Heaven on Earth

Exploring solar images at Kettle's Yard

By Maggie Ellis & Johannes Grebe-Ellis

> It is central to the philosophy of Kettle's Yard that a room is already furnished by the light that comes into it.[1]

Kettle's Yard: An Appreciation of Light was one of the suggestions Jim Ede came up with in the early 1980s as a title for the book that was then called *A way of Life*[2]. A perfect description of what visitors to the house and its extensions experience: spaces in which an infinitely diverse and varied interplay of light and shadow unfolds – different every hour, new every day and, depending on the time of the year, alternating between high and low arcs of the Sun, following the rhythm of the seasons. Light adds a decisive dimension to the unique place Jim and Helen had created as their home, a haven for art and a place to encounter its beauty in.

Wandering through the house, extension, galleries and garden of Kettle's Yard, you gradually discover a web of visual connections woven by light. They intertwine with Jim's visual dialogues between art, natural world and everyday life, turning Kettle's Yard into a place of visual experience. In it you can constantly discover new perspectives, noticing objects or constellations for the first time that you may have seen many times before, but have never consciously been aware of. Kettle's Yard is filled with optical phenomena (Fig. 1), like lens caustics, reflections, prismatic colour edges, image distortions, pinhole images, colour reflections (cupolas), polarisation and many more.

In this text, we would like to share observations on one optical phenomenon that is particularly iconic for Kettle's Yard, which is not easy to decipher, and never ceases to enchant the viewer. In doing so, we hope to make a contribution towards how to see, read and interpret it and to enhance the joy and wonder Kettle's Yard offers to its visitors.

Fig. 1: Light phenomena in the bay window of the sitting room.

Solar images at Kettle's Yard

Standing beneath the tall chestnut trees next to St. Peter's Church on a sunny day, you can discover delicate round patches of light gracefully dancing on the ground in the shadows (Fig. 3a). With every gentle breeze that rustles through the leaves, these patches flicker, disappear, reappear and overlap one another. They form a fragile, beautiful web of circles of light (Fig. 2), until the next cloud comes along and everything disappears. This performance is enhanced by the yellow deckchairs, which invite the visitors to linger. Their covers act as screens onto which the play of light circles is projected without the unevenness of the ground, shaping bright yellow circles (Figs. 2, 3b) – a premonition of Jim's lemon and the yellow circle in *Tic Tic* by Joan Miró?

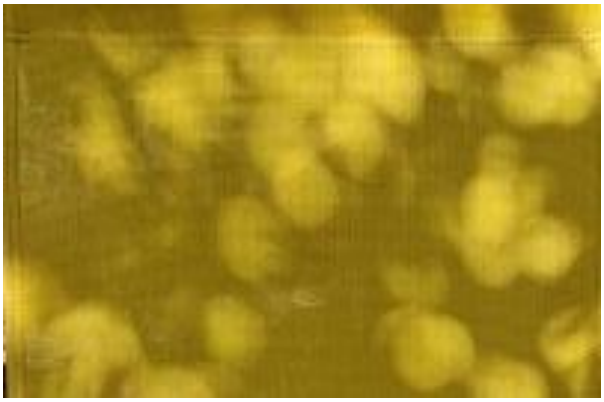

Fig 2: Light circles on the yellow deckchairs.

Fig. 3: St. Peter's with light and shadow under the trees (a). Yellow deckchair with circles of light (b). Angular openings between the leaves (c).

What are these circles of light? How do they form? Why are they all the same size? And why are some brighter and more blurred and others paler, but sharper?

Looking up, the astonishing, even confusing thing is that the origin of these circles cannot be found in the irregular openings between the leaves of the tree (Fig. 3c) that show tiny glimpses of the Sun. It is immediately apparent that our circles of light bear no resemblance whatsoever to the shape of these openings. So why are the patches of light circular? The question remains unanswered for the moment. With it in mind, we enter the house.

Surprisingly, we encounter similar circles of light again in the semi-circular bay windows on the ground floor. They are smaller and, unlike outside, appear arranged in several parallel rows that look like strings of pearls made of light laid across the round tables, continuing onto the floor and the walls (Fig. 4).

We have often seen these light beads at Kettle's Yard; they echo the formal language of Jim's compositions on the tables, forming fleeting, immaterial counterparts to the round pebbles. But as familiar as they are to us as a play of light and shadow created by the daylight filtering through the blinds, their origin poses questions, now that our attention is sharpened. What do these light beads have to do with the circles of light under the chestnut trees next to St. Peter's?

