Elucidation of mysterious movement of water and oil on the Istanbul tray

Sendai Daisan Senior High School
Team 06

1. Background

Istanbul tray phenomenon

We prepare a container with water and oil.
And, we apply the pendulum movement.

⇒・Oil surface is parallel to the tray
・Interface of water and oil shakes significantly

《Prior research》

1.Relationship with viscosity and shaking[1]
2.Relationship with pendulum fulcrum, the distance between the center of gravity, and container and shaking[2]

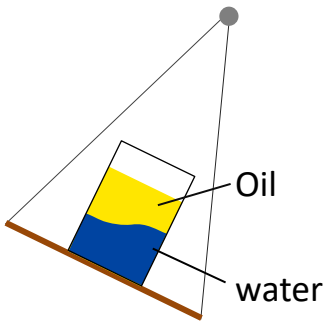

Figure 1. The Istanbul tray

2. Purpose

The cause of this phenomenon has not been elucidated
⇒Our goal is studying the movement direction causing Istanbul tray phenomenon

3. Materials

・oil 200 ml ・water 200 ml ・2 dynamics carts
・a vessel ・wood ・wire（to fix cart and wood）
・camera（smartphone） ・a board（a slope）
・springs

The experimental setup is shown on the figure 2.

The camera was installed in 2 ways.
1. Separated from the tray.
→ Camera did not move.
2. Fixed with the tray.
→ Camera moved along with the vessel

Figure 2. Method tool

4. Method

Experiment〔1〕

We raised or lowered the device. Then we observed the surfaces.

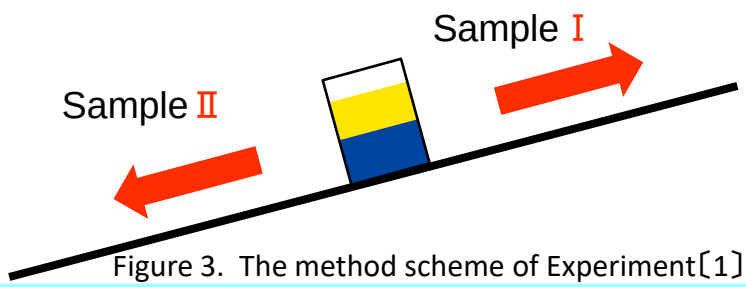

Figure 3. The method scheme of Experiment〔1〕

Experiment〔2〕

We used a spring to move the container. Then we observed the surfaces.

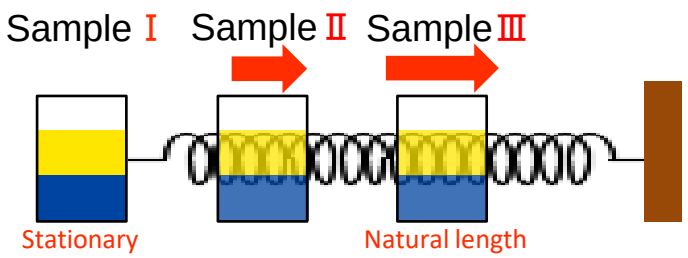

Figure 4. The method scheme of Experiment〔2〕

Experiment〔3〕

We used a spring to produce the reciprocating motion. Then we observed the surfaces.

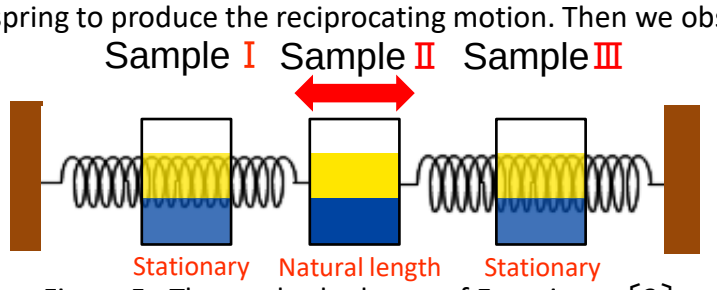

Figure 5. The method scheme of Experiment〔3〕

5. Result

The experiment results are shown on the figure 6.

