Why does the Blue Grotto appear blue?

Introduction

Why do Blue Grottos, such as the one in Capri, Italy, appear blue? This question is interesting as it concerns why water appears blue so I will study this by calculating its transmissivity.

Experiments

The experiment to calculate transmissivity of water

Equipment
A foam polystyrene box (35 × 20 × 20 cm³) and a black wooden box (180 × 20 × 20 cm³) were used. A halogen lamp, when the foam polystyrene box was used, and a fluorescent light, when the wooden box was used, were used as the light source.

Method
The light inside each container was analyzed and the transmissivity was calculated.

The experiment to check the water absorbs all red light

Equipment
Three foam polystyrene cubes (5, 10, and 20 cm on each side) and a drum whose inner part was covered with foam polystyrene were used. A halogen lamp, in the experiment of the foam polystyrene boxes, and sun light, in the experiment of the drum, were used as the light source.

Method
The lights inside each container was analyzed and the transmissivity was calculated.

Results and Discussion

Figures 1 and 2 show the percentage transmittance against wavelength. As Figure 1 shows, water absorbs a lot of red light and little green and blue lights regardless of container or light source. As Figure 2 shows, transmissivity can be almost zero,
you have a large amount of water as a drum. Larger volumes may absorb a larger spectrum of light.

**Conclusion**

Water absorbs red light and has potential of making blue similar to the Blue Grotto. In the future, to clarify the relationship between transmissivity and volume, I’ll experiment with higher precision.

Since the 1st Anglo-Japanese Science Conference, we have further explored this area. Below is a summary of our further work in order to achieve greater precision: We believe that $F(\lambda) = s(\lambda) \times a(\lambda)^d$ holds.

$\lambda$: Wavelength. Unit is usually nm.

$F(\lambda)$: Strength of light whose wavelength is equal to $\lambda$. Various units such as W/cm $^2$ are used.

$s(\lambda)$: Strength of light used as a light source whose wavelength is equal to $\lambda$.

Various units such as W/cm $^2$ are used.

$a(\lambda)$: Transmissivity of light whose wavelength is equal to $\lambda$.

d: Distance light goes through water. Unit is usually meter.

After identifying transmissivity ($a(\lambda)$), we can calculate the water’s colour ($F(\lambda)$) only by deciding the distance between our eyes and the light sources (d) and what to use as the light source ($s(\lambda)$).

Therefore, by calculating with a computer, we can analyze the light of the Blue Grotto only if we measure its spectrum. However, we have not yet had a chance to measure it in Italy!

**About the Authors**

Yuki Hara was born in Aichi, Japan in 1996. He has studied about the Blue Grotto for two years since he succeeded to his predecessors and in 2012 he received some awards and joined the science conference at St.Paul’s School. He is very interested in economics and his ambition is to be a greater entrepreneur than Mark Elliot Zuckerberg, the president of Facebook.

Yuki Matsuoka, Ken Ohashi and Shuji Yamada also attended the science conference at St.Paul’s School.