Chapter 1

How Did We Get Here?

"We look at the present through a rear-view mirror. We march backwards into the future."
Marshall McLuhan. The Medium is the Message. 1967

"The camera is the transport for my eye and carries my seeing from place to place."
Robert Rauschenberg

As I sit writing this chapter we are seventeen years into the twenty-first century and approximately ten years into the mass adoption of digital photography. That ten years has seen digital capture of both still and moving images move from DSLR's, to compact cameras and on to tablets and smartphones, whilst social-media platforms such as Facebook, Twitter and Instagram have launched, evolved and reached global domination as publishers of self-created and found images. Broadband widths have improved and WI-FI has become an expectation rather than an unrealistic hope. In short, forms of global communication and the role of photography within them have changed dramatically since the year 2000.

The use of the photographic image as a form of communication has become omnipresent and democratic. The days of analogue capture reside in the past now that digital photographic images are being created at a rate and of a quality not seen since the birth of the medium. This digital revolution has happened at such a pace that it seems that there has been little time or perhaps desire to understand the purity of straight photographic capture in the new photographic environment from a twenty-first century perspective.

It is interesting that those born since the digital revolution — including the students who populate our schools, colleges and universities — seem to have the hardest time re-imagining the role of photography in the world today. This is despite their lives as digital natives being shaped by the digital world from birth. However, they are not the only ones who seem to struggle with accepting new forms of photographic capture and consumption. Those whose photographic knowledge and practice were forged in the red-light lit darkrooms of analogue thinking can also seem to be too quick to dismiss the new democracy of photographic capture and dissemination. Similarly, those within academia whose photographic engagement is dependent upon established art theory laid down in a previous century to provide understanding of a continually evolving communication/art form often reject the power of social media out of hand and an online presence as an irrelevance to 'serious photography'.

It has been in the process of trying to address these entrenched beliefs that I started to use the metaphor of language when attempting to explain what photography is and can be, and what it can give a photographer in transferable creative life skills. A metaphor that sits comfortably with the development of the visual aspect of communication that is correctly described as 'graphicacy', a parallel discipline to literacy and numeracy. In a visually intense world the rise in the importance of developed 'graphicacy' cannot be underestimated and neither can the importance of the visual image as a primary form of communication.

I do not claim that this is a new concept or process of thinking, the Palaeolithic cave paintings of Lascaux in the Dordogne region of the South of France and the narrative wall paintings found within the Great Pyramids come immediately to mind as examples of images created as a form of language to tell stories.

However, today the marks of the past have been replaced with code just as stone has been replaced by the digital screen.

Photography as Art and Language

To understand photography as a language opens the door to understanding its role in our lives today and what our relationship with it should be in the future. But as well as seeing photography differently I also believe that those for whom photography is a profession or point of study need to engage with it differently to fully utilize the creative possibilities it can give today's image makers and visual story tellers. To do this requires a re-interpretation of the practice of creating photographic images and a willingness to embrace new forms of image capturing devices.

Photography today is a medium where art and commercial practice are interchangeable. Where once there were boundaries now there is collaboration, where once there were walls today there are bridges that allow image-makers to move from one area of practice to another with little if any condescension from the establishments of either field of work, although the art world still likes to keep some of its fences in place and repaired.

The understanding and acceptance of photography as an art form is a long and often contentious discussion that leads right back to photography's earliest days. William Henry Fox Talbot's experimentations with contact printing as early as 1834, are known as photogenic drawings. Images created by soaking drawing paper in a weak solution of salt, allowing it to dry, brushing it with silver nitrate, and then washing it in a strong solution of salt. The drawing or photograph – a word reportedly not used in relation to a photogenic image until 1839 by Sir John W. Herschel[1] – was then complete. This semantic association between 'photo' and 'drawing' is for me a starting point in a thought process that leads right up to today and the ways in which we could see and use photography as part of personal creative development and in turn redefining the terms of criticism that surround the photograph.

Photography as art is not a debate I want to enter but its associations with other visual arts is. The discussion concerning the mechanical aspect of photography has always been an issue in the 'photography as art' wars, and as a result, nineteenth-century photographers who considered themselves to be artists with cameras, rather than brushes attempted to demonstrate the medium of photography as one that could be manipulated manually through light, chemicals and materials outside of the camera itself. A reliance on a variety of post exposure procedures dominated this thinking and in 1861, the painter and photographer Alfred Wall wrote and published a book snappily titled: *A manual of artistic colouring as applied to photographs: a practical guide to artists and photographers containing clear, simple, and complete instructions for colouring photographs on glass, paper, ivory, and canvas, with crayon, powder, oil or water colours*. Post production on photographic images is not new! And neither is the adoption of new process's and image capturing equipment functionality within the history of photography.

In the February of 1900 the American film and camera manufacturer Kodak launched the Brownie, immediately inventing low-cost photography and as a result introducing the concept of the 'snapshot' to the masses. The Brownie was a basic cardboard box with a small and simple lens that sold for just $1 including film and processing and it made photography democratic and available to all. The artist photographers decried its mass market appeal and put their faith in the large format nature and

[1] "*Note on the art of Photography, or The Application of the Chemical Rays of Light to the purpose of Pictorial Representation*," presented to the Royal Society on 14 March 1839. Herschel, Sir John Frederick William.

expense of plate cameras to define the difference between their photographic images as art and those created by the common man, woman and child. Why they felt this need to differentiate their work is an interesting discussion point that I will return to, but the reality was that a tsunami of mass produced images led by camera innovation had begun and was showing no sign of slowing.

