

# The Magic Lantern

The Magic Lantern (in Latin "Laterna Magica") is the mother of all visual devices and media which are indispensable in modern day life. Even Leonardo da Vinci is said to have experimented with projected images. However, the Dutch physicist Christian Huygens (1629 – 1695) is regarded as being the actual inventor. In 1659 he constructed an apparatus for the projection of pictures painted on glass plates while using an oil lamp as a light source. Up to the triumphant advance of the slide and film projector in the last century, nothing has really changed fundamentally in the design principle of this "Magic Lantern" except for the fact that photography provides us with the pictures and the light comes from an electric lamp.

It is very difficult to imagine how much our predecessors were impressed or even overwhelmed by the light images which fascinated them at exhibitions on fair grounds and in bourgeois salons. Mobile lanterns were used to give the illusion of movement. Ghostly images were projected onto clouds of smoke or moving curtains while background sound effects created a scary feeling for all those gathered in the darkened rooms.

However, the lantern images were not always used for entertainment purposes. Motifs with biblical scenes were adopted for religious motivation. Some images showed country scenes or edifices from distant parts of the globe. Others showed illustrations of important events of contemporary history. In the 19<sup>th</sup> century the magic lantern was not only a childrens' toy but was also used for serious entertainment within the family circle and for lecture applications in schools and universities.

With the Laterna Magica of the AstroMedia\* series you have acquired a beautiful and, above all, a fully functioning cardboard replica of a 19<sup>th</sup> century magic lantern which was originally made of sheet metal. It will put you back into the atmosphere of former times. But above all you will be able to project photographed slides, self-drawn or PC-printed images. A safe battery-operated light bulb serves as a source of illumination.

**We wish you lots of enjoyment with the assembly and with your picture shows !**



## Assembly instructions for the Magic Lantern

### Contents of the assembly kit

6 printed and punched cardboard sheets, 1 section of black paper, 3 lenses (focal length +106 mm), 1 battery holder for 4 commercially available Mignon cells (= type AA, or LR6, not supplied with the kit), 80 cm insulated wire, 1 lamp 6V for bicycle lamp, 1 lamp socket, 1 parabolic reflector, 1 strip of printed images, 1 blank strip for picture images.

### Assembly instructions

Read each section thoroughly to the end before you start. The assembly itself is not difficult because all parts are pre-punched to fit exactly and all folds are pre-grooved. For the assembly work, you will require a sharp knife (e.g., a so-called cutter knife) to help you to remove the punched parts accurately from the cardboard sheet as well as to remove the insulation from the wire. Also a combination pliers or a sturdy scissors for cutting the wire to length, a small screw driver for the contacts on the lamp socket and a good all-purpose glue. An all-purpose glue containing a solvent is more suitable than a glue on a water-basis, a so-called solvent-free glue, because it does not cause waviness of the cardboard and gives the acrylic glass lenses a better holding support. For operating purposes, you need 4 leak-proof batteries type Mignon (= type AA or LR6). Each part is marked with a part number ([A1], [A2], [B1], [B2] etc.) and with its name. The letter of the part number is the same within an assembly group. Remove only those parts from the cardboard plate that you require for assembly, or write the number of the part on its rear side.

"Fold to the rear" means: I fold along the groove away from me when I look onto the printed side.

"Fold to the front" means: I fold towards myself. In order to get a really smooth fold, press it firmly, for example with the nail of your thumb or with a folding instrument.

Getting the glued spots to dry quicker: put a suitably thick layer of glue onto one of the sides to be glued, and then press the sides together

so that the glue spreads out on both sides, and then take the parts off each other again. Then blow 2 or 3 times over the surfaces and press the parts together again, making sure of a good fit – the glue holds immediately. Do not use this method when you are sticking the lenses into position. Glue threads could occur and lie across the lens.

### The walls

**Step 1:** Detach the housing wall [A1] from the cardboard. With great care, remove the punched parts from the broken-through ventilation rosettes of the future side wall. In order to avoid tearing the narrow ribs between the rosette elements and before removing the parts, get the sharp knife and run it along the punched lines. Also take out the round disk from the narrow part of the future front side where the light will come out later. Put this disk aside. It can be of help to you later when making your own picture strips. Fold all grooves forcefully to the rear.

