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An Inevitable Moment: US Brain Drain

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AN INEVITABLE MOMENT

US Brain Drain

By Brian P. Coppola

In Short

- The National Academies' *Rising Above the Gathering Storm, Revisited* identified China as the main locus of technological advancement, with "science and technology as the primary productive forces."
- That advancement has been powered by the return of Chinese citizens educated and employed the West and the country's recruitment of Western scholars.
- Whereas the best scientists in China increasingly have access to next-generation instrumentation and substantial government support, the ability of young US scientists to do competitive science is hindered by outdated equipment, the high cost of doing work, and low support for students.
- The stories of two young Western scientists working in China illustrate the advantages and difficulties associated with such a move. They report having excellent lab space, generous start-up packages, good students, competitive salaries, external research support, and stipends for publishing. Language and the social setting and culture turn out to be less of a problem than anticipated, but making and sustaining connections *(guanxi)* is key to success.
- The economics of doing research in the US need to change or else the competitive gap projected by the *Gathering Storm* reports will make China appear increasingly attractive to scientists.

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Since World War II, the United States has been the "go-to" nation for scientific training. Just prior to the Great Recession, however, the National Academies of Sciences (NAS) were already signaling strongly that the international competitiveness of the United States was lagging. The NAS 2007 *Rising Above the Gathering Storm* report called for reprioritizing investments because "the world is changing rapidly, and our advantages are no longer unique. Without a renewed effort to bolster the foundations of our competitiveness, we can expect to lose our privileged position over the coming decades" (p. 223).

Not only did the economic crisis make any substantial investment in science impossible, but in an unusual three-year follow-up report—*Rising Above the Gathering Storm, Revisited* —the National Academies pointed out the global competitiveness of the US was moving in the wrong direction. The gathering storm, according to the subtitle of the 2010 report, was "rapidly approaching Category 5."

Unsurprisingly, the second report identified China as the main locus of technological advancement. Post-Mao policies not only emphasized the development of a market-driven economy, but, as Xing Li noted, "science and technology as the primary productive forces." In the areas where capital investment can pay off, China has been investing aggressively. In Battelle's most recent R&D forecast, China's R&D spending, which is currently a close second to the US's, is projected to surpass the United States in the early 2020s.

China's Tianhe-2 supercomputer is the world's fastest. The number of patents granted per capita has increased by 800 percent since 2006, moving China from #15 to #7 globally. And the 2012 *Nature Publishing Index* contained "an unprecedented number of Chinese institutions": "217, up from 152 the year before. Nearly half the total were [institutions] appearing for the first time." China's proportion of the top 1 percent of cited papers skyrocketed from 2 to 12 percent during 2001–2011. In MIT's April 2015 report, The Future Postponed, nine of the fifteen case studies describing the "U.S. Innovation Deficit" include the scientific and technological growth in China as a significant factor.

My own molecular and chemical biology colleagues have pursued collaborations with their colleagues in China because the staggering growth in biotechnology, genetics, and life sciences research fuels demand for access to the best next-generation instrumentation. Francis Collins, director of the National Institutes of Health, in a 2015 interview with *The Lancet,* discussed his concern about young scientists in the United States who "are encountering the most difficult time in history to get their labs going and to sustain them. And many of those are becoming quite discouraged and some are actually leaving the field or leaving the country."

China's well-known campaigns (e.g., the "1000 Talents Program") to attract its scientist citizens back home have been successful. According to a recent report in *Nature,* about 3000 individuals have returned to China since 2008. Institutional settings, tradition, and collegial relations all vary, though, so returning scholars are cautioned to do their

homework to understand the environment in which they might find themselves.