The answer to this question is provided by the light beads themselves, but they need to be examined more closely. It is easy to see that the trails of light refer to the series of openings in the slats of the lowered blinds in front of the windows. Let's take a closer look at one such series. Each slat opening creates a spot of light. The first spot of light directly at the window belongs to the opening of the lowest slat, the next spot a little further away on the table belongs to the opening of the slat above it. This means that the higher the slat opening, the further away in the space the corresponding spot of light is and the longer the projection distance, i.e. the distance from the slat opening to the table or floor where the beam of light arrives.

By familiarising ourselves with the geometric relationship between the individual light spot and the slat opening that produces it, we have also

Fig. 4: Bay window in Jim's bedroom with beads of light.

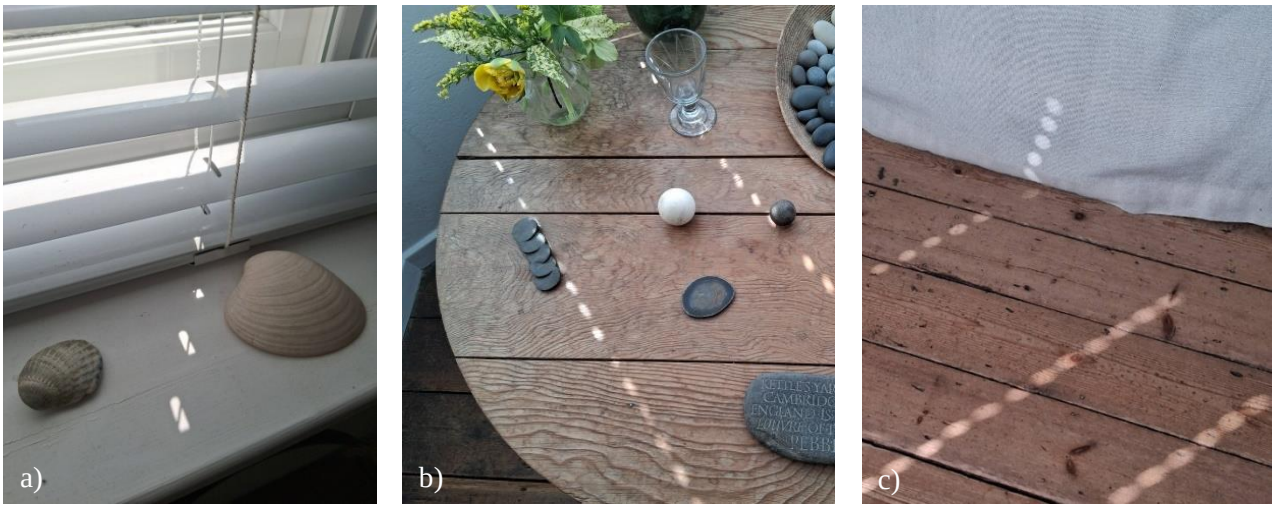

Fig. 5: Opening of the slats with string visible (a). Transformation of the shape from oval (b) … to elliptical and circular (c).

become aware of an observation that will prove decisive in solving our problem: the light spots in our series do not look the same. They show a characteristic change in shape the further away they are from the window: in the first 2-4 light spots, you clearly see the elongated silhouette of the slat opening. You can even see the shadow of the thin thread that is fed through the opening (Fig. 5a). If you follow the light spots, you will see how they become increasingly dissimilar to the openings (5b). The longer the projection path is and the larger the light shapes become, the more they transform into a circular or elliptical shape (5c) depending on the angle at which the beam of light hits the table, the floor or the opposite wall.

It is clearly no longer the slat opening that is depicted here – but what else can it be? The answer becomes clear immediately when a cloud begins to move in front of the Sun and you recognise the silhouette of this cloud in each individual circle of light (Fig. 11) and then realise: the circles of light are images of the Sun! The openings of the slats in the windows of Kettle's Yard (Fig. 8) and the openings in the canopy of the chestnut trees next to St. Peter's create pinhole images of the solar disc, which vary in size, depending on the distance of the opening that projects the image.