In 1912 Kodak followed the Brownie with their second game changing camera the Vest Pocket Autographic Kodak, or 'Soldiers Camera' as it became known due to its use by soldiers to document their personal experiences on the frontline during the First World War. Over 1,750,000 were sold from its's launch until it went off sale in 1926. Small, easy to pocket, easy to use with its own metal pen to write on the negative film whilst still in the camera, the images created by the FVC (Folding Vest Camera) are not derided today as lacking importance because of the camera they were created with in fact they are recognised as being a direct result of the camera's design, ubiquity and functionality. The images exist because of the camera's democratic nature, a context that helps us to understand the images captured and their subsequent consumption by newspapers eager to avoid government censorship and illustrate the reality of war, as seen from the soldier's perspective. An analogue Instagram before the digital platform existed. To continue this metaphor the basic functionality of the folding vest camera could just as easily be used to describe it as a smartphone of its time – in fact at the time of writing Kodak are promoting their first smartphone/camera, the Elekta – but just as a photographer working with a large format glass plate camera looked down upon those soldier's images so today those who profess to be 'serious' about their photographic capture too often look down upon the images that populate Instagram and other online platforms created with smart phones.

The tension between the mass consumption of photography and 'serious' photography is central to the study of the medium throughout the last century but so is the discomfort many academics have had with the mechanical aspects of photography. The German philosopher of the 1920's and '30s Walter Benjamin wrote in a *Short History of Photography*[2] "Man is created in the image of God and God's image cannot be captured by any human machine. Only the 'devine' artist divinely inspired, may be allowed, in a moment of solemnity, at the higher call of the genius, to dare to reproduce the 'devine-human' features, but never by means of a mechanical aid!" A pompous and over blown statement to today's ears and yet it strikes at the heart of the anti-technical notion of art that theorists of photography have struggled with over the last century. It also clearly states the belief that the artist is creating work at a higher level than the photographer, a belief that still informs some peoples thinking today and perhaps explains why so many photographers choose to use the term artist to describe their practice as a photographer. This is clearly illustrated in a true story told me by a New York based photographer.

Whilst being courted by an established New York gallery, the gallery owner suggested to the photographer that he might like to describe himself as an artist rather than as a photographer if they began to work together. What difference would this make? Asked the photographer. About $1,000 a print replied the gallerist.

From the Camera Obscura until the present day the artist has seen value in utilizing both the practical and visual opportunities the camera can give their creative progression and the symbiotic relationship between painting and photography has informed both practices. In a 1916 issue of *Photograms* Alvin Coburn called for a move from the pictorial obsession of photography and wrote how the photographer should be willing to experiment and embrace the spirit of the times[3]. He asked "Why should not the

[2] *A Short History of Photography; Paris, Capital of the Nineteenth Century; and The Work of Art in the Age of Mechanical Reproduction.* Walter Benjamin, 1931.

[3] *The Vorticists: Manifesto for a Modern World.* Mark Antliff, Vivien Greene, Robert Upstone. Tate Publishing. May 2011.

camera also throw off the shackles of conventional representation and attempt something fresh and untried? Everyone now has a Brownie and a photograph is as common as a box of matches".

As the twentieth century unfolded it was artists not photographers who chose to answer Coburn's question, as photography as art aligned itself with the abstract philosophies of the Futurists, Cubists, Dadaists, Russian Constructivists and the Bauhaus. Photographic images were de-constructed, collaged and re-built. This was photography as source material, and part of an artistic process. The term 'photographer' became superfluous to this work as the 'artist' looked to exploit the medium in the most creative and radical ways. Photographers/artists such as Man Ray, Moholy-Nagy, Hannah Hoch, Franz Roh, Georges Hugnet, Herbert Beyer, El Lissitzky, Gyorgy Kepes, Willi Baumeister and John Heartfield were at the forefront of this de-construction and re-interpretation of what photography could be as a base material for expression, but their work was far from the purity of immediate capture that most people would consider to be the essence of straight photography.

These re-interpretations of photography embraced its mechanical qualities and were inspired by the Bauhaus school and a European sensibility responding to the social, economic and political environment of post first world war Europe. That spirit was given fresh impetus however in 1939 with the publication of Andreas Feininger's *New Paths in Photography*[4] in which photographic creative techniques came to the fore including negative prints, solarized images and reticulated images. Revolutionary process's in their time achieved through chemical experimentation and a desire to remove the photographic image away from its primary function of accurate reproduction but all too familiar as built-in post-production filters to today's digital image makers.

Of course, the history of photography at this point was not only being written by artists. Photography as a tool to instigate change of both a political and social nature had been established by photographers documenting conflict since the American Civil War and photographers such as Lewis Hine had used photography to expose the sordid realities of living conditions for immigrants in New York City. The scientific applications of photography had been explored by Edward Muybridge and others leading to further understanding of our physical world through the documentation of movement, light, growth and structure. Photography had also become an intrinsic aspect of mass communication aligned with the technical developments of both the printing and publishing industries via newspapers, posters and magazines.

Photographers such as Edward Steichen and Edward Steiglitz moved between the figurative and post-modern factions as they saw their work showcased in magazines and galleries. The photograph as document was established and omnipresent in people's lives by the 1920's and practioners seized the opportunity to explore its documentary possibilities.

