

UNDERWATER COLORIMETRY

COLORS IN THE OCEAN-II

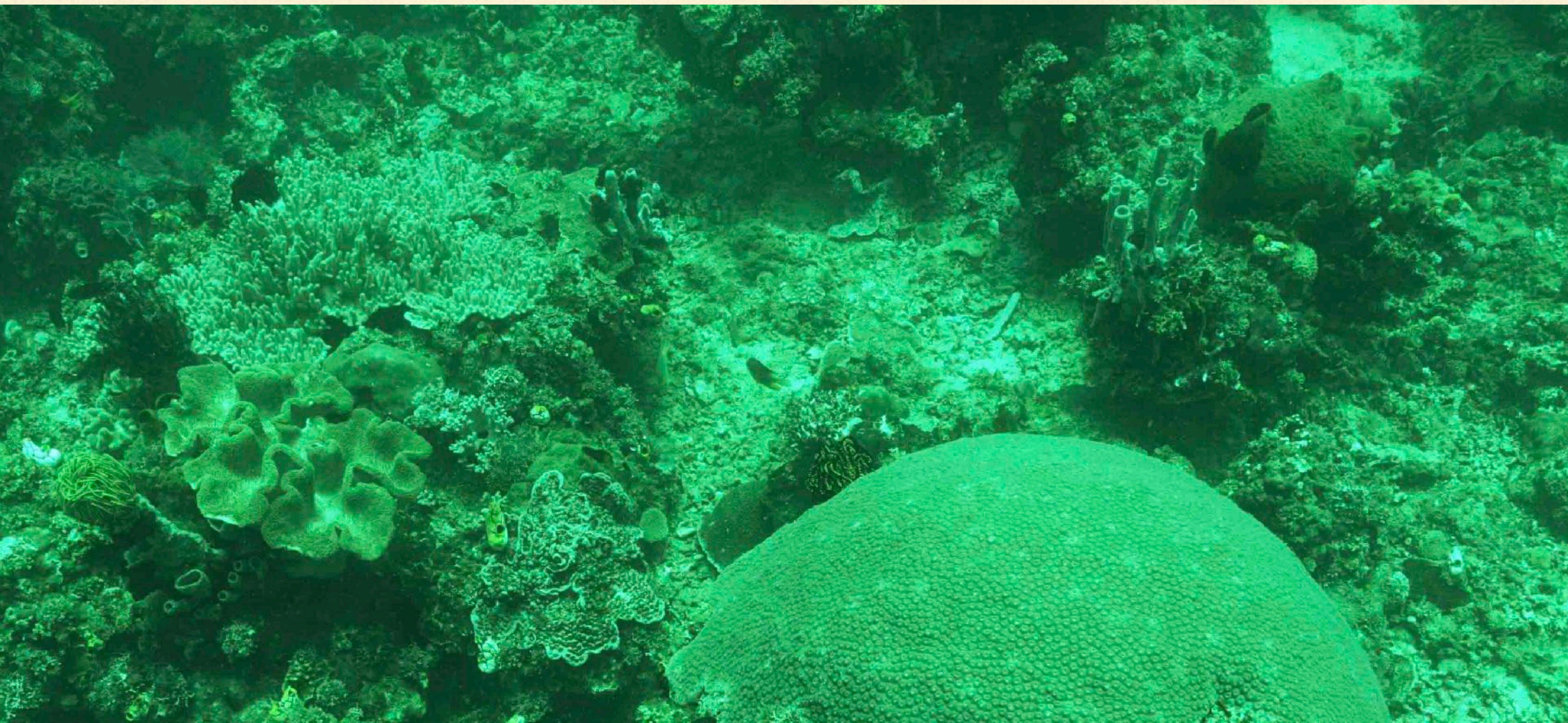


Dr. Derya Akkaynak | dakkaynak@univ.haifa.ac.il

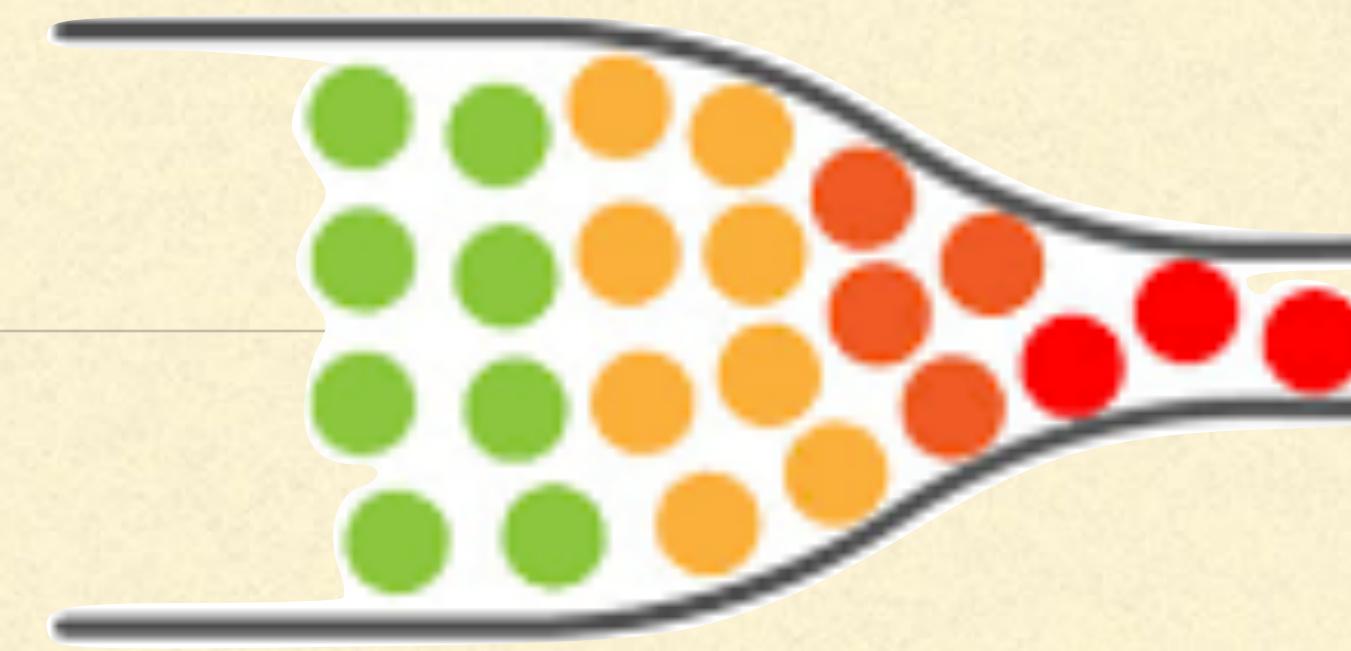
Ocean Color = **HUGE** Problem!



Ocean Color = **HUGE** Problem!