Optics of pinhole imaging

The *"*problem of Sun coins*"* has fascinated scholars since ancient times. In the pseudo-aristotelian *Problemata physica* [3] (4th century B.C.), one finds the question*: „*Why is it, that when the Sun passes through quadrilaterals, as for instance in wickerwork, it does not produce a figure rectangular in shape but circular?" In 1604 Kepler wrote: "It is a well-known fact that sunlight passing through any crack falls on the opposite surface in

Fig. 6: Showing the transformation from shadow to pinhole image of the Sun with a finger grid. The larger the distance to the wall, the more dominant the image of the solar disk: 'Sun coins'. Photos: Laila Ellis

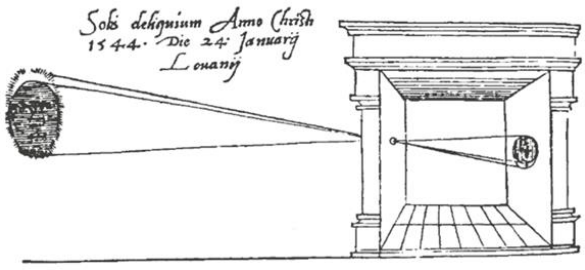

Fig. 7: Illustration by Rainer Gemma Frisius, depicting a solar eclipse in January 1544 – the first known published illustration of a Camera Obscura.

the form of a circle. This can be seen under cracked roofs, in churches with broken window panes, and also under every tree. Attracted by the wonderful appearance of this phenomenon, the ancients endeavoured to investigate its causes. But to this day, I have not found anyone who has provided a correct explanation."[4] It was Kepler who first understood the influence of the pinhole aperture on image formation in the pinhole camera and formulated a pinhole theory that is still valid today: When light passes through a small opening (such as a pinhole, a gap between leaves, an opening in blinds) into a darkened room or box, it creates an inverted (upside down) and reversed (left to right) image on the surface opposite the opening. The size of the opening affects the sharpness of the image. A smaller pinhole produces a sharper image, but reduces the amount of light that enters. A larger pinhole produces a brighter image, but it may be less sharp. An earliest depiction of the geometry of pinhole images and a Camera Obscura exists by Gemma Frisius (Fig. 7) from 1545[5]. The situation of the solar images being projected into the house through the blinds in the bay windows at Kettle's Yard is shown in (Fig. 8): the oval openings act as an aperture, projecting the image of the Sun into the room. If the light beams do not fall vertically onto a surface but at

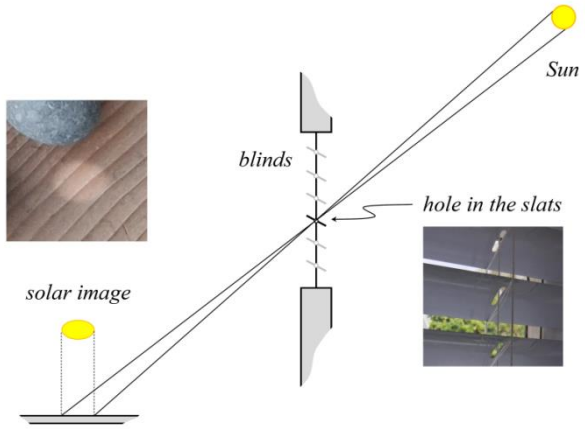

Fig. 8: The geometry shaping the pinhole images of the Sun.

an angle instead, the shape of the Sun images changes to more or less elongated ellipses as seen, i.e., in Figure 5b and c.

How come the sizes of the solar images vary? How large is a pinhole image of the Sun? A good rule of thumb is the following: the size of the pinhole image of the Sun grows by one centimetre for every metre of image distance. With an image distance of 2 m, the solar image therefore has a diameter of 2 cm. The solar images under the chestnut trees at St. Peter's are about 10 cm in size, which means that the distance to the imaging openings in the canopy is about 10 m (Fig. 9).

The relationship between the size of the Sun's image and its image distance can be easily studied by crossing the fingers of both hands in front of a sunlit house wall so that the shadow image of a finger grid is created on the wall. If you take a few steps back, the shadow image becomes blurrier, the openings in the shadow of the finger grid increasingly lose their resemblance to the openings in the finger grid and transform into bright circles of light of equal size: images of the Sun that differ only in brightness and sharpness (Fig. 6).