In one highly publicized controversy, Yi Rao, who returned to Peking University in 2007 to be the dean of life sciences, and Yigong Shi, who was hired a year later into the same position at Tsinghua University, have both been openly critical of the Chinese research environments as perpetuating "unhealthy cultures" compared with their experiences as professors at Northwestern and Princeton Universities, respectively (Shi & Rao, 2010). Quoted in *Nature,* Rao advises that if returning scientists "care about their research and integrity, [they] should go for institutions that have reformed or are determined to reform."

Within the last couple of years, a more significant watershed moment for the global picture of science has taken place quietly: the hiring of early-career foreign scientists into entry-level, tenure-track positions in China. Until recently, the appointment of a Western (non-Asian) scientist at a Chinese university has been a rarity.

An early pioneer is UK chemistry professor David G. Evans. In 1996, after many visits Evans took a position at Beijing University of Chemical Technology, where he is currently a member of the state Key Laboratory of Chemical Resource Engineering and chair of the local section of the Royal Society of Chemistry.

Since 2011, Eric Meggers—a bio-organic chemist who was educated in Germany, Switzerland, and the United States and who served on the faculty at the University of Pennsylvania and Philipps-University Marburg—divides his time between Marburg and Xiamen University as a professor of chemical biology. In 2013, the high-profile hire of a native Western scientist happened with Jay Siegel's appointment as dean of pharmaceutical science and technology at Tianjin University.

I have been interacting with chemistry departments around China since 2001. While I was getting ready to return to Zhejiang University ("Zheda") for a visit in the summer of 2014, I was surprised by the appearance of Simon Duttwyler on their faculty website.

> We figured the barriers to hiring non-native Chinese into regular faculty positions would be substantial.

Over the years, at countless dinners in Beijing, Shanghai, Nanjing, and elsewhere, my Chinese colleagues and I speculated on the question of when someone like a Simon Duttwyler would appear.

At our dinners, we figured the barriers to hiring non-native Chinese into regular faculty positions would be substantial. Specifically, the impediments would be 1) language, 2) social and cultural adjustment, and 3) the lack of necessary connections (*guanxi)* critical for being known by the right people in the right places. My hypotheses about Duttwyler's appointment were that he was adventuresome, that he had a long-standing and perhaps familial connection (or even a partner with connections), and that he was at least somewhat fluent in Mandarin. So he was equipped, in my imagination, to be a barrier-breaker.

Duttwyler's actual story is much more interesting than my made-up version, and it points to a more significant historical moment than I had imagined. Graduate students and post-doctoral associates thinking about academic careers, research mentors who advise these students, and soon, perhaps, undergraduates looking for PhD programs might all want to watch this story (and others) unfold over the next five to ten years.

Professor Simon Duttwyler (Zhejiang University)

I spent three days with Duttwyler and some of his colleagues, including two long afternoons with his research group, during July, 2014. I have also corresponded with him, his colleagues, and his scientific mentors via email before and after my visit.

Let me cut to the chase. To Duttwyler, the world is truly flat (in the Thomas Friedman sense). He replied to an advertisement, and he accepted the offer from Zhejiang University because it was the place where he thought he had the best chance of getting his science done.

He had never been in China until he stepped off the plane for his interview; he had never spoken the language or been compelled by any past associations with Chinese culture; he is not even that adventuresome. He wants to be a successful chemistry professor, to inspire good students and to make interesting discoveries. His motivations are so unremarkable as to be banal—at least compared to what I was thinking must be true.

Duttwyler grew up in Switzerland and attended the University of Zurich for his undergraduate studies (2000–2005). He stayed at Zurich for his graduate work in the aforementioned Jay Siegel's group—although they both assured me that their simultaneous presence in China was no more than a coincidence. During graduate school in Switzerland, he did a short residency at Riverside to pick up some laboratory skills. He completed his degree in Zurich, then returned to the United States for his postdoc at Yale.

During 2012, Duttwyler interviewed at schools in Europe, which would have allowed him to be near his family, but the availability of space, equipment, students, and funding were all non-ideal. Back at Yale, he was still scanning the advertisements for academic positions, when he noticed the announcement from Zhejiang University.