A Scientific Bottleneck



We were unable to consistently standardize colors in underwater images

COLOR IMAGING UNDERWATER

A SUBJECTIVE, NON-LINEAR TIMELINE

5

1826



COLOR IMAGING UNDERWATER

A SUBJECTIVE, NON-LINEAR TIMELINE

5

1826



First photograph
by J. N. Niepce

COLOR IMAGING UNDERWATER

A SUBJECTIVE, NON-LINEAR TIMELINE

5



1826



First photograph
by J. N. Niepce



University of Texas at Austin

Photo: Shir Bar

COLOR IMAGING UNDERWATER

A SUBJECTIVE, NON-LINEAR TIMELINE

5

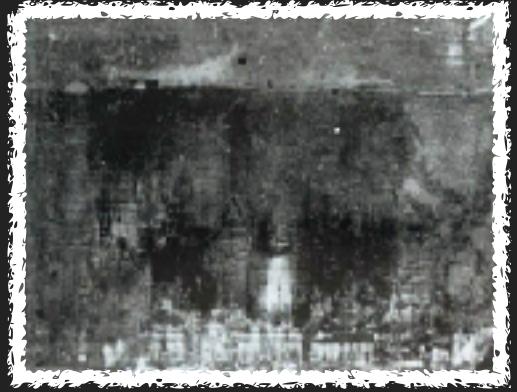
1826



First photograph
by J. N. Niepce

COLOR IMAGING UNDERWATER

A SUBJECTIVE, NON-LINEAR TIMELINE



First underwater
photograph by
W. Thompson

1826

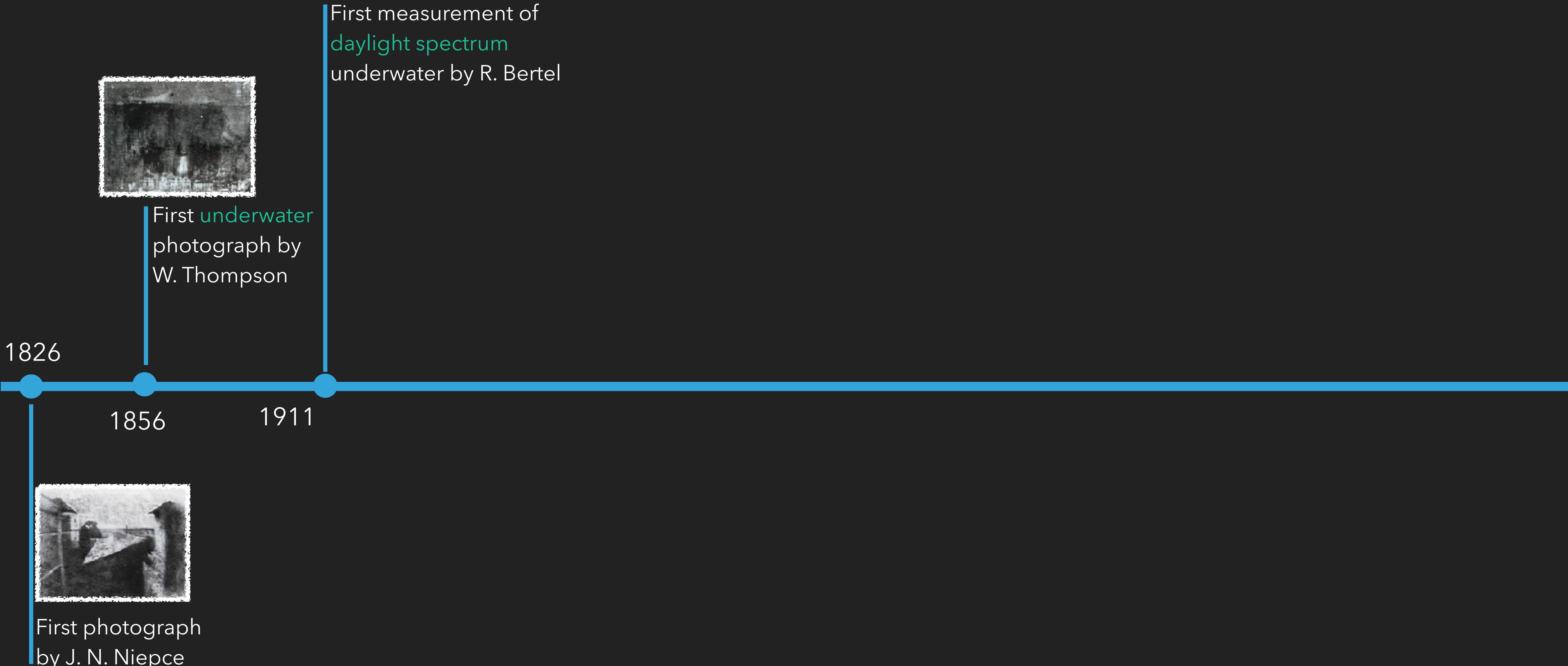
1856



First photograph
by J. N. Niepce

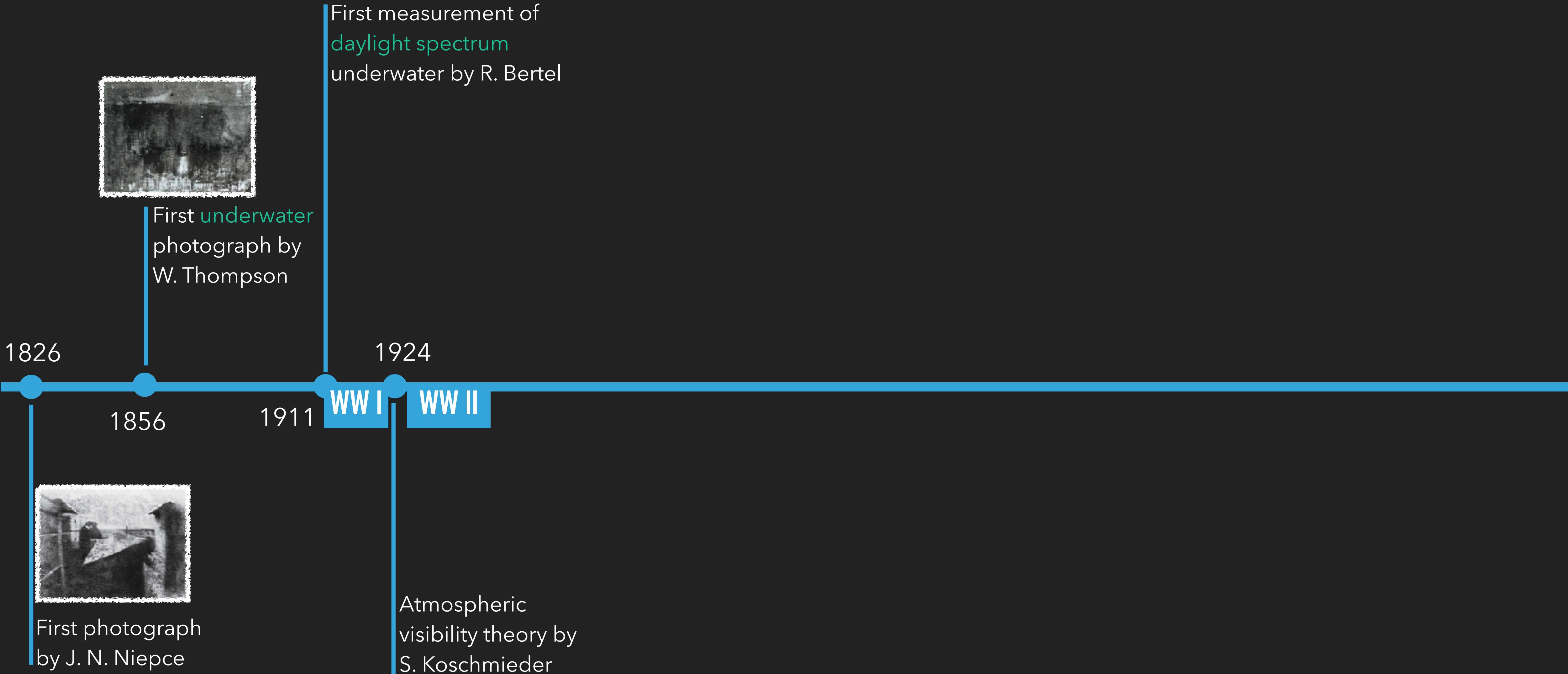
