A Report of the

Oxford University Materials Science

JCCU Industrial Visit 2007

Tokyo, Japan

With support from:

The Great Britain SASAKAWA FOUNDATION
グレイトブリテン・ササカワ財団

JEOL

Contents:

Foreword

Each year the JCCU organises a visit to research laboratories and industrial sites for students from the Department of Materials. The JCCU is the Joint Consultative Committee for Undergraduates and, as the name suggests, it exists to liaise between undergraduates and staff. The committee enables regular feedback on lecture courses so that any problems can be resolved and improvements suggested and implemented.

The Tour is organised by undergraduate students and takes place in 9th week of Hilary Term (early March). Other recent tours have visited Aerospace Research in Toulouse, France (2006); Semiconductor manufacture in Beijing, China (2005) and Engineering works in Munich, Germany (2004).

The focus of the tour is to allow students to see applications of Materials Science in practice. Other important aims are to introduce students to different cultures and to promote international collaboration with and recognition of the Department of Materials at Oxford.

The decision was made to visit Tokyo for a variety of reasons. The department had been tentatively developing links with the Tokyo Institute of Technology and it was hoped that the visit could strengthen these. There are many cutting edge research and industrial facilities within a small distance from central Tokyo and so it would be possible to organise day and half day visits close to our accommodation. Also, the culture of Japan is very different from that in the UK and the destination would help the trip would appeal to students. Creating and maintaining student interest in a project such as this is a very important factor in its success!

Alexander Zawadzki
JCCU Chairman &
Organiser of the 2007 Tour

Itinerary

11th March - Leave Oxford 0700
12th March - Recovery Day in Tokyo
13th March - Talk at the British Embassy
- Visit Yasakuni Shrine
14th March – Half day visit to Nissan
15th March – Half day visit to Hitachi
16th March – Full day visit to JEOL & Tokyo University
17th March – Visit to Kyoto (ancient city) by bullet train
18th March – Free day in Tokyo & Tour Dinner
19th March – Free day in Tokyo
20th March – Depart Tokyo after breakfast, return to Oxford early evening

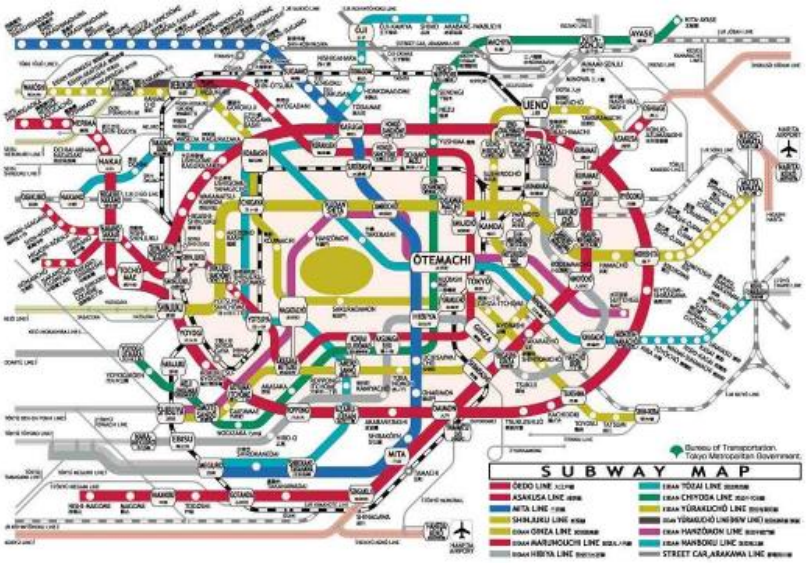
Days 1 – Departure

We arranged to meet up at Gloucester Green Bus Station at 0645 and take the "Airline" bus service to Heathrow Airport. At 0700 a bus set off with 18 bleary-eyed students and a similarly tired member of Academic Staff. Two students had arranged to meet us at Heathrow and two students had already flown to Japan the previous night and would meet us the next day at Narita Airport.