**Step 2:** Detach the other housing wall [A2] from the cardboard. Here also, make the ventilation rosettes free as well as the 4 small holes above and below the turning axis of the light switch, through which the contact wires for the light switch are guided later. Remove the turning axis 2 of the light switch [C5] from the future side wall and the axis of the door handle [B4] from the door in the future rear wall. Fold the groove which forms the door hinge to the front and all other grooves to the rear.

The walls are glued later to the housing when the door handle and the light switch are completed.

**Step 3:** Detach the two parts of the door handle [B1] and [B2] from the cardboard and fold them to the front. Glue a half of each of those parts against each other when then have together a T-shaped cross-section.

**Step 4:** Detach the outer basis of the door handle [B3] from the cardboard. Glue the turning axis of the door handle [B4] into the centre on the rear side. This is done exactly and sim-

ply if you first put the glue on the disk and then stick a needle through the point that is punched in the centre of both parts. Make sure that the axis is glued over the full surface, but at the same time make sure that no glues comes out at the sides.

**Step 5:** Glue the two free halves of the glued door handle [B1] and [B2] onto the front side of the basis. Allow to dry well.

**Step 6:** Place the door handle onto the outer side of the doors and turn it a little until the axis in its bear flushes with the inner side of the door. Then glue the inner basis of the door handle [B5] onto the axis in such a way that it lies exactly behind the outer basis. Make sure that no glues gets onto the door or into the axis bearing. Allow to dry well, and then make it to move with great care until the handle turns as required. To close the door, turn the handle in such a way that the door frame is held in the gap between the inner and outer handle basis.

**Step 7:** Fold the inner door handle reinforcement [B6] in the middle to the rear and at the



two other folds to the front. Glue the two inner parts against each other so that a T-shaped cross-section is established.

Then glue the reinforcement onto the inner basis of the door handle. It prevents the door handle from bending too easily if it is used incorrectly in an unintentional way.

## The light switch

The light switch functions as a rotary switch. With the wire placed into it, it bridges over in the vertical position the two contact wires which are located below and over it on the outer wall. In the horizontal position, the current flow is interrupted.

**Step 8:** Detach the wall reinforcement of the light switch [C1] from the cardboard sheet, remove the turning axis 1 [C6] from its centre and make free the 4 small holes in the wall reinforcement. Then glue the wall reinforcement onto the outer side of the wall [A2] in such a way that the 4 small holes and the axis bearing in the wall cover those of the wall reinforcement.

The reason for the wall reinforcement is to ensure that the two contact wires do not tear open the cardboard when they are drawn through the holes.

**Step 9:** Take the enclosed wire and cut off a 20 cm long piece and remove the insulation at both ends to a length of approx. 3 cm. Place the wire onto a flat surface and, with the knife, go over the wire at a flat angle so that a slice of the insulating plastic material is cut off without damaging the core of the wire. The remaining part of the insulation can then be easily removed.

**Step 10:** At one end, bend a 2 cm long piece at right angles, and then the whole bare wire at the boundary to the insulation once again. The bare wire end now forms a corner-shaped hook with a 1 cm width and whose hood end is 2 cm long.

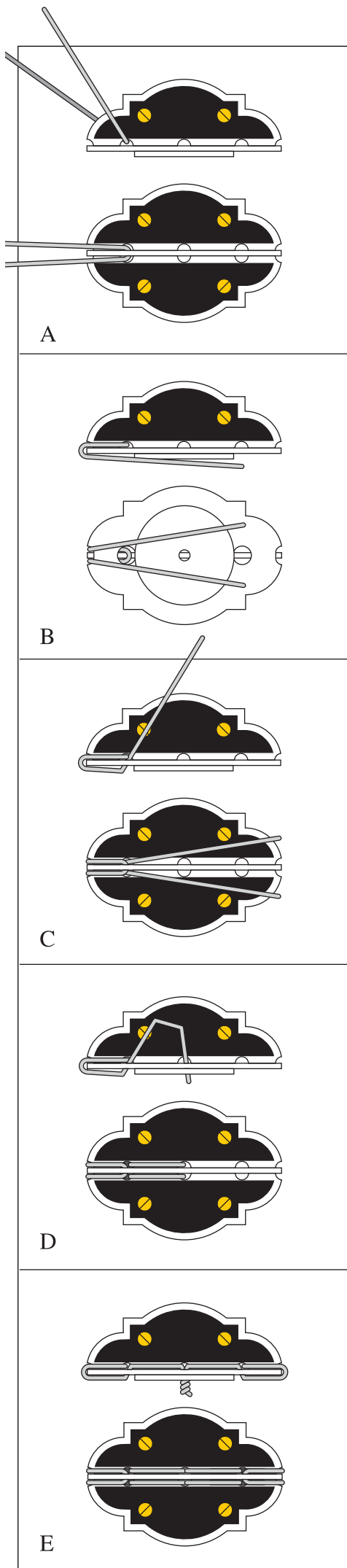
**Step 11:** Now insert the long end of the wire, from the printed side, fully through one of the small holes of the wall reinforcement for the light switch and the angular bent-off hook end into the 1 cm distant neighbouring hole. On the rear side of the wall, bend the hook end completely over and wind it around the remaining wire. Now, the wire can no longer loosen itself from the side wall, on whose front side a 1 cm long piece of bare contact wire is to be seen.