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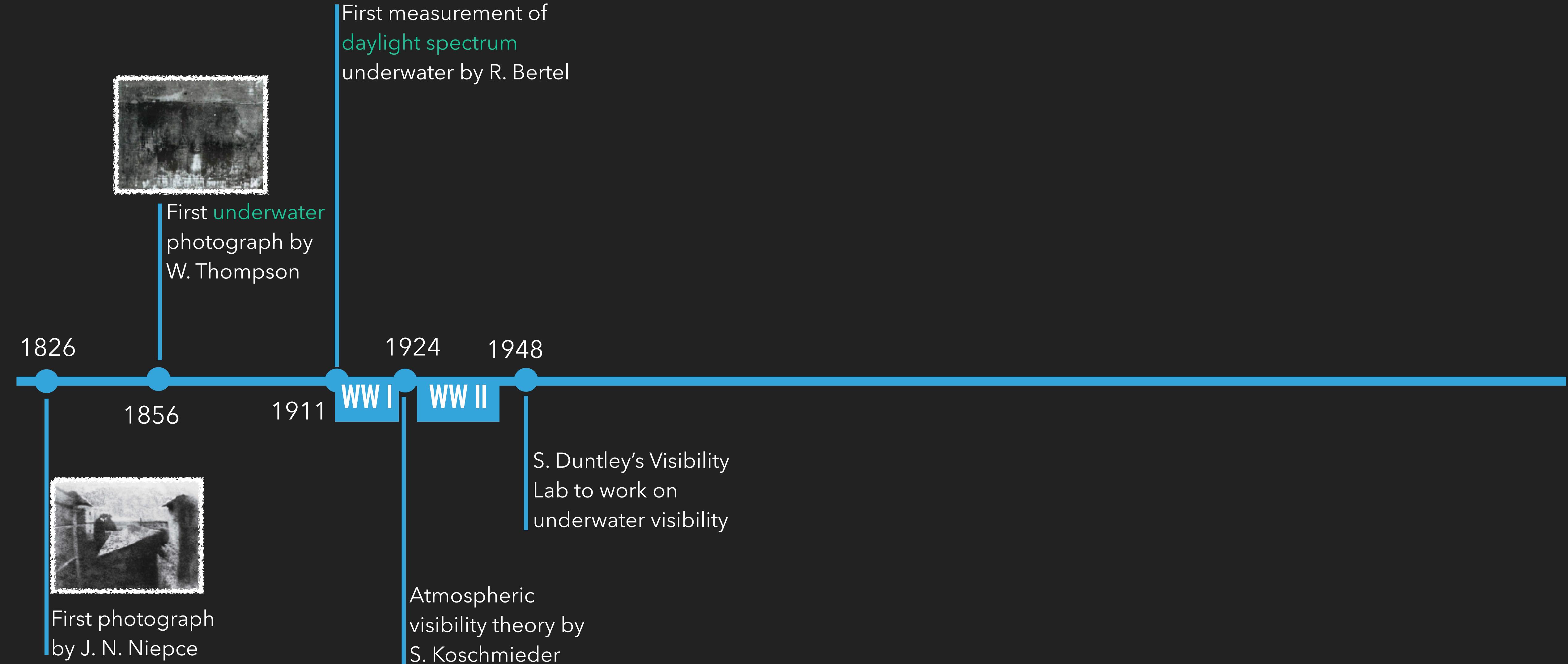
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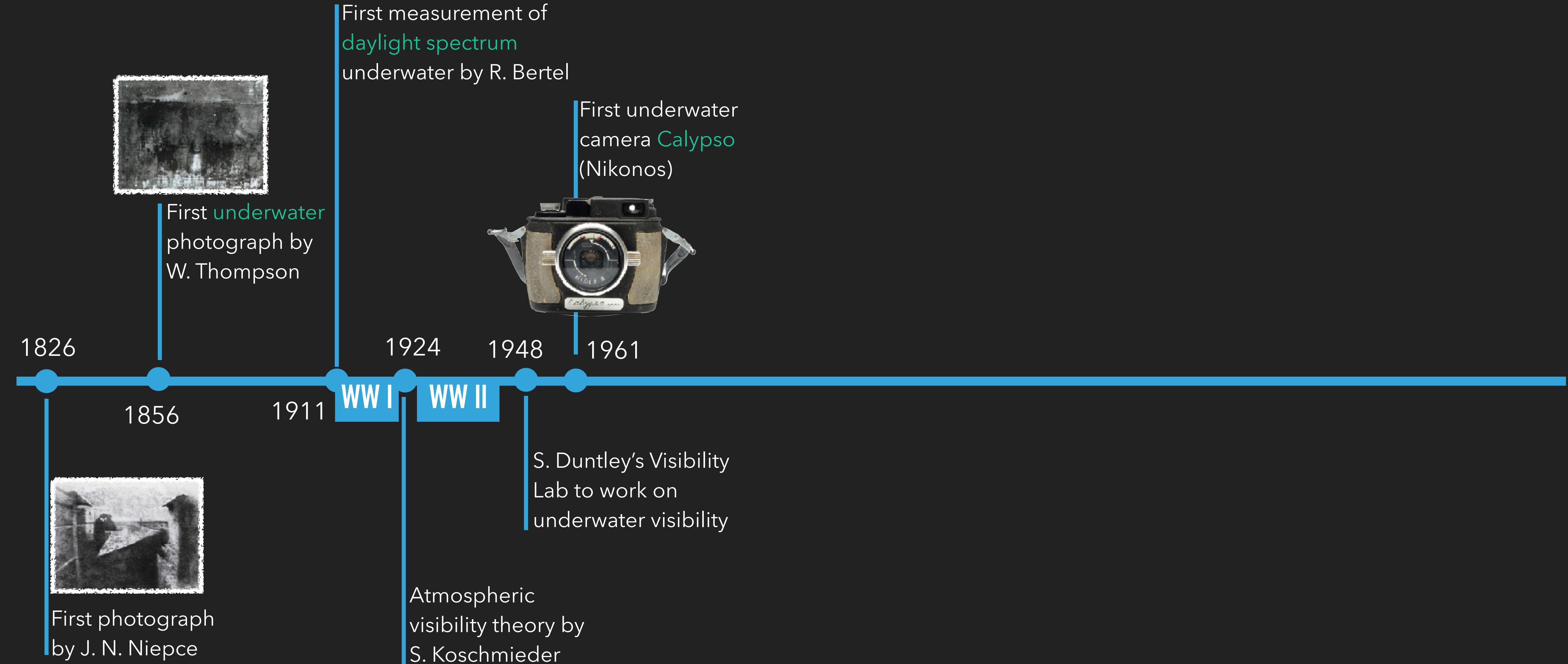
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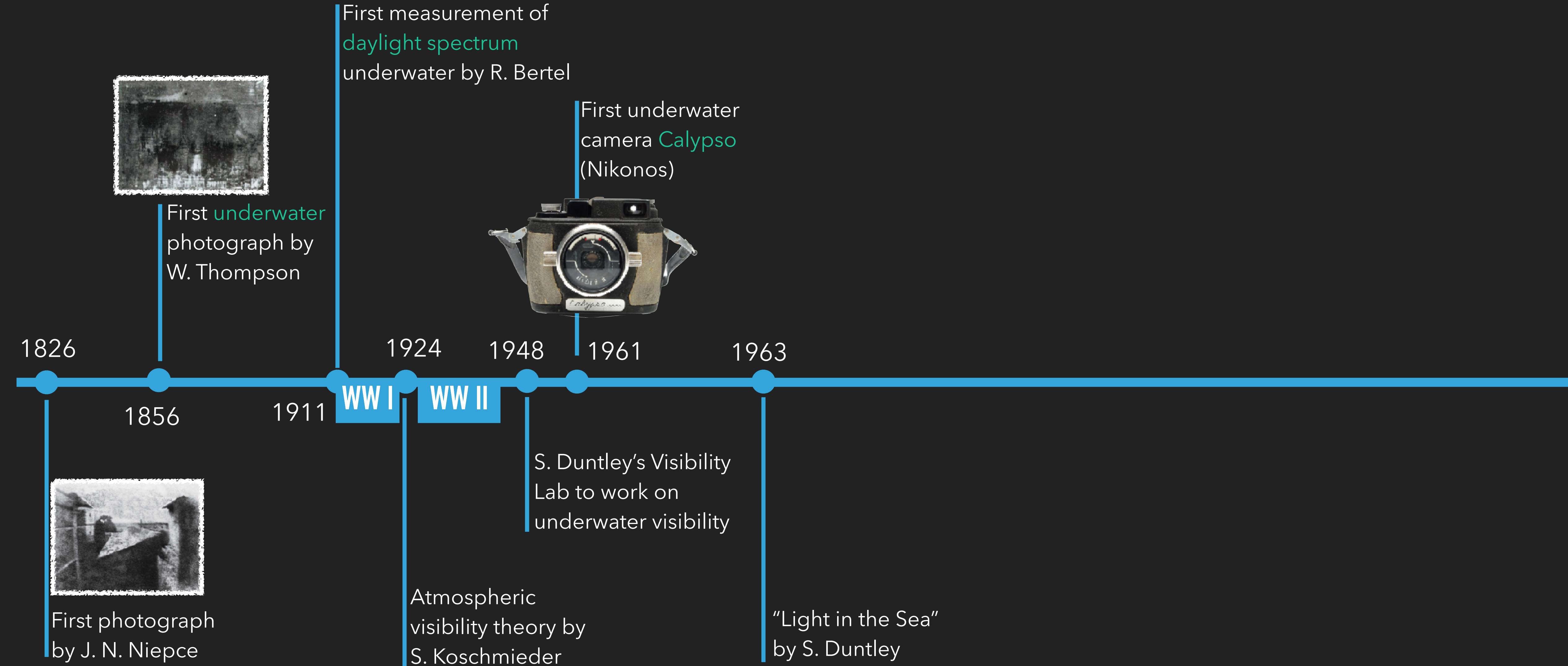
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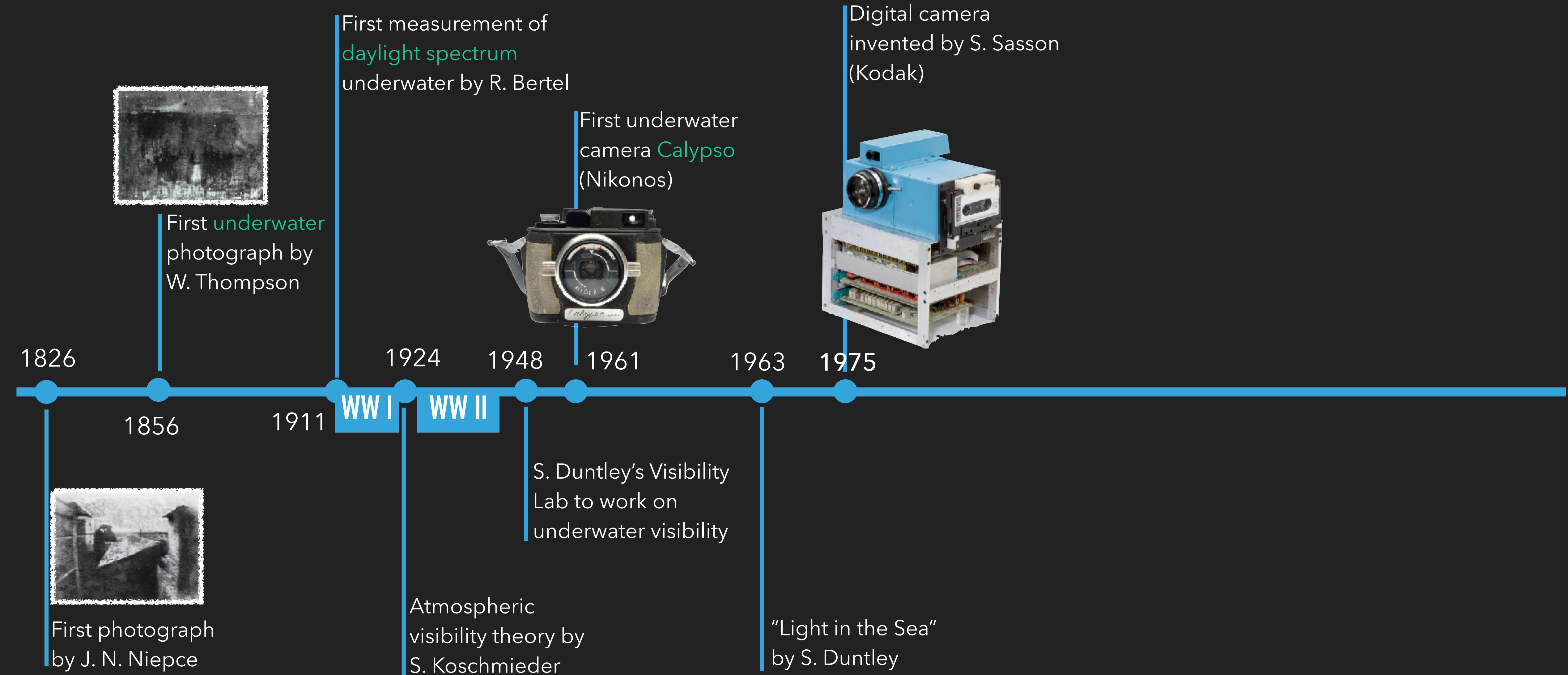
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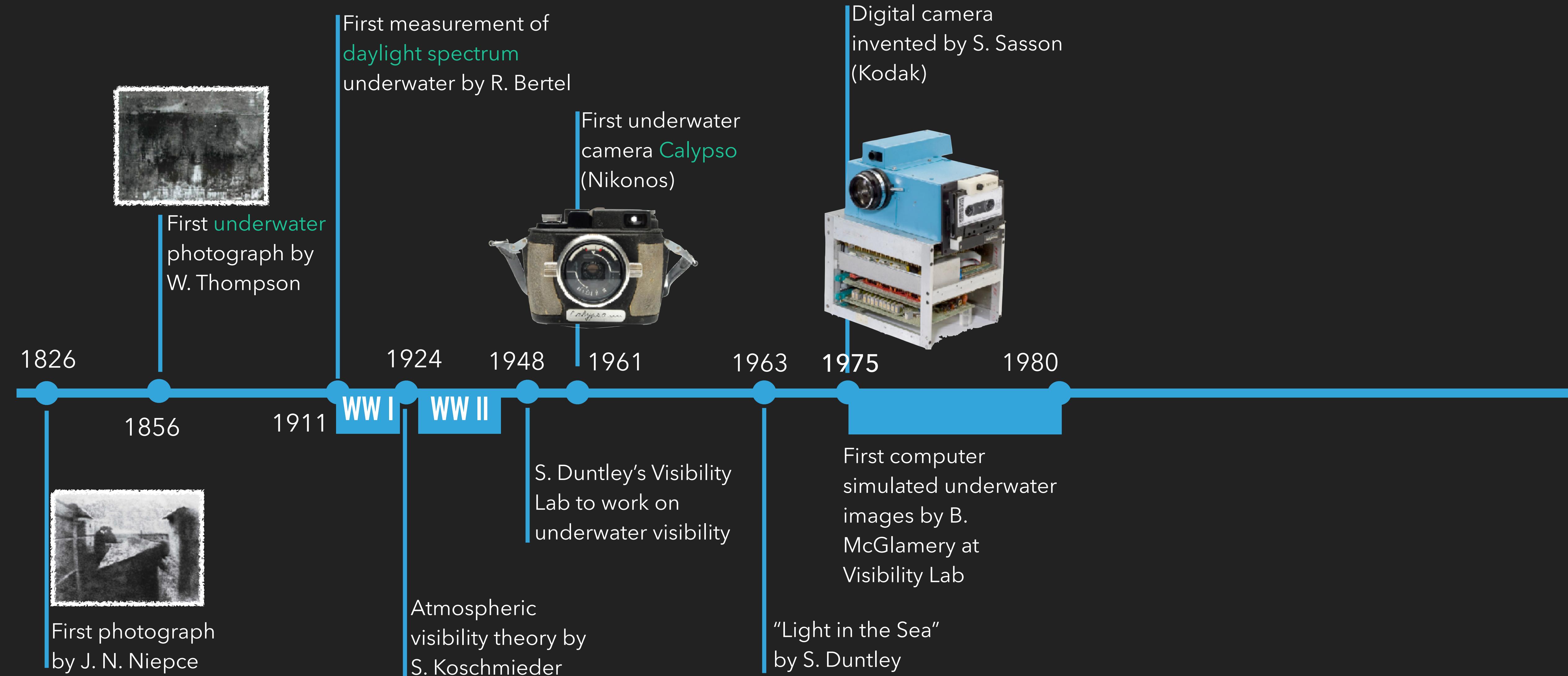
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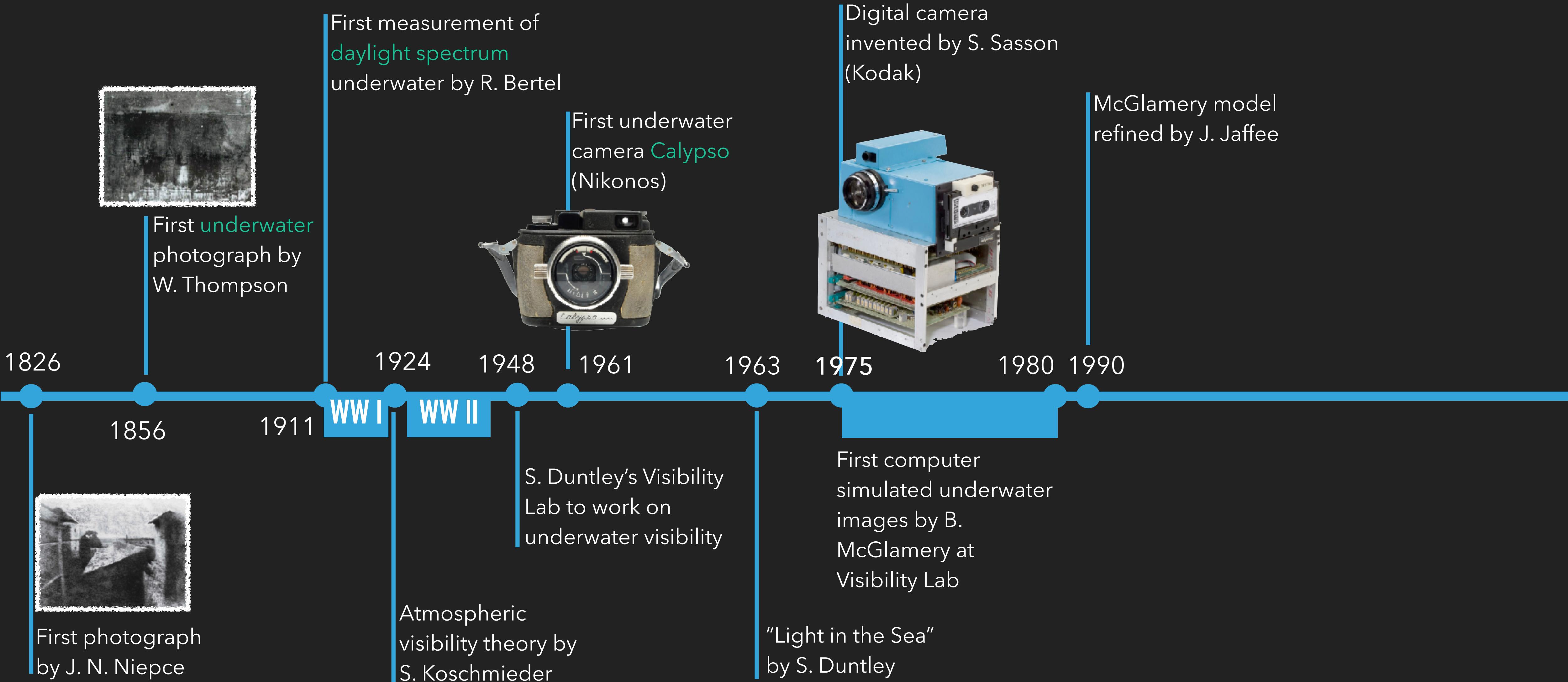
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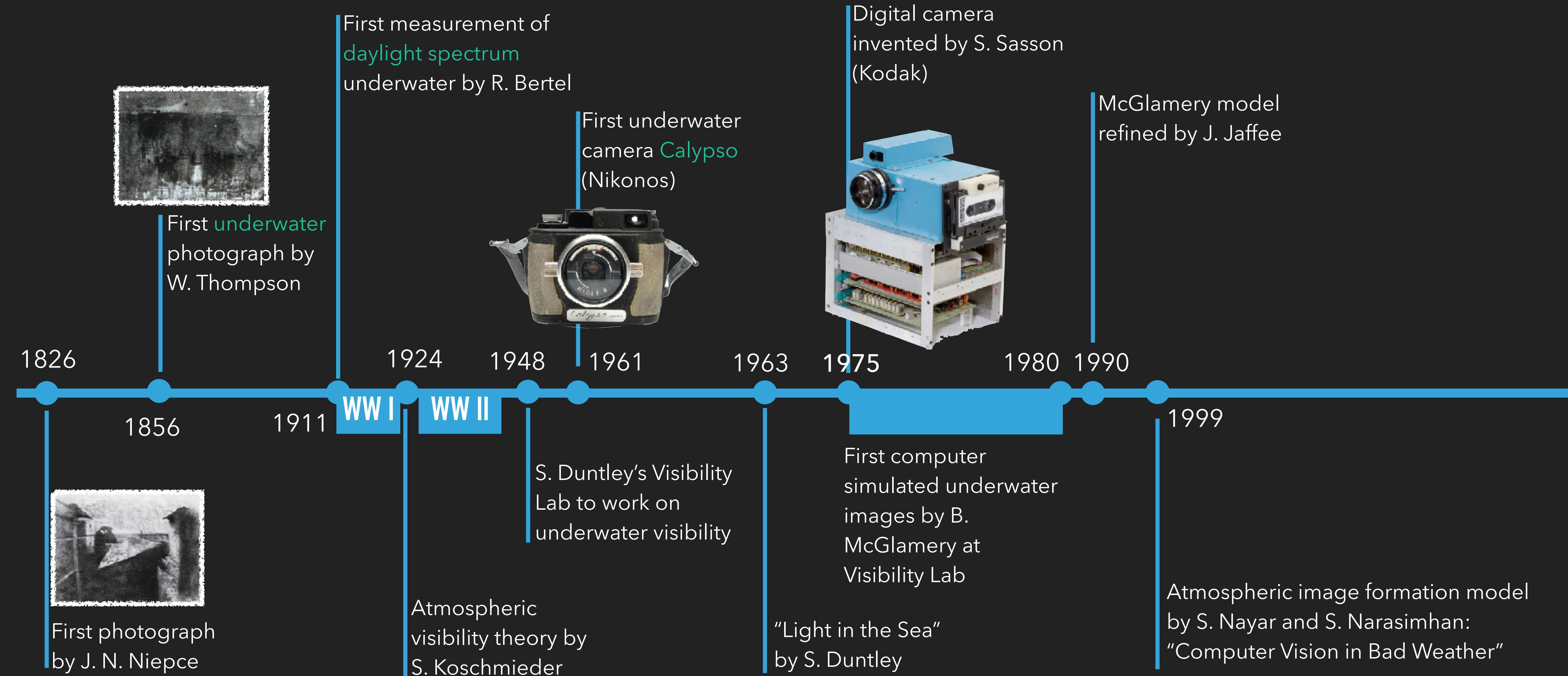
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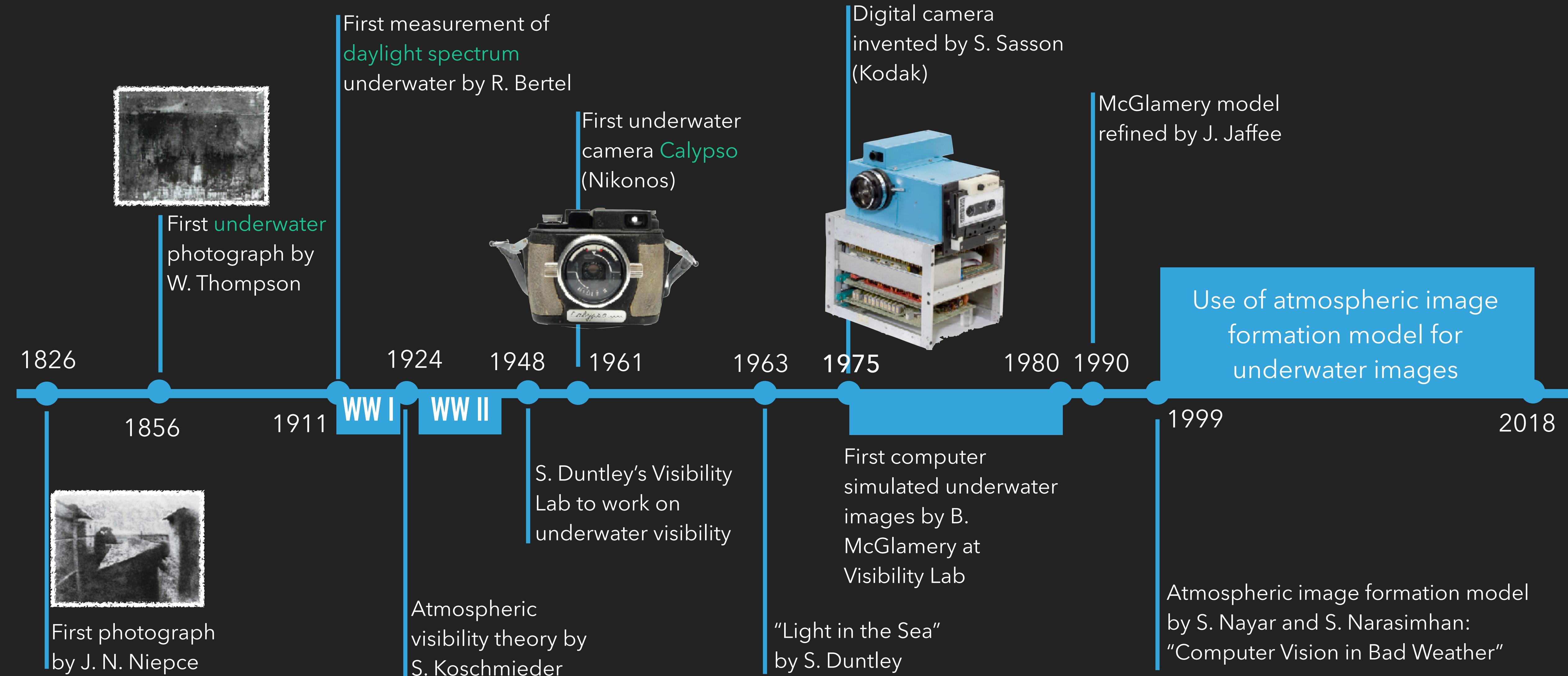
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COLOR IMAGING UNDERWATER