After the slow check-in had been completed the group dispersed to various shops and cafes until departure at 1300. We boarded our Virgin Atlantic flight and set off, settling down to watch in-flight movies. As the daylight faded most of the group were midway through Casino Royale and a few fast developers had already fallen asleep. The daylight returned after a few short hours – we had crossed through 9 different time-zones – and we began our descent into Narita Airport.

Day 2 - Arrival

Our plane arrived in Narita Airport at 1000 local time (EST) and we gladly disembarked. We collected three rental phones in the Arrivals building and took the Narita Express train into Tokyo. A little over an hour later we had changed trains in Shinjuku station and arrived next to our hostel in Iidabashi.



Iidabashi station is quite difficult to find at first, but with practice we got used to the system! We used the train network on all but one day of our visit. The rail passes gave us unlimited access to the JR lines across Tokyo and they were put to very good use!

We could not check in until after 1500, so we left our luggage in a locked room at the hostel and set out to explore the area. We split up and had Japanese-style lunches at some of the small soba (wheat noodles) restaurants in the area. The plastic food displays made it a lot easier to order food than trying to read menus in Kanji (the pictograms) or pointing to a meal at random although all three of these methods were tried with varying degrees of success. We never did find out what Adrian had for lunch! Nor did Adrian.

After checking in to the hostel we unpacked and then ventured out for supper and further exploration. We were all glad to stretch our legs after hours in the bus, plane and train journeys of the past twenty-four hours. Thoroughly tired, we were glad to retire to the hostel and get a good night's sleep.

Day 3 – Visit to the British Embassy

We had a few surprises the following morning - the earliest of which was unique to our accommodation. We were awoken at 0700 by announcement in every room that breakfast had started. When we reached the meal in question we found that it consisted of ham, mini-frankfurters, bread and salad. Breakfast during our stay cycled through a variety of different dishes including some form of macaroni and watery rice with fish and egg.

We set off out at around 0900 and decided that it would be good to walk into the centre in order to adjust to the feel of the area and to the new time-zone. Our walk from the hostel to Tokyo station passed the Imperial Palace Gardens where we spent a pleasant hour. The gardens were beautiful, and an impressive contrast with the surrounding metropolitan cityscape.

The skyline at the Imperial Palace Gardens

At Tokyo station we exchanged the JR receipts for Rail Passes and had lunch whilst this was being carried out. Again, the group split up and we had a "lost in translation" moment as we sat in a baroque-style restaurant in a Tokyo railway station eating 'カレーライス (curry) and listening to ABBA. Such a blend of different cultures is typical of modern Japan, but usually a shock to the unwary tourist!

After lunch we re-grouped in the station and then continued on foot around the fringe of the Imperial Palace, next to the moat.

The British Embassy is an impressive walled compound and is located very close to the Imperial Palace in the centre of Tokyo and Tokyo Station. We arrived at the gates on foot and collected the necessary passes from the guards. The security was quite stringent: all of our passports were checked against a list held at the guard post and I was greatly relieved that everything was in order.

We were met inside the compound by Ms Natsuko Nito who had arranged the visit for us. She introduced us to Jonathan Aves, the First Secretary; Chris Pook, the Counsellor for Science and Innovation and David Cairns, the Director of Trade and Investment. We were welcomed to the Embassy by Sir Graham Fry, the Ambassador!

The Ambassador, an Oxford man, kindly welcomed us to the Embassy and to Japan. In addition to his duties as Ambassador, he is President of the Cambridge and Oxford Society in Tokyo. The unnatural name of the society is due to the founders being from Cambridge and when Oxford members later joined it was on the condition that "Cambridge" preceded "Oxford" in the name!

The following talks introduced us to the history of Japan and, in particular, the evolution of Anglo-Japanese relations. Questions were asked about current political collaboration and differences. The Japanese death penalty, one of the few major sources of political conflict, was also discussed before we moved on to talk about the more familiar fields of science and innovation.

