Finnish Atmospheric Scientists have recently welcomed a number of top Chinese physicists, chemists and computer experts to their research space. Putian Zhou and Chao Yan belong to this growing group of young scholars specialising in air quality problems and clean technology.

Helsinki-Beijing commuters

Chao Yan, 30, arrived in Helsinki, Finland, five years ago, he was both surprised and a bit embarrassed. The working culture in Finnish campuses seemed to be quite different from the one he was used to in Shandong University, China.

“Generally, people in Finland behave in a very informal way, contrary to what is common in a Chinese scientific society. In addition to this, students of all levels are given a lot of independence here, which may sometimes slow down the studies,” he said.

Chao went on to consider his present job in the Institute of Atmospheric and Earth System Research, INAR, which has its headquarters in Helsinki University: “When it comes to the atmospheric scientists, it seems they have a very collegial attitude towards their minors. Junior scholars may join the research groups quite early, and they are treated as equal partners; they are taken seriously. This is why I started to feel at home in Helsinki.”

The head of the Finnish Atmospheric scientists, Academian Markku Kulmala, director of the Institute of Atmospheric and Earth System Research, is more than happy to hear Yan’s views. Since the beginning of the 2000s, he has spent much of his time and energy to build a bridge from Helsinki to Beijing and to other Chinese cities.

Today, China is investing heavily on air quality control and clean technology, as well as on basic environmental research. Kulmala’s institute and its multinational research groups are world-famous for their 35 years of experience in the field of atmospheric physics, chemistry and forestry. This is why China and Finland have a win-win situation by joining forces.

Science & industry from SMEAR stations

Since its establishment, Finnish Atmospheric Scientists has been a multinational society. Currently, the number of Chinese scientists is rising rapidly. Chao Yan is one of the specialists in aerosol formation.

The long-term data generated by the SMEAR-stations is used by the scientists to test and improve the understanding of the ecosystem and chemical phenomena of the ecosystem. This is why the stations in question are called ‘SMEAR’ (the abbreviation comes from ‘Station for Measuring Earth surface Atmospheric Relations’).
commercial purposes. The scientists at the Institute have already founded three spin-off companies which are used to develop, manufacture and export, amongst other things, particle counters and special sensors for the detection of hazardous chemicals.

Sino-Finnish knowledge swap
Currently, Kulmala spends an increasing amount of his own working time in Beijing, Nanjing and elsewhere in China. Beijing and Nanjing were the first Chinese cities to build a SMEAR-type observation station of their own — a project which would not have been possible without Kulmala and his colleagues.

“We consulted and supported our Chinese partners to develop the scientific idea of our SMEAR-technology, and in return we obtained great Chinese companionship and expertise, especially in the field of theoretical chemistry”, Kulmala said. “We now have close relations with Beijing University of Chemical Technology and several other Chinese universities, city officials, decision-makers and business people, with whom we are able to work together. Our first aim was to find the molecular-level mechanisms looming behind persistent smog, a phenomenon for which we already have some interesting results.”

Currently, the INAR research projects connected with China are worth more than €10m, of which China contributes more than a half. And, of course, it is hoped that this investment will deliver returns at a later date via both scientific...
breakthroughs and business opportunities and industrial byproducts.

During the long years of preparation which took place in order to establish today’s environment of Sino-Finnish co-operation, many Chinese students, postdocs and scientists became interested in the Institute of Atmospheric and Earth System Research, and, indeed, Kulmala’s specific way of leading it. As a result, there are now more than 40 scientists of Chinese origin on Kulmala’s payrolls, and on the other hand, many Finnish atmospheric scientists have moved to live permanently in Beijing and Nanjing. They are employed by the growing number of Chinese SMEAR-stations and spin-off companies connected with them.

**From Shandong to Helsinki**

Yan defended his doctoral thesis in September, but he has been working under Kulmala’s lead since 2013. In the future, he plans to create a purely academic career.

“I think it’s largely a question of technology when it comes to how we succeed in solving our environmental problems. However, I am personally more interested in basic research which may later support industrial applications,” he explained.

Yan undertook his undergraduate studies in Shandong University, China, where he developed basic skills in engineering, physics, chemistry and environmental sciences. Whilst here, he also became deeply acquainted with the design and implementation of water treatment and purification, before gradually becoming increasingly interested in atmospheric issues.

In his thesis, Yan studied the molecular-level events influencing the formation of secondary aerosol particles of the atmosphere. These particles are borne partly by Nature as a complex byproduct of various biogenic emissions, and partly by human action. The particles affect the climate by offering cloud seeds and by scattering the sunlight.

Yan made several important findings, one of which helps to understand what the climate was like in the pre-industrial era. This piece of knowledge is important to make sensible, quantified comparisons between different time periods.

**Computing the ancient atmosphere**

One of Yan’s colleagues, who is also of Chinese origin, is similarly working on the past-time climate in order to better understand the present-day phenomena— but the methods he uses are quite different from Yan’s.

Putian Zhou, 34, concentrates on modelling and simulating the microphysical phenomena of the atmosphere which prevailed thousands of years ago. Zhou, however, spends little time in laboratories or field stations, like many of his colleagues, such as Yan; instead, he works from his desk, coding, computing and modelling.
“I am, above all, interested in physics and chemistry, disciplines which have gone on to direct me towards environmental research,” Zhou said. He has another ambition, too: he wants to bring scientific computing forward in its potential to provide an increasing amount of support to the fields of substance.

In front of Zhou, on his display, there are thousands of lines written with computer languages. These are equations representing either basic laws of nature or phenomena of the atmosphere expressed in numbers or mathematical symbols. All of the equations are interconnected in a complex way, and by solving them simultaneously, scientists find out how a change in one link of the ecosystem affects the other parts of the entity. Many of the results can be tested empirically, at least to some extent. Reconstructing pre-historical conditions in a laboratory is a demanding, sometimes impossible task, however. This is why simulations are used as a first-hand guide.

**The best of the two cultures**

The Institute of Atmospheric and Earth System Research includes many physicists, chemists and forest scientists with remarkable engineering and manual skills needed during both the field work or in the laboratory as, in many instances, the scientists have to build their own instruments. As a physicist, Zhou has a basic understanding of lab activities performed with various tools, but what he enjoys most is the theoretical work.

“To get the best out of scientific programming and to utilise, say, self-learning algorithms optimally, we should collect different groups together, the majority of which consist of physicists and other experts on substances, as well as a few skillful coders or data scientists. I divide myself amongst both, and I like it. However, ideally there would be deeply specialised people working more tightly together,” he explained.

As with Yan, Zhou has also observed the differences between Chinese and Finnish working culture. “In China, the relationship between the supervisor and the master or doctoral student is, despite its formality, very tight – like the connection between a father and son. In INAR, the combination of the Finnish informality and Chinese protectiveness are combined in an ideal way.”