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2018 - a Breakthrough

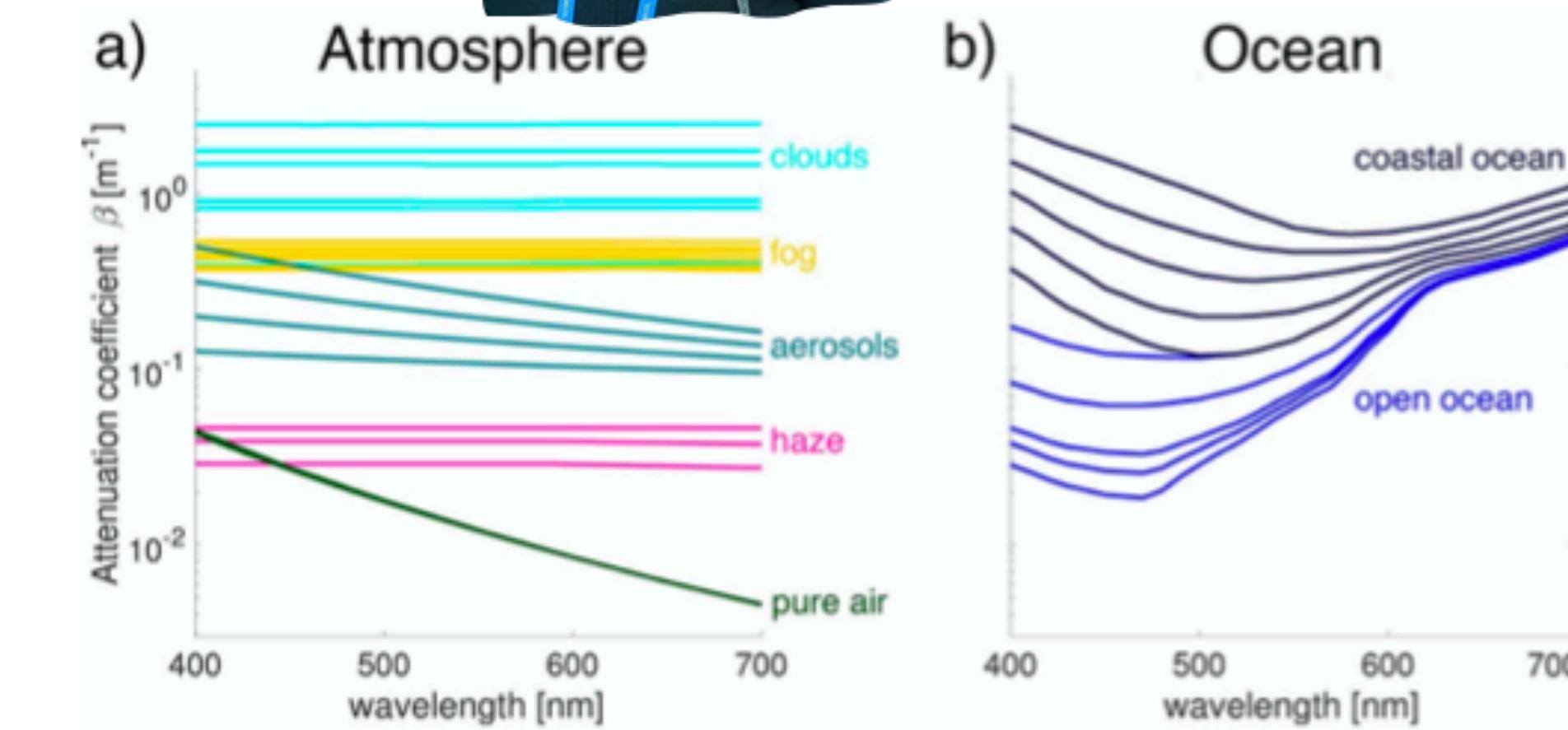
A Revised Underwater Image Formation Model



Abstract

The current underwater image formation model descends from atmospheric dehazing equations where attenuation is a weak function of wavelength. We recently showed that this model introduces significant errors and dependencies in the estimation of the direct transmission signal because underwater, light attenuates in a wavelength-dependent manner. Here, we show that the backscattered

Derya Akkaynak
Tali Treibitz
University of Haifa

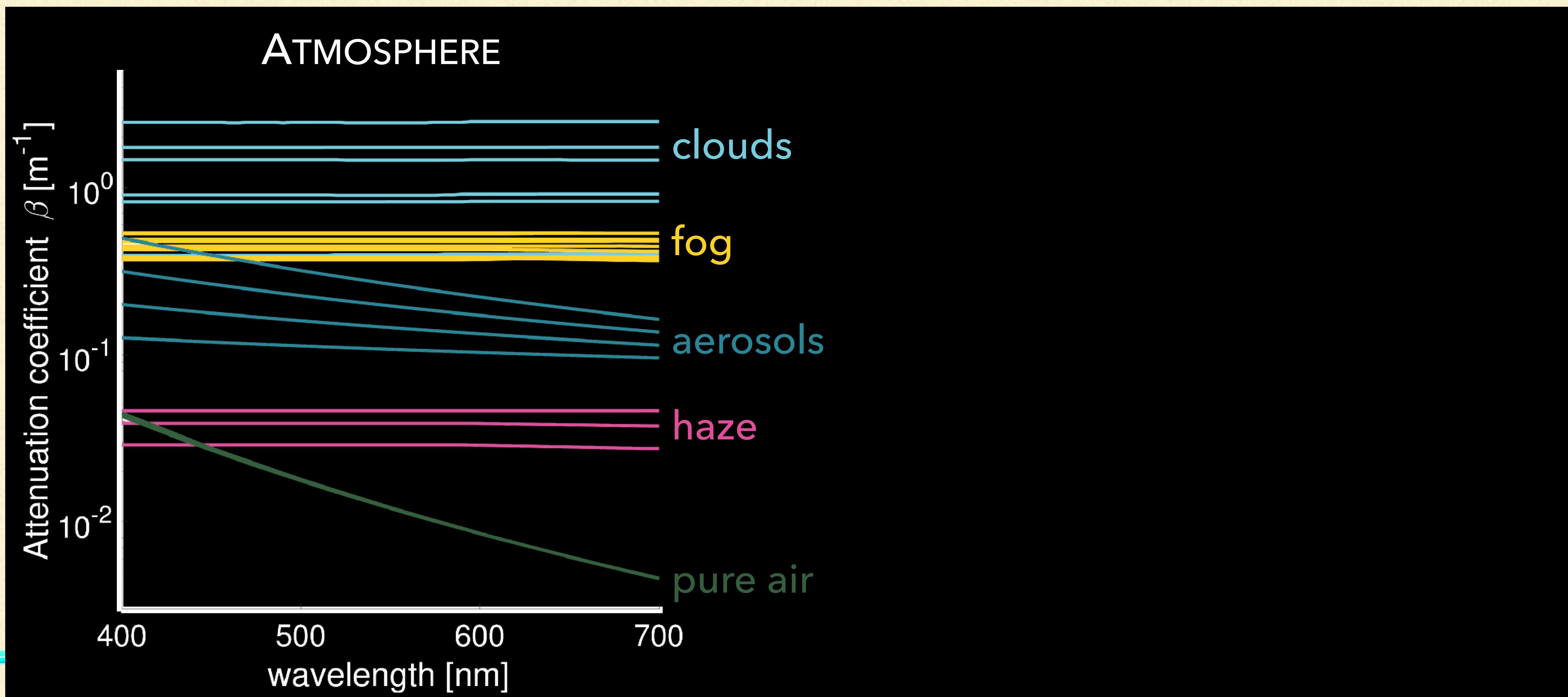


Light Attenuation in Air Vs Water

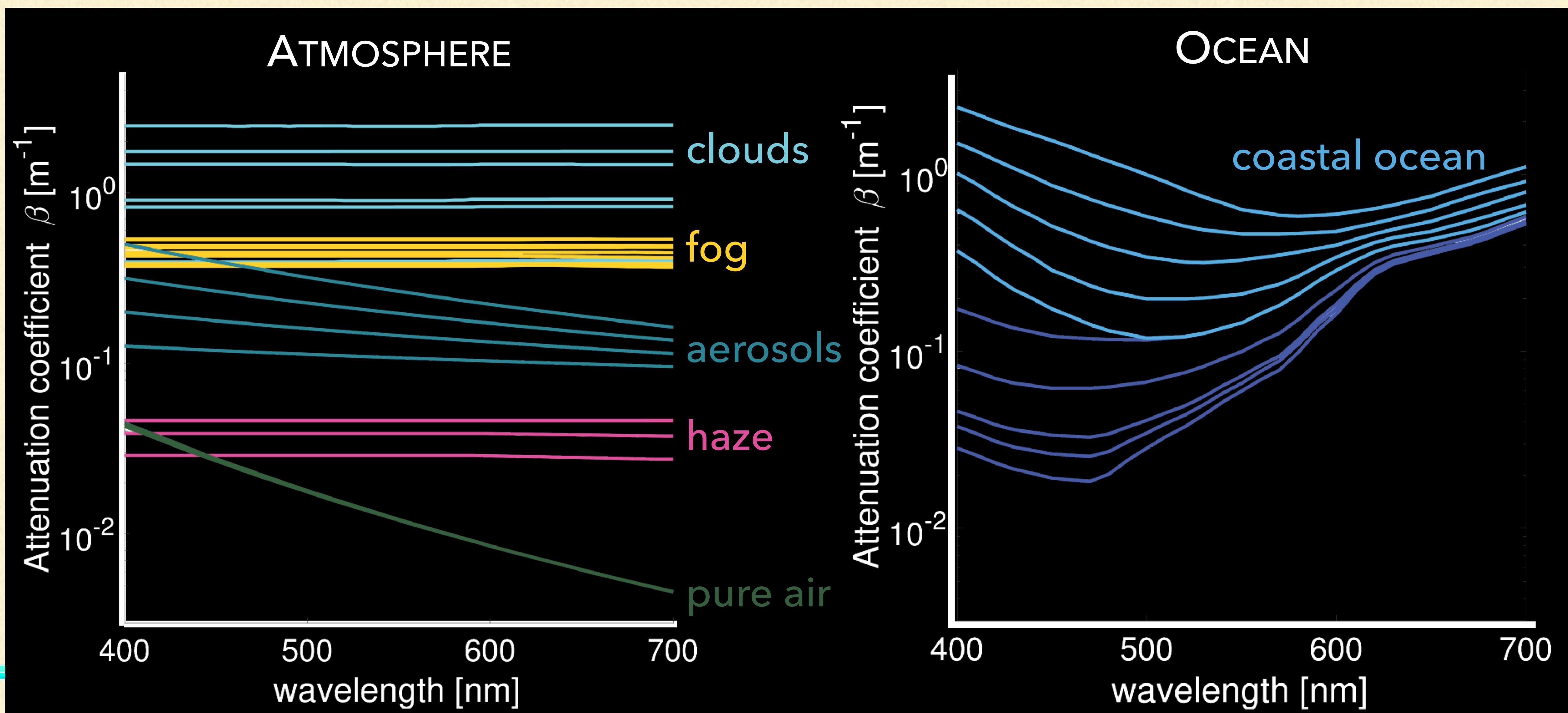
Light is changed differently in the atmosphere vs in the ocean.



Light Attenuation in Air Vs Water



Light Attenuation in Air Vs Water

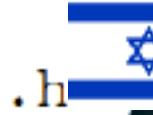


2019 - a Breakthrough

A method that standardizes light in underwater RGB-D photographs.

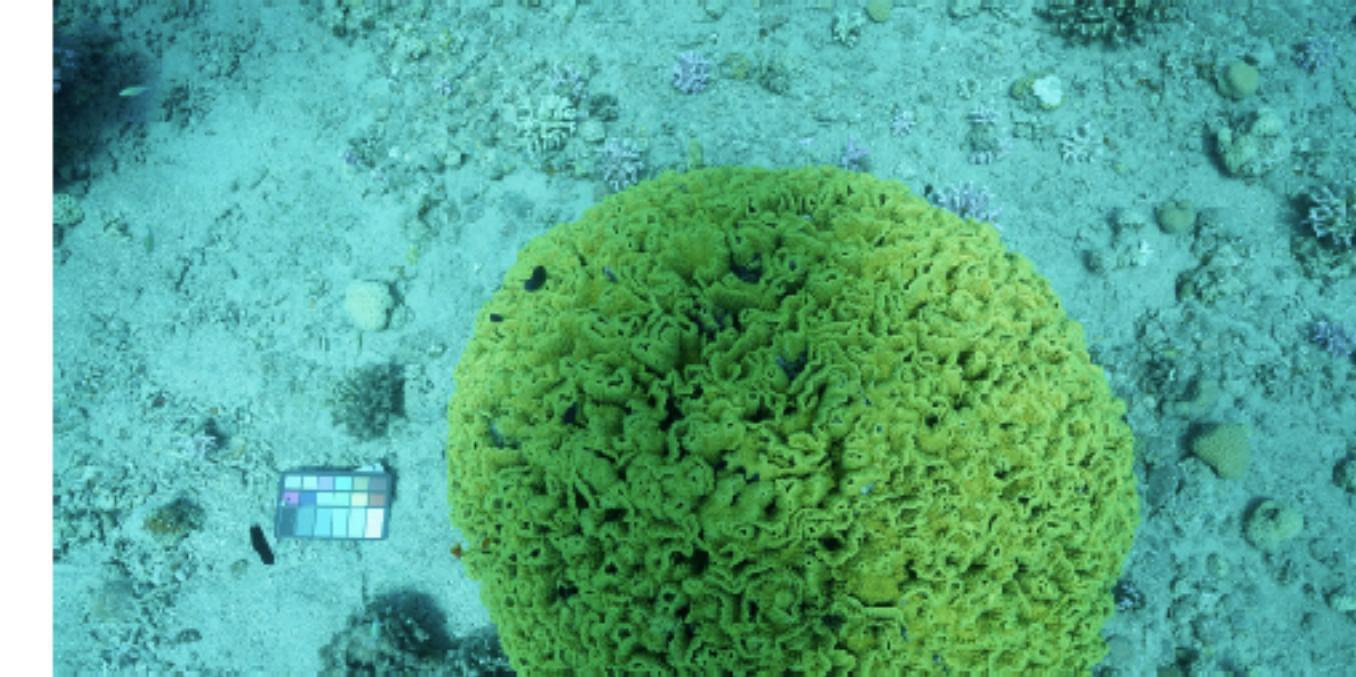
Sea-thru: A Method For Removing Water From Underwater Images



