Notes on Photography

General Remark

My current understanding of photography was mostly summarized in the photo book *Fall in Love with Photography*《爱上摄影》. There have been some developments since I completed the book. I show some key ideas here. Compared with the book I adopt a different logical structure here. The contents are arranged according to the logical order of generality, speciality and individuality. In the general characterization of photography its three aspects of technology, technique and art are explicitly demonstrated. However, photography art is the focus here.

The Three Aspects of Photography

Photography was originally a technical invention. It was invented in the first half of the 19th century as a way of recording images of objects on light sensitive chemicals. For a long time it was deemed as a direct copy of reality, and therefore denied the status of an art form. The first effort to obtain that prestigious status was to imitate painting. This was the pictorialist movement at the beginning of the 20th century. Since impressionism was the trend of painting at that time photographers tried to produce similar fuzzy effect in photography through soft focusing. This movement was soon reversed by Group f/64. As the name suggested, contrary to using soft focus this group of photographers tried to make their photos as sharp as possible. Ansel Adams, a prominent figure in the group, also developed a sophisticated zone system to help make the exposure perfect as well. In contrast they called their effort "straight photography." Even with straight photography, their works of the American West successfully demonstrated the artistic power of photography. Since then people no longer questioned photography as a unique art form.

Later development included the SLR revolution and the recent digital revolution. SLR stands for Single Lens Reflex. It's a type of light weight camera. The SLR camera itself has a long history. It's definitely cheaper than the original large format camera the generation of Adams used. But the essential part of the SLR revolution was auto-exposure and auto-focusing that came with SLR cameras. These two features step by step went into maturity in the second half of the 20th century. They greatly simplified photo taking and ushered the age of popular photography. Finally the digital revolution at the turn of the century replaced the original chemical media with the new electronic media. This made photo taking instantaneous and much more convenient. Resonating with the internet age now photography has become ubiquitous.

As its birthmark photography has been extraordinarily technology-laden compared with other art forms. Recording reality is still one of its main functions. It's widely used in scientific research and forensics for that purpose. But it can do much more than its original task. If demonstrating reality is a defining character of photography, then its space of maneuvering lies in the demonstration itself. As we will see, a wonderful demonstration of reality requires not just advanced technology, but more importantly skilful techniques and a unique view of reality. With money one can buy a sophisticated camera, but good photos require both talent and effort.

Technology

Technology in photography is embodied in equipments. Photography equipments may be grouped into four categories. **Cameras and media (films/memory cards)** are obviously the core photography equipments. For cameras with changeable lenses, the camera bodies and the lenses are often considered separately. Second come the **camera accessories**, which in turn may be classified into four classes: lighting accessories (hot shoe flashes), modifying accessories (filters and lens hoods),

stabilizing accessories (monopods, tripods, wired and wireless remote releases) and carrying accessories (bags, vests, etc.). While camera accessories generally have direct contact with the camera, the **studio equipments** play a more auxiliary role. Studio equipments include (tungsten & flash) lights, light modifiers (filters, concentrators, softeners, reflectors, etc.) and backgrounds. A handy light meter is essential as well. The studio equipments all help with pre-exposure preparations. The life cycle of a photo obviously doesn't stop at the exposure. We also need **post-exposure equipments** to take care of the phase after exposure. Specifically, we need image processing equipments (chemical/digital darkroom), storage equipments (film files/hard disks) and display equipments (slide/digital projectors, scanners, printers, frames, etc.).

The technologies applied in photography equipments may be divided into the following areas:

- **Optical technology** The optical technology is the cornerstone of photography. Without it photography is impossible. The light sensitive media could be switched from chemical to electronic. When we take away light and lenses we would have something that cannot be called photography any more.
- **Chemical technology** The chemical technology was also crucial to traditional photography, with film as the light sensitive media. In digital photography it's still relevant in providing light, sturdy and endurable materials for photography equipments.
- **Mechanical technology** Since most photography equipments contain mechanical parts, the mechanical technology is also important. Most importantly, the camera body needs a powerful shutter and the lens needs effective focusing and zooming mechanisms.
- **Electronic technology** All the recent developments in photography involved electronic technology, no matter whether it's auto-exposure, auto-focusing, or the new light sensitive media. This will be the future direction in this information age. Cameras will get smarter and smarter. But never think the camera will some day do all the photography for you! It's essentially just a tool. Photography is a perfect field to demonstrate the boundary of technology.

Technique

Now we move beyond technology. But before we reach the realm of art we need to pass an intermediate area in between. The reason why technique is still relevant is that technology cannot take care of all the technical part of photography, although it has occupied a large amount of territory which originally belonged to technique. In Adams's time, with a large camera which required a team using donkeys to transport, getting the right exposure and focus demanded a team effort. Now with an average SLR camera exposure and focusing in normal situations are all taken care of by the camera itself at the press of the shutter release button. Yet the camera cannot handle all the situations. Manual exposure and focusing are still indispensable for a serious photographer. And that demands skills. Generally speaking, while technology is embodied in photography equipments, technique is the skills to use the equipments. In a sense we can similarly say, photography technique is embodied in the photographer.

On the other hand, technique also distinguishes itself from art. Technique still belongs to the technical realm, so it's universal and easy to learn. Let's take the hyperfocal distance for example. When we want to make both a faraway mountain and a patch of flower near the camera sharp in the image we shouldn't focus on either of them. Instead, we should focus on the hyperfocal plane in between, to make better use of the depth of field. As far as I know the existing cameras cannot handle this situation automatically. But this is a skill which can be taught quickly. As soon as we explain the mechanism of hyperfocal distance to a photographer, he can easily apply it in his own practice. And for every photographer who use it, the hyperfocal distance is the same thing. In contrast, art is unique and difficult to learn. The art of a master photographer takes much talent and effort to establish. And once it's established, it's almost impossible for others to imitate. So using hyperfocal distance is photography technique, but not art.

