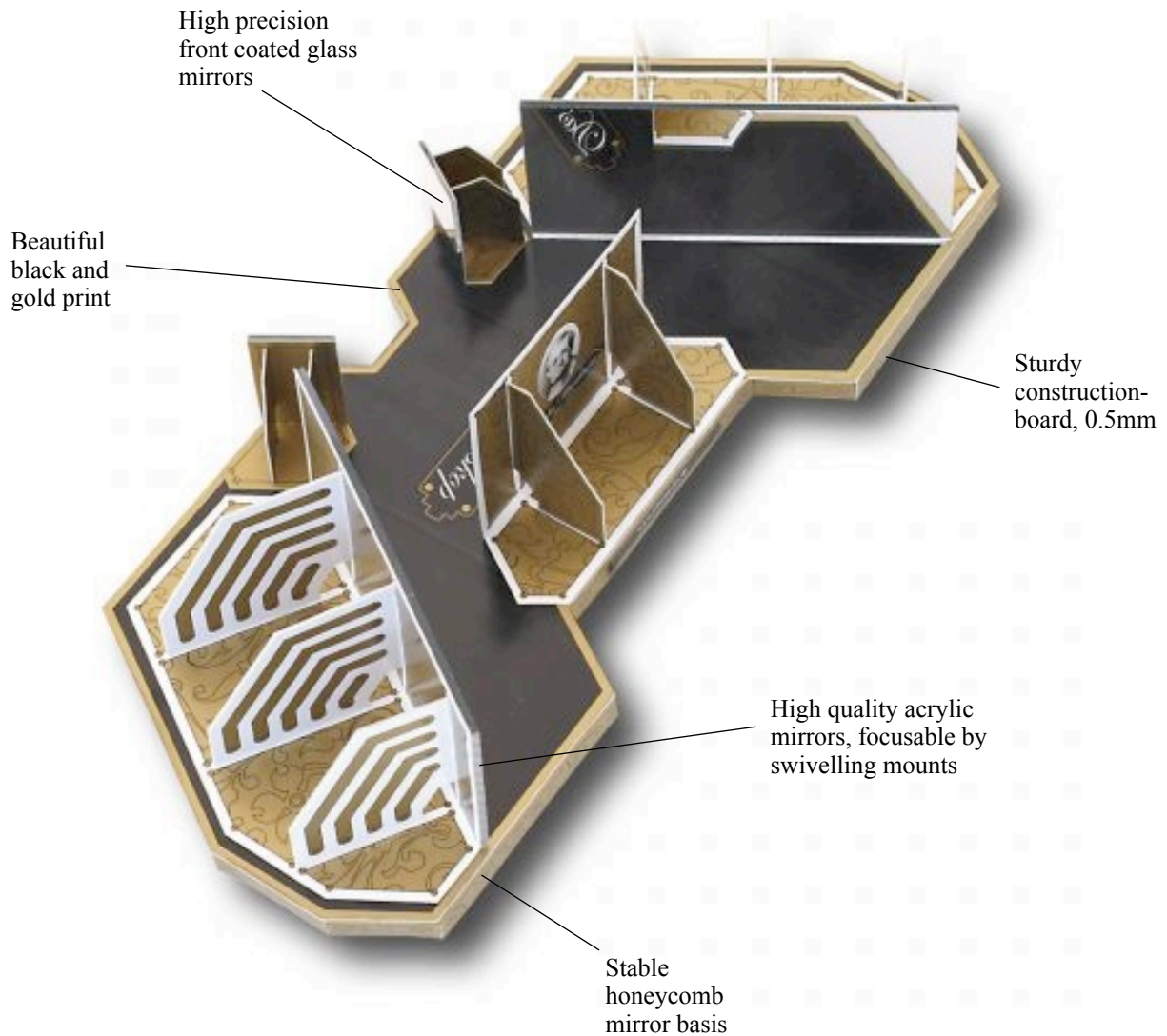


The Pseudoscope

Swaps the images perceived by the left and right eye and produces a reversed depth perception:
close objects appear far away, remote objects look close.