Derya Akkaynak Tali Treibitz
University of Haifa
 k@gmail.com, ttreibitz@univ.h

Abstract

Robust recovery of lost colors in underwater images remains a challenging problem. We recently showed that this was partly due to the prevalent use of an atmospheric image formation model for underwater images and proposed a physically accurate model. The revised model showed: 1) the attenuation coefficient of the signal is not uniform across the scene but depends on object range and



2019 - a Breakthrough

Sea-thru: A Method For Removing Water From Underwater Images

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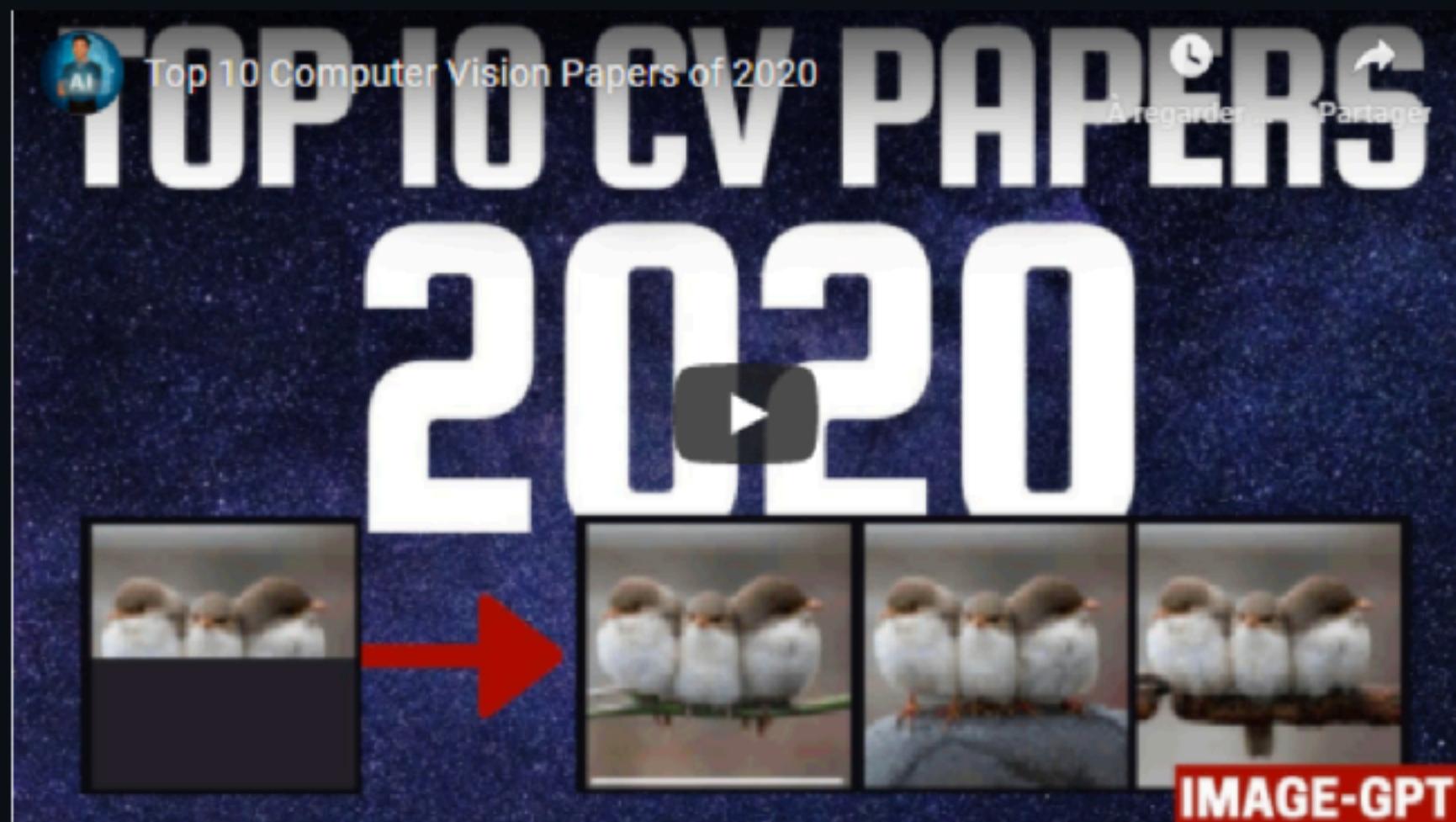
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A large red arrow points from the bottom of this slide towards the 'The Full List' section on the right.

Watch a complete computer vision 2020 rewind in 5 minutes



If you are interested in AI research, here is another great repository for you:

A curated list of the latest breakthroughs in AI by release date with a clear video explanation, link to a more in-depth article, and code.

[2020: A Year Full of Amazing AI papers- A Review](#)

The Full List

- [Sea-thru: A Method For Removing Water From Underwater Images \[1\]](#)
- [Neural circuit policies enabling auditable autonomy \[2\]](#)
- [NeRV: Neural Reflectance and Visibility Fields for Relighting and View Synthesis \[3\]](#)
- [YOLOv4: Optimal Speed and Accuracy of Object Detection \[4\]](#)
- [PULSE: Self-Supervised Photo Upsampling via Latent Space Exploration of Generative Models \[5\]](#)
- [Image GPT-Generative Pretraining from Pixels \[6\]](#)
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- [PIFuHD: Multi-Level Pixel-Aligned Implicit Function for High-Resolution 3D Human Digitization \[8\]](#)
- [RAFT: Recurrent All-Pairs Field Transforms for Optical Flow \[9\]](#)

2019 - a Breakthrough

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SEA-THRU ALGORITHM

Original photo: Matan Yuval, Eilat, Israel



SEA-THRU ALGORITHM

Original photo: Matan Yuval, Eilat, Israel



SEA-THRU ALGORITHM

Original photo: Tom Shlesinger, Islamorada FL Keys

12



Eilat (Israel)
Matan Yuval

SEA-THRU ALGORITHM

Original photo: Tom Shlesinger, Islamorada FL Keys

12



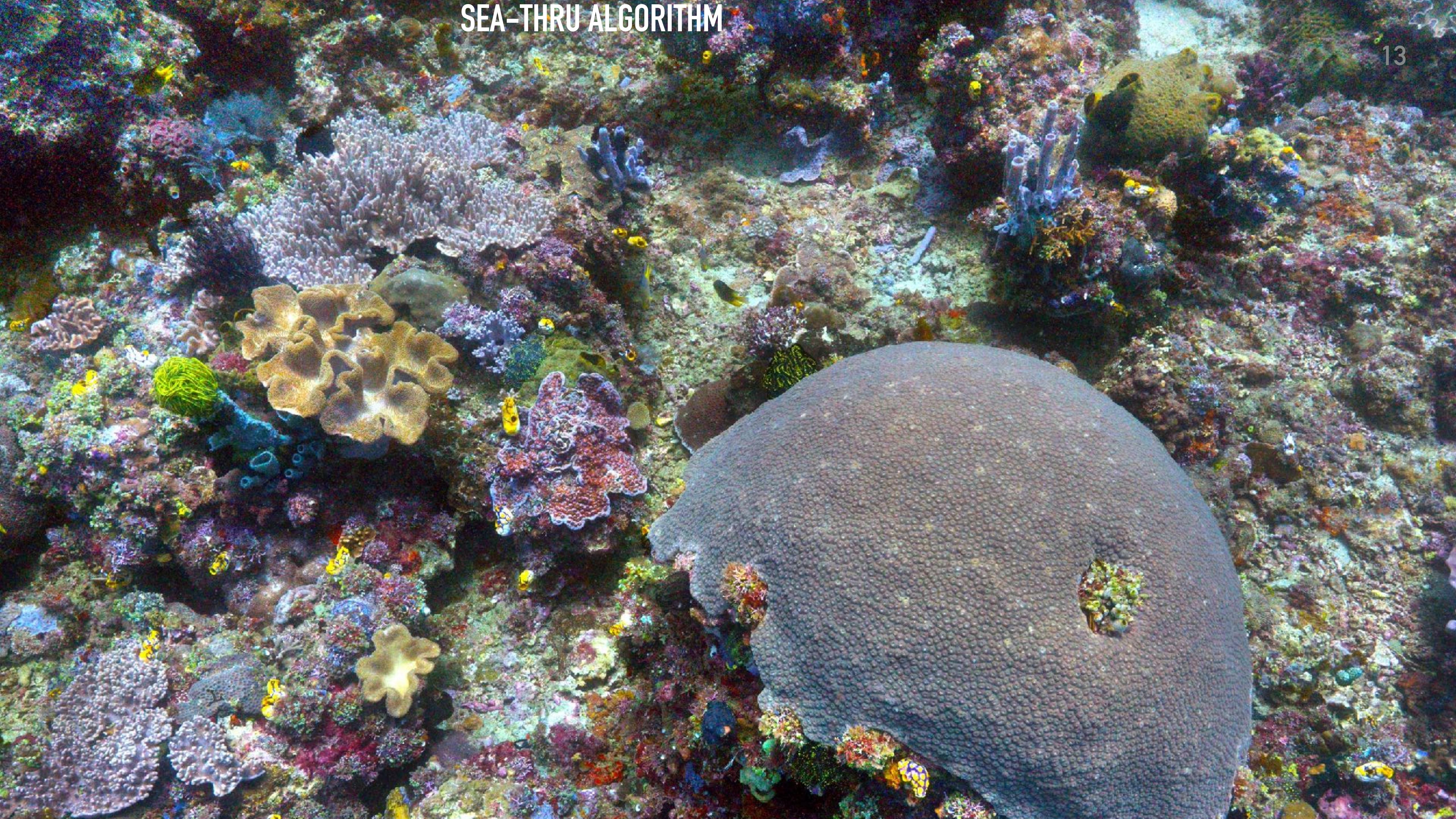
SEA-THRU ALGORITHM

13



SEA-THRU ALGORITHM

13



Yes It Works for Video



Lake Tanganyika (Zambia)
Video: Dr. Alex Jordan, Max Planck Institute



UNDERWATER COLORIMETRY

Yes It Works for Video



Lake Tanganyika (Zambia)
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SEA-THRU ALGORITHM



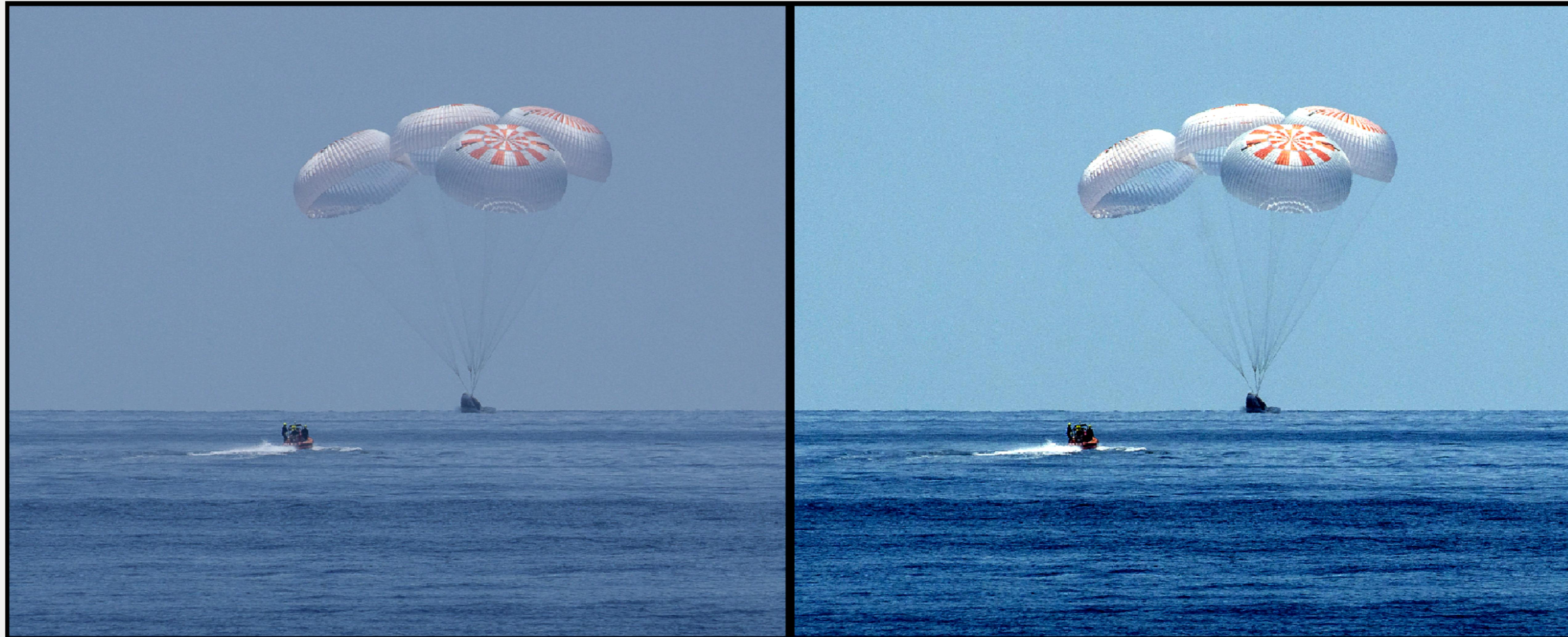
Original photo: James Rokop, Aquastarz Davis, CA

