

# A SCHOLAR'S SCIENTIFIC AND CULINARY ODYSSEY THROUGH THE LAND OF LEGENDARY SWORDSMITHS AND COMPUTER- GENERATED CRYSTALS

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My fascination with Japan started at an early age. Like most kids of my generation, I grew up devouring manga, watching anime, and playing Japanese videogames. Years later, I came to realize that Japan was home to countless pioneering discoveries. In the field of metallurgy, this is perhaps best illustrated by the country's legendary bladesmithing. Close to my scientific interests, namely in computational modeling of crystal growth, milestone contributions from Japan go from Kobayashi's first-ever computer-generated phase-field dendrites<sup>1</sup> to massively parallelized simulations of entire dendritic "forests" at record-breaking scale.<sup>2</sup>

In 2019, I was invited by Professors Takaki of the Kyoto Institute of Technology and Ohno of Hokkaido University to co-organize a symposium at the then-upcoming COMPSAFE conference to be held in Kobe in March 2020. All plans were lined up to visit several research institutions across the country. However, as the world was coming to the realization of the looming global health crisis, the TMS Annual Meeting of February 2020 in San Diego was to be my last international in-person conference for the next couple of years.

From top, clockwise: Damien Tourret visits the Torii gates at Fushimi Inari Shrine during his trip to Japan; a view of Mount Fuji from the bullet train between Tokyo and Kyoto; Tourret at the Kyoto Institute of Technology with Professor Takaki (rightmost) and group members; Tourret at the University of Tokyo with Professor Shibuta (top row, second from left) and group members.





Damien Tourret (second from right) on the way to dinner with, from left to right, professors Katsube, Yasuda, and Narumi of Kyoto University.

As such, when I received the great honor of being selected as the 2023 Japan Institute of Metals and Materials (JIMM)/TMS Young Leaders International Scholar, I was determined to make the most of it and decided to complement the annual 2023 JIMM Spring Meeting with visits and seminars in no less than four renowned research groups in three different cities across the country.

My first stop was Tokyo, a city whose scale, pace, and energy suffice to humble even the most experienced travelers. The cherry blossom season was barely starting, but many plum trees were already close to full bloom. My first visit was kindly hosted by Professor Shibuta at the University of Tokyo. There, I presented some recent research lines in the field of computational modeling of advanced manufacturing of metals and alloys at IMDEA Materials Institute (Madrid, Spain) and engaged in stimulating discussions on atomistic modeling of solid-liquid interfaces—thereby also gathering some useful tips on resulting data postprocessing technicalities.

The next day, before the start of the JIMM meeting, I had the opportunity to explore some of Tokyo's touristic highlights, such as Asakusa district. A look at the city from above at the Tokyo Skytree observation deck also provided me with a sense of the city's vertiginous scale. The JIMM Spring meeting was held on the Komaba Campus of the University of Tokyo in the following days. There, we (fellow TMS/JIMM awardee Mike Titus of Purdue University and I) were warmly welcomed and guided by JIMM Executive Director Hideaki Yamamura.

On the first evening of the conference, we were treated to a delightful welcome dinner hosted by the JIMM Board of Directors. The dinner took place in the Shibuya district, home to the world-famous Scramble Crossing and its bronze statue of the loyal Hachikō. It was a great opportunity to meet outstanding researchers from both Japanese and Korean materials societies. It was also a reminder of how small the world sometimes is, realizing I had colleagues/friends in common with some of my tablemates.

After the conference, I had the chance to visit Meiji Shrine and the nearby Shinjuku Gyoen National Garden before making my way to Kyoto. Japanese bullet trains (Shinkansen) are famous for their punctuality, speed, and smooth ride, and my trip to Kyoto was no exception. Remarkably, the Tokyo-Kyoto line also offers breathtaking views of the country's most revered mountain, Mt. Fuji, which is pictured on the opening page of this article.