Next I highlight some important photography techniques. They will be further discussed in the photography works section.

- **Exposure technique** The exposure technique is the technique to obtain the right exposure, or the intended exposure in a photo work. Normally the right exposure means the brightness of the main object of the image is within an optimal range. Exposure is dependent upon light strength. Therefore light metering is crucial to getting the right exposure. Given a specific lighting situation, the amount of exposure is determined by three factors: the aperture, the shutter speed and the sensitivity of the media. The auto-exposure system with built-in light meter greatly facilitates the exposure task. But as many entry-level photographers have experienced, even with the advanced auto-exposure system getting the right exposure is still a daunting task. The exposure technique today involves taking good advantage of the auto-exposure system and making necessary correction when it performs badly.
- **Focusing technique** Focusing is another unique feature of photography. With depth of field it jointly determines the clearness of a photo work. As a general rule we want the main object to be in focus. That's the aim of focusing technique. On the basis of optical laws the key to focusing is to measure the object distance. Originally this had to be done separately. When the object was close a ruler could be used. For faraway object more advanced technique might be used. In an autofocus system first the object distance is measured, then the position of the lens is calculated and finally the motor drives the lens to position. All these are done automatically. With the autofocus system focusing on moving object becomes possible. But still there are situations where auto-focusing cannot work well. The focusing technique today mostly involves handling moving objects and such difficult situations.
- **Lighting technique** Light to photography is like paint to painting. A painter has full control of paint, but a photographer is not that lucky. For studio photography the light sources and their positioning can be easily controlled. But outside the studio photographers have to use existing light, whether it's natural or artificial. So the lighting technique consists of two parts: choosing the right existing light condition outside the studio and setting up the right light condition inside the studio. In this area technology can provide little help. All it can do is to supply better photography light sources. The setting of the light sources is still dependent on the skills of the photographer. For uncontrollable light sources (mostly sunlight) it's even more so. Therefore, of all the three photography techniques listed here, the lighting technique is the most demanding.

Art

Building on photography technology and technique, photography art is the focus of this essay. Holding a cutting edge camera, having learned the necessary techniques we want to make some photo works that attract the viewers. This is the last phase and also the most difficult part. Technology and technique combined are the technical part of photography. Their common principle is universality. So we may set up distinct theories and list explicit rules in them. Whenever we have explicit rules to follow, the task won't be too difficult. On the contrary, the basic principle of photography art is uniqueness. Imitation in art automatically decreases the value of the work. As a result explicit rules are almost impossible in photography art. It to a large extent depends upon the photographer's intuition and feel. Those intuition and feel are based on talent, but can only be developed through long time of practice.

Perception, cognition and emotion are the three basic components of human mind. Accordingly the attraction of a photo work to a viewer may generally happen in the following three aspects, separately or combined.

- **Sensual effects** A photo work could have sensual effects on the viewer. Its beauty may lie just in its form. Symmetrical structures, harmonious patterns and vibrant colors could all please our eyes.
- **Emotional effects** A photo work could also influence the viewer's emotions. Humorous photos are good examples. There are many other contents that could cause emotional reaction in the viewer.
- **Conceptual effects** Finally a photo work may help change the viewer's mind concerning a specific subject. This constitutes an important part of photo journalism. Photos could demonstrate the cruelty of war, the misery of poverty and the damage of pollution. When we look at such photos our view on the corresponding subjects would be more or less influenced.

Photography as Art of Selection: A Comparison with Painting and Film

The previous section is a general examination of the whole field of photography. In this section we focus on the art aspect of photography. Specifically, we're interested in two questions about photography art: A. What's the foundation of the artistic appeal of photography works? B. What makes photography a unique art form compared with others? This can only be a philosophical inquiry. As its subject is art, this inquiry belongs to the specific philosophy area of aesthetics.

Art involves the human activity of creation and its products. Imagination plays an essential role in the creation. As a result there exists significant distance between reality and art. Although they may be based on elements in the real world, art works are normally totally new. The music composed by composers never exists before. The stories in novels are usually fabricated. The scenes depicted in paintings are often unreal. In this respect photography is very special. In the technical sense all photo works are just recordings of reality. There doesn't seem to be any space for imagination and creation to play. It's true, under the scientific world view, with reality being understood as absolute, disinterested objects and processes, photography can never be a form of art. However, under the hermeneutic world view the absolute, disinterested objects and processes are just dead material. Without interpretation there even can be no reality. So the reality we normally talk about is just reality under the common interpretation. The common interpretation may be based on our way of perception, habits and/or commonsensical believes. This gives photography a chance to have an impact. If photography could provide an uncommon interpretation of the physical world it would definitely have the similar artistic appeal to the viewers as composed melodies and plotted stories. In my opinion photography achieves the uncommon interpretation through selection. By selection photography generates an uncommon view of the world. Its artistic power lies in this uncommon view. Since it's uncommon it requires both imagination and creation.

The Art of Selection

To create an uncommon view of the world photography could make selection in different aspects. We experience the processes in a time flow, look at objects from a normal angle, pay attention to things according to our common believes and incessantly explore our surroundings. Therefore we could create unusual views by making the right selection in time, space, subject and object.

- **Selection of time** Processes happen in a time flow. Photography could freeze the most wonderful moment. We often see such photos in sports and journalism. This is selection of the right instant in time.
- **Selection of space** In our everyday life we usually see things from a normal angle, when we stand on popular spots. If we could try to squat down and walk around we would have more chance to capture unusual views.
- **Selection of subject** The common subjects we are interested in are shaped by our believes. Photography could bring an ignored subject to the fore. This requires transcending the accepted belief system.
- **Selection of object** When we normally look at the world around us we tend to explore the surroundings continuously. Even when our attention is put on a particular object its context is always included in our view. By separating the object from its large context and putting it in unusual highlight photography could also create unexpected effects.