SEA-THRU ALGORITHM

15



Atmosphere Is the Simplified Case of the Ocean



SpaceX Crew Dragon splashdown August 2, 2020



Atmosphere Is the Simplified Case of the Ocean

California Wildfires *2020*



Sea-thru



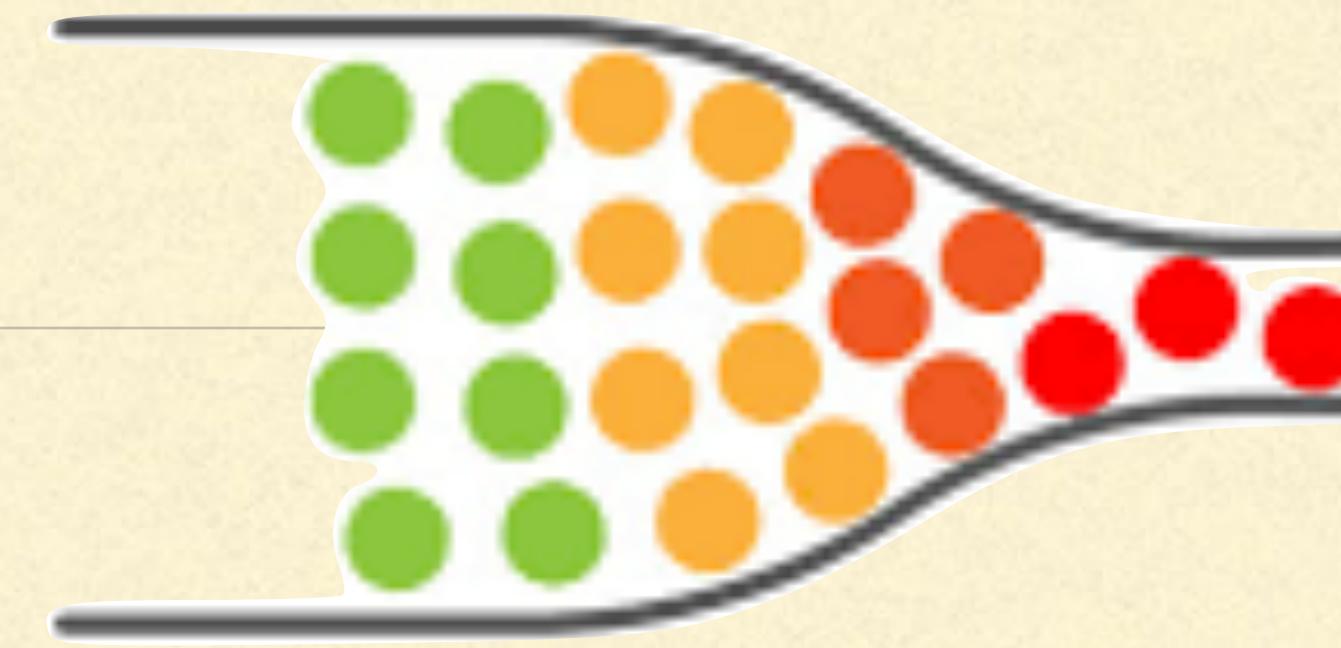
Twitter post by @AntonioParis



Why Isn't It in Every Camera?



A Technology Bottleneck



We are unable to estimate distance
underwater in real-time

Image formation

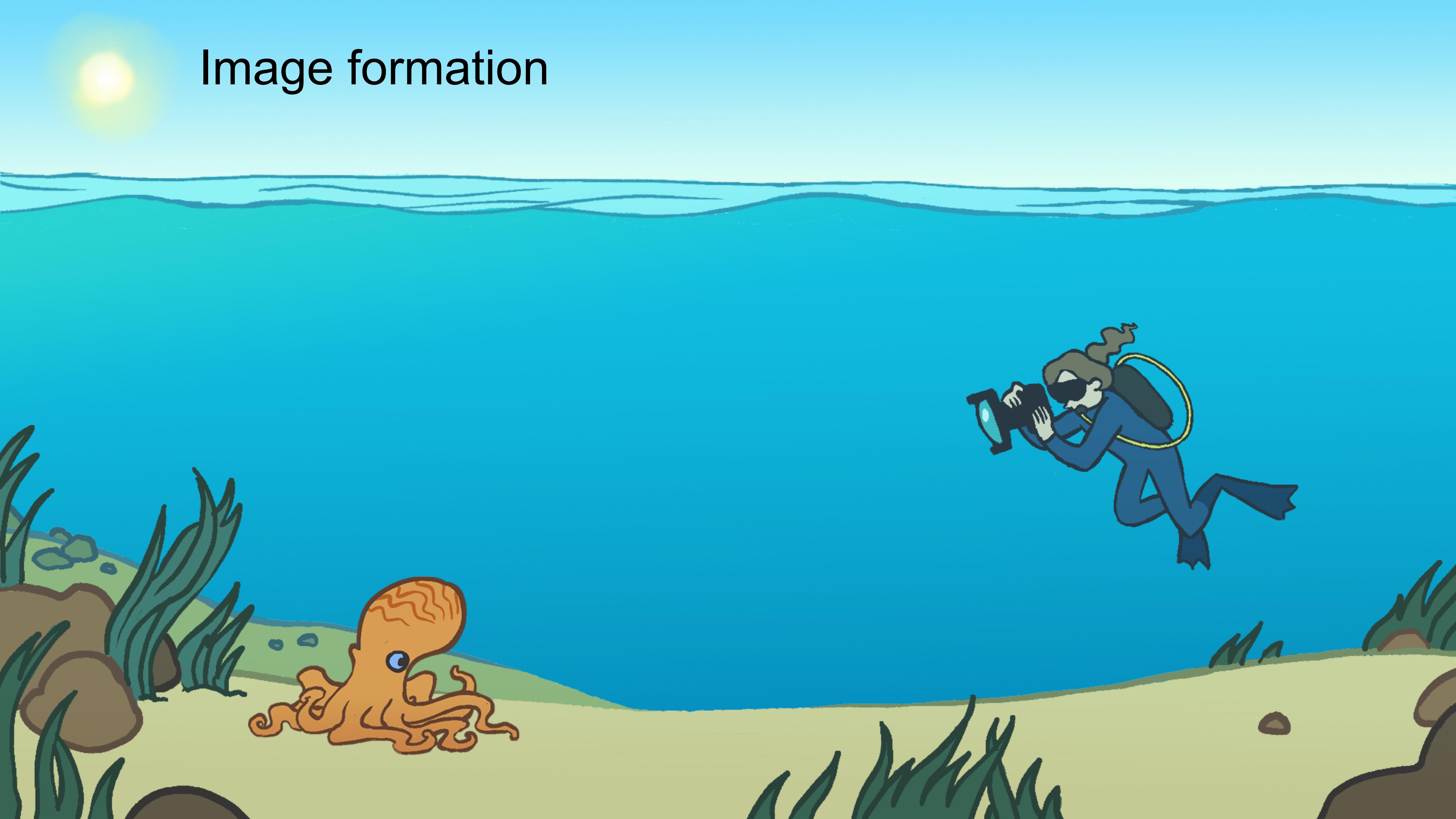


Image formation

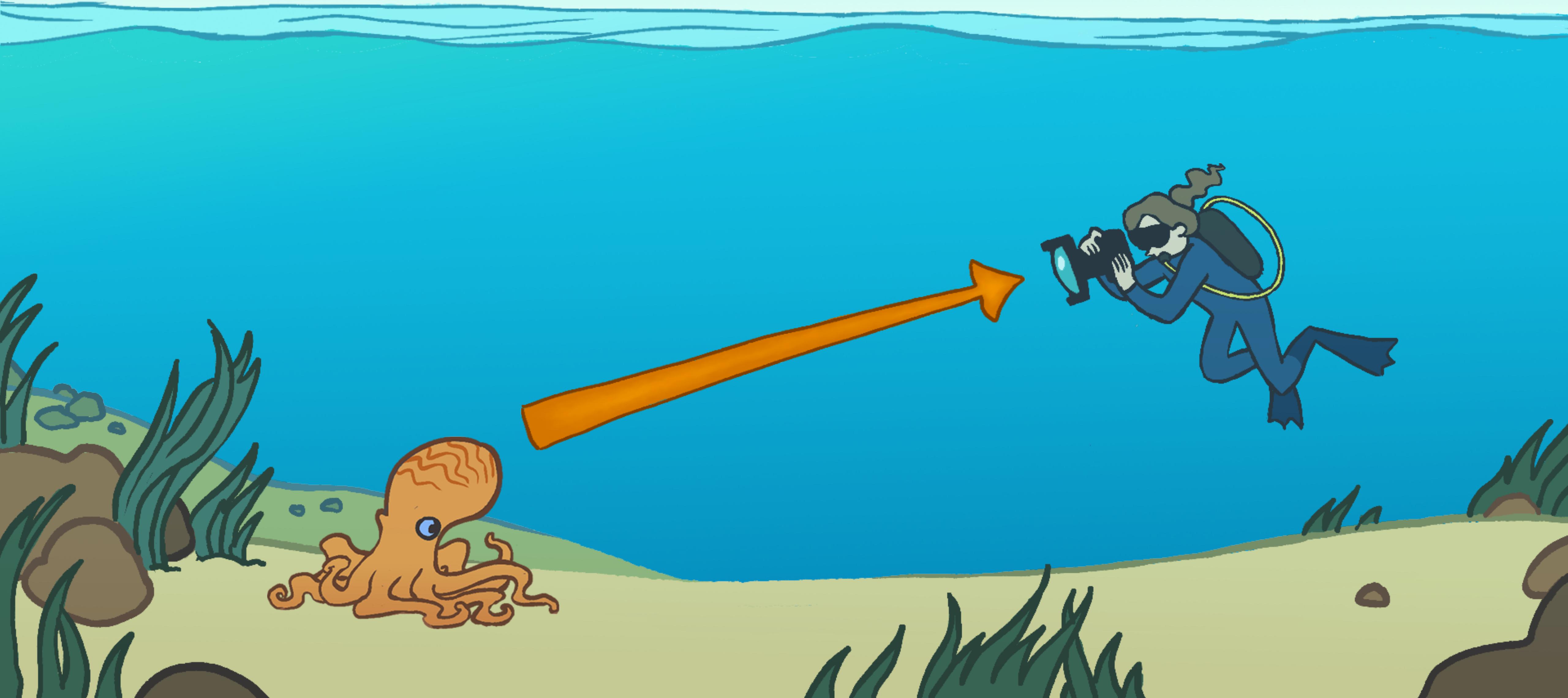


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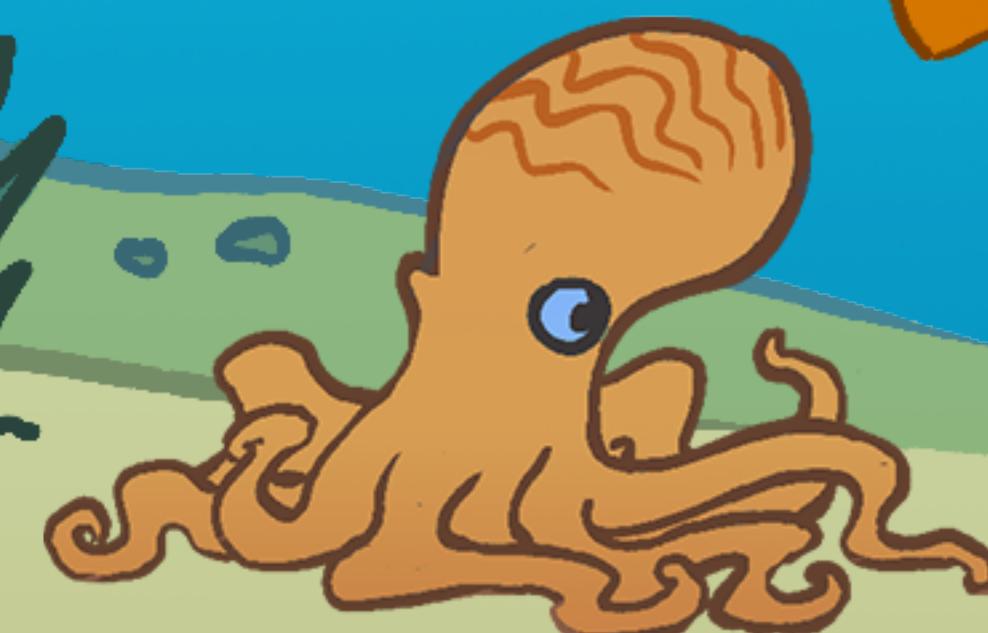
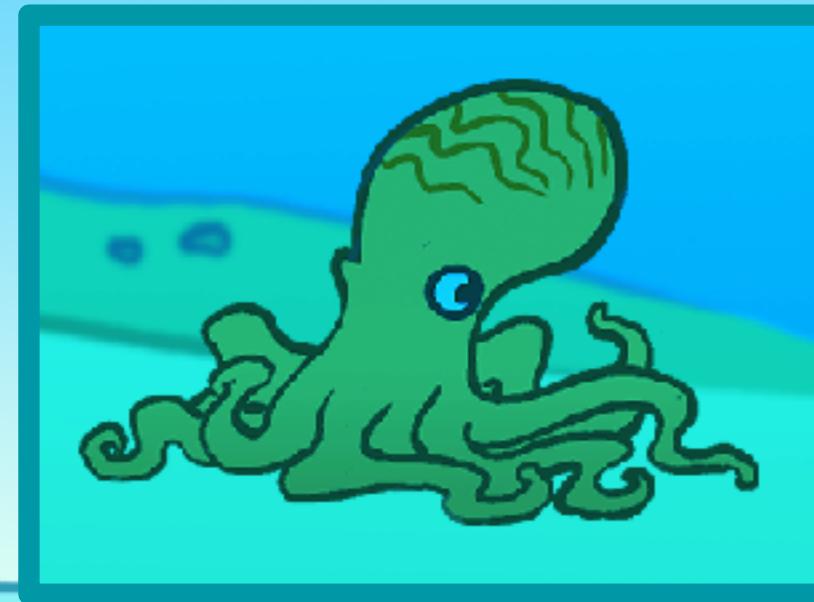