Duttwyler talked with his group, including a Chinese colleague who knew something about the school, and with his mentors. I asked Siegel, who was negotiating his position with Tianjin at the time, about their shared interest in China. He told me that Duttwyler

> independently came to me and brought up the idea of his taking a position at Zhejiang. He is a great scholar with an open mind who could see the enormous career potential of getting to China now when things are still developing. … It is all about getting people who are smart enough to master the scholastic parts of the job and culturally flexible enough to work within these new cultural surroundings.

Christopher Reed, with whom Duttwyler spent some time during graduate school, reports that Duttwyler thought "the time is ripe for Chinese science to compete."

Duttwyler recalls that the interview process was noteworthy for its rigor and length. He arrived in Hangzhou (home to Zheda) about midnight, following a 16-hour flight to Shanghai and a four-hour car ride, with the prospect of five days of meetings, dinners, and talks that started at 7:30 AM and went into the early evening.

He is positive, in retrospect, that maintaining any sort of pretense about one's interest in an academic position in China would not have been possible after just two days of this schedule, but he was sincerely excited about the thing he loves the most: getting good science done.

The only real assessment was the match between the department and the candidate. By the end of the week, Duttwyler had "a positive impression and a positive response. … The human factor is critical – being around nice people." And the entire setting and situation "felt right."

Less than a year after he started his position, everyone I talked with about his (and their) expectations said that they were being met. From Duttwyler's point of view, "every promise was fully kept with no hassle whatsoever." He has terrific lab space that was remodeled to modern Western standards, a generous start-up package that is fully competitive with what he would have received from any top US school, a highly skilled assistant who knows how to navigate the system, and a salary that is scaled appropriately to the cost of living in Hangzhou and is considered highly competitive for an assistant professor in China.

"Benefits from diverse thinking [are] strongly aligned with the international direction in which China wants to drive its science compared with 15 years ago.

Moreover, opportunities to enhance one's salary are abundant, from external research support to stipends for publishing papers in high-impact journals. Although it was not a condition of employment to receive an award, Duttwyler was successful in his "1000 young talents" application and in gaining funding in the "973 research support" program.

Duttwyler's colleagues are enthusiastic about him. Professor Ping Lv[1], and head of the department, Professor Yanguang Wang, both told me that hiring a potential winner is a high priority, and the success of its faculty members adds to the prestige and status of the institution.

They had received about 50 applications from foreign nationals in response to their advertisement. What struck them about Duttwyler on paper and in person was that he is driven to do good work in science, he is a consummate professional, he gives the impression (and then the reality) of being a good departmental and university citizen, and he does not start every other sentence with "I want. …"

Chinese universities are moving to start new faculty members in a five- to six- year pre-tenure period, followed by the customary external review. And although Rao and Shi both argue that the changes are not happening fast enough, funding now follows more closely the merit-review model, and publication is definitely benchmarked in the global marketplace.

Departments (or colleges) of chemistry at the major institutions, with 80–120 research faculty members, are two to four times the size of comparable departments in the United States. Wang sees the benefits from diverse thinking [are] strongly aligned with the international direction in which China wants to drive its science compared with 15 years ago. Wang's target number for international faculty members, looking at the 10-year horizon, is about 20 percent.

Duttwyler's mentors (foreign and domestic) all agree that once a foreign (Westerner, non-Asian, and particularly

[1] The "Lv" (or "Lü") construction indicates an unusual vowel sound for the surname "Lu."

American) faculty member has been rigorously screened and hired, that foreigner has a competitive advantage in some arenas. In July, while I was visiting, Duttwyler had just submitted his first research proposal to the National Natural Science Foundation of China (NSFC). With US funding reduced to single-digit success rates in the last few years, I asked Duttwyler what the average rate was going to be in the NSFC competition. We were at dinner with Professors Wang and Lv when I asked this, and as he began to say "40 percent," both of them chimed in, simultaneously, with "100 percent." In 2014, he was, in fact, successful in that round of funding.