Photography vs. Painting and Film

Of all the art forms the closest two to photography are obviously painting and film. Photography and painting are both two-dimensional visual arts. Photos and films are both created with cameras. However, there are essential differences between them. Clarifying the similarity and difference between them helps characterizing photography.

- **Photography vs. painting** Since photography and painting are both two-dimensional visual arts they share the same composition principles. However, their creation processes are very different and this distinguishes their artistic appeals. For instance, verisimilitude is valuable in painting, but

trivial in photography. On the other hand photos with lightning lines or double rainbows are precious, but similar paintings would be normal in that respect.

- **Photography vs. Film** Putting the sound track aside, the film pictures are made with the same camera as that in photography. So they share the same photography principles. However, film also has the time dimension and that makes film a very different art form than photography. The power of photography lies in freezing time. By contrast the power of film lies in the time flow. On the other hand, the contents of photography are mostly taken directly from the existing world, whereas those in film are mostly constructed, including the scenes, dialogues and actions.

Elements of Photography Works

Photography works are the products of photography activity. They are the crystallization and representation. A photo work tells a lot, not just about its contents, but also about how it's made and the spiritual world of the photographer. In terms of the dualistic world view, a photo work is not only a window of the objective world of reality, but more a window of the subjective world of the photo maker.

Analyzing a photo work into different elements helps with both photo appreciation and creation. Although the elements reside on different levels they all more or less contribute to photography art. Specifically we go from exposure and clearness as two mostly technical elements, through lighting, which involves more technique than technology, to composition and artistic appeal. The last two elements move beyond technique and belong to the realm of art. Whereas composition is the structure (form) of the work, the artistic appeal is the content.

Exposure

Exposure is a unique feature of photography based on its special mechanism. Getting the right exposure is a basic requirement of photography. A too much overexposed or underexposed work won't have artistic appeal. That said, what's the right exposure is not rocket science. It normally has the range of several stops. Within that range exposure could be used in favor of artistic appeal. The brightness of a scene normally has effects on the general mood and saturation of the colors.

The key to controlling exposure is to understand the factors of exposure and the mechanism of auto exposure.

Three Exposure Factors: Continuous Light & Flash

Exposure is determined by four factors following the law of reciprocity:

$$\text{Exposure} \propto \text{SceneLuminance} \times \text{ApertureArea} \times \text{ExposureTime} \times \text{MediaSensitivity}$$

$\propto$ is the mathematical symbol for "is proportional to." So if you increase/decreases any of the four factors on the right side exposure will increase/decrease proportionally. Of course, you could change more than one factors at the same time. Their joint effect is dictated by the multiplication symbol $\times$. The law of reciprocity states that the factors are reciprocal. For instance, if you increase one factor and decrease another factor with the same degree at the same time you get the same exposure. This is just another way to express the multiplication relations above.

Next we discuss each of the four factors briefly:

- **Scene Luminance** Luminance is different from the power of the light source, or even the strength of the light, strictly speaking. Hold a piece of paper under a light bulb. When you move the paper away from the bulb you get less luminance on it. If you tilt the paper you decrease the luminance further. We can see, beside the power of light source, distance and angle to the source matter as well. Generally scene luminance is the amount of light reaching a unit area on the scene during a unit time.
- **Aperture Area** Given the scene luminance the aperture area and the exposure time jointly determine the amount of light that reaches the media. The F numbers (e.g. F8 or f/8) normally

used to measure the aperture are actually the diameter of the aperture. In order to get the aperture area that number has to be squared. That's why we have a geometric series with the base 1.4 (the square root of 2) for the descending consecutive stops: F1.4, F2, F2.8, F4, F5.6, F8, ...

- **Exposure Time** The exposure time is normally measured with a fraction of a second, such as 1/60. It's controlled by the shutter.
- **Media Sensitivity** The same amount of light has different effects on media with different light sensitivity. There is an ISO standard for this. That's why it's often marked as "ISO" followed by a number, such as ISO100, ISO400, etc.

In **continuous light** situations, the scene luminance is usually fixed, as the lights are mostly uncontrollable. So the three factors left are **aperture**, **shutter** and **ISO value**. In the case of **flash**, when it's appropriately synchronized with the shutter action the speed of the shutter doesn't matter any more, because the flash only lasts for a short period of time and its power is well above that of the ambient light. So the three factors left are **flash power level**, **aperture** and **ISO value**.

Auto Exposure: Metering Modes & Exposure Modes

Auto exposure is based on the built-in light metering system. The system measures the scene luminance automatically and submits the data to the CPU in the camera. Based on the data the other factors of exposure could be set accordingly.

However, measuring the scene luminance is not an easy task, unless the scene contains a uniformly lit plane surface. In most cases the scene is lit unevenly and objects in the scene have various surface properties. The **metering modes** are designed to handle this issue. Normally we have matrix, center-weighted and spot metering modes. The matrix metering samples various points in the scene and average the final data. This works for a majority of the cases, but the other two modes are indispensable for handling tricky situations.

The **exposure modes** are the ways in which the exposure factors are set. Once the scene luminance is measured you could let the camera decide on everything. This most automatic mode could be based on a scene setting, such as flower, night scene, etc., to make the task easier. Or you could set the aperture or shutter speed beforehand and let the camera decide the rest. These are aperture priority and shutter priority modes. Or you could ignore the built-in metering results and set everything yourself. This is manual exposure.

Manual Exposure, Auto Exposure and the Hybrid

Why is manual exposure still indispensable? Because auto exposure doesn't work well all the time. Auto exposure is based on built-in light metering. When the metering is not feasible or very difficult, exposure needs human interference. Using studio flash is a case for the former situation. In this case the light lasts for miniseconds, the camera doesn't have enough time to first measure the luminance and then set the parameters. Therefore we need manual exposure. A tricky scene with wildly variant luminance distribution is a case for the latter situation. In this case the camera just can't get the right exposure, no matter what metering mode you use. Therefore we need manual correction of the auto exposure. Two popular methods are exposure compensation and bracketing. These are hybrids of auto and manual exposures.