AstroMedia

Translation: Andreas Schröer

The Pseudoscope

One of the topics the versatile English scientist and inventor Charles Wheatstone was interested in, was the question of how three-dimensional perception works. He invented several instruments that could influence the natural process of vision, one of which was the pseudoscope (greek: "wrong-viewer"). He was also the inventor of the stereoscope which allows 3-D vision by projecting two different pictures into the eyes of the user. He is therefore the forefather of modern 3-D cinema.

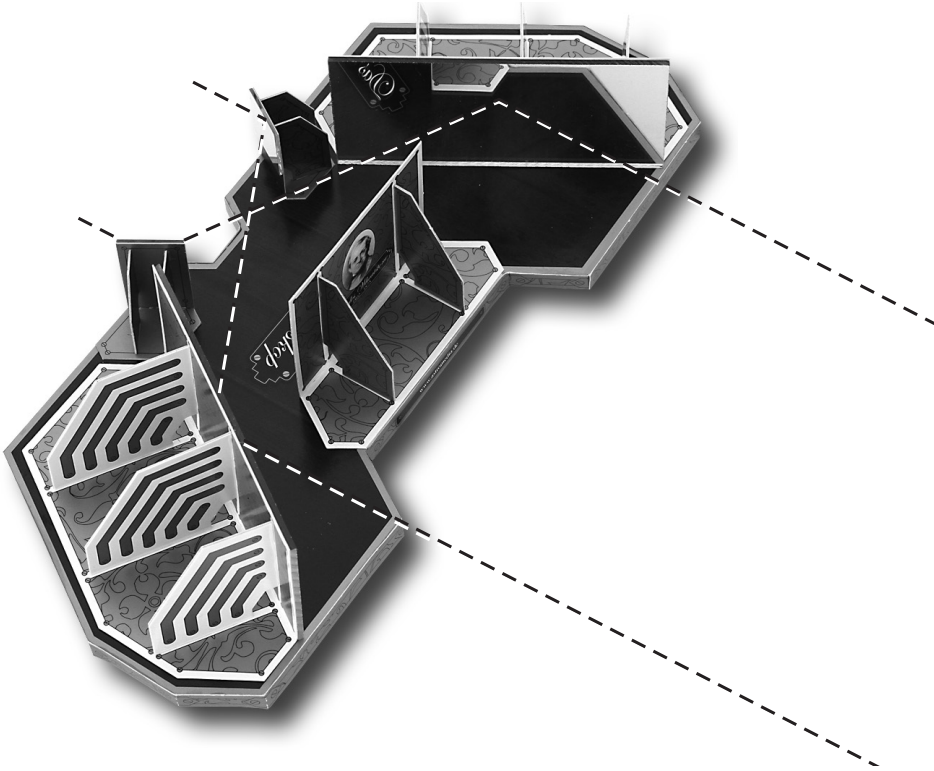
In 1838 Wheatstone described how our eyes, due to their distance of 60-65mm, each perceive objects under a slightly different angle. They then transmit these slightly different images from the retina through nerve impulses to our brain. In the brain itself these two pictures result in depth perception and our impression of the world around us, which is already a psychological process.

Vision, especially 3-D vision, is therefore a highly complex process, the beginning of which is the projection of the two images into our eyes. It doesn't even end with the neural activity in the brain because the result also needs to be interpreted and understood as a picture of our surroundings.

A pseudoscope differs from the stereoscope in the way that the images for both eyes are swapped and not projected in the way our brain would expect them. Therefore they are interpreted wrongly by our brain and the 3-D impression is inverted: concave turns



Charles Wheatstone
1802 - 1875



into convex and vice versa, a ball turns into a hollow mould, and a cup standing in front of a tea pot looks like it is standing behind it, although you can still see it standing in front.

