

# Experiments and Experience in SP173

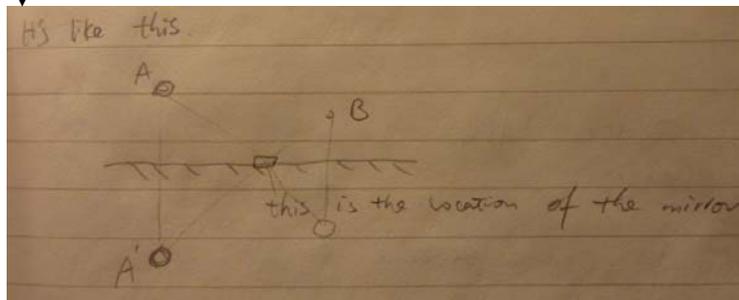
MIT Student

← me | there →

If we keep moving toward opposite directions  
we shall appear the same to each other.

Which reminded me of my diagram in Eleanor's class,  
that I drew to illustrate how to locate the mirror.  
If I couldn't understand that diagram then it was  
more mechanic recollecting of what I learned in high school

Pic.1



Pic.2

01-06-2009 10:30 a.m. Experiment

Photos of mirror  
what you can see from a mirror at A  
vs  
what you can see if it was a frame and you  
look through it from a symmetrical point to  
where you were seeing from the mirror, at B

Mirror (frame)

Reading of Galileo's Dialogue  
His friends & relatives, students & colleagues

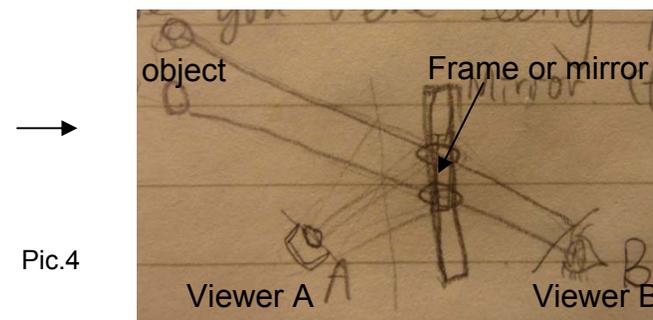
Pic.3

## Develop based on prior experience

When we were doing frame activity, TA and I found that given equal distance from the frame to both sides, if we move the same distance further away from the frame, we appear the same proportionately in the frame. (see Pic.1)

This reminds me of a diagram that I drew in another class, T440, (see Pic.2). The task was to locate a mirror so that people A and B could see each other. This diagram was recollected as a vague memory of my high school learning. I was all the time confused by A' and B'. What are they?

Then, I came up with a new idea. Given object and a place to place frame or mirror. You can see the object at viewer point B through the frame. If you replace the frame with a mirror and look at the viewer point A, you can see object through the mirror. Both images of the object have same size, but viewer A could see the object be flipped from left to right, while viewer B don't.



Pic.4

Subsequent experiment:



Refined experiment:



## Learn from daily observation

These photos were taken in a restroom. The steel reflective board Pic.1 reflects the lines on the ground, but changes their direction.



Pic.1

The board in Pic.2 however doesn't, actually, the lines reflects on board are perfectly aligned with the line on the ground of both sides to the board.



Pic.2

The reason to the different reflections is that the board in Pic.1 is not vertical to the lines as that in Pic.2 does.