Clearness

Clearness is another unique feature of photography. It's based on optics and the mechanism of human vision and jointly determined by focusing and depth of field. While focusing follows natural laws, depth of field is human dependent, not upon human individual but species. So clearness is a relative concept and has meaning only with reference to human beings. In most cases we want the main object in a photo to be clear. Compared with exposure clearness allows a larger space of creativity, because it not only has direct psychological effects as exposure, but also is a composition tool.

Depth of Field

There wouldn't be depth of field if our eyes were perfect in the sense that we could see the geometrical point. *Fortunately* our retina has limited resolution. The whole area whose image falls on the same cell on the retina is seen as an indivisible dot. According to geometrical optics, given a perfect lens, a point on an object is registered as a point on the image plane only if the original point resides on the focusing plane. Points residing in front of or behind the focusing plane are registered as disks on the image plane with various diameters depending on their distances to the focusing plane. It's not a linear relation, but a monotonic one. In other words, the farther away is a point on either side from the focusing plane, the bigger the disk. Now we look at the recorded image with our eyes. If we cannot discriminate a disk on the image, which means the disk is registered on the same cell on our retina, then the corresponding point on the object is seen clearly by us. Otherwise we see the point as fuzzy. So clearness also depends upon the way we look at a photo. When we move closer to a big bulletin board, or zoom in a photo, an originally clear part becomes fuzzy.

If you can understand the above paragraph then we may easily draw some conclusions on depth of field. Let's start with a point on the focusing plane and move away slowly from it on either sides along the axis of the lens. As the distance increases the size of the corresponding disk on the image plane increases with it. At the same time the area the disk registers on our retina increases as well. At a certain point the area on our retina covers more than one cell. That's the boundary between clearness and fuzziness. Therefore, depth of field straddles the focusing plane and consists of two parts: **the far field** and **the near field**. Both fields have a boundary parallel to the focusing plane. The position of the boundary is jointly determined by optics and the discriminating power of human eyes. And the far field is always bigger than the near field. This is solely based on optics. So do the following factors which influence the size of depth of field.

- **The smaller the aperture is, the bigger the depth of field.** An intuitive explanation is that, decreasing the aperture decreases the disk on the image corresponding to a point on the object. So we could move farther away from the focusing plane before we reach the clearness boundary. That translates to a bigger depth of field.
- **The shorter the focal length is, the bigger the depth of field.** A lens with shorter focal length bends the light harder. Intuitively it shrinks the scale of the image space including the disk on the image, compared to a lens with longer focal length. That again translates to a bigger depth of field.
- **The larger the focusing distance is, the bigger the depth of field.** As we move away from the lens along its axis the changing rate of the light angle decreases. Moving over a longer distance results in the same angle change in the image space. Therefore the object space is mapped to an image space with a smaller scale. It has similar effect as the previous case. This also explains why the far field is always bigger than the near field.

If you cannot understand the optical mechanism you need memorize the above three relations, especially the first one. Aperture is the mostly used tool to control depth of field. And as applications of the other two relations, remember telephoto lenses and micro lenses have relatively shallow depth of field.

Focusing: Manual, Auto and Combination

Depth of field is the area in which the objects look clear in the image. But it straddles the focusing plane, so the clear area is also determined by where to focus. When the positions of the object and the camera are given, focusing is the positioning of the lens so that a point on the object is registered as a point on the image plane. The key to focusing is to measure the distance between the object and the image plane. At the beginning of the history of photography, the distance was often measured manually. In auto focusing the distance is measured automatically by the camera. Then the position of the lens can be calculated with optical laws. And finally the motor drives the lens to the calculated position. Auto focusing works in most cases except the following:

- The object distance is difficult to measure because **there are no explicit lines** on it, such as cloud.
- The object distance is difficult to measure because **the object is transient**, such as firework.

- **We don't want to focus on any object** in order to have a strict control of depth of field, such as in micro photography.

In all these cases manual focusing still needs to be used. Some high end lenses also allow us to combine auto and manual focusing in the same shot. In this case we auto focus first and then do manual fine tuning while locking auto focusing.

Auto Focusing Modes

Auto focusing is most useful for photographing moving objects. Since focusing on static and moving objects are different, two auto focusing modes are designed. The **single servo mode** is for focusing on static objects. In this mode the camera does auto focusing and stops when the target object is in focus. Only then can the shutter release button be pressed. In contrast, in the **continuous servo mode** the camera keeps doing auto focusing all the time. And the shutter release button may be pressed at any time. This is apparently designed for moving objects. Advanced auto focusing system even allows tracking the moving object across focusing angle points. So even when the object moves from the left part of the view to the right it's kept being focused on.

Lighting

We can't say that lighting is a unique feature of photography, although light is essential to it. Lighting is also important for painting. Starting from lighting we'll see more and more commonality between photography and painting. As we said, painters can control the lighting of their works with paint brushes. In this sense they have direct control of the lighting effects. By contrast, photographers have to choose or set up the lighting conditions and control the effects indirectly. So they need to know more about light, especially the relationship between lighting conditions and effects in the work.

Properties of Light

To understand lighting conditions better we need to get some idea of the relevant properties of light. Light has many properties. Those that are related to photography can be listed as follows:

- **Path** Light travels in a straight line in the same medium, until it hits the boundary between this medium and a different one. Light changes path on the boundary in two ways: part of it is reflected back into the original medium and the rest is refracted and travels into the other medium. Reflection and refraction are the basis of geometric optics, which in turn is the foundation of lens building. What matters for lighting in this respect is the angle of light.
- **Strength** The strength of light is the energy it carries. It's an important factor of exposure. In terms of lighting it determines contrast, precisely exposure contrast. That's the exposure relations among different parts of the work.
- **Color** The color of light is determined by its frequency. It's measured by color temperature. In the process of evolution colors are endowed with different meanings and affect human emotions. Contrast also exists between different colors. The basic contrast is between warm and cool colors.
- **Polarization** Normally the energy of light wave is distributed equally on all directions perpendicular to its travel path. When it's polarized the energy is concentrated on a particular direction. Polarized light can be selectively filtered out with a polarizer. Popular uses of this are darkening the blue sky, removing reflections on nonmetallic surfaces and enhancing color saturation.
- **Diffusion** Whereas directed light has uniform direction of path, the directions are various in diffused light. In terms of lighting, directed light results in high contrast and hard look in the photo work. On the contrary, diffused light causes low contrast and soft looking photo work.