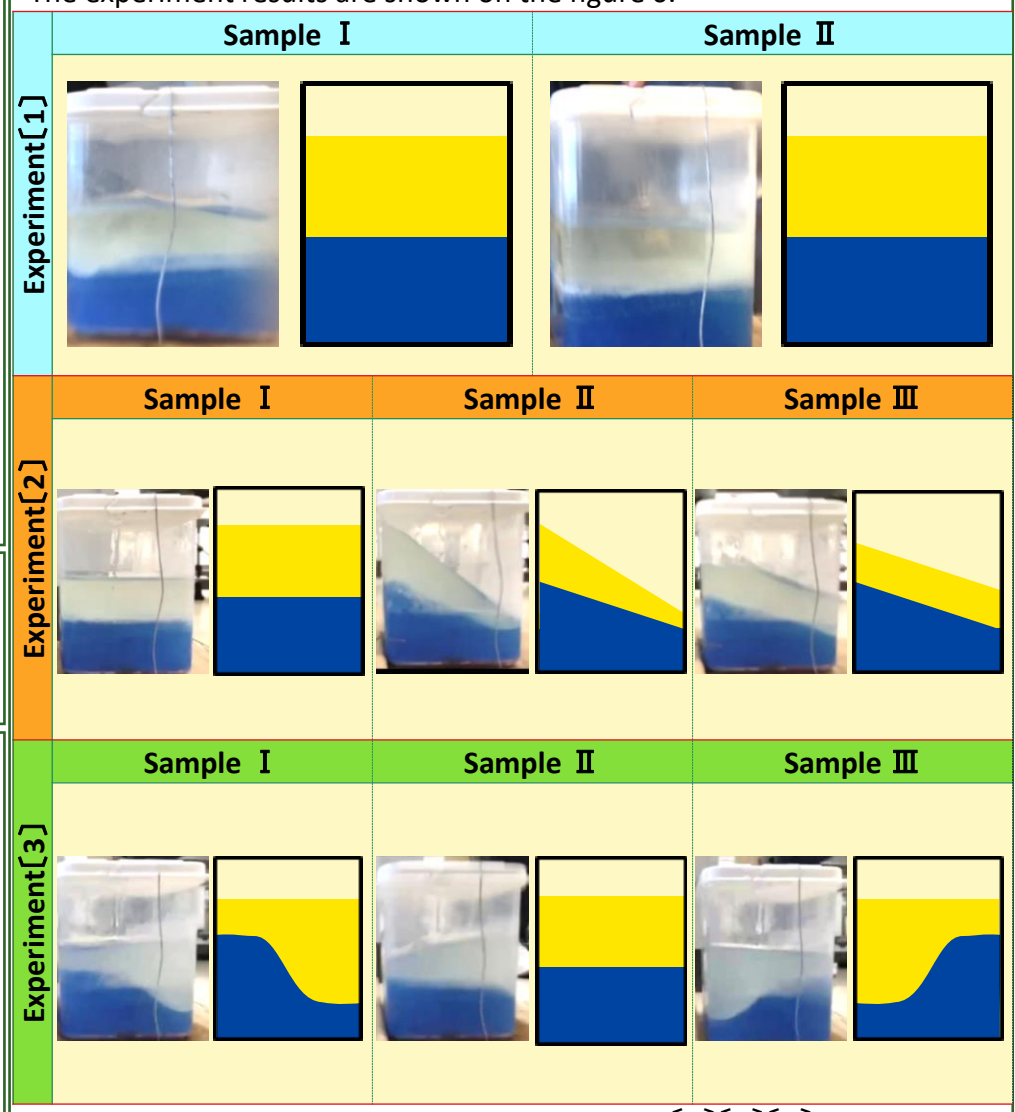

Figure 6. The results of Experiment〔1〕〔2〕〔3〕

6. Conclusion

1. Experiment 1 ⇒ Uniform linear motion does not cause the water-oil surface and oil-air surface to have.
2. Experiment 2 ⇒ Changing the magnitude of acceleration does not cause the water-oil surface and oil-air surface to have.
3. Experiment 3 ⇒ Changing the direction of acceleration causes the water-oil surface and oil-air surface to have.

The water-oil surface to have wave form, but not oil-air surface [Istanbul tray phenomenon]

Changing acceleration direction causes Istanbul tray phenomenon

7. Future work

1. Comparing the results between pendulum and Experiment〔3〕
We make cycles even, and comparing two of reciprocating movement, pendulum and linear.

2. Experiment with three-layer liquid
We only used two-layer liquid, and only one surface gives the move form. To study the relationship between two waves, we design the experiment using three-layer liquid.

3. Analyzing why changing acceleration direction cause Istanbul tray phenomenon
We studied Changing acceleration direction causes Istanbul tray phenomenon, but we don't know why Istanbul tray phenomenon happens. So, we want to analyze this movement by more experiments.

Previous Experiment

(1) In FY 2017, project studies「The movement of two layer liquid of Istanbul tray」
(2) In FY 2018, project studies「Elucidation of mysterious movement of water and the oil of Istanbul tray」