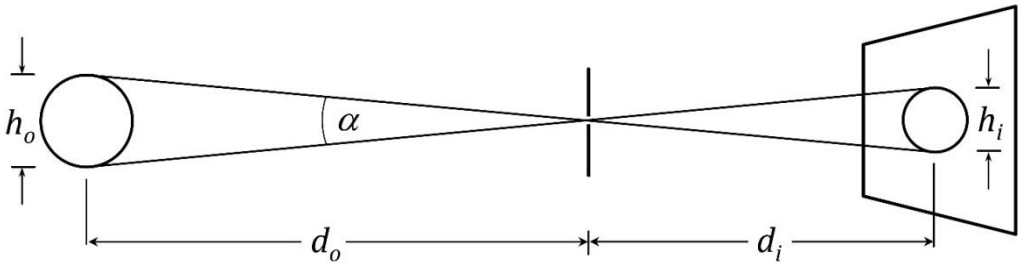

Fig. 9: Imaging geometry of the Sun image with the solar angle α, the size h_i of the solar image, the size h_o of the Sun, and the corresponding distances d_o and d_i.

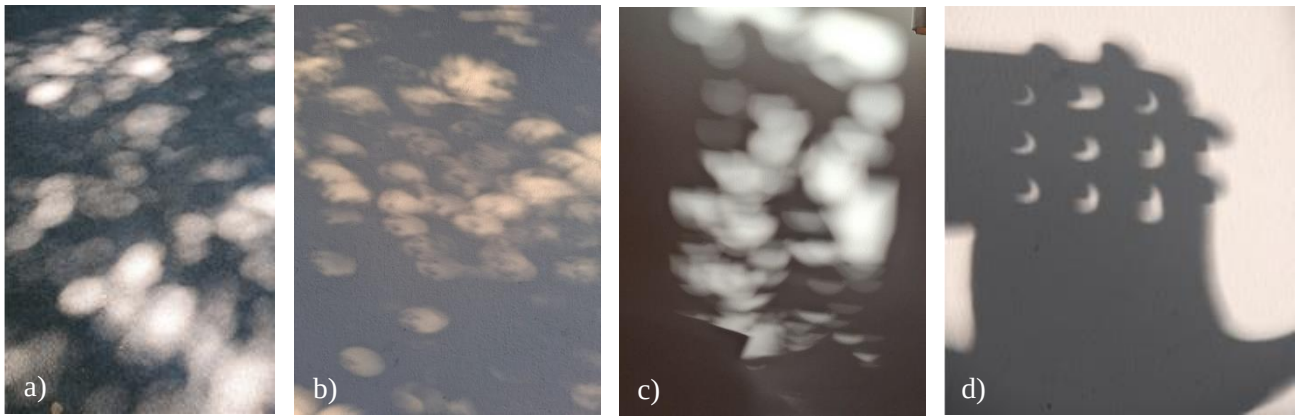

Fig. 10: Sun coins under trees (a), branches in front of the Sun (b), Sun setting behind a roof (c, upside down!), solar eclipse projected with finger grid (d).

Once we have realised that the circles of light we see are in fact images of the Sun, we can begin to observe subtle changes: Any modification of the solar disc in direct view is also visible in the Sun coins: clouds passing (Fig. 11) or tree branches in front of the Sun (Fig. 10b) are repeated in each individual Sun coin. When the Sun sets behind a horizontal roof, you can see how the Sun coins become increasingly obscured, but the obscuring edge comes from *above*, which shows that the pinhole image is upside down and reversed (10c). Sun images undergo a particularly impressive transformation during solar eclipses (10d).

Sundials at Kettle's Yard

Coming back to Kettle's Yard: Due to the location of the house with its semi-circular bay windows facing South (Fig. 12), the play of light and shadow the blinds create, moves across the round tables throughout the day – at a steeper angle in summer, lower in winter. When the blinds are closed, parallel series of Sun images are projected into the rooms. If you notice the directions in which they move across the table surfaces (Fig. 12, right), you suddenly discover that these tables function as sundials and that the time of day can be read from the direction of the Sun images: slanting from left to right at about 12 p.m. (Fig. 13) and from right to left at about 3 p.m. (Fig. 14).

Heaven on Earth

Knowledge about the formation of pinhole images of the Sun has changed our perspective. When the Sun is shining, we can now discover these circles of light everywhere: under trees, on the street, on house walls, behind lowered blinds, etc. Depending on the time of year and the obstacles forming openings for the Sun to shine through, we can find many more Sun images in the rooms of Kettle's Yard (i.e. Fig. 15). We can also actively create them ourselves by crossing our fingers, to form a grid (as shown in Fig. 16) and experiment with the distance needed to project the Sun images.