Image formation

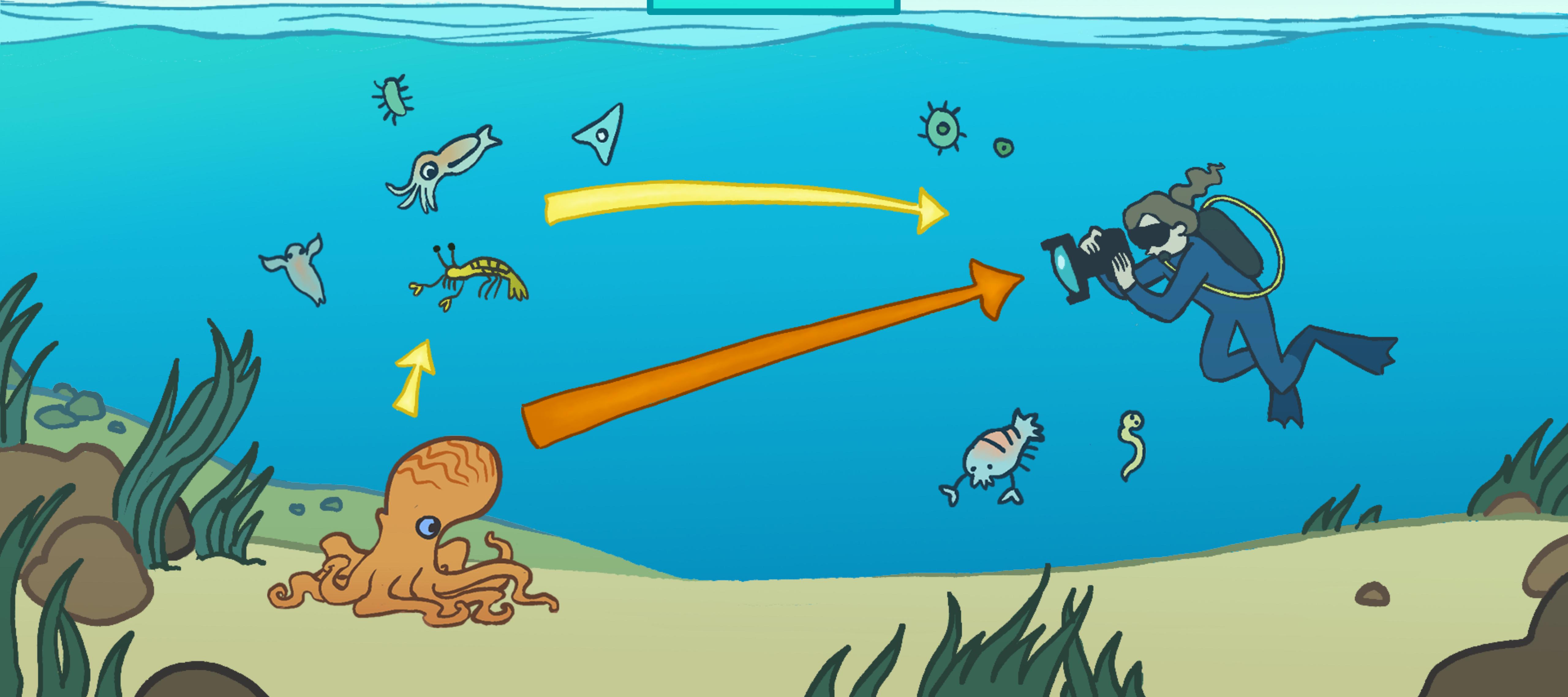
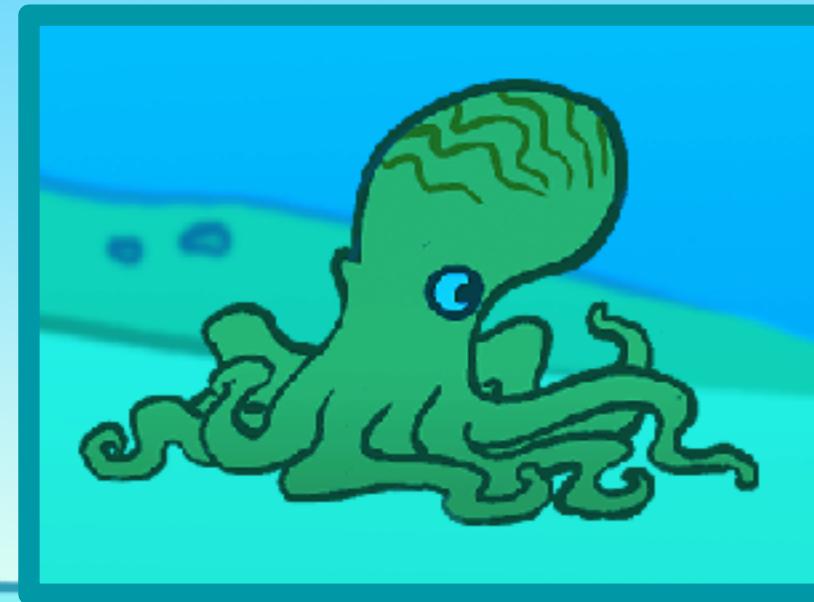


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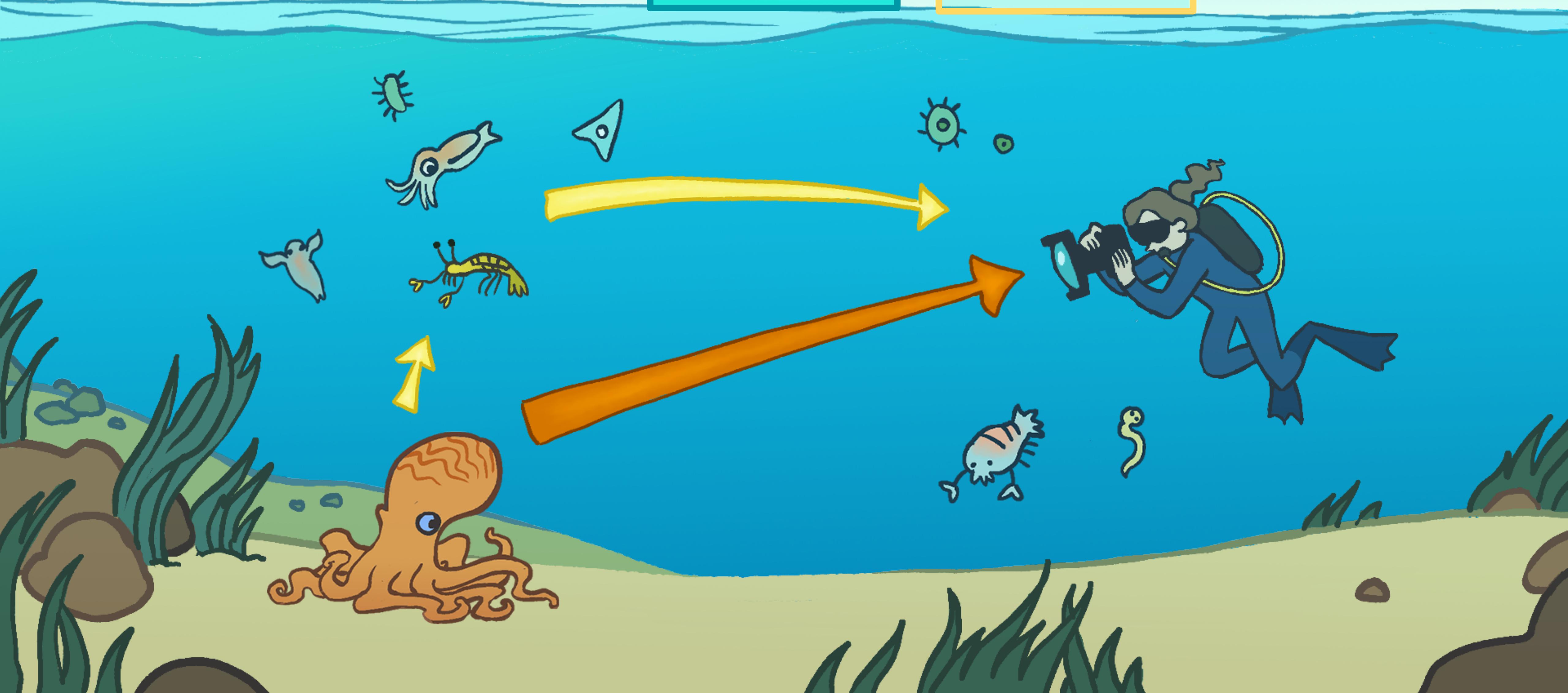
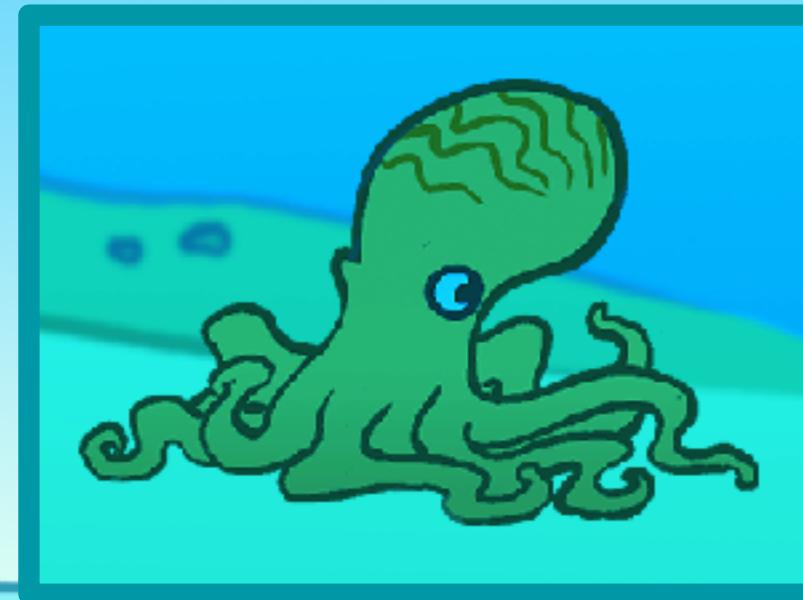
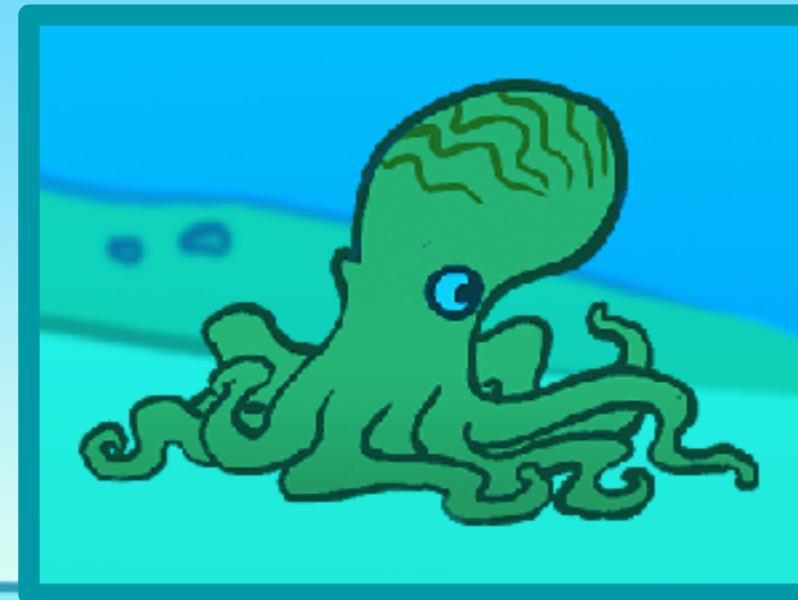


Image formation



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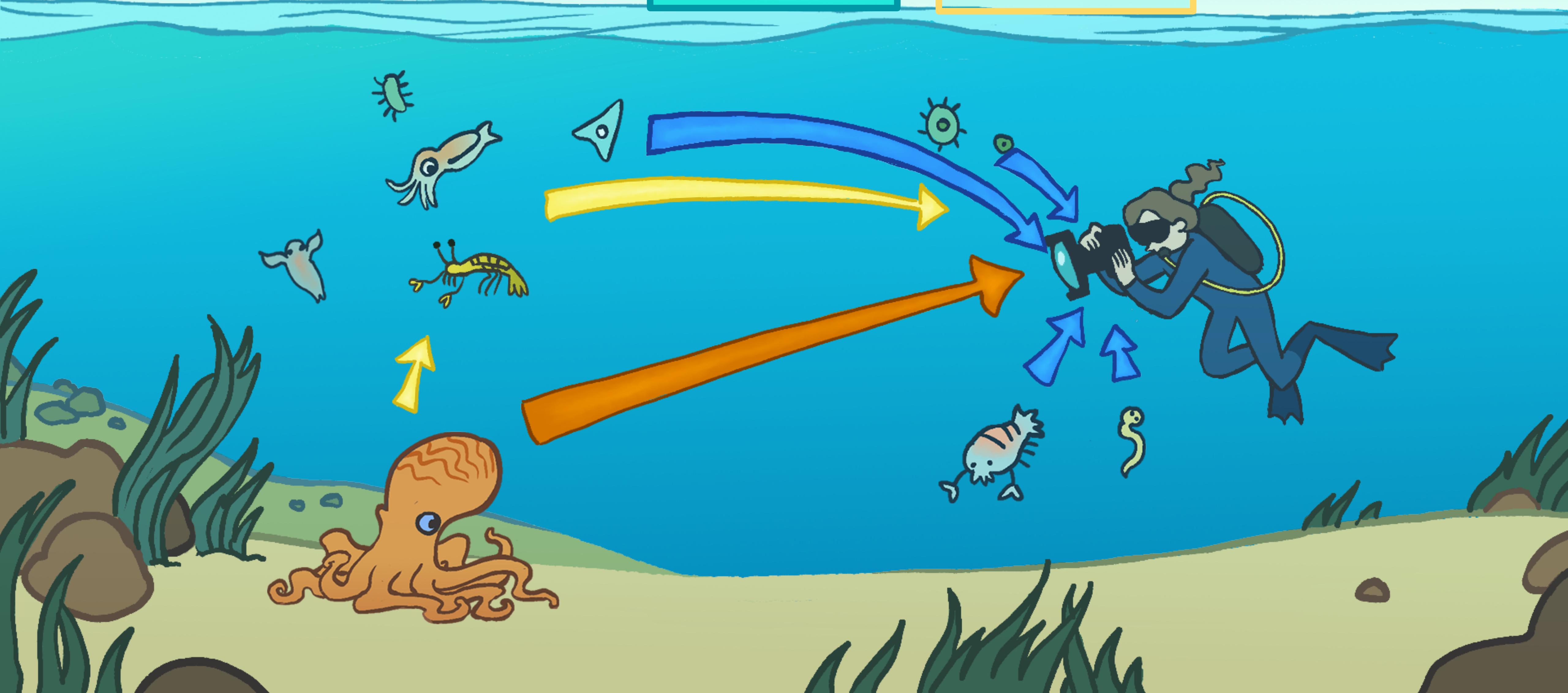