Noting that he had also been successful in attracting research students, his colleagues said Duttwyler was a desirable mentor because he already had a positive reputation for both his scientific expertise and his management style, which was perceived to be strongly focused on the educational development of the individual student. He clearly was a "different face," and the students believed that his approach to science would also be different from what they had experienced as undergraduates.

Observing Duttwyler with his students for a total of about 7–8 hours, I saw a research mentor who was keenly interested in their development. He had also adopted many of the traits I associate with Chinese research groups, where there is a strong sense of family and where academic colleagues are routinely called "school brother" and "school sister," both within the generation and inter-generationally. On the way to our meetings with the students, Duttwyler stopped at a small market for a huge load of candy, fruit and snacks to have out while we were meeting.

The advantages these students saw to being in the Duttwyler group, as Wang and Lv had noted, was a belief that there were Western ways of doing science that were important to learn. They also appreciated the good lab space and working conditions, experience with English, and a lot of hands-on direction.

Whether I was talking about science or the state of comparative higher education in science, I observed that

> "The poor funding in the United States and the intense competition for graduate students at [Chruma's] former institution made doing science there increasingly difficult.

Duttwyler was jotting notes on the white board and making sure the students were reflecting on the facts and implications. As Reed, who spent three months mentoring Duttwyler when he was at UC Riverside, remarked: "Simon brings the intrinsic qualities of an adventurous enquiring mind to his job. His highly principled approach to science will inspire high standards and integrity in his students."

But what about the impediments that I had imagined?

Language. Duttwyler had never spoken a word of Chinese before starting this job. And although he has tried to carve out time for formal study of the language, the life of an assistant professor is quite busy, so he has been learning as he goes. What I observed was a delightful interplay, over dinner, where Professors Wang and Lv were both catching up with what he knew how to say, and in turn took advantage of the moment to tutor him in a way that was more like a naturalistic explanation (or whatever it was they were talking about – my own speaking and comprehension skills are not even good enough to be embarrassing).

Social setting and culture. Duttwyler has a nice apartment that gives him great access to campus. From his point of view, if he can buy groceries and get to campus, he's set. Hangzhou is a big city, and at some level big cities are the same no matter where you are.

Making connection. His mentors made the right local introductions for him, and then it was up to him to manage and develop the relationships. Siegel spoke directly to this latter point:

> I think Zhejiang is looking after Simon well. He has good faculty mentors and help with translations and with making connections. … Clearly, getting connected is important in China, as it is elsewhere. It is however also important that young PIs be able to develop their own style and be a role model for change in the Chinese system. It is a gentle balance that needs to be struck, but China's growth and willingness to find new ways to move forward make this a special time to strike that balance.

Duttwyler's challenges and advantages are unique to his setting, but he also has a ton of the usual things that academic scientists need to deal with: doing good science, which includes getting students and motivating them; identifying funding; writing papers; giving talks; making connections; and learning how to make good choices. He was driven by his ability to get these things done, rather than worrying too much about where in the world he was doing it.

At the end of dinner, I asked Professors Wang and Lv what the biggest surprise was during Duttwyler's first half-year as a faculty member. They thought for a moment, exchanged a few words, and agreed that the most surprising thing that had happened was that there had been no surprises at all.

Professor Jason Chruma (Sichuan University)

Another young organic chemist has taken a position in China: Jason Chruma, at Sichuan University (SCU). This is his second academic position. Chruma had been an assistant professor at the University of Virginia for seven years before moving to China.

Like Duttwyler, Chruma had never been to China prior to interviewing at Sichuan University (SCU). Unlike Duttwyler, though, he had a connection: "My colleague at the University of Virginia, Lin Pu, has a joint appointment at SCU and he let me know that they were interested in hiring native English-speaking faculty for full-time positions. He helped with all of the negotiations and early set-up."