But sometimes our brain refuses to accept the images from the pseudoscope and the inverting effect is suppressed, e.g. when looking at a face. This shows that our 3-D vision is influenced by other factors as well, especially by life experience: We just know too well how some things SHOULD look.

Wheatstone's first pseudoscope used prisms to deflect the light. The AstroMedia Pseudoscope has mirrors that swap the two images the eyes perceive. It also has one innovation that no other pseudoscope has had before: the two large mirrors can swivel on axles and therefore make it possible to adjust the focus for objects at different distances.

Klaus Hünig



Contents:

4 pre-punched sheets of cardboard 0.5mm
2 front coated glass mirrors, 22x22x1.3mm
2 acrylic mirrors, 55x110x2mm

You will also need for assembly:

- * Standard solvent based all purpose glue, e.g. UHU, Evo-Stik Impact, B&Q All Purpose Glue. **Do not use water-based glue:** it softens and warps the cardboard, and doesn't stick properly to the printed surfaces. Solvent based glues also dry much faster.
- * A sharp knife with a fine point (thin carpet knife, craft knife, scalpel), to cut the thin holding tabs of the pre-punched parts.
- * A cutting board or mat, made from hardboard, plastic, or wood. Self healing cutting mats are ideal as the material re-closes after each cut.
- * A sewing pin for accurate positioning of the mirror axles.

Tips for successful construction - Please read before commencing!

- * In order to ensure good results and for straightforward construction, the building instructions have been broken down into chapters A to K, which are broken down further into smaller steps. Do not be worried by the long text - it is simpler and faster than it appears and helps to avoid mistakes. Read each step from the beginning to the end before commencing and allow yourself about 2 to 3 hours for the construction (depending on experience). The more care you take, the better the pseudoscope will work and look.
- * Every part has its name and/or part number printed on front or back. The part number consists of a letter and a number: the letter denotes the chapter it belongs to, the numbers denote the order of construction. The part number can be recognised by its rectangular frame, e.g. **J1**. Only remove the parts as you need them.
- * Places needing glue are marked in grey. On each of these grey areas you will find a part number followed by an arrow in a square:
J1  The number denotes the part (or tab of the part) that will be glued in this place. On some grey areas you will find the symbol . This means that the part will be glued to itself on this area. Please keep in mind that the glueing areas are slightly smaller than the parts that will be glued to them. This ensures that grey areas will be completely covered.
- * We recommend that you do not tear the parts out of the cardboard sheet, but cut through the thin connecting tabs to make sure that the edges stay smooth. Frayed edges can be cleaned with a nail file or with our AstroMedia File Set.
- * All folding lines are prepared by perforations. If they are to be bent "forwards", you have to fold them towards you when looking at the printed side of the part. If they are to be bent "backwards", you need to fold them away from you. You get a straighter fold if you position the folding line over a sharp edge.

Chapter A The bottom plate of the mirror base

The bottom plate [A1] and cover plate [B1] form the mirror base that will be used to mount the four mirrors. In order to make the base as sturdy as possible, both plates will be connected by an 8mm high honeycomb cardboard construction. The outer rim of the base is reinforced further and later covered by a strip of cardboard (Chapter D).

Step 1: Remove the bottom plate [A1, Bogen 2] from the cardboard sheet and place it face-down on your worktop.

Step 2: Remove the rim reinforcement parts for the bottom plate [A2 to 5, Bogen 4] from the cardboard sheet and first glue the grey sides of parts [A2] and [A3] onto the grey marked areas on the back of the bottom plate, followed by parts [A4] and [A5]. **Important:** make sure that all edges are completely flush. If one part stands out slightly, you can cut it off or file it back.