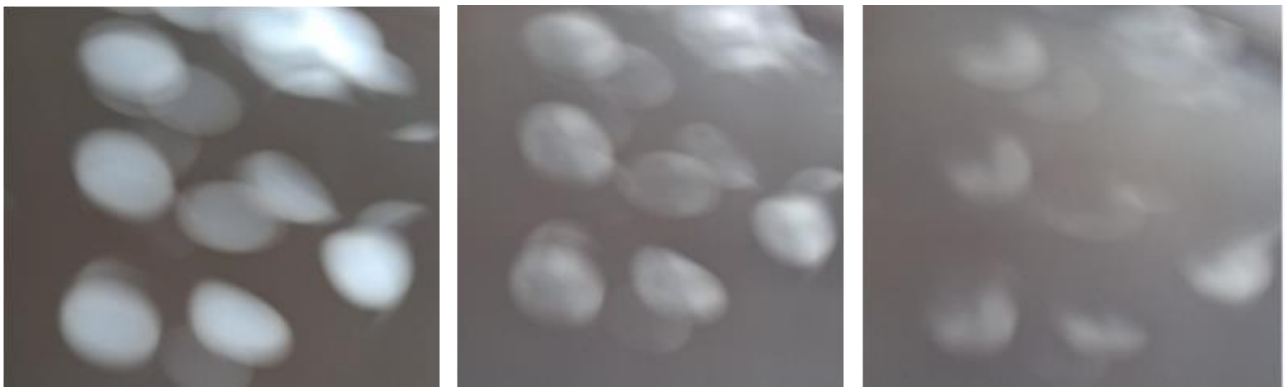

Fig. 11: Sun images with clouds moving through. Note how the patterns of the clouds repeat in each Sun spot.

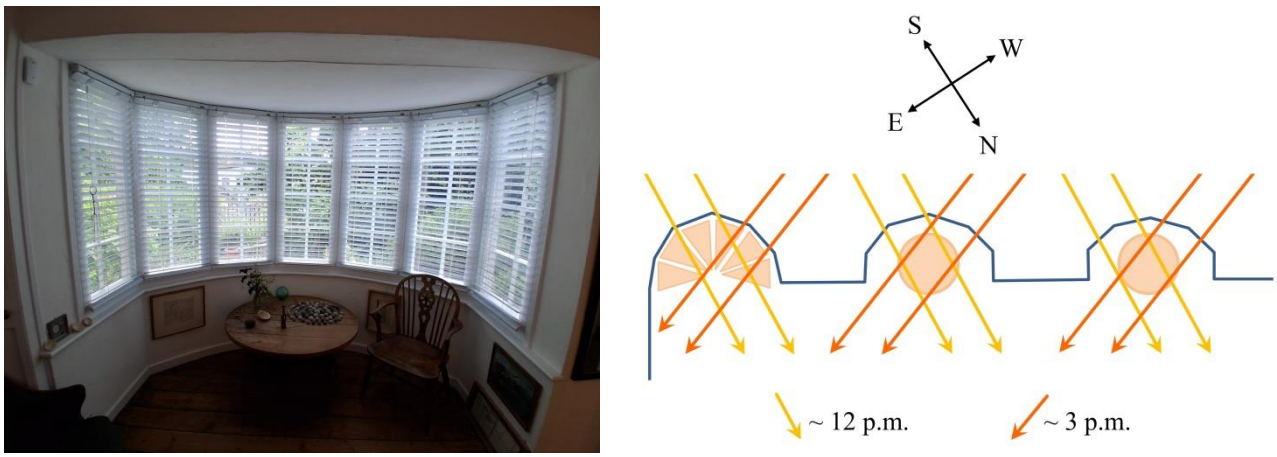

Fig. 12: The semi-circular bay windows in the house (left). Detail of the ground plan of Kettle's Yard with a schematic representation of the change in lighting direction throughout the day (right).