Because of his prior academic experience, Chruma was hired as the equivalent of a full professor with tenure and with the title of director of doctoral studies, which allows him to supervise PhD candidates. Because of existing institutional rules about hiring foreign nationals, his position carries a five-year contract with familiar eligibility obligations for renewal: numbers of papers written and students trained, plus the amount of funding.

Chruma's reasons for selecting China over the United States are "storm-worthy": The poor funding in the United States and the intense competition for graduate students at his former institution made doing science there increasingly difficult. He also sees China as the place to be in the future, and he wants to provide a unique cultural and educational experience for his family.

Chruma was also attracted to Sichuan University because it is positioning itself as forward thinking in its educational mission. He notes that the medical school already has several all-English sub-programs and hosts almost 1000 international students. Currently, SCU has a target number of 30 percent foreign nationals in the basic sciences (chemistry, physics, biology), as well as in mathematics and computer science, with the objective of all-English undergraduate major tracks in these areas. "I have already been recruiting more foreign faculty to join me at SCU; the lure of motivated students and ample research funding designated for foreign faculty is hard to ignore."

I asked Chruma to comment on the three impediments, since these issues vary from institution to institution and from department to department. He moved *guanxi* to the top of the list. "No foreign faculty should consider a position in China if they do not already have some connection with someone high up in the system. I had Lin Pu (and some of his former students who are now faculty at SCU) as my advocate…. Personal connections and word-of-mouth are key."

Like Duttwyler, Chruma did not consider language a huge challenge. He reported that "many of my younger colleagues speak English, and they usually serve as my liaisons on important matters." He too is studying Chinese, with help.

> Today's students are the third generation of modern scientists in China, perhaps the first generation where fundamental discovery will characterize scientific inquiry.

Chruma said that his mentor "frequently 'quizzes' me in a playful way during our interactions to help me learn." And while adapting to the lifestyle and social setting is challenging, he does not see that as any different from any career change where international relocation takes place. People who "have no interest [experience, or comfort] in foreign cultures [probably also have] no reason to even consider a position in China."

Chruma is doing more undergraduate teaching than Duttwyler. One change he has made accords with best practices in teaching while it adjusts his pedagogy to fit better within the culture: "I have switched to more team-based assignments to take advantage of (instead of fighting against) the more communal learning attitudes of the Chinese students."

But finally, he said,

> teaching undergraduate students at SCU has not been too different from those at UVA. Indeed, this has been the most familiar and comfortable part of the job –and Chinese students *really* appreciate a Western teaching style in comparison with what they are more likely to encounter: a PowerPoint machine gun and one test that determines your entire grade. And this is also changing. Last year (2014), the SCU administration mandated that the final examination could not count more than 40 percent of the student's grade.

The Lure of the Nobel

I have been with many groups of scientists, young and old, and the same question comes up: Chinese science cannot be good enough yet (it is posited) because it has not earned a Nobel Prize; when can this happen?

I generally answer this question with a brief history lesson informed by William Saywell's "Education in China since Mao," along with conversations with people who lived through this era. At the outset of the Cultural Revolution (June 1966), university classes were suspended to remake higher education. Although both the universities and schools were scheduled to re-open in six months, they only did so, slowly, from 1970–72.

The whole educational system was dismantled. Standards were lowered for both teachers and students: "Well qualified teachers were often replaced with politically acceptable but academically unqualified teachers," according to Saywell, who adds, "There was wide experimentation with factory-run schools, 'on-the-spot' education, and the use of workers and peasants for some classroom instruction" (p. 4).

The re-opened universities were unrecognizable. Admission to the three-year university program soon followed from only eight years of primary and middle-school education, plus several years of work. Five years of success as a worker was sometimes all that was needed.