Cameras as Instigators of Change

Meanwhile, the technology behind camera development continued at a pace and the desire to make photography easier to achieve and cameras smaller to hold remained a primary motivation for camera designers. Manufacturers had started to use 35mm film for still photography from 1905, but it was the German Oskar Barnack, who was responsible for research and development at the Leitz company, who decided to investigate using 35 mm cine film for still cameras, whilst attempting to build a compact camera capable of making high-quality enlargements. Barnack built his prototype 35 mm camera – the Ur-Leica – in 1913, but It wasn't until after World War One that Leica launched their first 35mm cameras, putting the Leica 1 into production in 1925. Its immediate popularity spawned many

[4] *New Paths in Photography*. Andreas Feininger. American Photographic Publishing Co. 1939.

competitors, most notably the Contax -— introduced in 1932 – and cemented the position of the 35 mm as the format of choice for high-end compact cameras.

The work created with these cameras by photographers such as Henri Cartier Bresson, Robert Capa, Bert Hardy, Grace Robertson, Wolf Suschitzky and Ilse Bing led weekly magazines such as *Picture Post, Life, AIZ* and numerous others to establish a new way of seeing for the masses from a photographic perspective. They documented everyday life and global conflict creating images and visual narratives that today fill books of photography, hang on gallery walls and fill auction house catalogues. The Leica camera and the Kodak Retina 1 launched in 1934 – which introduced the 135 film-cartridge that was then used throughout the twentieth century – helped establish the template for twentieth century photography and the twentieth century photographer both professional and amateur. Once again technological advancement had allowed people to develop their creativity, choice of subject and ways of seeing. Photography was now a profession and a hobby and thanks to the revolution in cheap mass printing methods available to view in magazines, newspapers and books.

The rapid development of camera design and innovation at the beginning of the twentieth century continued but it was with the development of the Twin Lens reflex and subsequent Single Lens Reflex camera's that photographic capture in the twenty first century was established.

The twin-lens Rolleiflex launched in 1928, was sufficiently compact to achieve widespread popularity and its medium-format TLR design became popular for both professional studio/location work and amateur snapping. More mobile and easier to use than large plate cameras but retaining a high level of quality these cameras forced a new way of seeing on their user's due to their waist level viewfinders. This camera revolution continued with the early stage development of the SLR design in 1933 with the introduction of the Ihagee Exakta, a compact SLR which used 127 roll film. But it was not until after the second world war that there was an explosion of new models and innovative features in SLR camera production.

The most important of these innovative features was the introduction of the eye-level viewfinder, which first appeared on the Hungarian Duflex in 1947 and was then refined in 1948 with the Contax S, the first camera to use a pentaprism. The same year saw the introduction of the Hasselblad 1600F, a camera that set the standard for medium format SLRs for the following decades and defined the square format as a frame for photographic composition.

Now at this point you may feel as if that's enough camera talk, as if like me you believe that photography should never be led by the equipment used but informed by the appropriate choice of camera based on the work you want to 'create' and I would agree with you. However, photographic creativity throughout its history has been led by the technological advancement of tools available to the photographer. That advancement has always been based upon two ultimate goals, simplicity of use and ease of transportation and by charting these developments the current conversation concerning the use of non-traditional cameras for photography is not only put into perspective, but it can also be dismissed as irrelevant.

In 1952, the Asahi Optical Company - which later became re-branded as Pentax - introduced the first Japanese SLR using 135 film, the Asahiflex. They were swiftly followed by other Japanese manufacturers including Canon, Yashica, and Nikon. Nikon's ground-breaking Nikon F led the way for professional photographers by offering a wide range of interchangeable components, lenses and accessories. An offering that remains today the basic expectation of any professional or enthusiast photographer looking to invest in a camera brand.

The availability and ease of use of both the camera and photographic reproduction saw many post-war artists incorporate photography into their artistic practice. Pop artists such as Andy Warhol, Robert Rauschenberg and Larry Rivers used the photograph as both a source material and component of their work as artists had earlier in the century, whilst photographers such as Arron Siskind used the Abstract Expressionist paintings of Robert Motherwell, Mark Rothko, Hans Hofmann and Barnett Newmann as a starting point for their photography. However, it was not until Edward Steichen's successor as Director of Photography at the Museum of Modern Art in New York John Szarkowski –1961 to 1992 – began his pioneering work showcasing the work of photographers such as Andre Kertesz, Dorethea Lange, Brassai, Eugene Atget, Garry Winogrand, Henri Cartier Bresson, Diane Arbus, Walker Evans, Bruce Davidson and Lee Freidlander that photography began to be taken seriously as an art form in its own right. Analogue photography as an art form was established and although technological and design advancements continued to be made over the following decades including experiments with film types, automation of functionality and multiple accessories, its basic premise remand the same until the birth of digital capture.

