




# Synthography – An Invitation to Reconsider the Rapidly Changing Toolkit of Digital Image Creation as a New Genre Beyond Photography

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**Abstract.** With the comprehensive application of *Artificial Intelligence* into the creation and post production of images, it seems questionable if the resulting visualisations can still be considered ‘photographs’ in a classical sense – drawing with light. Automation has been part of the popular strain of photography since its inception, but even the amateurs with only basic knowledge of the craft could understand themselves as author of their images. We state a legitimisation crisis for the current usage of the term. This paper is an invitation to consider Synthography as a term for a new genre for image production based on AI, observing the current occurrence and implementation in consumer cameras and post-production.

**Keywords:** Artificial Intelligence (AI) · Future of creative photography · Synthetic photography

*“Taking pictures with a cellphone is perhaps the most pervasive digital light activity in the world today, contributing to the vast space of digital pictures. Picture-taking is a straightforward 2D sampling of the real world. The pixels are stored in picture files, and the pictures represented by them are displayed with various technologies on many different devices. But displays don’t know where the pixels come from.”* Alvy Ray Smith [1]

## 1 Technical Advancements for a Creative Medium

Unlike any other visual media with a century old history, photography is rapidly changing, along with the technical advancements. In its beginning, photography was recognised as a craft which demanded technical and scientific knowledge but also an aesthetic sense. The skilful image composition, the accurate illumination and the particular palette, let alone the chemical and optical process behind the image, deserved elaborate proficiency and year-long training and practice. Nowadays, billions of images are captured every day without any consideration towards exposure, musings on the effect of focal length or focus, aperture, shutter speed or ISO. On top of that, even more images are captured by machines – not necessarily for the human eye, but to be read again by machines, well beyond our visible spectrum; my reflection on this has been addressed in

the research on *Phasmagraphy* [2]. Editing software facilitates the improvement not only of exposures but as well of flaws in the motive itself. Thanks to this amount of images, Artificial intelligence (AI) enabled editing software to improve impressively – however, I dare to question if this form of image production may still be called “photography”, in its etymological description, based on the Greek terms which are commonly translated as ‘painting or drawing with light’<sup>1</sup>.

With my background as a photographer, being professionally trained using large format cameras and analogue processes in my practice while appreciating the effortlessness of digital sensors and accelerated post-production, I keep pondering on the development of the medium in the days in which every one – human, animal or machine – is able to take correctly exposed and focused images, even optimised, fully automated. With the ease in shooting and the increasing quality, we have already observed a change in the attitude, in particular a desire to ‘over’-beautify or aestheticise the captured reality. Therefore I propose with this paper that the image creation by ‘intelligent’ apparatuses might pave the path for a new creative medium beyond the classic understanding of photography<sup>2</sup>: *Synthography*. With this term, the methodology of synthetic<sup>3</sup> production relates to AI but also encompasses images rendered by 3D software while the process of ‘drawing’ is still included in the second part of the term, linked with the ‘O’ as a remainder of *phōtós*.

## 1.1 The Autopilot

Perhaps it helps to remember that in aviation, systems have been established since the 1930s that can intervene in the control of aircrafts in a variety of ways as technology has advanced. First it was for airborne stability, then for possible changes in altitude, subsequently to follow the plotted course and finally to control the speed, so meanwhile, from take-off to landing, the entire process has been completely automated [3].

While these devices have been established at sea for 100 years, the beginnings of autonomy in road traffic are only very gradually becoming widespread. There are a myriad of parameters to process and decisions have to be made very quickly – similar to the processes between the photographer’s eye and finger.

Piloting a planetary craft through the infinite reaches of space will be a rather monotonous activity, unless there is a flotilla of UFOs waiting in the shadow of a moon, just as navigating on the vast oceans, in the skies above or on hundreds of kilometres long straight and grey highways. But surely photography should be anything but boring – so why automate this activity?