Contrast

Generally speaking contrast is the comparison between different components of a photo work according to a certain property. The property could be various things, such as size, shape, color,

distance, alignment, and even sex and health. Contrast is an import structuring/composition tool. What are relevant to lighting are exposure contrast and color contrast. These two types of contrast may be controlled by lighting.

- **Exposure contrast** Exposure contrast can be controlled by lighting different areas in the scene with lights of different strengths. When the light is not controllable, such as the sunlight, we could wait for the moment when it's more directed or diffused. Polarized light can also be used to affect the exposure contrast. A polarizer normally increases contrast.
- **Color contrast** The color of the light source can be selected or modified. In the case of sunlight, its color temperature varies during the day. During sunrise and sunset it's very warm, whereas during noon time it's cool. The color of studio light may be easily changed with a filter. Usually we don't light the scene with lights of different colors, but the object color and the light color could be put into an interesting relation.

Studio Light Setting

In studio all the properties of light listed above can be controlled, including the light angle, strength, color, polarization and diffusion. Specifically, the light angle can be controlled by putting the light source at the appropriate location and pointing it to the right direction, with optional barn doors and snoot. Some lights allow power adjustment. If not, the light could be moved nearer or farther, which is another way to change the light strength. The light color and polarization are controlled by light source filters. Diffused light can be created with light box, umbrella or reflector. In setting up the lights for a scene the following types of lights are involved:

- **Main light** The main light to light up the objects should be the strongest. It defines the general lighting of the scene.
- **Secondary light** The secondary light is normally used to fill up the shadows, to reduce contrast.
- **Special effect light** Examples of special effect lights are rim light, which is used to highlight the edges of the object, and spot light, which is used to light up a restricted area in the scene.
- **Background light** The background light is used to light up the background behind the object.

Composition

Composition is the structure of a photo work. It's about what components are included and how those components are organized in the work. However, the organization here is not just a physical organization, although every photo work contains a space in it. Psychological properties often play a more important role in the organization. As we've already moved into the realm of art, there are no universal standard according to which we could judge whether a composition is good or not. Each photo is unique. The judgement has to be based on the feel of the photographer. And the more experience he has, the more meaningful the judgement is. The principles discussed here are just rough guidelines based on my personal experience.

Principle of Subject

Principle of subject: The components of a photo work should be selected and organized around a clear subject.

The subject is the main content of the work. Generally the subject is the answer to the question: What is the work *about*? Here we need to make a clear distinction between subject and object. While the subject is the content, the object of a photo work is the carrier of the content. Similarly we may say, the object is the answer to the question: What is the work *of*? An example helps clarify the concepts. Imagine two photos of the same lake. In the first photo we see green trees and colorful flowers. Several sailboats are floating on the limpid water. In the second photo we see instead leafless trees and some abandoned boats floating on the filthy water. Not far away we can also see dark colored water flowing out of several rusted pipes. In this example the object of the two photos is the same lake,

but their subjects are quite different. The subject of the first photo is the beauty of the lake, whereas that of the second photo the damage of pollution.

The principle of subject contains two parts: First, the subject of a work should be clear. When a viewer looks at the work, he should have a clear idea of what the work is about. Second, a work should only have one subject. Don't try to tell more than one things in a single photo.

Principle of Simplicity

Principle of simplicity: Only the components that contribute to the subject should be included in a photo work. Those components should be organized with a simple structure.

The subject of a work needs to be carried in the objects. The objects can be divided into main objects and secondary objects. The main objects carry the majority of the weight. Without them the subject cannot be demonstrated. The secondary objects play a supportive role. Anything that doesn't contribute to the subject is just noise.

The principle of simplicity also contains two parts: First, a work should only include useful components. On the one hand, all the noise should be excluded as much as possible. For instance, when we take a photo of a person, an eye catching red object on the background needs to be excluded. Otherwise it would compete to get the viewer's attention with the main object. On the other hand, the secondary object can't compete with the main object either. When we take a photo of a professor, it's helpful to include his book shelf on the background. But if the bookshelf is more prominent than the professor, then the viewer would be confused about the subject of the work. The second part of the principle is that the included components should be arranged in a simple way. Typical structures include triangle, parallel lines, converging lines, symmetric image, mirror image and frame.

Principle of Balance

Principle of balance: The components of a photo work should be arranged in balance inside its image space.

A photo is two dimensional, but it contains a three dimensional space. Besides the left and right, top and bottom, it also has depth. Along the depth dimension the space is usually divided into foreground, middle ground and background. The arrangement of the components should be balanced along all the three axes. Balance has to be based on certain weight. In this case it's the psychological weight of the components. The factors that determine the psychological weight include volume, brightness, color, complexity and the viewer's common habit. The balance along different axes follow slightly different rules:

- **Horizontal balance** Humans are most sensitive to horizontal balance. It's so exact that it roughly follows the law of the lever. A component with bigger weight near the center of the image on the left can be balanced with another component with smaller weight farther from the center on the right, and *vice versa*.
- **Vertical balance** Vertical balance follows different rules. People normally expect an object to be light at the top and heavy at bottom. If it's turned upside down it would look unstable.
- **Depth balance** People tend to pay more attention to things closer than farther away. So as a rule, try to avoid a photo with empty foreground. Depth balance is influenced by perspective. A component farther away will be assigned more weight than it appears on its own.

