

# The Kaleidoscope

In the year 1816 Sir David Brewster, a Scotsman who actually wanted to be a clergyman but later became the most famous physics professor of his time, invented a tube which he formed from mirrors with a small transparent cell at one end. This was filled with coloured chips of glass. By looking through the lens at the other end you could suddenly see, as if it were magic, the unending repetition of beautiful geometrical patterns. He patented his invention and called it a kaleidoscope. This is a Greek term and means: nice-image-viewer – a most suitable name for his invention.

Within a very short period of time, the kaleidoscope had spread successfully throughout the entire European continent. It won the hearts of countless children and adults and practically every household had one. Unfortunately for Brewster, it was distributed in large numbers by imitators who made use of the loopholes in the patent laws prevailing at the time.

Since it was invented, the kaleidoscope has had a permanent place in the shelves of toy shops and opticians and is probably the most popular optical toy of all times. Over the past decades, the kaleidoscope has been enjoying a true renaissance in Europe and in USA, and it is available in numerous variants and sizes. The largest kaleidoscope in the world (only one model was constructed) was designed by Holger Danneberg from Molbath. The smallest kaleidoscope which is only 1.3 mm thick and long, comes from the SunWatch Publishers in Essen/Germany and is presently available in the shops under the name "Twinky".

With this kaleidoscope from the AstroMedia series, you have a high-quality and fully functioning cardboard replica with a design based on the first salon kaleidoscopes of the 19<sup>th</sup> century. Its very special and rarely seen advantage is a cell where the contents can be replaced at random and adapted to the size of the inserted objects. Paper scraps are transformed into rose bouquets, coloured glass chips into sparkling colourful stars, blossom leaves into magnificent patchwork patterns – no limits are placed on your imagination.

**We wish you lots of fun when you assemble your kaleidoscope. And enjoy the lovely pictures as well !**



Sir David Brewster

## Instructions for assembly

### Contents of the assembly kit

3 printed and punched cardboard plates, 3 mirror blanks with protective foil, 1 lens (focal length +225 mm), 1 punched high-transparent covering, 1 punched semi-transparent covering.

### Before you start, read each section to the end.

The assembly itself is not difficult because all parts are pre-punched to fit exactly together and all folds are pre-grooved.

For the assembly, you will need a sharp knife (e.g., a so called cutter knife) in order to cut out the punched parts accurately from the cardboard plate, a few rubber rings, adhesive strips and a good all-purpose glue. A solvent-containing all-purpose glue is more suitable than so called non-solvent glues on a water basis because it does not cause any waviness of the carton and it gives the acrylic glass lens a better hold.

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 achieve

a smooth fold, apply force to it, e.g., with the rear side of your thumb nail or with a suitable folding object.

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 on the lens because glue threads could form and lie on the lens in the process.

### The eyepiece lens

In order to produce thorough image sharpness in the cell, the AstroMedia kaleidoscope has an eyepiece with an enlarging lens.

**Step 1:** Detach the lens holder [A1] from the cardboard, remove the round disk from the middle and fold the 6 tongues to the rear. Then, glue the lens with its flat side onto the rear side of the lens holder. Be careful and make sure that no glue gets onto the interior of the lens.

**Step 2:** Detach the hexagon from the middle of the eyepiece holder [A2] and fold the 6 tongues to the rear.

**Step 3:** Fold the 6 long grooves of the eyepiece tube [A3] to the rear and the 6

sticking tongues at the one end forward and to the outside, respectively. Before you glue the eyepiece tube [A3] to form a tube, insert it from the rear side through the hexagonal hole of the eyepiece holder, with that particular end out front that does not have any sticking tongues. In this way, check to see if it is perhaps necessary to have the eyepiece tube somewhat narrower or wider so that it sits properly in the hole of the eyepiece holder. Then, glue it together to form a hexagonal tube.

Insert again the eyepiece tube from the rear side through the hexagonal hole of the eyepiece holder, with the end out front that does not have any sticking tongues. Push the tube all the way through and then solidly glue its tongues on the rear side of the eyepiece holder as required.

**Step 4:** Glue the lens holder and the lens with its 6 tongues onto the free end of the eyepiece tube in such a way that the lens is lying on the inside.

**The eyepiece lens is now completed.**

### The mirror tube

*The mirrors consist of unbreakable polystyrene vaporised on the surface with aluminium. The arrangement with the cross-section of an equilateral triangle results in a six-fold mirroring of the image section (this is the classical mirror arrangement but not the only possible one). At one end of the tube the eyepiece lens is located, the other end is covered with a high-transparent foil.*

**Step 5:** Detach the mirror tube [A4] from the cardboard, fold all grooves to the rear and glue it together to form a hexagonal tube.

**Step 6:** Glue the eyepiece lens with the tongues of the eyepiece holder onto the marked end of the mirror tube whose hexagonal form is stabilised in this way.