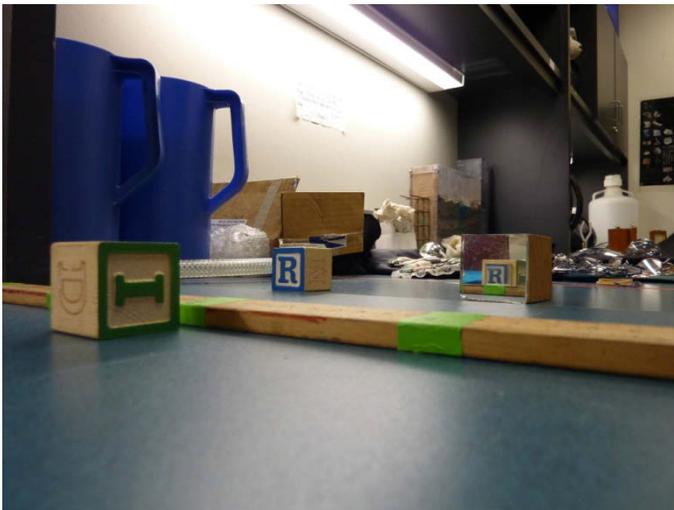
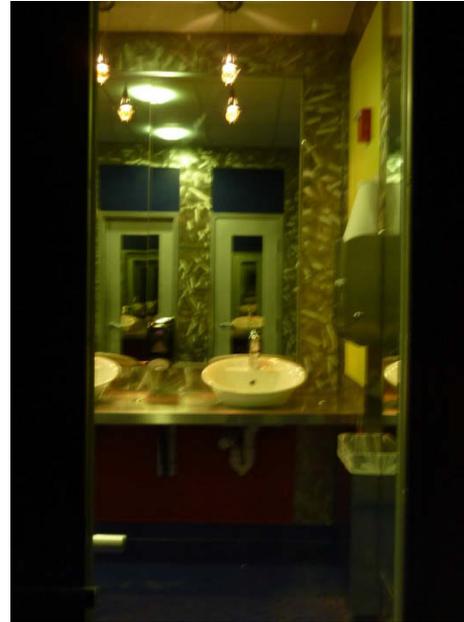
Pic.3

## Subsequent experiment



In this experiment I realized that if I moved the mirror further away at a vertical angle to the objects, objects could be seen as much smaller given the location of the viewer and the object. The book on the left side appear in the mirror to be a natural part of itself. What a trick!

## Relevant photographing

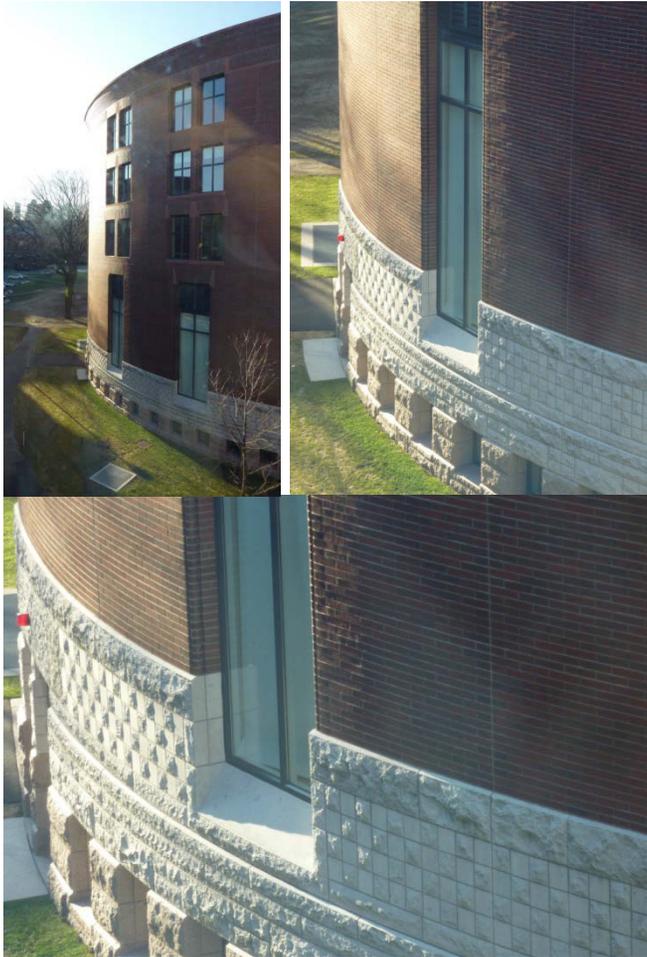




## Galileo's moon painting and my orange sketch

Can he see the part of the moon which is not illuminated? The trunk of the elephant... ..