Chapter B The honeycomb of the mirror base

Step 3: Remove the strips for the 15 honeycomb rings [B1 to 15, Bogen 1 and 2] from the cardboard sheet. A 16th strip is available as reserve. Fold the strips along the perforated lines to form hexagonal rings and glue each of the grey marked areas behind the opposite end of the strip. Push each of the rings against your worktop before the glue sets to make sure the edges are completely flush.

Step 4: Glue the hexagonal rings onto the grey marked areas on the back of the bottom plate [A1]. For this trace the grey outlines on the bottom plate with a generous amount of glue and push the edge of the rings into it. When all rings are glued in, turn the bottom plate over, rest it on the rings, and weigh it down with a small weight, for example with a book.

Chapter C The cover plate of the mirror base

Step 5: Glue the reinforcement parts [C2 to 5, Bogen 4] onto the back of the cover plate [C1, Bogen 1], following the instructions in Step 2.

Step 6: Put the bottom plate on the worktop with the honeycomb rings facing upwards and next to it the cover plate with the fitted reinforcements also facing

upwards. Now trace the grey outlines for the honeycomb rings on the back of the cover plate with a generous amount of glue. You have to do this rather quickly to make sure that the glue doesn't set before you are finished. Now place the cover plate on top of the bottom plate so that the edges are flush. This ensures that the traces of glue and the honeycomb rings match exactly. Again check that the edges are completely flush before the glue sets, for example by pushing all edges against your worktop.

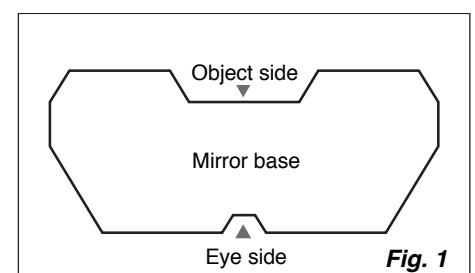
After the glue has set, you have a very stable honeycomb base plate.

Chapter D The edge cover of the base plate

The edge cover of the base plate consists of 4 cardboard strips that are glued onto the edges of cover and bottom plate. The best way to do this is to apply the glue only on the backs of the strips, but not to close to their edges. The front and rear cover strips have short grey glue tabs on their ends so that the strips can be put on without any gaps.

Hint: Cardboard is a material that can have slight variations of its thickness, even die cutters and printers can have an influence on it. It is therefore possible that the width of the edge cover might differ slightly from the thickness of the base plate. In case the edge cover is too wide in places, you can cut it back with a sharp knife or a scalpel, or you let it protrude on the underside, where you won't notice it so much.

Step 7: Fold the grey glue tags of the object side edge cover strip [D1, Bogen 3] along the perforations backwards. They should fit in the gap between bottom and cover plate. If they are too wide, you can cut them to size. The other two perforated lines are folded forwards. Now glue the strip onto the edges of the bottom and cover plate on the object side of the mirror base (see Fig. 1). Push the two glue tags so far into the gap between the two plates so that later the two connecting edge cover strips will reach exactly to the perforations of the two folding lines.



Step 8: Fold the two inner perforation lines of the eye side edge cover strip [D2, Bogen 3] forwards. The other four perforation lines are folded backwards. Now glue this edge cover strip onto the eye side of the mirror base (see Fig. 1) and push the grey glue tags a little bit into the gap between the plates.

Step 9: Fold all perforation lines of the left edge cover strip [D3, Bogen 1] backwards. First try without any glue whether it fits nicely onto the left side of the mirror base. If it doesn't fit, try turning it around by 180°. Now glue the strip in place. Also put some glue onto the ends of the strip so that they stick to the grey glue tabs of the other strips.

Step 10: Now glue the right edge cover strip [D4, Bogen 2] in a similar way onto the right edge of the mirror base.

This concludes the construction of the mirror base. As you can see it is very sturdy and warp resistant, but at the same time also very lightweight.