Facts and figures were presented to us showing the enormous extent of both government and private investment in Research and Development in Japan. The numbers were quite staggering – investment in engineering and science far surpasses that in Britain. We also heard about current collaboration between Japanese and British companies in R&D – of particular interest was Rolls Royce who use a materials testing centre near Tokyo. Sadly this was not to be part of our tour, but it struck a chord since some of the group had visited a Rolls Royce centre in Bristol a few weeks previously.

We left the Embassy with the impression that the British Government is busily at work across the world!

After the Embassy we visited the Yasakuni Shrine which is near the Embassy and quite a high profile shrine. It was dedicated to those who gave their lives for the Emperor, in particular those who died fighting in the Second World War. It has attracted media attention because twelve Class A war criminals are enshrined in the site and a lot of the military history is revisionist in nature. Visits to the Yasakuni Shrine by the Prime Minister of Japan have triggered protests in China, South Korea, Taiwan and Japan itself.

The shrine was closing as we arrived – we had not planned to visit but had discussed the nature of the shrine at the Embassy and agreed that it would be well worth a detour. The museum section was already closed, so we walked around the grounds and the garden.

We found, to our surprise, that not only humans were represented at the shrine but also animals. We saw statues of dogs and birds who were also enshrined at that site

The Yasakuni Shrine

The Sushi-Ya Restaurant

We left Yasakuni and took a metro back towards Iidabashi. We decided to try traditional Japanese cooking, and so we found a small restaurant serving sushi and sashimi. Sashimi is sliced raw fish and may be served with a separate bowl of rice or by itself. 'Sushi' refers to the vinegar-rice and may mean the rice and fish combination that people expect or something completely different!

The restaurant was three stories high but the floors were small. The floor was made of traditional tatami bamboo matting and we sat on the floor on cushions. We ordered both sushi and sashimi as well as Japanese beer and some sake. Luckily for us the menu came with pictures and so a lot of the risk was removed from ordering. As the picture shows, the sake was much enjoyed. I should emphasise that the sake was drunk from glasses much smaller than the bottles that Shafiq and Yuan-Tsan are shown holding!

The group were adventurous, although they had little choice, and all allergy problems were successfully navigated. Everyone agreed that the meal had been enjoyable, although there were a few people who were still less than keen on sashimi.

We had to make our way quickly to the metro to get back before the hostel's curfew. When we had asked about curfew we had been told that the entrance would be shut, the lifts would be turned off and the doors would be locked after 11pm. We did not know how strictly this was enforced, but we didn't want to find out!

Day 4 Visit to the Nissan Plant in Oppama

Manuel Schnabel, Mansfield College
Pascal Bugnion, St Anne's College

Our visit to the Nissan car assembly plant in Oppama, just south of Tokyo, began with a comprehensive introduction to the company in general and the Oppama plant in particular.

Nissan employs around 200,000 people in sixteen countries; some in research, but most in production, distribution and sales. The Oppama plant was opened in 1961 and is now the largest of the dozen factories Nissan operates in Japan. It employs 4,600 people, most of whom are involved in assembly. The factory runs with a day and a night shift allowing it to be operational seventeen hours and produce over 1,000 cars daily. Furthermore, the entire assembly process for a single car, which comprises twenty to thirty thousand parts of which 70% are made outside Nissan, takes just sixteen hours, so a car can be finished within a day.

Although it is primarily a production facility, the Oppama plant also has a research centre employing about 1,500 people and a large track for testing vehicle performance. One major challenge facing Nissan R&D at the moment is making cars more environmentally friendly, and fuel cell powered cars are being actively researched, albeit not yet produced.

We were then given a tour of the 1.5km^2 plant, which has a number of huge assembly halls and a similarly gigantic shipping area. As shipping by sea is the cheapest transportation method available, Nissan has located all of its major plants on the coast. Being an assembly plant Oppama needs to have many parts shipped there, but more importantly the 35,000 cars produced every month need to be shipped away, and the facilities here are sufficient to ship five thousand cars every day. The cars, driven onto ships by professional drivers, then have only four inches clearance between them (and have white tape on to protect the paint), but even so only 800 will fit in a typical ship, so this means 6-7 ships may be filled here daily. When we visited we saw a fleet of 'Infiniti' cars waiting to be shipped; we were told these were the luxury brand of cars Nissan sells primarily in America under a different badge.