Principle of Dynamism

Principle of dynamism: The components of a photo work should be arranged in such a way that they look dynamic, but not static.

Although breaking balance sometimes could create dynamic effects, these two principles are not incompatible to each other. Many photos are both balanced and dynamic. The dynamism of a work may be enhanced with the following factors:

- **Position of the main interest** As a rule of thumb photographers try to avoid putting the main interest of a work in the center. They form *the rule of the third* on the basis of experience. That rule suggests people to put the interest at the third from the edges. And the upper-right third is the best choice among the four positions of third.
- **Dramatic lines** Including dramatic lines in a work could make it dramatic. Strict horizontal and vertical lines are static. Dramatic lines include diagonal straight lines and more effectively curves.
- **Association among components** Putting independent components together would make a static set. Adding some connections among the components immediately makes the set more interesting. Association may be formed in various ways. It could be based on size, shape, color, etc.

Artistic Appeal

Finally we reach the artistic appeal of a photo work, the core of photography as an art form. In photography we could put art well on the basis of psychology. That's the way I would construct the aesthetics of photography. But here I don't want to get into philosophical investigation. Rather I'd summarize some personal experience as a photographer. Compared with composition these summaries are even more rough, general and abstract. If there are universal laws in exposure, focusing and lighting, common intuition and judgement in composition, the artistic appeal of photo works is diverse and individualistic. The art of a photography master is both unique and personal. As general summary I can only say something very basic here.

Uniqueness

A unique photo has more artistic appeal. This is based on human psychology, a result from evolution. Familiar objects were not interesting, because our ancestors could handle them at easy. In this way they could put more attention on strange things, which generally were more dangerous. This apparently had survival benefit. In our case unique photos are more interesting, because they are different from most of the photos we've seen before. A photo may be unique with the following features:

- **Unique subject** Try to photograph something people normally pay little attention to. For a familiar object try to demonstrate an unusual aspect of it.
- **Unique shooting angle** Move around the object, stand on chairs or stairs, squat down, or even lie on the ground, then you have more chance to find a unique shooting angle.
- **Unique components** Include something which is rare, such as lightning lines, double rainbows, reflections, etc.

Visual Impact

Photography is a visual art. Sheer visual impact could already attract the viewer's attention. Common factors of visual impact include:

- **Volume or height** Big mountains, huge waves and skyscrapers themselves can have visual impact.
- **Vibrant colors** Vibrant colors are bright colors. The blue sky, red sunset and pink tulip all have vibrant colors. Of all the colors red is the most salient.
- **Contrast** Any big comparison catches attention. Exposure and color contrasts are just two types of comparison. The comparison may be in other respects, such as size, shape, distance, etc.

Emotions

A photo work may contain emotions in it. It may includes laughing or crying people. But more important for photography art is that a photo work can cause emotions in the viewer. A humorous photo makes people laugh. But the photo doesn't need to contain laughing people. It even could contain crying people. Besides laughing a photo may also cause other emotions, such as fear, anger and sadness. It could even just bring the viewer into a tranquil mood.

Ideas

A photo work may express an idea, such as in the case of concept photography. But more importantly it can influence people's mind. Advertisement photography is a typical example. The purpose of an ad photo is clear. It's used to persuade customers to buy the product. Apparently this is just one way of influencing the viewer's mind. Many journalist photos also convey clear messages.

Photography Areas

All the above sections contain general characterization of photography. Now we handle speciality of photography. Photography is normally divided into different areas according to their specific objects/subjects. The special objects/subjects in each area require special equipments and techniques and involves special type of art. The areas discussed here are those in which I have had some experience.

Landscape

The subject of landscape photography is nature in large scale, such as mountains, rocks, trees, fields and sand dunes. In this sense landscape photography doesn't have to be of land. The objects could also be lakes and seas. So people coined the word "seascape" for sea views. On the other hand landscape photography intersects with nature photography, but is not equivalent to it. Photography of flowers and animals in nature belongs to nature photography, but not landscape photography.

Equipment

Landscape photography has the highest requirement on resolution, because the works may be displayed in a very large scale. Therefore, it demands good camera and lenses. The large format camera is definitely better, but it's cumbersome to carry in the field. So many landscape photographers still use 135 cameras, or the medium format cameras as a trade-off. Both wide-angle and telephoto lenses are useful, the former for the wide view and the latter for far-away objects. Since the quality of zoom lenses has been greatly improved recently, they are more convenient for composition than fixed-focal-length lenses. Reducing lens changes in the field is also good for protecting the equipment from weather erosion.

Helpful accessories include:

- **Polarizer** for darkening the sky and removing water reflection.
- **Neutral Density filter** for creating the soft look of running water.
- **Graduated ND filter** for pulling the exposures of the land and the sky together.
- **Tripod and remote shutter release** for stabilizing the camera.
- **Bags and vest** for convenient carrying and protection.

Technique

In landscape photography we have to use natural light, including mostly sunlight, moonlight, lightning, etc. The quality of sunlight varies widely during the day. The golden window for landscape photography is 20-30 minutes around sunrise and sunset. The sunlight in that time window is perfectly diffused and has a pleasing warm cast. If you miss that time try to pick an overcast day. Avoid strong direct sunlight in any case.

For exposure the matrix metering mode works most of the time. You just need to pay special attention to the luminance difference between the land and the sky. A trick is to use spot metering to find that out. If necessary, you may use an appropriate graduated ND filter. Focusing is not an issue for landscape photography. When you include very close foreground objects, hyperfocal distance focusing is probably needed, to have the biggest depth of field. In terms of composition the horizon worth special attention. Make sure it's levelled. Otherwise, the whole view would look unstable.