**Step 12:** Cut off a second 20 cm piece of wire and proceed as described in Step 9 and Step 10. Secure it as described in Step 11 in the two other small holes of the wall reinforcement. Above and below the axis bearing for the light switch, the two horizontal 1 cm long contact wires can be seen on the outer wall.

**Step 13:** Detach the two parts of the light switch handle [C2] and [C3] from the cardboard and make free the three small holes. Fold the parts to the front and glue them, as in the case of the door handle, with one half each to one another. From the basis of the light switch [C4], remove the cardboard from the small holes and glue the handle on.

**Step 14:** Glue the turning axis 1 of the light switch [C5] onto the turning axis 2 [C6], after you have made free the holes in the centre, and then glue this double-thick axis onto the rear side of the light switch. Here, the small hole is exactly located below the hole in the middle of the switch.

The switch has a central hole in the middle and next to it one on the side in each case. Through these holes, the wires are wound with which



the contact wires in the outer wall are bridged over. You can insert the wire vertically through the holes in the switch, then it appears on the underneath side. You can also do it horizontally, then the wire remains above and leads only to the other side of the switch handle. In addition, the switch has a small round recess on each of the two ends, over which the wire is led, as described in the following step.

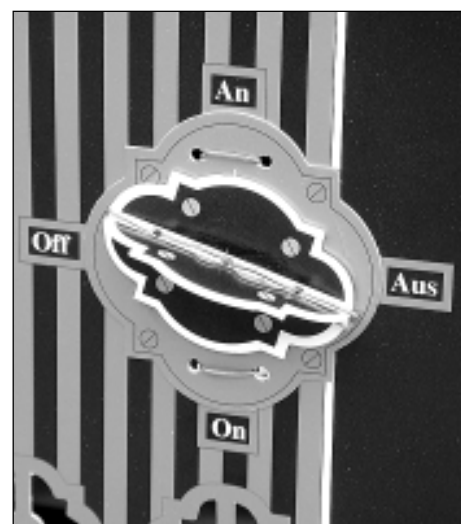
**Step 15:** Cut off a 10 cm long piece of wire, remove the insulation completely over the full length and make a sharp bend exactly in the middle. Push half of this wire through one of the two side holes in the switch handle, but do it in such a way that both wire halves remain on the upper side of the switch (Fig. A). Then lead both wire ends together to the end of the switch and bend them over the small round recess on the lower side of the switch (Fig. B). Then wind both ends through the nearby hole and again back to the upper side so that they appear again there where the wire begins. Make sure that there is a piece of wire on each side of the switch handle (Fig. C).

After this, insert both wire ends through the hole in the middle of the switch so that they protrude on the lower side out of the centre of the axis. Draw and press the wire smooth with great care and, if necessary, use a combination pliers to do so (Fig. D).

**Step 16:** Cut off a further 10 cm long piece of wire, remove the insulation and position it exactly as described in Step 15 into the other half of the switch. The 4 other wire ends that protrude on the rear side of the switch from the hole in the axis are now wound up together (Fig. E).

**Step 17:** Locate the light switch with its axis from the outside into its axis bearing and check to see if it can turn and that the axis flushes with the inner side of the wall. It may be necessary to widen the hole a little, e.g. by scraping with a sharp blade or by reducing the axis disk accordingly.

**Step 18:** Make free the small hole in the middle of the round inner part of the light switch [C7]. Insert the light switch into the axis bearing and turn it until the axis flushes with the inner side of the wall. Now glue the inner part [C7] onto the axis, and here you must wind the wire ends of the switch through the hole in the disk. In this way, the switch is fix-positioned in the wall and you can turn it also. When mounting the door handle, be careful that glue only gets in between the axis disk and the inner part and not into the axis bearing or onto the wall. Allow to dry well and then turn carefully and ensure ease of movement.