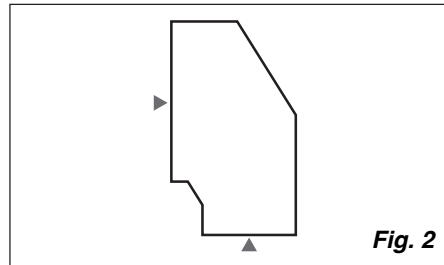
Chapter E

The holder for the left small mirror

All mirrors have to be mounted at exactly right angles on the mirror base. Otherwise the images for the two eyes would be shifted against each other. Therefore the mirror holders all have a perforated fold line roughly in the middle, so they can be folded at right angles. This way one side of a mirror holder carries the mirror, while the other side lies flat against the mirror base. To fix the right angle, mirror brackets are glued with their edges onto the grey glue marks. These edges are cut exactly at right angles and therefore ensure the 90° angle as long as they are glued in without a gap. The mirrors themselves are only glued onto the holders in the penultimate step.

Step 11: Fold the holder for the left small mirror [E1, Bogen 3] forwards and re-groove the fold with your thumb nail to make sure that both sides can form a right angle without warping. The trapezoidal side is the foot of the holder, the other side will later carry the mirror.

Step 12: Remove the four bracket parts for the left small mirror [E2 to 5, Bogen 1] from the cardboard sheet. Glue two of each back to back, so you end up with two mirror brackets with a thickness of two layers of cardboard (see Fig. 2). Push the edges of the brackets against your worktop before the glue sets to make sure they are completely flush.



Step 13: Glue the two brackets against the folded corner of the small mirror holder, exactly onto the grey glue marks, so that the two sides form a right angle. For this, apply enough glue onto the edges of the brackets and check several times that there is no gap between the brackets and the holder while the glue sets, so that the sides of the holder are exactly at right angles. Let dry thoroughly.

Step 14: Without applying any glue yet, put the foot of the mirror holder onto the grey glue mark, denoted [E1], on the left front side of the mirror basis. The grey glue mark for the mirror then faces towards the rim of the mirror basis, as do the two arrows on the foot of the holder. The edge of the foot of the mirror holder has to be exactly flush with the edge of the cover plate (NOT with the outer side of the cover strip). Now glue the holder into this position. **Important:** Check again before the glue sets that the edge is exactly flush with the edge of the cover plate.

Chapter F

The holder for the right small mirror

Step 15: Construct the holder for the right small mirror [F1, Bogen 3] and the two brackets [F2 to 5, Bogen 2] in the same way as in Step 11 to 12 and glue them together as described in Step 13.

Step 16: Once the glue has set, glue the holder for the right small mirror in its place on the mirror basis, again making sure that its edge is exactly flush with the edge of the cover plate.

Chapter G

The holder for the right large mirror

The two holders for the large mirrors will not be glued onto the mirror base, but remain turnable. This way the mirror can be adjusted to focus on objects at different distances. The axles are the cardboard discs [G2] and [H2]. They can be precisely glued on using a sewing pin, because in their centre as well as in the middle of their grey glue marks on the mirror basis are pre-punched small holes. The holders

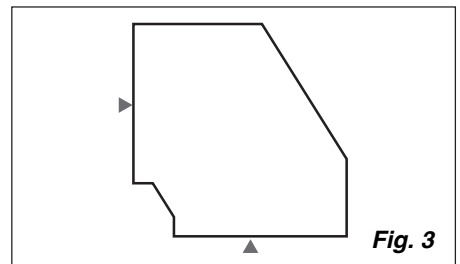
for the large mirrors are held at right angles by one small and two large brackets.

Step 17: Remove the holder for the right large mirror [G1, Bogen 3] from the cardboard sheet and push out its axle [G2], a cardboard disc of 18mm diameter.

Step 18: Stick a sewing pin halfway through the little hole in the centre of the axle [G2] and apply glue to its underside. Then stick the pin through the hole in the cover plate that is marked with [G2] and push the axle down onto the cover plate. This way it will sit in exactly the right position. Take care that no glue squeezes out from under the axle or remove all of it if that happens. Now you can pull the pin out again.