Then We Went Digital

It is generally accepted that digital capture began in 1975, when a 24-year-old engineer named Steven Sasson invented digital photography whilst working at Eastman Kodak by creating the world's first digital camera. However, Kodak were not exactly enthusiastic about this potential industry-changing breakthrough. Sasson's camera weighed eight-pounds and created 0.01-megapixel black-and-white images that had to be recorded on to cassette tapes. Each photograph took 23 seconds to create, and the only way to view them was by reading the data from the tape and then displaying that information as an image on a television screen. Sasson showed this slow and cumbersome but revolutionary technology to a number of Kodak executives, but they couldn't see the potential of what digital photography could become in the future. In an interview with the *New York Times* in August 2015 Sasson[5] commented on their response at the time, "They were convinced that no one would ever want to look at their pictures on a television set. Print had been with us for over 100 years, no one was complaining about prints, they were very inexpensive, and so why would anyone want to look at their picture on a television set?" At the time, Kodak was the dominant brand in the US photo industry, and they didn't want to cannibalize their film businesses. They did eventually make the big switch to digital, but it took them 18 years to do so, by which time they were too far behind in the digital revolution to compete with their competitors. Eastman Kodak filed for bankruptcy in 2012.

The digital world we now live in had begun photographically at the end of the 1980s, when the technology required to produce truly commercial digital cameras came into being with the MegaVision Tessera. The camera that had a name that promised more than it could deliver, was closely followed in 1989 by the first portable digital camera going on sale in Japan, the Fuji manufactured DS-X. These were early days in making digital capture both affordable and available to all but just as before in the history of camera manufacture it was Kodak who broke through with a concept that was expensive but had possibilities of further development.

In 1991, Kodak launched the Kodak DCS (Kodak Digital Camera System), the beginning of a long line of professional Kodak DCS SLR cameras that were based in part on analogue camera bodies. It used a 1.3 Megapixel sensor, had a bulky external digital storage system and was priced at $13,000. Early digital was not cheap, easy to use or of high quality and for many it seemed to be no match or competition for the established analogue photographic process. However, the manufacturers sensed a new market and were not going to stop pushing their digital offerings.

[5] *Kodak's First Digital Moment*. James Estrin. *New York Times, Lens Blog*, August 2015. www.lens.blog.nytimes.com.

The move to a digital format had been aided by the formation of the first JPEG and MPEG standards in 1988, which allowed image and video files to be compressed for storage. But it was with the launch of the Casio QV-10 in 1995 featuring a liquid crystal display on the back of the camera that the way in which photographic images were seen before capture changed, and yet this was nothing new. Early plate cameras and waist-level viewfinder cameras had allowed the photographer to view and compose their images on a glass screen before capture, so in many ways these new digital cameras were transporting photographers back to the birth of the medium without the need for dark cloths, chemicals and film.

Digital camera sales flourished, driven by technological advances and as the mega pixels grew and the prices dropped the digital camera market segmented into multiple categories: Compact Digital Cameras, Bridge Cameras, Mirrorless Compacts, Digital Backs, Digital Medium Format and Digital SLRs. However, it was the technological advancements in the development of low price CMOS – complementary metal–oxide–semiconductor – sensors, that drove digital camera development and enabled the evolution of high quality photographic capture within smartphones and the subsequent widespread adoption of the device as a principle choice of camera.

Digital photography replaced analogue photography at a pace which caught out the established camera and film supply manufacturers. Those adopting digital technology who were not interested in high quality images were seduced by the ease and low cost of using a digital camera. As a result, film sales and processing experienced a rapid drop in demand catching out supply companies and leading to large scale internal restructures and closures. Kodak who had led the photographic revolution for over one hundred years found itself out of step with the times they had helped create and suffered the most. Photography had been released from the shackles of chemistry and was about to enter a new world of both capture and dissemination.

We are now in that new world, but it shows no signs of slowing or ceasing from its rapid evolution to a destination that can only be guessed at. The writer on photography Stephen Mayes commented in an article for *Time*: *Lightbox* in August 2015[6] that “Digital capture quietly but definitively severed the optical connection with reality, that physical relationship between the object photographed and the image that differentiated lens-made imagery and defined our understanding of photography for 160 years. The digital sensor replaced to optical record of light with a computational process that substitutes a calculated reconstruction using only one third of the available photons.” Mayes continues in the article to quote veteran digital commentator Kevin Connor on the issue of digital capture "The definition of computational photography is still evolving, but I like to think of it as a shift from using a camera as a picture-making device to using it as a data-collecting device."

This is all interesting stuff and highly relevant within the debate concerning digital-image-manipulation, but it is in Mayes recognition of the importance of the smartphone in photography’s evolution that I believe that an essence of what photography may become lies. He says “The twist is that new forces will be driving the process. The clue is in what already occurred with the smartphone. The revolutionary change in photography’s cultural presence wasn’t led by photographers, nor publishers or camera manufacturers but by telephone engineers, and this process will repeat as business grasps the opportunities offered by new technology to use visual imagery in extraordinary new ways, throwing us into new and wild territory. It’s happening already, and we’ll see the impact again and again as new apps, products and services hit the market.”

This belief confirms my own thoughts concerning the future of the medium, that is that we are living through one of the most exciting periods of the history of photography and that we should not be confined by its history or a pre-conceived notion of what photography is or can be.

[6] *The Next Revolution in Photography is Coming*. Stephen Mayes, August 2015. www.time.com.

Technological developments are progressing at such a pace that I have little doubt that by the time you read this book you will already know of developments that I at the time of writing have no knowledge of. However, perhaps a sign post to the future may have been planted just as I finished this book. The Japanese camera manufacturer Canon has presented a concept for a mini modular camera[7], that may or not become a reality by the time this book has been published. According to Canon their modular camera will be only a couple of centimetres thick and will incorporate a non-removable wide-angle lens that will allow it to be dust and splash proof. The battery will only be 1cm thick, allowing the whole package to remain quite compact, recording internally to MicroSD cards. What's interesting about this Canon modular camera is that its functionality will be expandable with additional parts, such as an additional SDI output module or a larger battery. This would make the system capable of fulfilling many roles, from a body camera to a studio and broadcast-capable tool. It takes little imagination or camera knowledge to see this as a direct reaction to smartphone camera technology and we can only wait and see if these and other developments from rival companies such as Sony come to fruition.