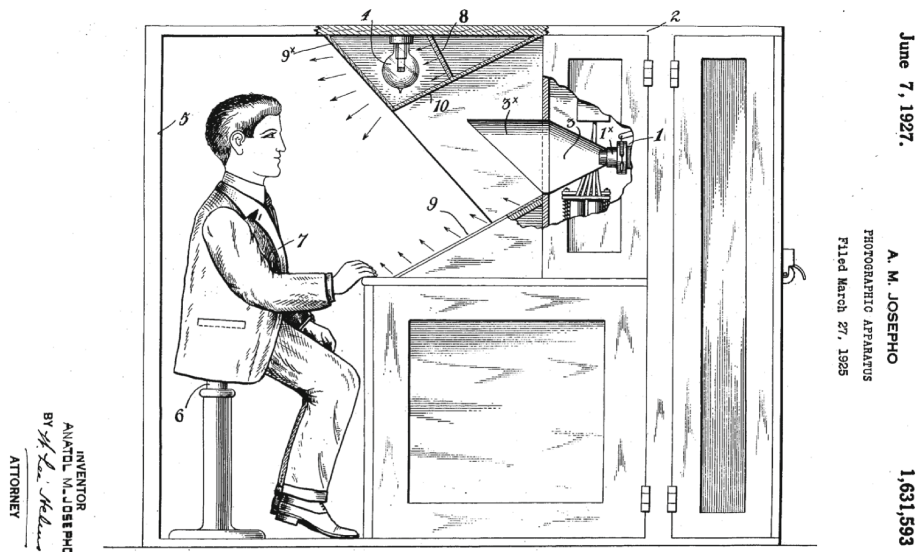
<sup>1</sup> φωτός (phōtós) is the genitive of φῶς (phōs), light and γραφή (graphé), drawing.

<sup>2</sup> Although other terms like computational photography have been used, I argue that synthography for the detailed subset is more appropriate.

<sup>3</sup> σύνθεσις (súnthesis), in its original meaning putting together, construct, compound. From 1874 onwards used in reference to products or materials made artificially and from 1934 established as a noun for ‘synthetic material’. <https://www.etymonline.com/word/synthetic>.

## 1.2 The Autonomous Camera

Not long ago, I shared my observation how the role of the photographer shifted more and more to the automatism of the cameras [4] while today the software behind these basic programmed settings has taken over. It could be argued that a good camera depends today less on the size of its sensor or the optical quality of the lens, but on the processor and the AI faculties behind these features.



**Fig. 1.** Patent US1631593A of the *Photographic Apparatus* in 1925, later named Photomaton.

The concept of an automated photographer is not a fancy idea or a futuristic invention but a very reasonable notion, merging the possibilities of image-capturing and -recognition. Although Kodak's George Eastman promised the ease of photography with their legendary slogan "You Press the Button, We Do the Rest" after patenting the roll-film camera [5] in 1888, they could not guarantee that each image would be correctly exposed to the full satisfaction of their clients, photography seldomly takes place in a controlled environment as in the following example: Non-intelligent fully automated photography-machines were already established with the Photomaton in 1925 [6], a coin operated imaging machine which delivered eight in-situ developed portraits within eight minutes (see Fig. 1). This static setup including diffuse lighting, fixed settings and exposure enabled acceptable results and its analogue and digital descendants are still in use today.

Jumping almost a century ahead on the timeline, with a much shorter lifespan, the Google Clips camera was announced with exciting prospects: a small and inconspicuous camera which could be placed anywhere and capture all the important moments in one's life. Equipped with rudimentary AI capabilities, the camera was supposed to know who, what and when to capture and even recognise the quality of images, by applying the rule

of thirds and detecting motion blur. The little personal surveillance device was considered ‘freaky’ by many, but nothing compared to the omnipresent surveillance cameras which are surrounding us today. One well-recognised example are camera traps for wildlife photography. The images captured and recorded by night or day provide insight into their often endangered lives and habitat, analysed and evaluated through AI.

Most of the resulting images nonetheless are unlikely to ever be seen, some will be deleted or simply lost, become unreadable after the next update, or they will disappear in an ocean of data without being missed. The essence of digital photography is itself transient, since these photos exist only as long as you look at them, they are generated by the imaging software instantly just to dissolve again as bits in the stream of data then, and they manifest themselves only for a moment.

With the actual image being gone, the authenticity of the creator becomes arguable, especially so if it is an AI [7]. Images ‘inspired by ...’ – let us say Rembrandt or Van Gogh – are frequently created, however the development of an independent artistic and aesthetic language will become harder to achieve.