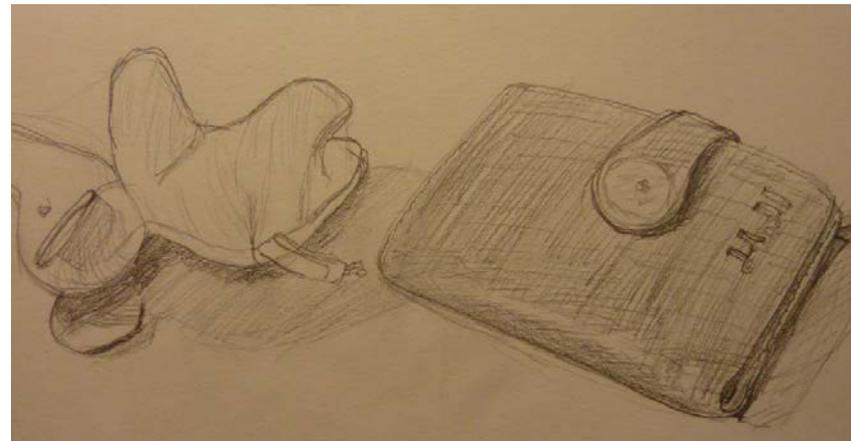
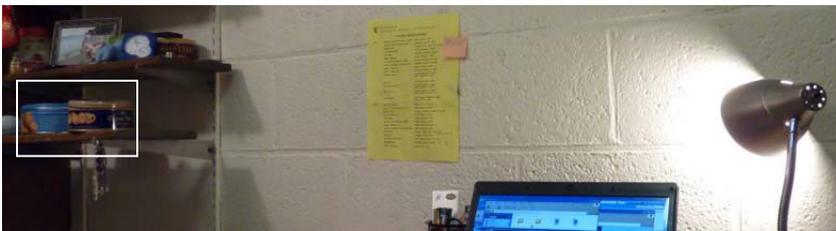
“Moon” effect everywhere



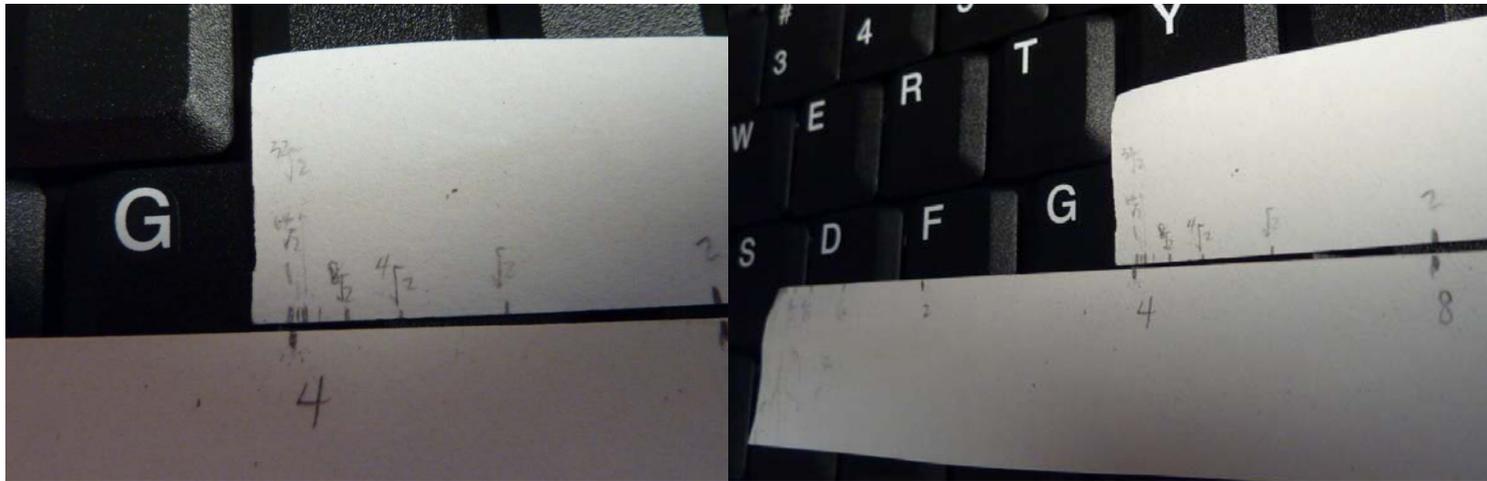
Observation can tell... ..