What Does This All Mean?

Since the earliest days of the digital revolution the democratization of the digital image and therefore photography has seen the place of the photographic image take on a new meaning within our everyday communication and in our personal, regional, national and global interactions. It has been a democratization that has been led throughout the history of photography by technological developments and the adoption of those advancements by photographers and artists to fully utilize the tools at their disposal. The outcome of this is that photographers have adopted the medium in its purest form as a medium for documenting both the seen and felt, the personal and international, the political and the everyday. They have embraced its immediacy and its possibilities but as the medium evolves new ways of seeing are becoming evident as new tools and dissemination channels develop.

As I have outlined through a brief history of cameras each technological development has forced and encouraged the photographer to reconsider the way they see and their relationship with the creation of the photographic image. It is hard to argue against this view of the history of photographic seeing and yet it is rarely presented as a history so closely linked to the mechanical reality of the capture of an image and the impact it has had on the resulting photographic image. That is how we got to where we are today but where are we today?

The most commonly heard answer to this is that "We are all photographers now!" that may be true, but I would expand upon that statement by saying that we are all image-makers and publishers now. Every time we post, share and send an image we are engaging with the process of publishing our images. This instantly changes the role of the photographer as we are no longer reliant on others to share and publish our images, that is a positive situation to be in but the negative aspect of this is that the added role of publisher brings with it additional responsibilities and required knowledge to ensure that the publishing of those images is both appropriate and effective. This in turn raises the issue of where the images should be published, the context they are going to be given through the publishing platform chosen and the expectation the publisher has of what that platform will achieve for themselves and their images.

The transferable skills required by the photographer today are multifarious and yet rarely identified within photographic education. The reason for this is that there is a lack of diversity of experience amongst those charged with teaching photography today within academic institutions. Those with the skills and experience required to teach these elements come from multiple backgrounds connected to photography but not necessarily as photographers and have held roles such as art directors, art editors,

[7] IBC Conference, Marcel Hess, Canon. September 2017.

journalists, writers, publishers, broadcasters and photo editors. These are the people who have been working with the photographic image within the context of visual narrative communication and are therefore experienced in the idea of the photograph within publishing environments. They also understand the concept of creating online brands, personalities and consistent visual language. And yet it is rare to find people from these backgrounds either teaching or acting as visiting lecturers or speakers. The reason for this of course lies in the continued fractured relationship between the acceptance of photography as either a commercial practice and/or art medium. Unless specifically designed as a commercial photography – or professional as I believe to be a more accurate description – course many photographic courses see themselves primarily as theory based and informed. Focusing on personal development with a cynical eye on the realities of the working commissioned photographic industry. I believe that the new photographic environment requires more than this to ensure that the student can fully utilize the opportunities available to them as part of their photographic education.

This may be seen by some as being a confrontational statement but as I have outlined previously we have got to where we are today as visual storytellers by embracing technological development to stop doing this because it takes us away from the recognised area of expertise of the photographer which at its heart is mechanical, makes no sense.

If we accept the basic premise that photography is the act of capturing light in a box, we should as photographers have no issue as to what that box looks like. The emphasis in the previous sentence lies on the word 'light' and not 'box' but that box is a valuable tool that enables all visual storytellers and image-makers to communicate including those who do not use the term 'photographer' to describe their main area of creative activity. It is in this context that I embrace all forms of camera including the smartphone and all forms of image dissemination including those that have social media functionalities. It is how we choose to use the smartphone and digital platforms that determines our understanding of both and ability to embrace the new creative opportunities being presented to us.

Computational Photography

We are in the early days of computational photography and its implementation so far has been restricted to effects within existing camera formats but its implementation within smartphones is currently being developed and in the early stages of implementation by phone manufacturers. It is therefore worth discussing as a potential indicator to the future of photographic capture. Despite all of the technological developments of the medium a traditional camera – both analogue and digital – today is still based on the basic principle of the Camera Obscura and as such it produces linear perspective images. A computational camera however uses unconventional optics to capture a coded image and software to decode the captured image to produce new forms of visual information. Computational Photography or computational imaging are terms that refer to the capture of a digital image and the subsequent processing techniques that use digital computation instead of optical processes and is a technological development most relevant to cameras within smartphones as it can be used to reduce the cost or/and size of traditional camera elements.

In 'film-like' digital photography, the captured image is a two-dimensional projection of a scene, which due to the limited capabilities of a camera, is recorded as a partial representation of what you can see. Despite these limited capabilities, the captured image is considered acceptable as what you have seen is what you almost get in the finished photograph. In Computational Photography, the aim is to achieve a potentially richer representation of a scene during the camera's encoding process. In some cases, Computational Photography is reduced to the process of Epsilon Photography, where a scene is recorded via a series of multiple images, each captured by the epsilon variation of the camera parameters. For example, successive images (or neighbouring pixels) may have a different exposure,

focus, aperture, view, illumination, or moment of capture. Each setting allows the recording of partial information about the scene and the final image is reconstructed from these multiple observations.