**Step 7:** Remove very carefully the protective foil from the mirror blanks. Hold the three strips with your hand as if you were holding a bunch of flowers and let them form a three-corner tube with the mirrored sides on the inside. Place a few rubber rings around this mirror prism in order to maintain the shape. If you look through, you will notice that the image in the middle has multiple mirroring on the walls.

**Step 8:** Perform the jointing of the mirror prism on the working surface in such a way that the edges at the end flush accurately as required. Make sure the longitudinal edges are jointed together in the same way. In this way, it is ensured that the mirrors are lying flat despite their flexibility and that no curvatures occur.

**Step 9:** Fix the mirrors in this position to one another by wrapping adhesive tape around the prism at both ends with at least two locations in between. Move the rubber rings as required.

**Step 10:** Insert, just for trial purposes, the mirror prism into the mirror tube. It touches the tube at three edges. It must fit in exactly and flush with it as required. Take it out again, apply the glue on the inside on the three edges that will touch the mirror prism and insert the prism again.

**Step 11:** Detach the punched high-transparent foil covering from its sheet and fold all 6 tongues in the same direction. The folds lie there where the tongues begin and together they form a hexagon. Do your best to avoid touching the hexagonal surface in the middle as little as possible in order to avoid finger prints (if necessary, you can remove these with spirit). Then, place the foil covering onto the open end of the mirror tube in such a way that the hexagon covers the tube end and the tongues are lying on the tube at the side. Glue the tongues in this position by wiping them free of folds on the tube walls. In this way, the tube obtains its final stability. Allow to dry well as required. Tip: because a gluing between plastic and cardboard only dries slowly, you can fix-position the tongues with a rubber ring until such time as the cell tube – as described in Step 13 – is pushed over them. For technical reasons, the foil covering can turn out to be too big. In such a case the rims go beyond the edge. You can simply use a scissors to cut this projection off.

***The kaleidoscope tube with the eyepiece-lens is now completed.***

## The cell

The cell is pushed onto the end of the kaleidoscope and can be filled at random with various types of objects. At the front and at the side windows, it is covered with semi-transparent paper that allows enough light through for the objects in the cell.

**Step 12:** Detach the cardboard from the 6 window openings of the cell tube [B1], fold all grooves to the rear and then glue it together to form a hexagonal tube. Tip: for bending, place the groove over an edge (board, pocket-book). In this way you avoid a buckling of the narrow window frames which lie directly next to the grooves.

**Step 13:** Push the cell tube onto the end of the mirror tube glued to the glass-clear foil covering, until their ends flush as required. Detach the cell covering from semi-transparent paper from your sheet, place the hexagonal surface in the middle onto the end of the cell tube and fold the 6 lateral tongues onto the walls of the cell tube. Take the semi-transparent covering off again and fold again the 6 tongues, place them again onto the cell tube and glue the tongues solidly on the outside onto the window frames. In this way, the semi-transparent paper covers the window openings in the cell tube.

**Step 14:** Detach the cardboard from the 6 windows of the window covering [B2], fold all grooves carefully, as described in Step 12, to the rear and glue the covering over the tongues of the semi-transparent paper at the end of the cell tube. The 6 windows now have something similar to that of a window frame.

**Step 15:** Fold all grooves of the sleeve [B3] to the rear and glue them as a reinforcing ring around the rear rim of the cell tube.

***Your kaleidoscope is now ready for use.***

## The stand

The stand consists of a rectangular base, slanted at the sides, and two supports in which the kaleidoscope rests when it is not required.

**Step 16:** Detach the bottom plate [C1] from the cardboard and fold all grooves sharply to the rear.

**Step 17:** Fold all grooves of the base [C2] solidly to the rear and glue the small triangular tongues, located on the side at the short base walls, behind the long base walls. With the slanted walls, the base now has a trapezoidal cross-section.

**Step 18:** Glue the supports [C3] and [C4] with the non-printed sides against each other, also the supports [C5] and [C6]. The two supports now have on the one side a white field onto which the supporting foot is glued.

**Step 19:** Fold all grooves of the supporting feet [C7] and [C8] to the front and glue the two supporting feet, each with one half of their black main part on the rear side against each other. Proceed with the supporting feet [C9] and [C19] in exactly the same way.

**Step 20:** Glue one supporting foot in each case onto the white field that the supports have on the one side. If you now place a stand onto the working surface, two of the round bottom sticking tongues, consisting of one eighth of a circle, always come together to form a quarter circle.

**Step 21:** Glue the two supports with the round bottom sticking tongues of the feet onto the white-marked fields of the base surface.

**Step 22:** Glue the base onto the bottom plate. The sticking tongues of the bottom plate disappear completely in the base.

***Your kaleidoscope is now completed. Congratulations! You are now the proud owner of a fully functioning cardboard replica according to a design from the 19<sup>th</sup> century. We wish you lots of enjoyment with your kaleidoscope.***