Where collects most amount of light?



## Knowing through doing



I videotaped the process while RR was teaching me how to use the slide the rule. I got frustrated easily, and argued with him along the way how should a teacher conduct his teaching and how a learner learns.

When I was making a slide rule my self, I felt no pressure and in full control of my activity. Although I knew how to use a slide rule to do multiplication by then, I was excited during the process while I was making my own slide rule following the instruction. I exclaimed, "Ah, this is how it works!" In the middle of 1 and 2 is not 0.5, but square root of 2!

## The empirical and the theoretical

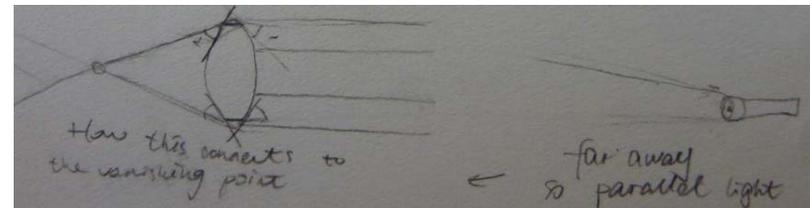
I saw TA drawing the path of light travelling, and didn't find it compelling. I wanted to draw my own diagram illustrating my understanding. Given two beams of light travelling from left above, I drew them according to a set of rules, and found that they didn't converge on the other side, instead they were diffused. This is contrary to the experiment Therese and I did one night.



Pic.1

The experiment was using a torch to find where on the other side of the convex lens the light converge.

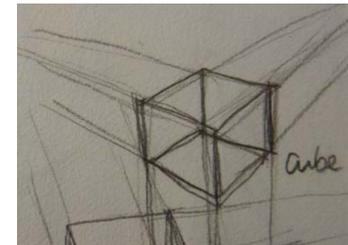
The trend was that light beams converged. So my rules in my drawing in Pic.1 might be wrong.



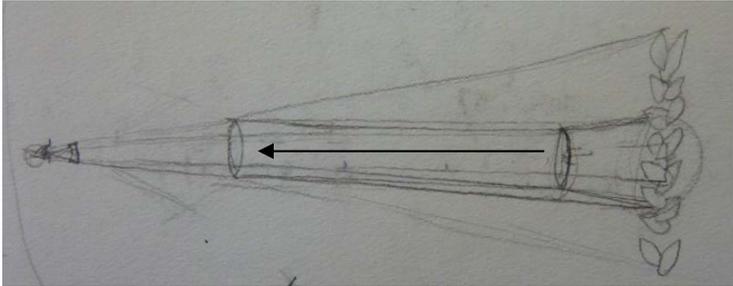
Pic.2

## From question to more questions...

I further thought about a technique involved in our experiment with the torch. If we wanted to see the converging point, I remembered that the torch needed to be held a certain distance away from the convex lens. Maybe it was because then the light beams become parallel. So I generated the cause-effect relationship between parallel line and converging point, which drove me to the idea of perspective and vanishing point. So at this point, I started to compare my eye to a lens.



On my way... ..



TA was drawing a diagram to illustrate how telescope worked. I couldn't understand her diagram. She had a totally different language and system from mine. In order to understand her logic, I felt I needed to keep track of her thoughts from the beginning. I said, I had my way drawing it, I will show you when I finished drawing. I was still on my way to draw it, and not quite ready to share.

This is related to our frame activity. I got my understanding from my previous experience when DS, TA, and I were doing the frame activity group. We noticed that given the viewer point and object, if we move the frame further from the viewer and closer to the object, the object captured by the frame appear to be bigger proportionately. We tried to draw what was seen through the frame. The viewer walked toward the frame, picked up her pencil and paper, looked at the frame again, and realized what she could see now was totally different from what she could see before. So I was wondering when we proceeded to playing with lenses, the effect of lens, or the magnifying effect was actually to pull the scene in the frame from a further distance to a closer distance to the viewer without losing the proportion of image to the frame.