The term 'Episilon Photography' was established by Professor Ramesh Raskar[8] and was developed as an alternative to light field photography as it does not require specialized photographic equipment. You may not be aware of the term Episilon, but you will most probably have either used it without knowing or be aware of a number of its functionalities that are already being implemented within digital cameras such as High Dynamic Range, multi-image panorama stitching and confocal stereo imaging. The common thread within all of these imaging techniques is that multiple images are captured in order to produce a composite image of perceived higher quality, such as richer colour information, wider-field of view, a more accurate depth map, less image noise/blur and greater image resolution.

The area of Computational Photography also includes developments that do require specialized equipment such as the light field camera, or 'plenoptic' camera. This captures information about the light field emanating from a scene; that is, the intensity of light in a scene and the direction that the light rays are traveling in space, in contrast with a conventional camera that only records light intensity. This is a form of image creation we are most used to experiencing as a Hologram. In other cases, Computational Photography techniques lead to 'Coded Photography' where the recorded photos capture an encoded representation of the world. In some cases, the raw sensed photos may appear distorted or random to a human observer. But the corresponding decoding recovers valuable information about the captured scene.

The sense that photography is now in the hands of the coders who are directly focused on the photographic capabilities of the smartphone was further illustrated with the 2017 launch of Apple's iPhone 8 Plus with them leading its promotion as a phone with the premise that the camera within the phones were the best they had ever produced. Their continued quest for these cameras to be seen as a 'professional' piece of equipment was led with coding that promised a functionality that delivered a portrait lighting feature allowing the user to create 'professional' looking images. Amongst the professional photographic community such claims are viewed with scepticism and disdain, but the manufacturers continued desire to deliver what they believe to be professional images gives an accurate indication of how these cameras will develop in the future.

A number of reviews of the iPhone 8 obsessed over the camera and the website *TechCrunch*, for example, chose to review the phone purely as a camera dismissing all of its other functionality[9]. The interesting developments that the iPhone 8 demonstrated rely on the fact that its functionalities are not merely reliant on filters, instead they are closer to computational photography in their ability to sense a scene, map it for depth, and then change the lighting contours over the subject, all of which is completed in real time. In many ways, it could be seen as the fullest realization of the democratization of high-quality imagery that the company has been working toward since their iPhone 4. To achieve this Apple reportedly studied the work of artists and photographers such as Richard Avedon, Annie Leibovitz to inform the mimicry their coded software was able to mimic and imitate. "If you look at the Dutch Masters and compare them to the paintings that were being done in Asia, stylistically they're different," Johnnie Manzari, a designer on Apple's Human Interface Team, commented in an online

[8] Ramesh Raskar is a Massachusetts Institute of Technology Associate Professor and head of the MIT Media Lab's Camera Culture research group.

[9] *Apple's iPhone 8 Portrait Lighting Let's Mobile Photographers Mimic Studio Lighting*. Darrell Etherington, 2017. www.techcrunch.com.

article on the *Buzzfeed* website in September 2017[10]. "So, we asked why are they different? And what elements of those styles can we recreate with software?" and continued to elaborate on their process of research “We spent a lot of time shining light on people and moving them around — a *lot* of time," Manzari says. "We had some engineers trying to understand the contours of a face and how we could apply lighting to them through software, and we had other silicon engineers just working to make the process super-fast. We really did a lot of work." This attention to detail when designing the camera functionality within a smartphone must point to not only how we will capture what we see in the future but also what we will use to document what we see and how we will view the medium of photography.

Philip W. Schiller the senior vice president of worldwide marketing at Apple spoke in the same September 2017 *Buzzfeed* article about the issues Apple were addressing with the development of the smartphone as an image capturing device that further outlines the progression and implementation of computational photography. "There’s the Augmented Reality team, saying, 'Hey, we need more from the camera because we want to make AR a better experience and the camera plays a role in that,'" Schiller says. "And the team that's creating Face ID, they need camera technology and hardware, software, sensors, and lenses to support on-device biometric identification. And so, there are many roles the camera plays, either as a primary thing — to take a picture — or as a support thing, to help unlock your phone or enable an AR experience. And so, there's a great deal of work between all the teams and all of these elements." Schiller has also spoken about the evolution of the iPhone's camera, acknowledging that the company has been deliberately and incrementally working towards a professional-calibre camera. But it is in his statement concerning Apple’s relationship with the photographic medium that he perhaps gives the clearest picture as to the process of how we may engage with photography through their products. He says "It's what camera can we create? What can we contribute to photography?"

Apple are not a traditional camera manufacturer recognised by professional photographers like Nikon, Canon or Leica for example. They do not have the photographic history, and many believe that this form of computational implementation merely leads to a dumbing down of the photographic medium. Manzari spoke out about this "This is not about dumbing things down," Manzari observed, noting that as devices become more professional, they often become more intimidating. "This is about accessibility. It's about helping people take advantage of their own creativity" and it is exactly this point that forms the foundation of my willingness to embrace smartphones as a valid and useful tool within the visual creatives toolbox. Apple have slowly been building toward this level of photography with the iPhone over past decade, but the blurring of the lines between professionalism and amateurism remains a contentious issue for many within the sometimes ‘conservative’ world of photography.