**Step 19:** Turn the 4 wire ends again tightly together, shorten them to half the size by means of a buckle and press the whole lot with a combination pliers so that the electrical contact between the wire ends is ensured. Press the whole bundle flat onto the round inner part of the switch so that you cannot be injured by it. If necessary, glue a piece of cardboard over it.

**Step 20:** Glue the two walls [A1] and [A2] at the side tongues to the rectangle housing.

**Step 21:** Detach the bottom sheet [D1] from the cardboard and remove the punched rectangle in the middle where the parts of the light switch were earlier on. Important: the printed side of the bottom sheet is the underneath side of the Magic Lantern, the housing comes onto the non-printed side. Fold the 4 peripheral tongues [D2], [D3], [D4] and [D5] along the groove to the front and glue them with the half limited by a straight edge onto the non-printed side of the bottom sheet. The straight edges coincide with the periphery of the bottom sheet and join together in flush with their rounded ends. With their other half, the peripheral tongues are standing upwards and, with their swung edges, they form a circumferential rectangular fence.

**Step 22:** Place the housing [A1] and [A2] into this fence made up of peripheral tongues in such a way that the ventilation rosettes are on the long walls below and the short wall with the door is lying there where, on the printed lower side of the bottom sheet, the nameplate for the name of the owner and the year of construction is located. Glue the housing with its gluing tongues onto the bottom sheet and the swung peripheral tongues of the bottom to the housing walls.

**Step 23:** With the bracket for the battery holder [D6] fold all 3 grooves to the rear, open the door in the rear wall and glue it with the printed side of the gluing tongues on the right/front into the corner between the rear and side walls. The bracket, rear and side walls form a square-shaped opening into which the battery holder can be placed.

## The reflector

The parabolic reflector throws the light of the lamp from the focal point in a forward direction as a parallel beam bundle.

**Step 24:** Fold the 18 tooth tongues of the reflector holder pointing inwards [E1] to the rear. Then place the parabolic reflector with the large opening facing downwards onto the working surface and slip the reflector holder over it so that they lie flush with the printed side on the working surface and the 18 tooth tongues press against the outer wall of the reflector. In this position, the reflector holder is glued at the reflector. Wait for the glued spots to dry well. If the glue does not hold on the plastic material of the reflector, you can roughen up the gluing spots with sandpaper. Finally, fold the 8 rounded gluing tongues of the reflector holder, pointing outwards, to the front.

**Step 25:** Fold all grooves of the reflector tube [E2] to the front and glue it with the lateral tongue to form an octagonal tube that is black on the inside. The 8 narrow auxiliary tongues are not glued; they help later to insert the reflector tube into the condenser tube.

**Step 26:** Place the reflector holder with the glued-in reflector onto that particular end of the reflector tube that has no auxiliary tongues, and glue solidly the 8 rounded tongues on the outer side of the reflector.

## The condenser

The purpose of the condenser is to collect ("condense") all the light of the lamp that would otherwise be reflected to the side and go unused and to divert it forwards. As in the case of the reflector, the tube is black on the inside in order to reduce disturbing reflexes.

**Step 27:** Make the 8 oval holes in the condenser tube free [E3], fold all grooves to the front and glue the part to form an octagonal tube that is black on the inside.

**Step 28:** Fold the 8 tongues of the holder for the condenser lens [E4] to the front and remove the disk in the middle so that an orifice is created. Take one of the three lenses and glue it with the narrow rim, that runs round the curved side, exactly central onto the printed side over the hole. Make sure that no glue gets onto the lens. If you look onto the part from the non-printed side, you see the curved side of the lens behind the orifice.

**Step 29:** Push ahead the holder with the condenser lens into that particular end of the condenser tube where there are gluing tongues, but only to such length until the tongues of the lens holder flush with the folding line of the tube tongues. The lens is now seated 2 cm deep in the condenser tube and the 8 tongues of the lens holder form a small black chamber. Glue the condenser lens with its holder solidly in this position.

**Step 30:** Detach the disk from the middle of the orifice for the condenser tube [E5]. Glue the orifice with its printed side onto the tongues of the condenser tube folded to the inside. It closes off the small black chamber with the condenser lens like a cover. Allow to dry well.