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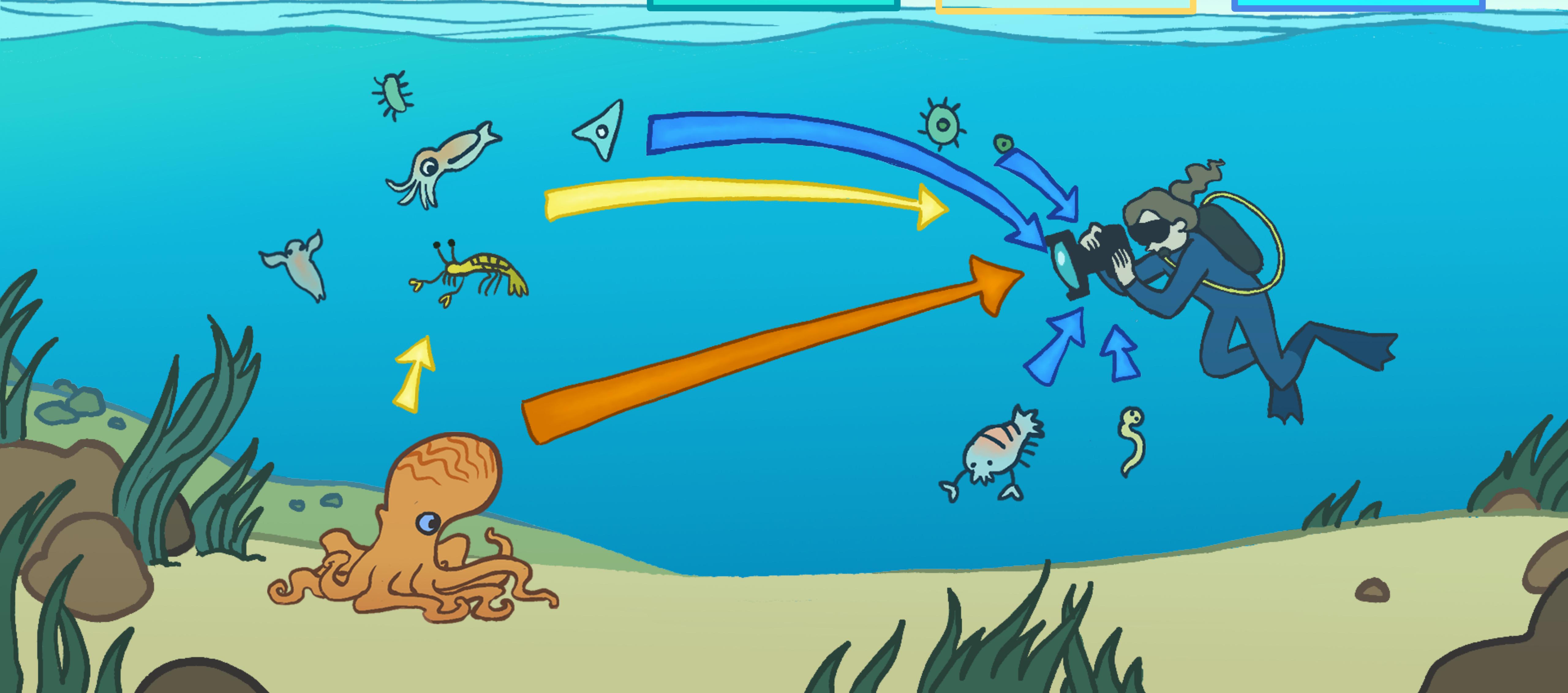
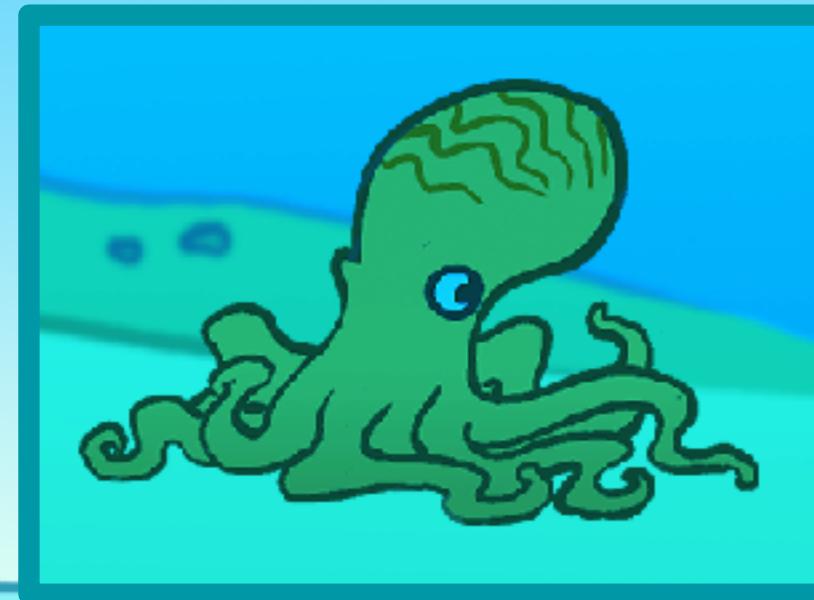
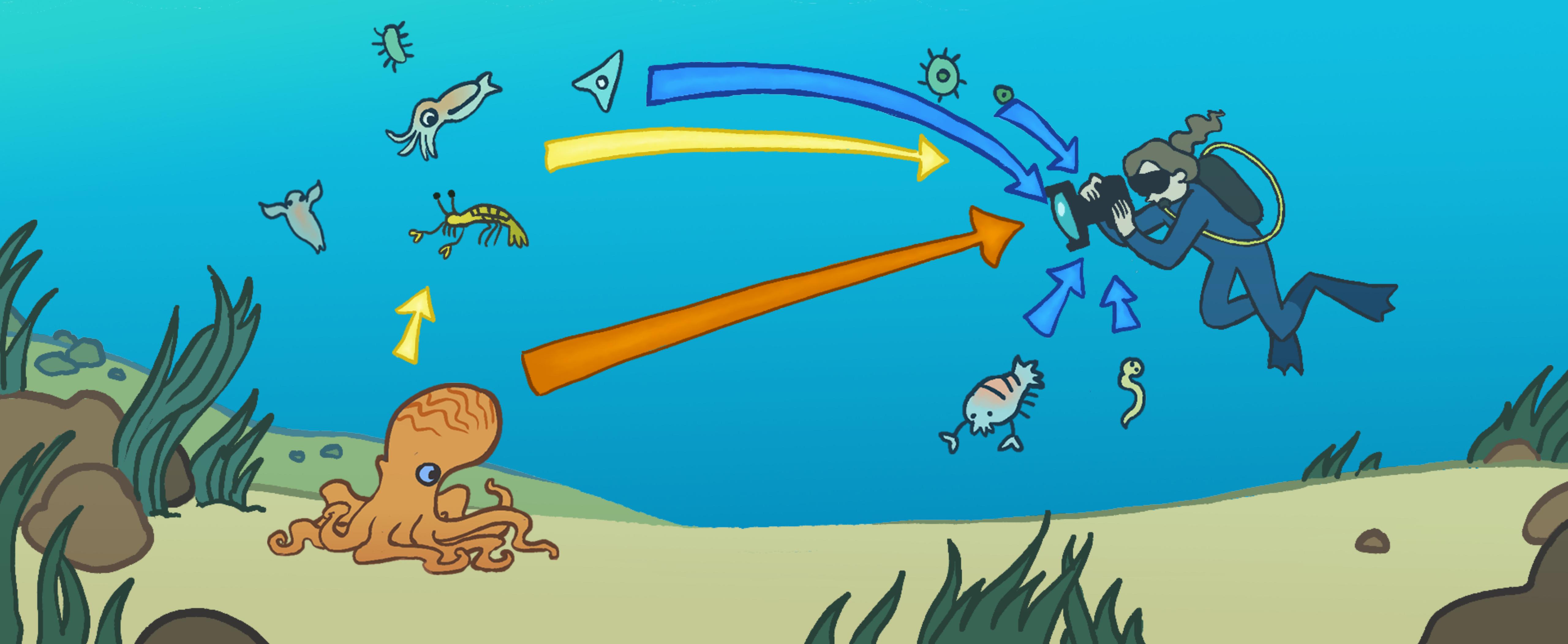
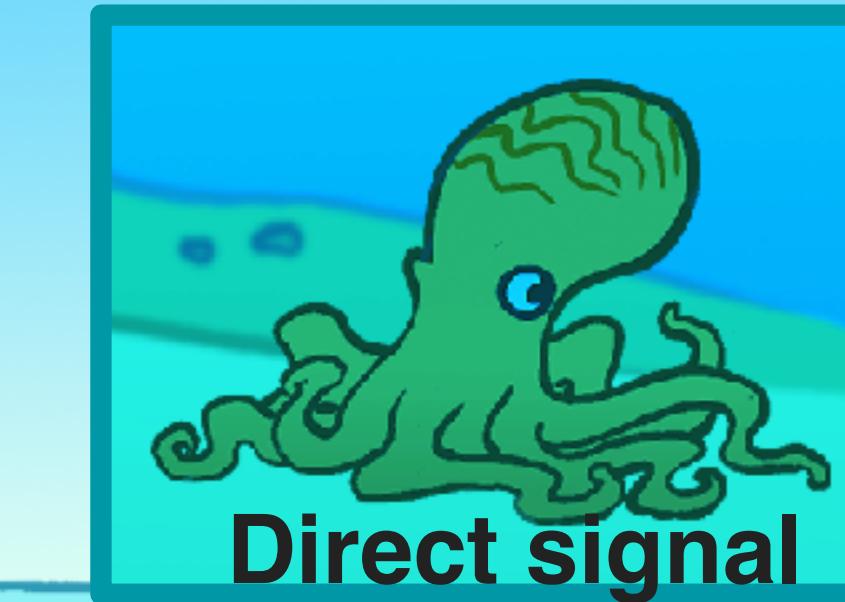
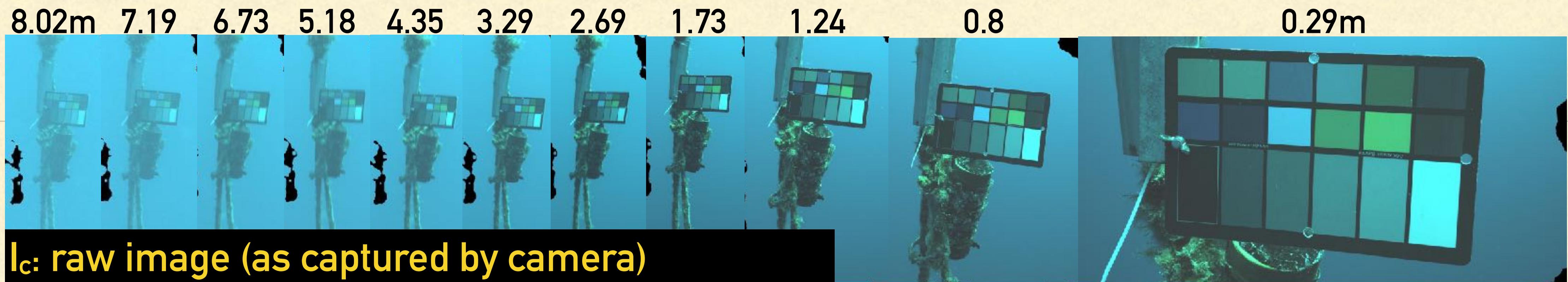


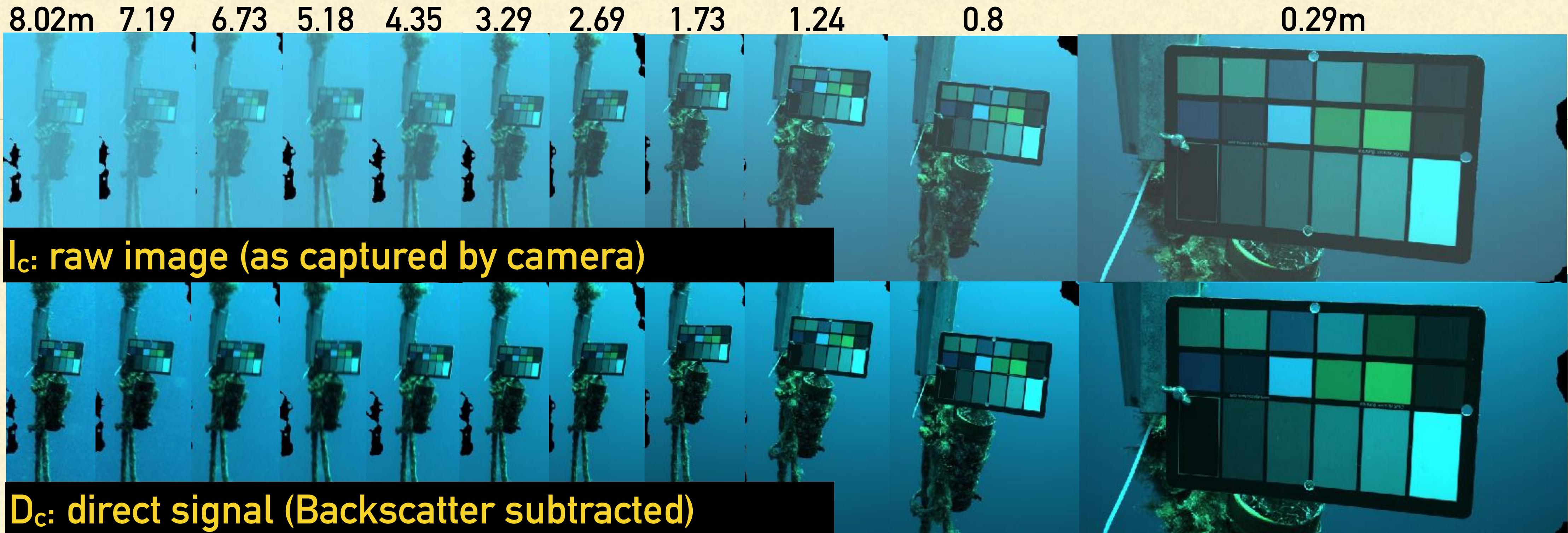
Image formation



Distance Dependency



Distance Dependency



Distance Dependency