The tough compact camera manufacturer Go Pro that has done so much to change the world of capture amongst action and sports imagery both still and moving has also begun to explore computational functionality and Virtual Reality with their 2017 launch of a 360-degree spherical camera. Their *Fusion* camera boasts 5.2K resolution, powerful image stabilization in-camera, and spherical surround sound. It's also waterproof at up to 16-feet, has a voice command feature, and works with the GoPro app so you can preview your shots and stitch them together right on your phone. The *Fusion's* OverCapture feature, allows you to capture spherical content and frame it within a traditional video format. Because the camera captures everything at once, the photographer/filmmaker is the able to view the footage and select the angles they like best and want to use. The development of VR as a form of visual experience is of course an expansion of the traditional still image but just as once a still camera only

[10] *Inside Apple’s Quest To Transform Photography: How does Apple think about iPhone camera design? Obsessively*. John Paczkowski, September 2017. www.buzzfeednews.com

captured still images, it was then able to also capture moving image it can only be a matter of time before VR becomes an expected functionality all within one image capturing device.

Virtual Reality is not the only buzz phrase in the evolution of computational photography at the moment, Augmented Reality or AR is also changing the way in which we are engaging with the medium. Based primarily on the imposition of objects, characters and filters to adapt our photographic viewing AR is the logical next step in a lineage of image enhancement that can be traced back to coloured lens filters, practical effects, polarizers, subtitling, digital CGI, and most recently, Snapchat filters. We engage with AR without realising it every time we use our smartphones as cameras and each new functionality is a direct result of AR development, but it is in its ability to recognize an object without needing to record that object as a photograph that the opportunities for computational photography to impact on our daily lives becomes most exciting. If we see AR as a broad computational platform, and not just as a collection of individual apps and software fixes to manipulate images, its possibilities are endless and life changing as it adapts your phone into an all seeing and connecting tool. What I mean by this is that you will be able to point your phone at an object, receive contextual suggestions about what you're pointing it at, and receive advice on what to do in that situation. By capturing an image and transferring that image AR will be able to use the digital image as an information artefact to instigate actions and implement a decision-making process. VR is changing the way in which we see but AR will be able to change the way in which we act.

During a panel discussion at the New York PhotoPlus Expo 2017[11] recorded and posted on YouTube but since removed, several experts explored different scenarios for what computational photography could mean for professional creatives. Their conclusions were those that I have outlined previously with the further development of both smaller and lighter cameras and as computational photography suggests a more immersive virtual reality. It was accepted within the discussion that for many photographers, computational photography creates some cognitive dissonance. According to Allen Murabayashi the co-founder of the online platform *PhotoShelter* "You no longer have to get it right in camera" because the camera is increasingly smart enough to get it right for you. But that doesn't mean that all of photography is on a glide-path toward a utopian future". Despite this comment coming from someone who claims to understand the professional photographer this type of comment can be incendiary within the professional photographic community and destructive in those photographers adopting the possibilities of computational photography. The idea of placing the control of an image into the hands of a software engineer is unacceptable to any creative and only goes to reinforce the belief that the resultant image will consist of a homogenised digital representation lacking creative input. Murabayashi continued by stating that the central question photographers face is whether they can "transcend the novelty of these [technologies] to best leverage these features for storytelling." On this point, I agree with him, but his previous comments do not help photographers overcome this sense of novelty. Whereas Murabayashi's comments were made from his perspective of being involved with an image sharing platform Jim Malcom, the General Manager of Humaneyes, North America - makers of the 'Vuze' Camera - bought the non-traditional camera manufacturers viewpoint to the discussion. Malcolm stated that "People don't know what they want until they experience it," extolling the rapid growth of Virtual Reality adoption and indicating that VR will become an additional platform for visual imagery to be experienced. There are 15 million headsets in circulation now, he added, and stated that the market for VR content is already valued in the billions of dollars and that he believes that it is the artist's responsibility to experiment with the format. The predicted sales of VR equipment confirm these beliefs as according to a 2017 report from the International Data Corp sales of augmented and

[11] *Eyes of the Machines: How Will Smarter Cameras Help Photographers?* October 2017. Panelists: Dr. Rajiv Laroia, CTO and co-founder, Light, Jim Malcolm, general manager, North America, HumanEyes, Steve Medina, Director, Product Management, Avegant and Allen Murabayashi, photo industry blogger.

virtual reality headsets will rise 108.3 percent by 2020. In 2016, 10.1 million VR headsets were sold and IDC reports that this number is expected to reach 61 million in 2020.

It was left for Rajiv Laroi, another representative of a non-traditional camera manufacturer and the co-founder of the comany Light, who made the most sweeping prediction for the future of both photography and computational photography. Laroi stated that "In the coming years, computational photography 'will be the norm' and that DSLRs will be like film cameras are today: a small audience will still use them, but most photographers will have moved on… It's like when flat panel TVs came out, there was no longer a reason to buy a CRT". A bold statement but one that makes sense particularly coming from Light who have created a camera that is seen by many as the most obvious progression for computational photography the L16. The L16 is Light's first product and combines 16 cameras into a single, relatively compact body while still producing huge RAW files – up to 160MB at a pop – with light field capabilities to alter focus points and depth of field after an image has been captured. It was however, left too Steve Medina, from the augmented reality company Avegant who identified exactly how we should see the development of computational photography at this point. Medina commented that "Augmented reality doesn't replace photography, it adds context and information."