Art

Why is a landscape photo attractive? Some beautiful scene itself is already attractive enough. But as artists we shouldn't be satisfied with just recording a beautiful scene. Especially for those famous views, thousands of people would take the same photo every day. We need to ask the question, how can my photo stand out among millions of other photos? In this sense we might want to avoid too famous scenes, or at least try something unique with it. We could explore a different shooting angle, include some unique components, such as a moon, a lightning, star trails, etc. In the end just uniqueness might be still not enough. Even a natural scene could be endowed with human emotions. This has been practised in painting for a long time. And it's also one of my personal goals to achieve.

Architecture

The objects of architecture photography are apparently architectures: buildings, bridges, dams, monuments, big sculptures, etc., constructed by human beings. Although architecture photography is close to landscape photography in terms of scale, it has quite different characteristics due to its special objects. For one thing many architectures have both exterior and interior. There are also differences between photographing these two aspects.

Equipment

Most architectures are in the city, among many other architectures. Normally we have to stand very close to get a desired view. And they are always taller than us. That means very often we need to tilt our lens up to capture the view. The image plane is perpendicular to the lens axis in medium format and 135 cameras. In this case perspective distortion is unavoidable. The foundation of the architecture appears unproportionally bigger while the top appears smaller. A large format camera can easily overcome this problem. Even when the lens is tilted up, its image plane can be adjusted to be parallel to the architecture facade. So the distortion goes away. Since we stand close to the object, a wide-angle zoom can handle a majority of the situations.

Architecture photography also requires less accessories. When the light is strong enough a tripod is dispensable. But for dawn and night scenes, it is necessary. Sometimes a polarizer is useful for removing reflection from glass surfaces. While photographing on intricately lit street a lens hood is helpful to shade unwanted light away.

Technique

The lighting condition of architecture is much more complicated than landscape. It involves both natural light and uncontrollable artificial lights. And the artificial lights are diverse in strength and color and irregularly distributed. In photographing architecture exterior using sunlight we should also avoid strong direct sunlight. With artificial lights we should try to avoid complicated situations by choosing the appropriate shooting angle. In photographing the interior hot shoe flash and studio lights may also be used.

As a result architecture photography is most demanding in exposure skills. Matrix metering doesn't work all the time. Exposure compensation is not rare. Using a digital camera with histogram, exposure is easy to check and correct. Focusing and depth of field control is trivial. Auto focusing with a F11-F16 aperture should work almost all the time. Since its objects and contexts are often complicated, composition in architecture photography is also very difficult. Sometimes it's just impossible to get rid of distracting objects nearby. And the scene is often cluttered.

Art

Certainly an architecture photo can demonstrate the beauty of the architecture itself, just like in landscape photography. However, architectures are created by human beings. Compared with nature they are culture-laden. This special aspect cannot be ignored by architecture photography. Besides,

there is much more communication between humans and architectures. All in all architecture can be used as a window of culture. This is the direction I would explore more in the future.

Portraiture

The main objects of portraiture photography are people, a single person or a group of people. In the past portraiture was made for powerful people to leave souvenir. Before photography was invented it had been done solely by painters. As photography got mature portraiture was its first major application.

Equipment

Portraiture photography has low requirement on equipments. A 135 camera is quick at capturing transient expressions and postures. For posed portraiture an 85mm fixed-focal-length lens is enough. For photographing moving models a zoom lens facilitates the composition. If the portraiture is done in the studio, no extra accessory is needed.

However, the whole set of studio equipments are all helpful. These include lights, light modifiers and background. The importance of a standalone light meter decreases with digital photography. We could take test shots and check the exposure directly.

Technique

Main portraiture techniques lie in setting up the photographing context and capturing the desired facial expressions and body postures of the people. The context include lighting (main light, secondary light, etc.), the background, supporting objects (stools, flowers, toys, etc.) and costumes (makeup, clothes, etc.). All the components in the context have to coexist harmoniously. The pose and expression can be designed. While pose is easier to hold, even an actor cannot hold a particular expression very long. To avoid stiffness and make the pose and expression look more natural, we often ask the model to keep moving and pose spontaneously in the process. So the capturing skill is essential for a portraiture photographer. We need to press the shutter release button at the right moment.

When the lighting is set up, the right exposure setting on a digital camera could be found with several test shots. Even photographing a moving model auto focusing is good enough. The depth of field for portraiture shouldn't be too big. Usually the aperture is set at F5.6. In terms of composition, once the background is set up it's easy to compose a studio shot. Outside the studio, attention needs to be paid to distracting objects around the people. They should be avoided as much as possible.

Art

A photo of a handsome boy or a beautiful lady is attractive by itself. However, the body is just a superficial part of a person. A photo of a beautiful scene is a good landscape photo. In contrast we have much less justification to stay at what we directly see in portraiture photography. Besides the body, a human being also has a spiritual world. And that's the core of what a person is about. Therefore, the highest art of portraiture photography is to reveal the soul through the body.

Still Life

Still life photography covers yet another area. Still life refers to small items in both nature and culture. As long as the items are small enough they could be anything: petals, leaves, pebbles, books, coins, hand phones, etc. Although they are called "life" most of them are inanimate. Still life photography is extensively applied in advertisement. But as an art form it can do more than that. The micro scale views were unpopular in traditional still life painting, but micro photography has become an important part of still life photography.

Equipment

We have the most control in still life photography compared with other areas. As a result the quality expectation is also the highest. So does the requirement of equipment. A large format camera is definitely better in this case than a 135 camera. High quality lenses with focal lengths in a big range, from normal to telephoto, are useful. And for micro photography a dedicated micro lens is indispensable. Before I bought the micro lens I once tried close up filters and the extension tube. They became useless thereafter. For black and white photos we could use colored filters. Other than that no accessory is essential.

Still life photos are mostly taken in the studio. In this case studio lights are necessary. However, the still life setting is quite different than portraiture. We could put the objects directly on the table, but very often special platform is needed. For instance, if we want to put the main light under the object a normal table won't work. Usually a still life stool with transparent platform can be built. Sometimes equipments are also needed to fix small objects. Clips and glues may be helpful in these cases. In fact there is no limit of equipments for still life photography.