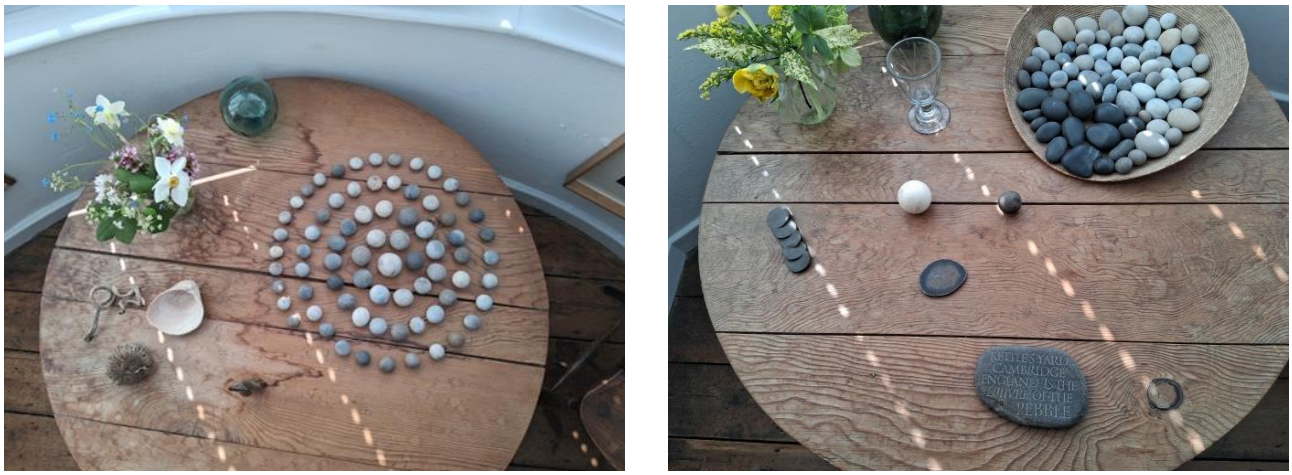

Fig. 13: Sun coins forming sundials on the round tables in the house: slanted from left to right at ~ 12 p.m. ….

Fig. 14: … and slanted from right to left at ~ 3 p.m. ….

Fig. 15: Sun images shaped by a tree in front of the window (upstairs extension).

Fig. 16: Creating Sun images with crossed fingers (downstairs extension).

Jim Ede used spheres and circles everywhere in the house, including in his iconic spiral of pebbles (Fig. 19). The importance of circles in the house is emphasized and honoured in the Logo of Kettle's Yard, in which the apostrophe is depicted by a circle (Fig. 18). The round Sun images form another layer of meaning to the circles throughout the house. Fleeting and changing with the time of the day, the seasons, the leaves of the trees and shapes of holes through which the Sun traverses.

Having learnt to see and even create the images of the Sun reinforces the feeling of Kettle's Yard being a place that is open to the sky, a place where human artistic creation and the artistic creation of nature intertwine in a special way.

We do not know whether Jim Ede was aware of the secret of the Sun images. But we believe he would have been pleased to know that these round circles of light, which blend into his pebble arrangements on the tables on the ground floor so beautifully (Figs. 19, 20) and whose traces can be seen on the steps of the spiral staircase leading to the upper floor (Fig. 17), are live images of the Sun. It is possible to sit inside, watching celestial movements in real time: a constant cosmic live stream, showing all the changes happening in front of the Sun. Jim would most certainly have greatly appreciated the fact that one of the optical phenomena at Kettle's Yard proves to be – quite literally – "Heaven on Earth": images of the Sun projected into the house.

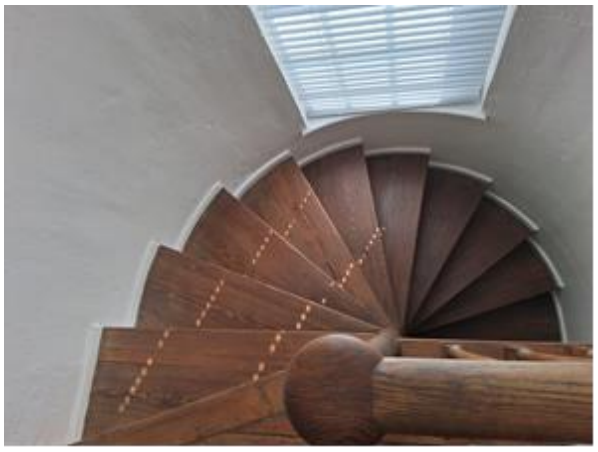

Fig. 17: What time was this picture taken? You can now read from the direction of the beads of light: around 3 p.m.