### 1.3 The Indecisive Moment

The ‘decisive moment,’ as postulated by Henri Cartier-Bresson, serves as a catchphrase for ambitious photographers to describe their craft, finding exactly the right adjustments and timing for each picture. Photography is for him “the simultaneous recognition, in a fraction of a second, of the significance of an event as well as of a precise organization of forms which give that event its proper expression.” [8, p. 102].

This acknowledgement has all been disrupted through recent photographic technology, described in the following features, which can be divided into AI support during the capturing process, in post-production but also in the image creation itself.

The technical history of photography shows plenty of inventions to simplify the act of image-taking by automating certain stages in the process. The approach remained always the same, streamlining the technique to free the person behind the lens from any obstacles, with shutter priority, aperture priority, program mode or autofocus. Today’s techniques allow even retrospective decisions. While the tools became more powerful, photographers were always informed by the technical limitations of their machinery, “the possibilities offered by the apparatus” [9], until now.

Different from the hardware technique with its rigid rules provided by engineers, machine learning (ML) algorithms are capable of adjusting and adapting from the large amount of training images. Neural networks use the context of a scene in a split second to determine the section of the image to focus on and to adjust the exposure accordingly.

**High Dynamic Range Imaging (HDR/Smart HDR).** This is made possible by intentionally over- and underexposing the same picture, weighing the different light values into an image and allowing the recovery of unseen details in bright and dark areas, making it previously difficult to represent moving subjects in this way. Smart cameras enhance the ability of HDR by recognising specific components in the image and manipulating the brightness gradients accordingly. To include dark shadows or to overexpose clouds in a picture becomes virtually impossible, since the routines evaluate every image along the secret formula and process with a generic lighting profile.

This trend provided us especially with homogeneous landscape and architecture images, with uniform lighting and a tendency to be perceived as flat, monotonous and kitsch – albeit every detail well visible. Images captured as RAW supported the adjustment of highlights and shadows to a certain degree through their wider dynamic range, however not to the extent of HDR, and particularly not Smart HDR, featured by many modern day mobile phone cameras. Through computational photography techniques, the best image is composed out of an image series with a range of exposures while touching the shutter.

**Pre-Capture.** Also known as Pro Capture – eliminates shutter lag and reaction time by recording a series of images while the shutter is only half pressed. If released, no images will be saved, until fully pressed, then the significant moment gets preserved as a still image.

**Automatic Shutter Release.** For instance, camera traps for wildlife capture images with AI evaluation [10]. Usually, the classification of the generated footage is processed after the fact, utilising large datasets of similar captured animal sightings and ML. The necessary operations of filtering unwanted events from triggering the shutter is provided in arrays of cameras connected to Raspberry Pi microcomputers already in the wild, generating a much more valuable output [11].

**Shutter Delay.** ‘Intelligent’ cameras can delay the release of the shutter until the presumed subject is in focus – or even more: over a decade ago, Sony introduced the smile detection algorithm in certain cameras to the effect that all portraits were made with happy faces. However, the intensities of the desired smiles could be adjusted by the photographer in the pre-sets [12]. Today, this feature is not limited to human faces anymore. AI powered content detection such as animal-, in particular bird-detection, supports focussing on the eyes.

**Low Light/Night Sight Mode.** Available light gets amplified through a series of long exposures which are stitched together, supported by a machine learning algorithm and countermeasures are calculated against involuntary movements while the shutter is open, either with electronic compensation or by optical means on the sensor, the lens or both.

**AI-Powered Stabilisation.** Beyond in-camera stabilisation, gimbals, with adapted speeds according to focus length are available on the market, stabilising the image even further, mainly for filming. Scene analysis allows locking selected objects, while panning, zooming or following objects.

**In-camera Focus Stacking.** Through this feature, it became possible to focus retrospectively. The lens is moved in small increments to achieve the maximum depth of field and only the sharpest segments are actually recorded. For smart phones with multiple lenses, the second camera creates a depth map of the captured situation and helps to define the focal plane. In the well-established portrait mode of Apple’s iPhone, people are recognised in the image in real time and the desired depth of field can be retrospectively adjusted.