Kyoto is known as "The City of Ten Thousand Shrines" and hosts a great number of temples, shrines, palaces, and gardens. So, naturally, I spent the rest of the weekend exploring the city and its surroundings, such as Arashiyama Bamboo grove, and many temples such as Ninna-ji, Ryōan-ji, and Kinkaku-ji—the latter being better known as the "Temple of the Golden Pavilion."

Starting my second week in Japan, I resumed my scientific journey with a visit to the Kyoto Institute of Technology, kindly hosted by Professor Takaki. There, after my seminar, I had the chance to attend short presentations by various group members and to have enlightening scientific exchanges on topics related to large-scale phase-field modeling of dendritic solidification and the coupling between crystal growth and semi-solid deformation.

For my second visit in Kyoto, Professor Yasuda welcomed me to Kyoto University. On my first day there, I was introduced to an impressive variety of furnaces for in-situ X-ray imaging of metal solidification experiments. Professor Yasuda is a pioneer of in-situ imaging of metallic microstructure formation and evolution. He and his group, in typically Japanese fashion, have perfected their craft to a level more often seen in Swiss watchmaking than in an academic research lab. The day continued with a series of presentations and discussions involving several group members, capped off by a lovely dinner in a traditional Kyoto-style restaurant, where we were joined by Assistant Professors Narumi and Katsube (Kyoto University) and Professor Takaki. On my second day at Kyoto University, I gave a seminar



Sushi dinner in Sapporo with Professor Ohno (second from right) of Hokkaido University and group members.

which had kindly been advertised and arranged in a hybrid format, thus allowing scholars from other universities across the country to attend and take part in subsequent discussions. Later in the afternoon, I made my way to Osaka airport to fly to the last and northernmost stage of my journey.

In addition to its namesake beer and its cuisine (such as ramen and seafood), the city of Sapporo on the northern island of Hokkaido is famous for its snow festival. So, it should be of no surprise that my visit there was punctuated by a few dendritic ice crystals falling from the sky—better known to most people as snowflakes. My visit to Hokkaido University was graciously hosted by Professor Ohno. Here, I delivered the final seminar of my trip. This was followed by discussions on various research activities across the materials science and engineering department with Professor Muira and on the integration of computational modeling and experiments (e.g. via data assimilation techniques) with Professor Ohno.

The following morning, I started my journey onward to the TMS 2023 Annual Meeting & Exhibition in San Diego. As is the case every year, this was a great opportunity to both catch up with old friends and colleagues and to make new ones.

In addition to the inspiring scientific exchanges, my most vivid memories of Japan will remain the remarkable hospitality, the inner peace from a stroll through its traditional gardens, and the wonderful cuisine. Regarding the latter, I would be remiss not to emphasize the absolute treasure that is Japanese food—from the buzzing streets of the Tsukiji fish market to the many quaint traditional restaurants. The late chef and insatiable explorer Anthony Bourdain once wrote, "If I had to eat only in one city for the rest of my life, Tokyo would be it." While the rest of my culinary journey was equally as sensational as its Edo stage, I cannot help but relate.

Alas, I am not able to name every single one of the amazing people I met along the way and who made my journey unforgettable. However, I will long harbor fond memories of their kind welcome through lab visits, scientific discussions, and guidance in exploring the finest local cuisine and spirits. I can only conclude by expressing my heartfelt gratitude to not only all my wonderful hosts in Japan, but also to the TMS Foundation for making this all possible, and by most enthusiastically encouraging anyone eligible for the TMS Young Leaders International Scholar Award to apply.

#### References

1. R. Kobayashi: "A Numerical Approach to Three-Dimensional Dendritic Solidification," *Exp. Math.*, 3, 59-81 (1994).
2. T. Shimokawabe, et al., "Peta-Scale Phase-Field Simulation for Dendritic Solidification on the TSUBAME 2.0 Supercomputer," *Proceedings of 2011 International Conference for High Performance Computing, Networking, Storage and Analysis*. (New York, NY: IEEE, 2011, pp. 1-11).

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