What we are talking about here is a radical change in the moment of capture and a re-imaging of the basic process of what photography is. The world of computational photography is connected to that of the experimentation currently taking place with virtual reality visual experiences. Whereas photography offers an interpretation of a situation controlled by the photographer, computational photography places the control of what is interpreted into the hands of software that aims to create a heightened experience of what is seen to potentially exactly replicate the experience of being at the moment of capture. The reality of this heightened experience in turn alters our understanding of what we see and how we see. We have already seen this expectation of the heightened experience of photography with the saturated colour and extreme contrast of so much digital photography. The digital images we see are rarely the world we experience thanks to the pre-programmed nature of our digital visual devices and their desire to present images that are bright, colourful and sharp. In that sense, we have already left the photographic world of accurate representation and entered the hyper-realism of computer coded image making.

One of the most difficult aspects of writing such a book is this is that the very subject matter I am attempting to address is in a state of constant fluidity and evolvement. This is particularly the case when it comes to the development of technologies with which we create and experience the images we choose to make and the creativity these tools allow us to explore. As I have mentioned throughout this chapter those technological developments introduce us to new tools, new tool creators and inevitably those who have failed to move with the times become suffer economic hardships. Despite this state of constant evolution there are some key moments that I feel are worth noting as signposts to the medium's history. One of these was announced in the Autumn of 2017 in the form of a Press Announcement from the camera manufacturer Nikon's board of directors[12] announcing plans to close Nikon Imaging a subsidiary based in China, where some 2,500 workers at a factory produced compact digital cameras and DSLR lenses. The closure, says Nikon, is due to "the rise of smartphones" and the 'rapidly shrinking' compact camera market. This was the released announcement "In recent years… due to the rise of smartphones, the compact digital camera market has been shrinking rapidly, leading to a significant decrease in operating rate at NIC and creating a difficult business environment. The Company has decided to discontinue operations of NIC". At the time of writing Nikon controls 30% of

[12] Nikon to Discontinue Operations of a Consolidated Chinese Manufacturing Subsidiary of Imaging Business. October 2017.

the digital camera market it will be interesting to see when this book is published whether that control has decreased.

Only time will tell if the Rylo camera will be seen as a similar signpost to that of Nikon's manufacturing decision in the development of moving image capture. Created by two former Instagram employees Chris Cunningham and Alex Karpenko who had previously built the Hyperlapse app the Rylo utilizes software development to control image creation post capture. Constructed with two cameras within one small camera body, each camera captures a 195-degree field of view, which the Rylo stitches together into a single sphere from which single still images, panned, split and standard moving image footage can be extracted. Interestingly the Rylo team discovered that software was not the complete answer to the creation of a new form of imaging device as they struggled with the traditional camera lens issues of distortion. Computational photography still has to address issues that traditional camera manufacturers have mastered but it is interesting how they are choosing to do this. For example, Google's Pixel 2 smartphone has achieved its depth-perception functionality by training an algorithm to recognize the human head. Apple have taken a similar approach with their Portrait Lighting feature. The Rylo is at the time of writing in its very early stages of development but the fact that an imaging device is being developed by people from an image sharing background further illustrates the convergence of image creation and sharing not only in practice but also in the creation of the devices we will use in the future to document the world we see.

The future for how we capture what we see is constantly evolving but how those images are displayed and one of the reasons why we now live in such an image saturated environment can be explained by

Haitz's Law that acts as an observation and forecast on the technological and manufacturing development, over many years, of light-emitting diodes or as they are most commonly known LEDs. Haitz's Law states that every decade, the cost per lumen – a unit of useful light emitted – falls by a factor of 10, and that the amount of light generated per LED package increases by a factor of 20, for a given wavelength of light. To every action there is a reaction as we are taught at school and the counterpart to Haitz's Law is Moore's Law which states that the number of transistors in a given integrated circuit doubles every 18 to 24 months. Both laws rely on the process optimization of the production of semi-conductor devices. At this point you may feel as this has little relevance to photography, but it is an intrinsic explanation for how we now engage with the back lit photographic image in our daily lives. Haitz's law is named after a scientist called Roland Haitz and was first presented at a conference titled Strategies in Light in 2000. In addition to the forecast of exponential development of cost per lumen and amount of light per package, the publication also forecast that the efficacy – a measure of how well a light source produces visible light – of LED-based lighting could reach 200 lm/W – lumen per Watt – in 2020, crossing 100 lm/W in 2010. The paper outlined that this would be the case if enough industrial and government resources were allocated for research on LED-lighting. More than 50% of the electricity consumption for lighting – 20% of the totally consumed electrical energy – would therefore be saved. This prospect and the continued implementation of LEDs within areas such as digital devices and LCD-backlighting has led to a massive investment in research as suggested at the conference and as a result LED efficacy crossed the 100 lm/W threshold in 2010. It is now believed that if this trend continues, LEDs will become the most efficient light source we have by 2020. What this means is that the screens we view images on will become larger, brighter and cheaper and in turn the back-lit image will become the dominant photographic engagement experience as brands utilize these digital billboards to speak to us on a daily basis.

The Oxford English Dictionary definition of the word camera is "A device for recording visual images in the form of photographs, film, or video signals". There is no requirement that a camera must only perform one function, that it cannot also send messages, access websites, play music or allow you to speak with others. To believe that a smartphone is not a camera is to dismiss the evolution of the

photographic medium throughout its history and the changing nature of the photographic image. This is not something that I am willing to do.