**Computational Improvements.** Many applications of AI during the capturing process are already well established while others are still in their early days. The implementation of AI in smartphone cameras enhanced their capabilities significantly, which were limited due to their small size, and made them into highly advanced devices. Deficiencies of the size constraints, such as the minuscule sensors and the less elaborate lenses are compensated by computational corrections, eliminating the disadvantages towards ‘real’ cameras. For mirrorless and DSLR cameras, some applications exist, but here, the emphasis is on the workflow outside of the camera. Crowdfunded startup projects like Alice Camera or Arsenal are exploring the application of AI with attachments to smartphones or cameras. While the software Skylum Luminar AI led the way into AI supported editing, Adobe is improving a wide range of tools based on the experience with machine learning.

**Neural Processing Units.** NPUs provide the necessary computing power to allow AI processing on board, which is used for tasks like semantic image segmentation, the recognition of elements for the application of specific settings. Saliency mapping is applied to weigh the calculated results according to the centre of interest [13].

**Postproduction.** Although the decisive moment appears now to have moved into post production, to the selection of the image with the best composition and significance – yet the AI supports the tedious work of sorting the images and tagging the captured results; even the choice from a burst or the correct crop, auto-tilted in the right direction, is machine-provided. Developments such as plenoptic cameras, also known as light field photography, enable the photographer to decide retrospectively on focus and the depth-of-field. Analogously, postponing the perfect framing, while shooting a 360° image in high resolution, one can subsequently choose any aspired angle. The Insta360 One records movies or stills as a full sphere and allows to frame the final image according to simple markers, put into the software viewer with the claim ‘Shoot First, Point Later’ [14]. Since the framing of the shot constitutes the essential idea of a compelling image similar to the decisive moment, the prospect of finding another perspective retroactively seems propitious and sombre at the same time. Not only because of an excess pixel-resolution and with the extreme wide-angle lenses of omnidirectional cameras, the retrospective framing became easily possible. In the case of Insta360’s auto frame possibility, the software suggests central motives and compositions, according to well established principles [15]. This technique comes also handy today in classrooms for hybrid online teaching and is implemented in Adobe Sensei to facilitate cropping video for multiple devices. In the current iPad, a similar feature is included: thanks to a wide-angle camera, a section containing mainly the face of the speaking person will be presented during online meetings, no matter if there is movement involved. The cinematic mode in the current iPhone applies the same technology, allowing the automatic rendering of focus ramps in live video.

The following properties are part of the current AI supported toolkit:

- Image recognition and classification
- Retrospective focus
- Retrospective framing/content aware cropping

- Retrospective depth of field
- Adaptation of different lens characteristics
- Exposure correction
- Retouching of skin while respecting textures and details
- Content aware background fill
- Enlarging (predicting and adding extra pixels)
- Sharpen and blurring (camera shake, movement blur, lens quality)

All the above mentioned features support and facilitate the creation of the image, although they sometimes overshadow the artistic intention of the photographer and need to be turned off or adjusted, if this possibility exists.

**Content Creation Through AI.** Research in the field of artificial intelligence has meanwhile progressed to the point where findings about individual abilities acquired through machine learning can be tested using the tools of experimental psychology. Knowledge about optical phenomena as the law of completion [16], an idea from Gestalt psychology, can be verified with the experimental set-ups from IQ tests.

As soon as a generative adversarial network (GAN) is trained to create an image which resembles a photograph, I propose to better describe it with the term synthograph.

Phillip Wang attempted to raise awareness and interest for this rapidly improving technology with the viral success of his website, stating in its URL address that ‘This Person Does Not Exist’ [17]. Several websites now display cats, horses, automobiles, beaches, food and other once favourite snapshot subjects by random while others allow sophisticated fine-tuning. For instance generated.photos [18] advertises ‘unique, worry-free model photos’ which can almost convincingly be created by adjusting gender, age, hair- and skin tone, mood and further details (see Fig. 2).

The special force of the neural network named DALL·E [19] is the promise to create images from verbal descriptions of objects and their possible attributes [20]. Resulting in imaginative and surreal items, they still appear believable and could support a designer’s inspiration (see Fig. 3).

While the generated creations are becoming better and more refined, accordingly, at the same time attempts are being made to reveal images through AI which do not originate from the real world or are intensively manipulated. Unless flaws are obvious, most frequently in the eye area or at the hair or facial contour, the distinction is almost impossible, once the photorealistic synthograph has been generated.

