manipulators to be safely protected inside the chest and rump of the horse, the horse was now slightly bigger than life-size. This had raised the spine substantially higher than shoulder height and my fear was that this increase in size had also raised the centre of gravity to an impossible height.

So it was with a feeling of immense relief that we watched these beefy actors carrying an adult on the horse almost immediately. The downside was that they weren't all puppeteers. Over the next

couple of days, after trying various combinations, I took a chance, let the acrobats, with one exception, go and kept the trained puppeteers. Their empathy for the figure was what made them valuable. For the endurance required, they would simply have to work out.

HORSE PLAY

The prototype horse soon received the approval of the workshop. Marianne Elliot had joined Tom Morris as co-director and they and Toby Sedgewick began working scenes with actors that would test it within the demands of the story.

We had also decided fairly early on that all the horses would be mute. In the novel, Joey, like *Black Beauty*, is the narrator of the story. In the theatre this narrative device could veer dangerously near to anthropomorphism. So in the play the horses sound like we hear everyday horses. The puppeteers literally become their voices by whinnying, neighing and snorting when needed.



The external puppeteer wields a control box with three levers: two for the ears and one to move the head up and down. The rod moves the neck in any direction and can be rotated to be used either side of the head © Simon Annand

Taking away the narrative element meant that it was even more important that the audience believed in the realism of our animals. Our horses needed to carry the emotional weight of the show and how we did this was by focusing on the movement. We compromised on the looks and perfected the movement. The final creation is deliberately stark, it looks like it is made of cane, gauze and leather with an aluminium structure - which it is.

It gives the impression of being like the drawing of a horse and the viewer's eye follows the

shape. As it turns, the impression continues and the onlooker subconsciously joins up the dots.

At night, when the studio had gone quiet and the prototype was hanging alone in the big rehearsal room, the Spanish cleaning ladies dubbed it 'Rosinante', the skeletal horse of *Don Quixote*.

HEALTH AND SAFETY

With a functioning horse now a possibility, the physiotherapist from the *Lion King* was summoned to give an opinion on the effects of my operating

systems on the wellbeing of the puppeteers. I was told that the elaborate triple lever controls that operated the front legs, would, within weeks, cause severe repetitive strain injuries, and would have to be completely redesigned. To avoid injury the position of the controlling hand would have to be turned through 90 degrees. The backpacks would also need some more lumbar support.

Next would be the convincing of Nick Starr, head of finance at the National Theatre, that this project should go ahead. Factors militating against it were by now building

up. The story, in the form of a play, would require a large cast of actors. Each main horse would now require three manipulators and the battle scenes would need to be augmented with video. The script was still in development. More development time was needed on the puppets of which a full cast list had yet to materialise. There was no way the production could be ready to occupy its designated slot in the Olivier Theatre.

War Horse was given extra time. *Coram Boy*, another of Tom's projects, was fast tracked

into our slot and as fortune would have it was so successful that it ran to two seasons, affording us the time for the building of all that eventually came to be required.

IN THE STALLS

The first season of *War Horse* at the National Theatre was a major breakthrough for Handspring as a production company and for the acceptance of puppet theatre. The first night was an absolute success – the audience seemed amazed by the spectacle we had put before them and the thought of it still brings tears to my eyes. Record-breaking audience

numbers have given puppetry a boost in its claim for legitimacy. As for the principles behind the puppetry, our craft has been pushed forward yet again by the demands placed on us. We continue to learn the engineering behind what

we do, which is driven by a love of the medium. The technical advances made in the construction of the horses will be usable in many different ways by ourselves and anyone else who needs them.

A related article by Adrian Kohler and Basil Jones of the Handspring Puppet Company concerning the craft of puppet-making will be published in the Journal of Modern Craft, issue 2.3 (November 2009). For more information see: www.journalofmoderncraft.com

BIOGRAPHY – Adrian Kohler

Adrian Kohler spent a year at The Space Theatre in Cape Town, South Africa and another teaching puppetry in Birmingham, UK before accepting a post as director of the University of Botswana's National Popular Theatre Programme, which he ran until 1981. He then returned to South Africa to start Handspring Puppet Company. The company took shows on tour to schools for five years before embarking on a series of productions for adults, which continues today. Kohler's works have been exhibited at the Museum for African Art in New York and at the South Africa National Gallery and are held in public and private collections. He is the recipient of many awards including the 2008 Olivier Award for Set Design, shared with Rae Smith for *War Horse*.

The author would like to thank Chris Atkinson for help in the drafting of this article.



During rehearsals, the actors and puppeteers had studied horse and rider behaviour with The King's Troop Royal Horse Artillery. In a return gesture, Chester from the cavalry brought along his rider to meet Tophthorn (left) from *War Horse* as the performance began its run at the National Theatre © Simon Annand