**Step 31:** Glue the condenser tube with the glued-on orifice in the lead onto the inner side of the housing front wall. The hole in the orifice of the condenser tube and the hole in the housing wall must lie exactly over each other. Allow to dry well. After this, do a trial to find out if the reflector tube with the narrow auxiliary tongues in the lead can be pushed without problems into the condenser tube.

The picture holder

**Step 32:** Glue the outer guide rails of the picture holder [F1] and [F2] onto the inner guide rails [F3] and [F4].

**Step 33:** Remove the disk from the middle of the picture holder [F5] and glue the two now double guide rails with the printed side behind the picture holder in such a way that the swung recesses on the guide rails are in line with the corresponding recesses above and below at the picture holder.

**Step 34:** Now glue the entire picture holder outside onto the narrow front wall of the housing. Be careful that the round orifices in the picture holder and in the housing wall lie exactly over each other and that the guide rails are horizontal. The two guide rails produce a clearance between picture holder and housing wall. Later, the 4 cm wide picture strips are slide-moved through the shaft created in this way.

## The objective lens

**Step 35:** Fold the 8 swung rim tongues of the large lens tube [G1] to the front and the 8 long grooves to the rear and glue to the part together to form an octagonal tube.

**Step 36:** Remove the disk from the lens holder for the large lens tube [G2] and fold the 8 tongues to the front. Glue one of the remaining two lenses centrally onto the lens holder, with its flat side onto the printed side of the cardboard. Allow to dry well.

**Step 37:** Push the lens holder to such a depth into the end of the large lens tube surrounded by gluing tongues, until the tongues of the lens holder flush with the folding line of the tube tongues. The lens now sits roughly over 1 cm deep in the tube and the 8 tongues of the lens holder form a small black chamber all around the lens. Glue the lens holder solidly in this position.

**Step 38:** For reinforcement, glue the collar [G3] around the open end of the large lens tube.

**Step 39:** Now glue the large lens tube with the 8 swung tongues exactly centrally over the orifice of the picture holder. The space for the tongues is marked on the picture holder.

**Step 40:** Fold and glue the small lens tube [G4] to form an octagonal tube.

**Step 41:** Remove the disk from the lens holder for the small lens tube [G5] and fold the 8 swung rim tongues to the rear.

**Step 42:** Glue the last of the 3 lenses with its flat side centrally onto the non-printed side of the lens holder. Allow to dry well.

**Step 43:** Glue the lens holder with its 8 rim tongues onto the related marked end of the small lens tube in such a way that the lens comes to rest inside the tube.

**Step 44:** Draw the rectangular black piece of paper, according to length, over an edge so that it can be rolled to form a 7.6 cm long tube. Insert it completely into the small lens tube and fix-position it with a drop of glue so that it acts as a black lining for the inner wall of the tube. This is to suppress undesirable light reflexes which would disturb the projection. The picture can later be focussed by drawing in and drawing out movements. With that, the optical system of the Magic Lantern is completed.

## The stack

There is a stack on the roof of the Magic Lantern so that the air heated up by the lamp can escape. Where safety is concerned this is really not necessary as the bicycle lamp produces only very little heat. However, the stack is a typical feature of the equipment of former times which was operated with candles or oil lamps. For this reason it belongs to this cardboard replica.

**Step 45:** Remove the foot part of the stack [H1] as well as the middle part [H2] and the upper part [H3] from the cardboard. Draw each part carefully with the non-printed side over an edge so that it curves and then glue it with the lateral tongue, which is **not** folded, to form a ring. Three short pipe pieces result, of which the middle part is slanted at both ends, the upper part and the foot part only at one.

**Step 46:** On the two slanted sides of the stack middle part [H2], at that location where it is wide, fold the tooth tongues to the rear (meaning, into the interior of the pipe) and there where it is narrow to the front (coming out of the pipe). Mount the upper part [H3] with its slanted end onto the one opening of the middle part so that the tooth tongues all disappear into the interior of the upper part and the two parts form together an obtuse angle. Glue the parts together in this position.

**Step 47:** Glue the foot part [H1] in the same way onto the other opening of the middle part. Foot part and upper part now form a right angle to one another.



## The roof

**Step 48:** Detach the long and the short side parts of the roof [J1] and [J2] from the cardboard and fold all straight and swung gluing tongues to the rear. Then glue the long side part with its left slant edge onto the right slanting gluing tongue of the short side part. The two parts now stand in an obtuse, almost right angle to each other.