Step 19: Fold the holder for the right large mirror [G1] forwards along the marked line and re-groove the fold with your thumb nail to make sure that both sides can form a right angle without warping.

Step 20: Glue the bracket parts for the right large mirror [G3 and 4, Bogen 4] and [G5 and 6, Bogen 4] back to back and push their edges against the worktop to make sure they are completely flush and form an exact right angle (see Fig. 3).



Step 21: Construct the other, slightly smaller, bracket for the right large mirror from parts [G7 and 8, Bogen 1] in the same manner.

Step 22: Without applying any glue yet, hold these three brackets against the mirror holder, so they sit exactly on the thin grey glue lines. The smaller bracket should stand close to the angled side of the holder. Observe the correct orientation of the brackets: their angled rear side should have a steep slope, not a flat one (see Fig. 3 and title photo). Glue the brackets in this position and again make sure that no gaps develop while the glue sets. Let dry thoroughly.

Step 23: Put the mirror holder onto the right hand side of the mirror base so that the axle clips into the hole in the holder. Turn the holder back and forth around the axle until you are sure that the surface of the holder is completely flush with the top of the axle. To permanently connect the mirror holder with the axle, the axle cover [G9, Bogen 3] is glued on top of the axle.

Apply some glue onto the top of the axle, but spare the golden rim around the edge, and put the axle cover centrally on it. Take care that no glue is squeezed out so that the mirror holder can still swivel around the axle. Let dry thoroughly and then check the mechanism by carefully rotating the holder back and forth.

Chapter H

The holder for the left large mirror

Step 24: Remove the holder for the left large mirror [H1, Bogen 3] from the cardboard sheet and push out the axle [H2]. Construct the three brackets for the holder from parts [H3 and 4, Bogen 4], [H5 and 6, Bogen 4], and [H7 and 8, Bogen 1] by gluing them back to back.

Step 25: Now put all parts together following the steps for the right large mirror holder. Then fit the left large mirror holder to the mirror base with the help of the axle cover [H9, Bogen 3].

Chapter J

Fitting the mirrors and the blind

*In the centre of the mirror basis we will fit a blind that makes it easier to adjust the eyes to the small mirrors and not to look straight past them. But first we need to glue the mirrors in place. **Important:** the small mirrors have a blue protective cover on their coated front. The back is*

reflective as well, so at first glance it could be mistaken for the front. Don't let this confuse you: the side that should face the eye is the one covered by the blue protective film. The large acrylic mirrors are protected by a milky white film, their back is covered with matt paint that can't be peeled off. The protective film will only be removed after the mirrors are glued on and the glue has set, but it is a good idea to carefully loosen one corner of the film with a knife before fitting the mirrors.

Step 26: Glue the small mirrors (22mm x 22mm) onto the grey glue areas of their holders with the blue protective film facing away from the holder. The mirror edges should be flush with the upper and side edges of the holder. The centre of the mirror now is at the same height above the mirror base as the centre of the large mirrors will be.

Step 27: Now glue the two large mirrors (55mm x 110mm) with their matt painted backs onto their holders. Their edges should be flush with all edges of the mirror holders.

Step 28: After the glue has set, remove the protective film from all four mirrors by carefully loosening one corner with a knife and then peel it off very slowly. Take care that you don't bend the cardboard of the mirror holders whilst doing so.

Step 29: Fold the blind [J1, Bogen 4] forward at right angles and glue parts [J2 and 3, Bogen 1] as well as parts [J4 and 5, Bogen 2] back to back to form the blind

brackets. Then glue the brackets onto the grey glue lines on the blind, the same way as the brackets for the mirror holders were done.

Step 30: Glue the blind onto its grey glue mark on the mirror base.