Having been shown the shipping facilities we were then taken round one of the assembly halls, where the assembly process began by welding together the body of the car. We saw various stages of the welding process where the two side-walls (each light enough to be carried by a man) were welded to struts and then to each other to create a space frame. Nissan was one of the first plants to introduce robotic welding, and here almost all of the three thousand welds that go into each car are done by robots.

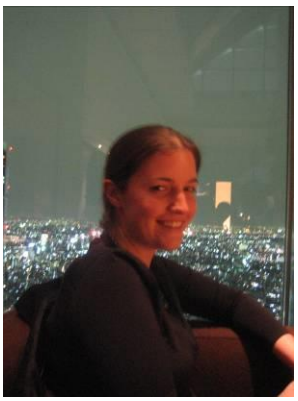
We were not allowed to take photos in the factory or during the bus tour around the site, so sadly do not have any pictures of the automated spot welders or the robotic supply chain. Nor do we have pictures of the impressive sight of hundreds of cars being lined up on the docks in preparation for shipping. We were allowed to take photographs of the plastic models on display in the showroom, though they don't quite capture the scale or complexity!

Nissan is trying to automate as much of the assembly process as possible but due to the number of different models in production and because Nissan tries to make cars to order, most of the assembly process is still done by manually. The cars move slowly down a manual assembly line, and each worker adds roughly the same parts on each car (e.g. just the lining of the boot and the rear windscreen wiper, or just the dashboard and side door linings). Each worker is trained for three different production line jobs so that a degree of flexibility exists within the workforce.

The assembly details are given on a sheet of paper attached to the car, and the components are stored in a box that moves along at the same rate as the production line. More robots work to ensure that the components necessary for each car are at hand to be used by the human worker. These robots came in a variety of different shaped and sizes – they looked very fragile in contrast with the welding robots and they all played synthesized tunes to avoid being trodden on by a careless worker.

Once the car was finished it underwent a series of tests to ensure that everything worked. Usually it does, and only one or two cars per day fail the tests. These are either fixed, or dismantled and all but the defective parts re-used.

All in all, the visit was very impressive as it gave us some insight into the production of cars on a vast scale, and showed us where advanced technology, in particular robotics, has already made huge changes to the manufacturing process, and where there is still the possibility for it to lead to yet further improvement.



In the evening we split up to explore more of Tokyo. A group of us went to the Park Hyatt Tokyo in Shinjuku-ku. This hotel was used during the film "Lost in Translation" for its opulence and amazing night views over Tokyo.

On the top (52nd) floor there is a cocktail bar with glass roof and walls and mainly lit by small candles on the tables. As anyone who has seen the movie knows, the sight from here is truly breathtaking.

We lingered over cocktails for as long as possible and admired the lights of the cityscape below.

Day 5 Visit to the Hitachi Central Research Laboratory

Fei Fei, Queen's College

The Hitachi Group is made up of over 900 companies and has over 350,000 employees worldwide. Hitachi Ltd, whom we were to visit, was founded in Tokyo in 1910. In 2006 the company had 41,157 employees and total revenue of 2,713 billion JPY (about £13billion).

The Hitachi Central Research Laboratory

Hitachi manufactures a broad range of electrical goods using its knowledge and technological expertise. The R&D Group acts as a hub linking customers and partners for collaborative projects.

Hitachi Central Research Laboratory (HCRL) was established in 1942 by the founder of Hitachi, Mr Namiher Odaira. This laboratory has created many of the company's backbone businesses such as semiconductors, computers and communication technologies. The aim of the lab now is to create change through convergence of information, electronics and life-science technologies, and lead Hitachi to become the "Best Solution Partner".

We visited HCRL on the 15th March 2007. The schedule was as follows: 10am, Greetings and Overview, 10:30am Recent Research Topics, 12:30pm Bento lunch and walk around Garden.