Following Mao's death, the restoration of higher education began. In December 1977, the first entrance examinations were administered for the resumption of classes in spring 1978. For that year, students up to 30 years old were allowed to take the entrance examinations, providing a chance for those who were denied the option of a traditional university education during the Cultural Revolution. I have met a few senior chemistry colleagues in China who belong to "the class of 1977," including Jianhua Lin, newly appointed president at Peking University, and Yanguang Wang, the head of the chemistry department at Zheda and one of Duttwyler's mentors.

The situation for members of "the class of 1977" is remarkable and worthy of greater study. Less than 40 years ago, a group of students was admitted to universities whose programs had been interrupted for over a decade and whose faculty had likely spent significant time on communal farms.

The first-year students who matriculated in spring 1978 had no sophomore class to learn from, no senior class, and no graduate students. Their faculty instructors, though highly respected, were woefully out of date. Throughout their careers, the class of 1977 and their near-successors have reinvented higher education.

The Cultural Revolution came at a particularly inopportune time, because Chinese scientists were disconnected from science during the post-Sputnik burst of technological advancement. Nevertheless, science in China has moved from zero to competitive in less than 40 years. As Xing Li notes, the "Dengist China… [has emphasized]… science and technology as the primary productive forces."

I have a strong and poignant memory of an afternoon in 1979, while I was in graduate school, of a delegation of senior Chinese chemistry professors who were visiting the University of Wisconsin-Madison, standing at my laboratory bench and fiddling around with some of my glassware. My dominant impression, as one of them twirled the ground glass stopper inserted into a round-bottomed flask, was their culture shock. At that point, laboratories in China were

severely underequipped, for both instrumentation and glassware that had been commonplace in the United States for 15–20 years.

One of my former undergraduate students, Chaoxiang (Mike) Cheng, is originally from China. Cheng is only one generation removed from a completely different sort of education. He recounts stories of how his parents' generation (they were both born in 1955) was affected by the Cultural Revolution.

> Mom said she was homeschooled from the equivalent of 6–12 and took a "prep" year at a local high school before college. They had been sent to the countryside with my grandparents for re-education on the farms, etc., and afterwards my mom and uncle were just plopped into college, having missed any formal middle and high school education. She said that teachers were mostly concerned with propaganda rather than education—but she did have a teacher that had a stash of Western books that he carefully disguised and would sneak to select students, including my mom. During graduate school, she said that they didn't even have the technology to run simple gel electrophoresis. She and her classmates somehow got their hands on a manual for running Southern blots written entirely in German and had to construct their own apparatus—with limited success.

Today's students are the third generation of modern scientists in China, perhaps the first generation where fundamental discovery will characterize scientific inquiry. In Chruma's experience, his students' existing instincts for playing it safe

> makes it [absolutely] critical to establish an environment, within my own research group, where it is blatantly clear that they can take intellectual risks—and that it is okay to fail as long as that failure also results in new knowledge.

Chruma is quick to caution against over-generalization. Some negative traditions (lax laboratory safety practices, playing it safe, taking shortcuts) exist, but they are not uniform and they are not immune from improvement. Siegel thinks, though, that "China's students thrive when given a more open scholarly platform from which to learn. It will not be long before liberal education has a strong hold in China."

One or more of these students may well win that coveted Nobel Prize.

The Future

All of the faculty members I spoke with agree that if a Western student is thinking about studying science in China and a faculty career there, laying the groundwork early is useful. Siegel says that these students must have a joy for the

adventure of learning about new cultures and exchanging one's own experiences with others. This is not a complex or mystical thing. The opportunities are here and good scholars with interest should jump at the chance to be part of the change and growth in what will inevitably be the next dominant center of scholarship on our planet, either in a form compatible with the West or in isolation from it.

Reed recommends that these students "be sure that their major professor has a strong interest and contacts in China. Networking is important. And learn to speak Chinese." Chruma and Duttwyler (in retrospect) also urge interested individuals to develop their language skills, visit the country, and be interested in the global picture. They will need to be adaptive to a changing landscape.