Technique

Compared with portraiture the main technique of still life photography resides solely in the set up. Since still life is still, capturing is trivial. The poses of people are limited. We could let a person stand, sit, lie, or at most ask a youth to stand on his hands. But with still life objects we could do all kinds of crazy things. In making a still life setting, the arrangement, structuring and lighting all are important. Sometimes the interest mainly comes out of dramatic lighting effect.

The lighting condition of still life photography is normally intricate. Matrix metering seldom works. Very often we put the objects on a completely dark background. In this case the metering has to be focused on the objects. Spot metering is not rare case. If the exposure is still not right based on test shot, use exposure compensation directly. Auto focusing helps in still life photography, but under many circumstances we have to switch to manual focusing. Still life photography is very sensitive to depth of field. Especially in micro photography, stepping even one stop up or down in aperture would have noticeable image effect.

Art

In the aspect of art still life photography generally has no special characteristics than other areas, although its objects are special. There exist also different levels of art. Photos of beautiful flowers, colorful pebbles and amazing jewels cause sensual pleasure in the viewer directly. This could also be created by interesting patterns, textures and shapes. To go a step further, still life photography could reveal the micro scenes that evade our attention in everyday life, and hence satisfy our curiosity. But again the highest art must be able to touch the highest faculty of human mind. If van Gogh could reveal the life of peasants with a pair of shoes, there is no reason why still life photography cannot do that.

Event

The above four photography areas cover almost all the objects. The only exception I can think of now is animals. Event photography is special in terms of subject. It's about a social event. So both people and items are involved. And depends on the location of the event, landscape and/or architecture are also involved. In this sense event photography is a synthesized area. To demonstrate an event we need to use a group of photos, but all the photos must effectively contribute to a single subject. This is the area I entered the latest and have the least experience of.

Equipment

To photograph an event we'd better have two 135 cameras ready at hand, with different lens attached. Two zoom lenses with 24-70mm and 70-200mm focal length ranges should be able to cover all the

interesting views. Since the important moments in the event run so fast there is no chance to change lens during the event. Since many events take place in low light indoors, a powerful hot shoe flash with an appropriate diffuser is very helpful.

Technique

As a synthesized area, for specific objects, whether they are landscape, architecture, people or items, all the related techniques in the above areas can be used. But the critical technique of event photography is to select the right view to photograph. Important people, items and moments in the event must be given special attention. For a Western styled wedding, the bride and groom are the most important people. The rings and cake are the most important items. The entrance of the bride led by the father and then the ring exchange are the most important moments. All these cannot be missed in wedding photos. For a complete demonstration of an event, besides the important objects the context of the event should also be included, such as the location, guests and audience, and even behind-the-curtain views.

Art

Each photo in an event set could have its own artistic appeal. However, the general appeal of a whole set of event photos doesn't directly depend on that of each photo. In this case the viewer is looking at the set as a whole. On top of all the separate photos there are higher level features to consider, such as balance between different aspects of the event. These features are more important.

Photography Practice

Now we reach the individual part. My photography practice was divided into several phases:

- **Entrance** 1993-1996: Basic theory
  My interest in photography first appeared at PKU. Moving from USTC to PKU I felt a cultural shock in the campus. It became clear later that I was experiencing a fundamental transition of thought. Art became indispensable under the new humanistic world view. For the first choice photography, as a heavily technology-laden art form, naturally appeared to be the best candidate. This phase was focused on basic theory, as I even couldn't afford an SLR camera.
- **Studying** 1997-2001: Further studying and practice with SLR
  With an excellent Teaching Assistantship at UConn I was able to buy an SLR camera and several lenses in the second school year. Now I could have a feel of aperture, shutter and lenses with different focal lengths. In this phase I studied over a dozen of photo books and practised accordingly. Although I didn't see my level of photo taking significantly raised for a long time, the untired practice laid the foundation for later developments.
- **American West** 2002-2005: Landscape in the natural parks and cityscape in the major cities
  I made a major upgrade of my photo equipment after two years of working at Novell. Then I started to use slides instead of negative films. The hardware upgrade partly contributed to the improvements in this phase. But the main factors were active participation in the activities of a local camera club and the Photographic Society of America and intensive practice on over a dozen photo trips I made in the American West. On the basis of personal experience and exchange with fellow photographers I was able to move to a higher level.
- **China** 2006-2009: Portraiture and flowers in Beijing and beyond
  When I moved back to China I had the plan to do the same thing in China as in the American West. I even conceived several specific photo trips. But the transition from single to family life forced me to change the original plan. Marriage and child rearing brought constraints, but also opportunities. I quickly shifted my focus from landscape to portraiture photography to take advantage of the new opportunities. Besides portraiture I also did some flower photography near home in Beijing. During this period I was only able to make two photo trips to Huang Shan 黄山 and Ba Shang 坝上.

- **Europe** 2010-2013: Architecture and events in Karlsruhe and beyond
  Photography as a hobby in my case has to be tailored to my master plan. Studying in Germany changed the pattern of my photography activities again. Since the study was just a short period expedition I had no chance to do either landscape or portraiture photography. Most of my photo equipment was left in Beijing. I had to shift my focus again to architectures, gardens and events, to take advantage of the local offerings. Generally it's a shift of subject from nature to culture. While working on my dissertation intensively I tried hard to squeeze time to travel around. This also provided extra opportunities for photography.
- **Singapore** 2014-
  Singapore is a new place with many new characteristics, some of which are quite unique. In this general settling-down period, especially still with a very young child, I can only continue what I was doing in the previous two phases. On the current level the major development of my photography practice lay in diversifying the areas. Once I have more resource to invest into photography I will try to move it to the next level, on which I would focus more on art and develop personal style.

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