## Unexpected Chandelier



I took a picture of the spilled tea on my laptop. I saw the pattern quite interesting, like the image of dropping milk exhibited outside of our classroom.

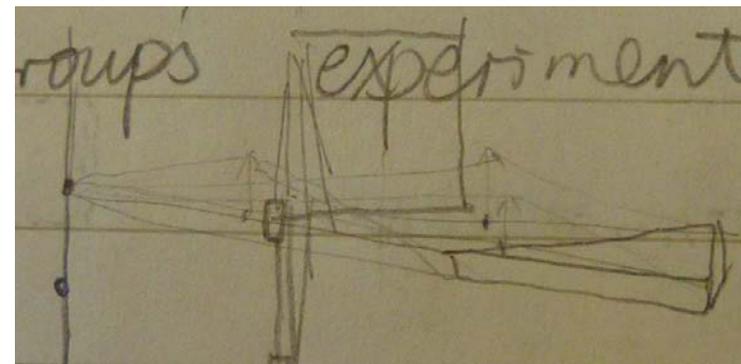
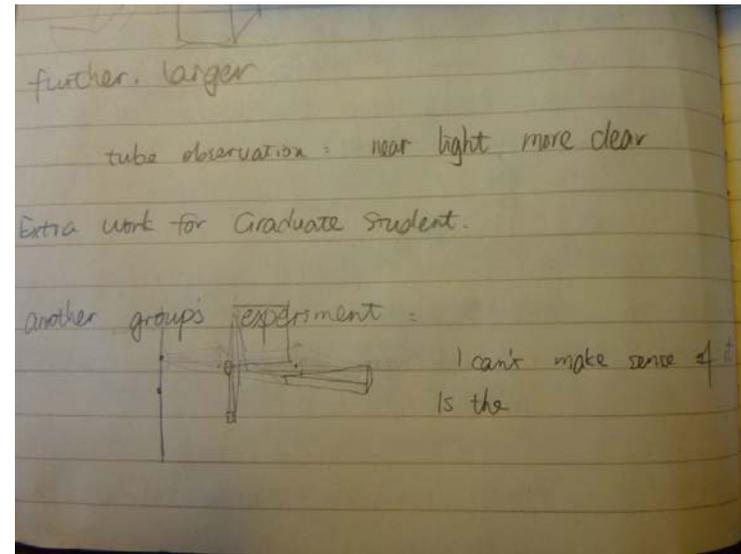
I viewed the picture in my camera and looked at my laptop again. This time, I noticed that by my naked eyes, I could not see a clear reflection of the chandelier on the laptop. But it was quite clear in my camera image.

Why? What does that mean? The camera has the function to make object appear sharper?

## A long-term confusion

I was amazed when seeing classmates' work of painting the lute. I didn't know how they made it. They didn't know either. I was confused, I persisted at figuring it out for a couple of days, but let it go as time went by. Recently, when I was reviewing my notes, I came to understand how it worked. It was owing to my experience playing with compass and understanding magnifying and shrinking effect of lenses.

It is hard, even impossible, for the teacher to decide when the student should and could come to a transformative point. It was quite unexpected. My experience told me that reviewing and returning back to one's own confusion could help.



## Iranian painting: How to portrait people's feet

I was very excited to see how feet were painted in those ancient Iranian paintings. Most of them lack a sense of three-dimension. They appear to be like a sheet of paper. When I was very young, I had problem drawing feet, too. I couldn't represent them in a realistic way just like the ancient painters in Iran.

Figures removed due to copyright restrictions.

## A sense of history

When I was visiting the art museum, I started to pay attention to when the paintings were painted. Through examining the composition, whether or not it was composed according to a coherent perspective, I could tell roughly the time of the paintings.

Figures removed due to copyright restrictions.