**Step 49:** Proceed with the other long and short side part of the roof [J3] and [J4] exactly as in Step 48.

**Step 50:** Now glue the 2 roof halves together. You now have a flat pyramid stump which has a right-angle cut-out above and the swung gluing tongues are at its lower edge.

**Step 51:** Detach the upper part of the roof [J5] from the cardboard, remove the round disk from the middle and fold all of the swung gluing tongues at the rim to the rear. Now insert the foot part of the stack with its irregularly long tooth tongues, from the printed side, through the hole in the roof upper part and fold all of these tooth tongues to the outside so that they stand off from the stack. Turn the stack in such a way that its angled part is parallel to the longer side of the roof upper part. With that, the shorter tooth tongues come to lie there where the roof upper part is at its narrowest point. Glue the stack foot in this position with its tongues on the rear side of the roof upper part.

**Step 52:** Glue the roof upper part with its stack above on the pyramid stump as formed by the 4 side parts of the roof.

**Step 53:** Now glue the whole roof onto the housing, where the angled opening of the stack points to the rear in the direction of the door (see below). Housing and roof are glued together both by the upper gluing tongues of the housing as well as by the swung rim tongues of the roof.

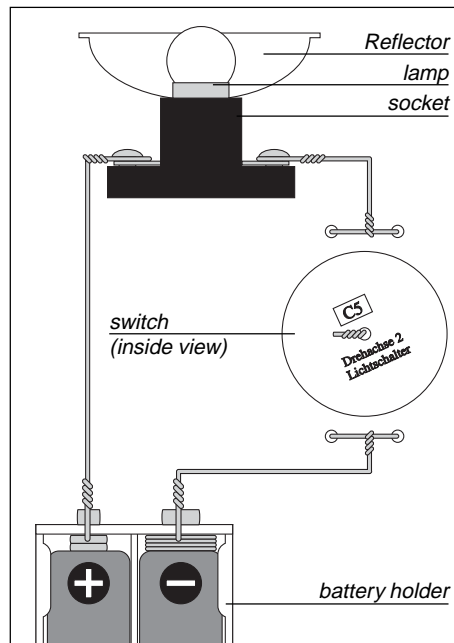
*The Magic Lantern is now complete except for the installation of the electric lighting.*

## Installation of lamp and battery

Important advice on safety: even though there is really no danger with a weak power source such as the 4 Mignon cells, it is advisable to observe the following rules: Never leave the lamp burning while unattended. Remove the batteries from their holder if the Magic Lantern is not in use over a longer period. Under the supervision of adults, it can be operated by children as from a school-going age without difficulty.

**Step 54:** Position the lamp socket, the battery holder and the remaining 20 cm long piece of wire as required. At one end of the wire, remove about 2 cm of the insulation, bend the wire to form a loop and screw it to one of the two contacts of the lamp socket.

**Step 55:** From the other end of the wire, remove about 2 cm of the insulation, insert the bare wire end from the outside through one of the two contact nipples of the battery holder, bend it over and guide it around the outside back to the contact nipple again. Wind it a few times with the pliers around the wire so that the wire end can no longer slip out. If a battery is then put in, it presses against the