Let's assume that the gathering storm has reached Category 5 and is having its way with the US. Let's assume that Duttwyler and Chruma therefore end up staying in China. Let's assume that by 2025, 15 chemistry departments around China, averaging 100 faculty members, have hired 20 percent international faculty members. This could mean 300 research groups led by native Western (non-Asian) people.

Meanwhile, let's assume that applications to US schools from Chinese graduate students continue to decline with the growth of the competitive science programs in China. Some fraction of the graduate students from China who populated research groups in the US and Europe now work in international groups without leaving China.

The number of non-Chinese Westerners doing postdoc appointments in these groups will be the first thing to increase. The NSFC recently launched a funding program (Distinguished Young Scholars) for Chinese scientists and non-Asian foreign nationals under 45 to carry out research in mainland Chinese institutions, as well as a companion program for under-40 foreigners (NSFC Research Fellowship for International Young Scientists).

According to the 2002 American Chemical Society Report, *Graduate Education in Chemistry,* there are 190 departments in the United States that offer the chemistry PhD. Half of the students are at 30 of these schools, and only 19 departments have over 150 chemistry graduate students.

At some of these schools, the ability to do competitive science is hindered by outdated equipment, the high cost of doing work, and low support for students. At some schools, the students have non-competitive stipends from which they pay high fees and health-care costs, and they sometimes need to pick up outside jobs to make ends meet during the summer.

In 2025, if you were thinking about a PhD in chemistry and you had the choice of a stipend that easily covered your cost of living with no need to take a job, and you had access to some of the best equipment in the world, and you had more than enough research groups led by any number of high-profile faculty members from around the globe to choose from, where would you go?

The number of US departments from the lower tiers that offer the chemistry PhD could be reduced by 25–35 percent by 2025 because of lack of funding and graduate students. While I do not think this new West-to-East brain drain will be a severe problem for the strongest chemistry programs, the economics of doing research in the US need to change or the competitive gap projected by the *Gathering Storm* reports will make China increasingly attractive to scientists.

There will always be students who elect to stay near to home in the US and in China. But there will be plenty of young Duttwylers and Chrumas. Motivated by doing the best science they can possibly do, they will take the bachelor's degree in the US and then join some international group in China for the PhD, or a postdoc, or a faculty position—simply because they want the chance to do their best. C

The author thanks all of the people who generously gave their time to be interviewed for this essay, and in particular Professors Yanguang Wang, Ping Lv, and Simon Duttwyler, all of Zhejiang University, for hosting his visit there during July 2014. He also thanks his U-M colleague, Professor Anna K. Mapp, for her keen commentary on earlier drafts of this manuscript.

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Resources

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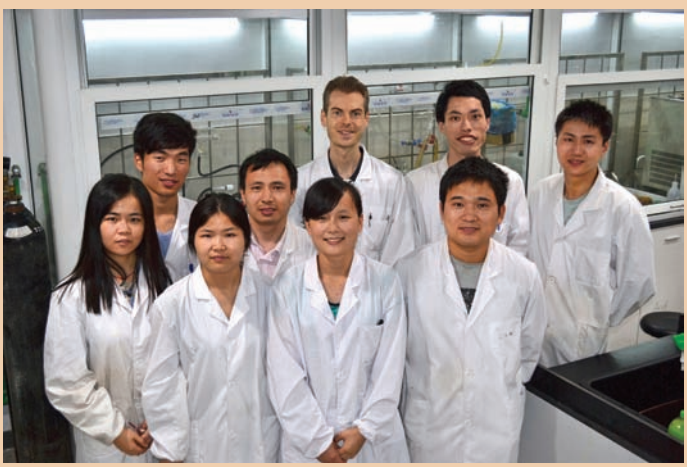

Simon Duttwyler and his research group, Zhejiang University, July 2014