## Motion experiments: Galileo phenomenon

According to Settle(1996), Galileo didn't reject Aristotle's theory on motion from the very beginning, actually when he first noticed that bodies with different weights appear to reach the ground at about the same time, he came up with an explanation in favor of Aristotle's theory. He proposed that because of the "imposed impetus", lighter bodies fell faster at its early stage of falling, while heavier bodies were less affected. Modern psychologist discovered from their experiments that due to unconsciousness, when people hold two bodies and release them at the same time, they tend to release the lighter one slightly earlier than the heavier one, which explained why Galileo came up with a incorrect explanation.

Before reading Settle's writing, I had experience playing with heavier and lighter bodies. In my experiments, I tossed two bodies upwards. I noticed that the different weights would affect my action: my both hands would not give the same strength to the two bodies. Such effect would be hard to reduce because it was unconscious reaction. I put my hands together and jump in order to minimize the unconscious effect. It was hard and awkward to jump continually. So I decided to place them on a board, and act on the board. So that the balls could be treated equally.

I was very excited when I was reading Settle's article, especially this part which resonated much to my experience. At that point, I felt myself participating in Galileo's experiment process.

## Looking through a Tube

I had experience looking through a tube, and was excited to see that with a tube I can see things which was overshadowed by strong light nearby. I saw details of the chandelier near the light bulb with the tube. I looked at the surrounding area of most shiny places and got to see the otherwise unperceivable part.

While reading *The Invention of Telescope* (Albert Van Helden, 1977), I thought of my experience, which generated questions in my mind. The author quoted Aristotle's writing about the function of a tube to aid vision. I was wondering if the function noticed by Aristotle was similar to that by me. If not, how come he find it was helpful? Aristotle compared the use of a tube to look through a pit or well, which sounds so empirical, isn't Aristotle been considered as someone who is not fond of empirical study? Isn't he taken as irrelevant to modern science? Is there a clear-cut dividing line in the proceeding of history? What is the relationship between Galileo and Aristotle? Or maybe he was the grandfather of science?

Then I found myself interested in knowing more about Aristotle.

## The value of glassblowing

As I asked Elizabeth “what is the value of Peter’s work in general”, she responded immediately, “People love doing that.”

“What is the value of observing the moon?” “What is the value seeing through lenses?” All the questions about “values” seem to devalue and inhibit a curious mind, to refrain the free imagination, to hinder human effort to make sense of things.

Art and science share the same characteristic, that is to open possibilities to explore the unknown territory. It is emancipating, liberating. It is breaking the constraints of fixed standards. It is freedom. While people dispute that freedom will lead to anarchism and immorality, art and science, with the gift of freedom, make significant marks in human history. Maybe it is because of art and science that history proceeds.

While I was reading articles about the invention of telescope, I was amazed by the seemingly inadvertent steps which hinged the whole chain toward the outcome: the spyglass. History is unpredictable. It is like an on-going creation of a piece of art work by people of the past, the present, and the future. Isn’t it beautiful for us to be at present, be part of this art work, and meet and talk?



“Can I take a picture of what I see through the eyepiece?”

“No!” V.S. “You can have a try.”

Different responses to MC’s question make me reflect on unconscious reactions and responses. I found the habit that I had was very entrenched; it was engraved in my behavior. I reacted automatically. Exposure to alternative responses is very powerful to drive me to emerge from my habits, to reflect upon it. What it means to teach or to have a dialogue?

## How to reach the impermeable

It is terrible to talk, to listen to, not to mention to argue with, your friend who has an impermeable mind.

Worst of all, to teach them.

The learner possesses words, which are like arrows; the teacher, on the other hand, has no arrows, nor shields, which actually is the best way to fight. The teacher becomes a black hole, leaving no response, no comments, no confrontation.

In a world where arrows don't reach anything, arrows start to question who they are. This question is a start for thinking, also a start to action. In the process of thinking and action, arrows will make themselves who they are.

Give company to the "arrows" in the black hole is the way to reach them. Whenever they go, mark their footprint for them. Cheer them up. Connect them to others' groping and inquiry.

Finally, "arrows" get old; "arrows" die;  
Finally, "arrows" write their own story;  
Finally, "arrows" inscribe themselves into the eternal book;  
Finally, "arrows" get rebirth.

*Wonderful Journey!*

*Thank you!*



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