KETTLE'S YARD

Fig. 18: The Logo with a circle as an apostrophe

Fig. 19: The spiral of pebbles with Sun images……

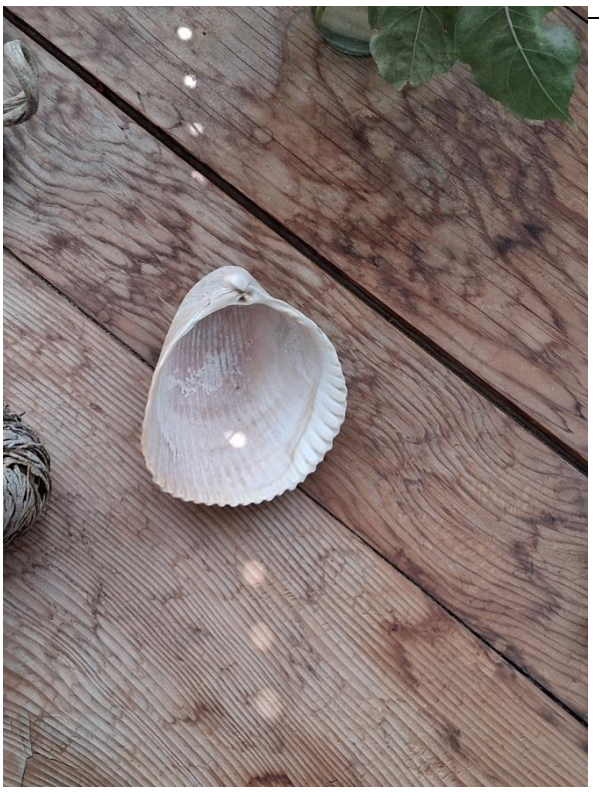

Fig. 20: … nature as an artist, creating beauty.

Notes:

[1] Ede, Jim (1984): *Kettle's Yard A way of Life*, Cambridge University Press, p. 13

[2] Freeman, Laura (2023): *Ways of Life. Jim Ede and the Kettle's Yard artists*. Vintage Publishing, Penguin Random house, p. 299

[3] Aristoteles (1991): *Problemata Physica*. Ed. by H. Flashar. Berlin: de Gruyter

[4] Kepler, Johannes (2000): *Optics*, translated by William H. Donahue, Green Lion Press

[5] Gemma Frisius, Rainer (1545): *De Radio astronomico et geometrico liber*. Antverpiae: Disthemus, p. 64

All photos and graphs:
Maggie Ellis and Johannes Grebe-Ellis

Further reading:

Grebe-Ellis, J. & Quick, T. (2023): Soft Shadow Images. *European Journal of Physics* 44 045301

Grebe-Ellis, J. & Quick, T. (2025): The study of Shadows - Kepler´s light figures and pinhole imaging. *Physics Education* 60/5 055020

Quick, T. & Grebe-Ellis, J. (2025): Kepler´s Moon puzzle - A historical context for pinhole imaging. *American Journal of Physics* 93/3 pp. 215-222, doi.org/10.1119/5.0228366.

About
Maggie Ellis & Johannes Grebe-Ellis

Kettle's Yard is a place that we are deeply connected to. Maggie's connection to the house reaches back to her parents, George Ellis and Sue Kafka-Ellis, who lived in a flat in 7a Castle Street from 1963-1967. The space where their flat used to be is now converted into offices and the galleries. George and Sue used to look after the house, when the Ede's were travelling, and sometimes rang the bell of St. Peter's in the evening. Sue worked as a Potter with Zoë Ellison at that time. Some of Zoë's ceramic works are included in the Kettle's Yard collection. George co-authored *The Large Scale Structure of Space-Time* with Stephen Hawking, who was a frequent guest at Castle Street 7a in the 60ies. When Maggie was born,

Helen Ede knitted a tiny jacket and pants for her, made of soft white wool. Maggie studied painting and is an art therapist; currently practicing at a special needs School in Wuppertal, Germany, where she also teaches sculpture and ceramics.

Johannes is a physicist and professor of physics education at the University of Wuppertal. He specializes in phenomenological optics and colour theory and is interested in the connections between physics and art. He is passionate about light and shadow and loves teaching these topics with great enthusiasm. He was introduced to Kettle's Yard by Maggie and instantly was thrilled.

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