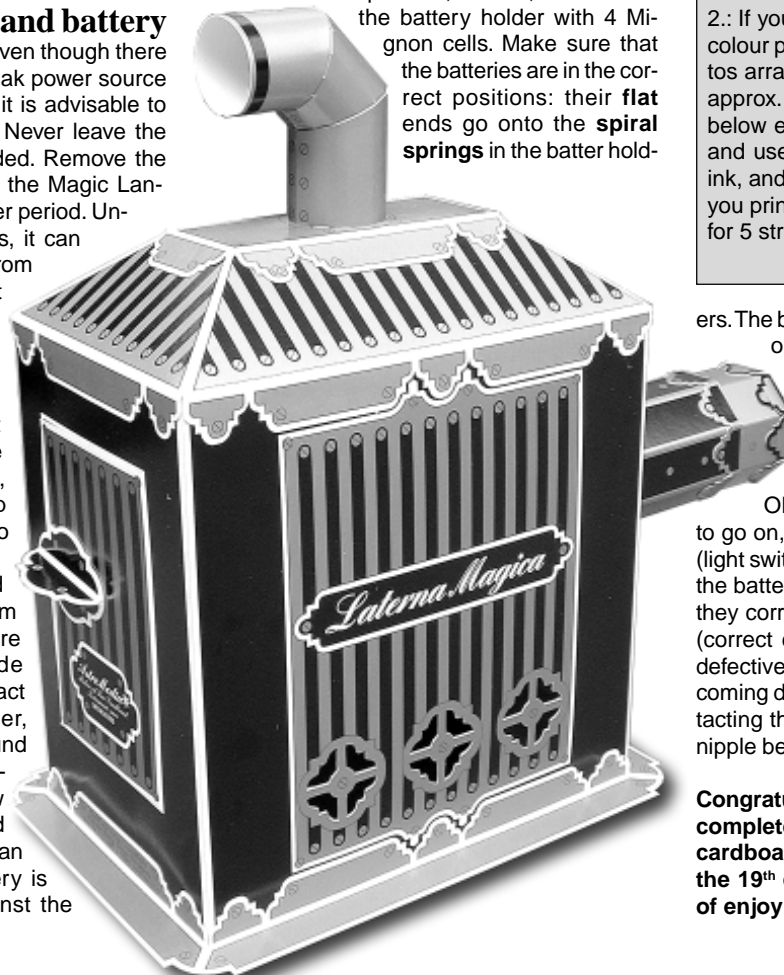
bare wire, thus producing an electric contact.

**Step 56:** Bend the bare end of one of the wires coming from the light switch to form a loop and screw it to the other contact of the lamp socket.

**Step 57:** Insert the 6V-bulb from the inside through the hole in the reflector and screw it with its thread into the lamp socket until the bulb, reflector and socket are tightly joined together as required. Then put the reflector tube into the condenser tube.

**Step 58:** Insert the bare end of the second wire, coming from the light switch, through the other contact nipple of the battery holder and secure it in the same way as in Step 55 for the other wire. Here also, the positioned battery presses against the wire, thus producing the electric contact.

**Step 59:** Turn the light switch into the horizontal position, to OFF, and now fill the battery holder with 4 Mignon cells. Make sure that the batteries are in the correct positions: their flat ends go onto the spiral springs in the battery holder.



## How to project pictures with your Magic Lantern

- 1.: Push the printed picture strip between the upper and lower guide rail of the picture holder, with its printed side facing the light source and the pictures standing head downwards.
- 2.: Direct the lens towards a large white wall surface or a screen. Darken the room, extinguish all other light sources and switch on the projection lamp. The picture may seem weak at the start but that will change when your eyes have grown accustomed to the dark.
- 3.: Push the lens tube back and forth until you get a clear picture. The further away from the wall, the larger the picture. The clearness of the picture can also be influenced by pushing the reflector tube back and forth.

## How to make your own picture strips:

- 1.: Cut the enclosed blank foil into single strips 40 mm wide.
- 2.: Draw or paint your pictures with coloured pens, as used for overhead projectors and available in shops for office material. As a template for the picture size, you can use the cardboard disk as mentioned in Step 1 with a diameter of 30 mm. You can make corrections at any time with a little spirits. With such pens, you can also colour the pictures of the printed foil.

## How to project photographed or printed pictures:

- 1.: Push the strip of a slide film between the rails of the projection shaft.
- 2.: If you have a PC, a scanner or an inkjet colour printer, you can scan pictures or photos arranged on the screen in rows with an approx. 30 mm diameter. Place these rows below each other with a spacing of 40 mm and use a foil suitable for the printout with ink, and then cut in strips as required. Tip: if you print the foil in A4 format, there is room for 5 strips with 8 pictures on each strip.

ers. The batteries are correctly positioned when opposite poles are joined up by way of the contact bridges in the battery holder. In this way, 4 batteries with 1.5 V each are switch in series and form a union with a total of 6 V. If you now turn the switch by 90°, to ON, the lamp lights up. If the light fails to go on, first check all the electrical contacts (light switch, lamp socket, battery holder), then the batteries (are they strong enough and are they correctly positioned?), and then the bulb (correct contact in the socket, or is the bulb defective). You can test the bulb with the wires coming directly from the battery holder by contacting the side of the thread and the contact nipple below the thread.

**Congratulations! Your Magic Lantern is now completed, a valuable and fully functioning cardboard replica based on models from the 19<sup>th</sup> century. We wish you many hours of enjoyment with it!**