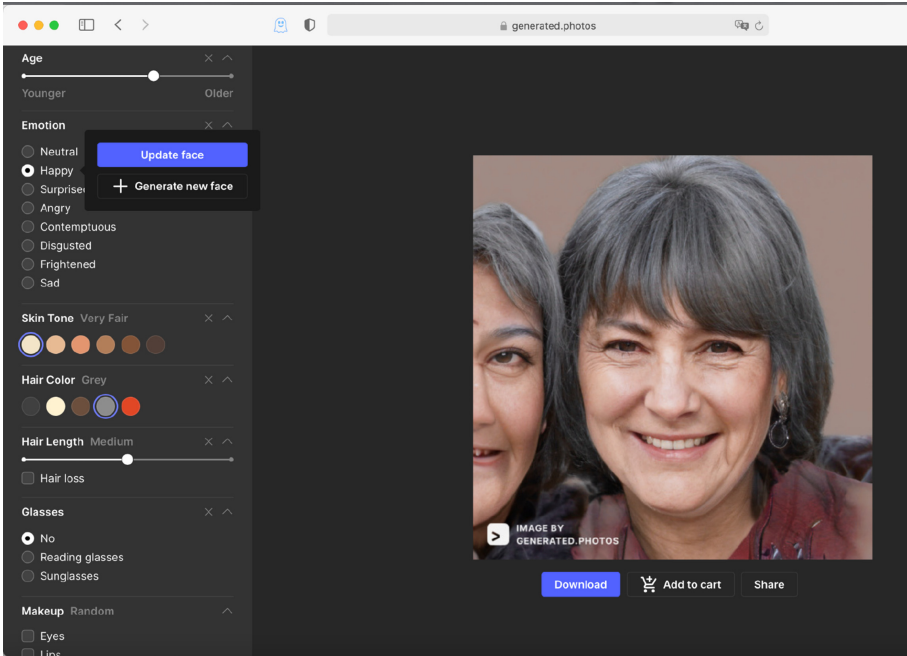


Fig. 2. AI generated portrait according to pre-sets on generated.photos, with mishap (left)

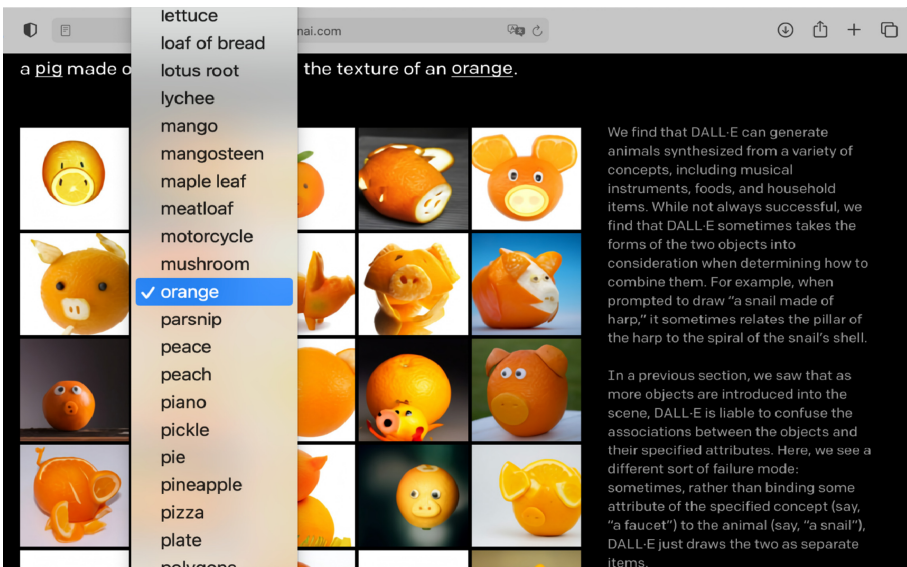


Fig. 3. Synthographs of 'a pig with the texture of an orange' as suggested by DALL-E

## 2 Autonomous Photographers

Based on the observations of the state-of-the-art, we can only imagine what will be the next technical achievement to facilitate and automate photography, considering all the industrial advances in image recognition and generation.