Chapter K

The stands

Step 31: Remove stand 1 [K1, Bogen 3] from the cardboard sheet and fold it backwards along the six perforated fold lines. Glue the long grey tag behind the opposite end to form a hexagonal tube. Then fold the six small grey glue tags inwards and the golden ones outwards. Glue the stand cover [K2, Bogen 1] onto the six grey glue tags. The cross section of the stand now looks like a slightly elongated hexagon.

Step 32: Repeat the last step with stand 2 [K3, Bogen 3], stand 3 [K5, Bogen 3], and the covers [K4, Bogen 2] and [K6, Bogen 3] to form the other two stands.

Step 33: Glue the three stands with their golden tags folded outwards onto their grey glue marks on the bottom plate of the mirror base.

Congratulations, your Pseudoscope is now complete! You are now the owner of a remarkable and rare optical instrument, that otherwise can only be found in a few collections of scientific instruments.

How to use your Pseudoscope:

Important preliminary note: To be able to see the pseudoscopic effect, you need to have stereoscopic vision. Some people do not have this ability, for example because one of their eyes is considerably weaker than the other. Many people don't even know that they have this condition. Only if they try watching a 3-D movie, they might realise that it looks as "flat" as an ordinary film.

1. Choose objects that are suitable for beginners. Irregular objects that you don't know very well are better suited than regular ones. A bunch of flowers or a tree branch are good objects to start with, since the brain doesn't know their exact composition in advance. Therefore the spatial inversion effect is much easier to accomplish. Objects like faces on the other hand are so well known to us, that it is much harder to see the pseudoscopic

effect when you look at them. Our brain just knows too well, that the nose is sticking out towards the viewer and the eyes are further back and it is therefore much harder to deceive. It seems like we have some sort of automatic error correction built into our visual "software".

2. Start with objects at a distance of 1-2 metres. Trying to look at very near and very far away objects at the same time is problematic, since the large mirrors can only be focused on one image plane. Hold the Pseudoscope in front of your eyes and look into the two small mirrors with your index and ring fingers on the movable ends of the large mirror holders. If you now look at an object, you see a double image until the two large mirrors are in focus. Carefully move the two mirror holders inwards or outwards until the two images combine.

3. Take your time and relax. Don't try to imagine beforehand what you will see and let the image develop by itself.

4. What will you (not) see? A face will probably not look like a hollow mask because we know too well how it SHOULD look like. But looking at a bunch of flowers, you will suddenly see a branch sticking out towards you, although the leaves are clearly in the background. The more you look, the more oddities you will find and the more you practise letting go of your normal way of seeing things, the more objects will exhibit this strange effect. Maybe one day you will even be able to turn a face into a hollow mask!

Send us your comments! If you think you found a good object to view with your Pseudoscope and want to share this with others, we would love to hear from you.

Understand Science

with the fascinating and fully operational cardboard kits
by AstroMedia ✨



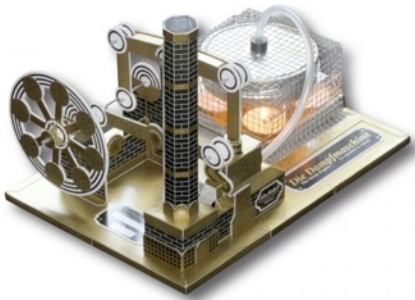
Reversing Goggles



The Orrery



The Newton Telescope



The Steam Engine



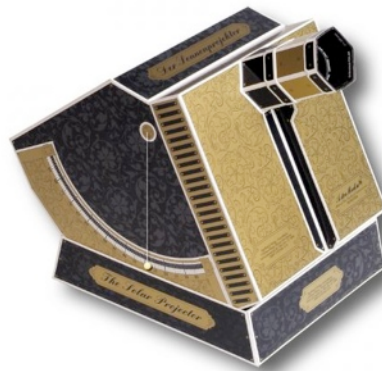
The Ferris Wheel



The Stirling Engine



The Stardial



The Sun Projector



The Magic Lantern

and many, many more