Certain aspects of the photographic profession will disappear, since repetitive chores are superseded by different means, as in other industries. More than three quarters of the products in IKEA's catalogue are already photorealistic images rendered by CG-artists. Before they manipulated vectors and shaders on their computers, the 3D-illustrators were trained in product photography, to emulate this visual vernacular [21]. Similarly, fashion photography can skip the lenses and shutters, while the imagery is produced on graphical engines [22]. Soon, even no photo models will be necessary to wear the fabrics, since AI generated avatars can provide a fresh face for every look.

This kind of image creation shifts the role of the individual author to a group of people, distributing tasks among many professionals with diverse but circumscribed assignments. Many other images are created without any author or anyone waiting for the decisive moment.

Surrounded by surveillance cameras, the individual photographic apparatus might soon become superfluous, at least for selfies and other concepts to record the proof of an individual's happiness at a certain location or event.

The public spaces around us, cities and crowded places all over the world, are pervasively furnished with surveillance cameras which act as autonomous photographers, framing and recognising faces, following people's movements, and filling databases. Since these devices point in every direction to catch perpetual glimpses of us, we could demand to capture us on our holidays and deliver the images right to our email account, associated with our facial recognition profile<sup>4</sup>. With adjustments for stylistic elements such as basic rules for composition and colour, these postcards from the omnipresent observer could console us in our loss of independence and privacy.

Based on the wide range of existing and analysed images, there will be plenty of results applying a familiar style, the colour palette and lighting of famous artworks are already frequently applied examples [23]. But could an independent practice be generated out of these pre-sets, other than reiterating the already known? Waiting rooms or hotel walls around the world provide plenty of examples. For young artists, it would no longer be the challenge to develop a personal style but rather find sophisticated algorithms and explore idiosyncratic combinations.

Currently, the more interesting artistic positions are the ones which critically examine the development of artificially generated images. The neutral and revealing observations of operational images and surveillance in the work of Harun Farocki [24] could be regarded as a foundation for the investigations of Trevor Paglen. He excites our curiosity in combining diverse aesthetically attractive images with intense backstories. For

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<sup>4</sup> “[A]lthough Facebook will delete data on more than a billion faces, the company will retain DeepFace, the AI model trained with that data. [...] The deep learning model was created in 2014 with 4 million images from 4,000 people, the largest dataset of people's faces to date.” Kari Johnson, *Facebook Drops Facial Recognition to Tag People in Photos* <https://www.wired.com/story/facebook-drops-facial-recognition-tag-people-photos/>.

instance the accompanying text of a series of portraits of ten ordinary people entitled ‘It Began as a Military Experiment’ (2017) reveals them as military employees which are part of a database of thousands of portraits for Face Recognition Technology (FERET), developed by the US Department of Defense in the 1990s. On close inspection, facial features are defined through small white letters and rectangles, ready for automatic identification.

The ubiquity of cameras at any time of day in every corner of the world results unsurprisingly in hardly anything happening unnoticed. But not only the arbitrary activities of anyone will be recorded, so will our surroundings be documented for future generations. In times of unrest and war, these documents can come handy – when the dust settles, an architectural site which lies in ruins could be reconstructed only with the aggregate of the many existing photographs. This restoration would not necessarily depend on a professional photogrammetric assessment. The mass of images from all angles could suffice such as in the reconstruction of Palmyra [25].

### 3 Diverging into New Disciplines

With these observations, I anticipate a diversion into a new form of art, connected to image creation and improvement through artificial intelligence. The classic photography, already known as slow or late photography [26] with all its flaws and peculiarities will always have a right of existence. Just by looking at the performative aspect of arranging a composition through the optical lens, the fascination for the precision engineering of the apparatus itself, the pleasure of the chemical process which almost like a miracle brings the latent motive into being and the pleasure – but also sometimes the disappointment – which the final result inherits. AI supported image creation will always appear different as long as we do not recognise the originator as a sentient being. Therefore, to observe and treat ‘synthesised’ images in an independent way is of paramount importance. The paper is an invitation for further discussion, in particular where to draw the boundaries between AI enhanced digital photography, AI supported postproduction, CGI created images – and the obvious application for synthography – images fully generated by AI.

It is comparable to the autonomous driver on the highway, the support by automatic transmission and cruise control, versus the classic convertible car on the country road – all may take us to the desired destination – the same is valid for synthography, AI supported- and ‘classic’ photography.

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