The Recent Research Topics include:

1) Organic LED Displays (OLED) – we saw a prototype screen which was only 2 mm thick. The circuit technology enables Peak Brightness Control, which achieves more than twice the brightness of an all-white picture in a local bright spot on a flat panel display. Because the OLED display only generates the desired colours rather than generating white light and then filtering it, these displays are much more energy efficient. This is especially useful in portable devices because it means that they will consume less battery power. The images displayed were amazingly sharp and the colours were vivid.

2) Sensor Net – this was a network of sensors (nodes) that transmitted data wirelessly to computer. We saw a demonstration wrist-watch like device that recorded information such as 3D spatial accelerations, skin temperature and heart rate. This can be used for people who need to monitor their health and will be useful in Japan with the increasing average age of the population. We saw a behavioural chart about one of the researchers who had been wearing a prototype watch for three years! The motion patterns from the 3 accelerometers could be translated into different activities – we were told that the sensor could also be used in an office chair that could tell employers when the occupant was busy or idle and from the "fidget patterns" could even tell who the occupant was! We weren't totally sure if we liked this idea.
3) Ultra-Small µ-chip Radio Frequency Identification (RFID) Technology. To visualise this, it looks like a grain of sand! We were shown tiny silicon chips which are nearly invisible. The lab minimises the chip size to lower the cost as the materials cost is relatively high and also to strengthen the system which the chips are in. The µ-chip is the world's smallest non-contact IC chip developed by Hitachi. The chip converts antenna-received 2.45 GHz microwaves into energy without a battery and transmits back 128-bit signal wirelessly. In February 03 Hitachi developed and confirmed the operation of a model measuring 0.15 mm per side and 7.5 µm thick. These chips have been successfully used in tickets for the 2005 World Expo in Japan, and so may be used more widely in the future.
4) Personal ID System using Finger Vein Pattern. Some of the problems with fingerprint biometric systems are that fingerprints are not distinct enough - the sensors occasionally make mistakes. Fingerprints also get worn down from manual work or injury. And, as fans of action films know, there is the danger that criminals will remove a finger or two in order to break through biometric systems. Hitachi has developed a scanner that uses infrared imaging to build up a 3D picture of the veins in a finger or thumb. This is as unique as a fingerprint, and can be more accurately read and differentiated by computer. If your finger is stolen, then without blood pressure inside the veins the scanner will reject it – though we hope that this is an unnecessary precaution.

The bento lunch was delicious – bento is a traditional 'packed lunch' assortment of cooked fish or meat, rice, pickles and vegetables. It involved using chopsticks, but we were all getting better at using these. During lunch we talked with some of the students who had just started work at the CRL and they were all very enthusiastic about their work.

HCRL has a beautiful garden with natural springs and a lake.

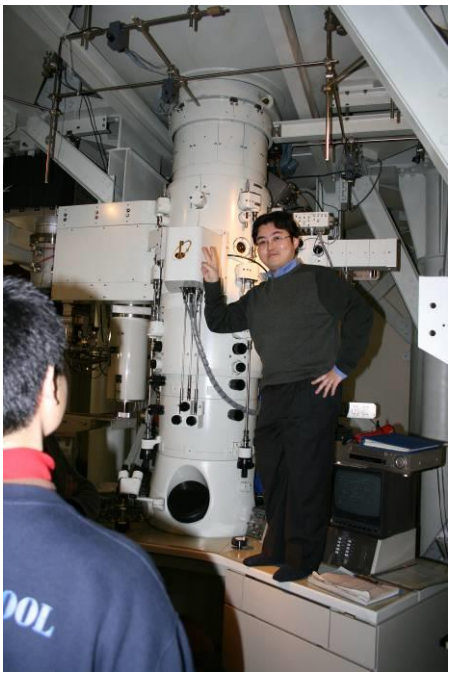
The gardens are extensive with trees, a natural spring and a lake. The Emperor gave swans to Hitachi and their descendants now live here! Hitachi is justifiably proud of the location.

Day 6 JEOL

Our visit with JEOL (Japan Electron Optics Laboratory) was split into two halves. The first half was a visit to the Institute of Engineering Innovation at the University of Tokyo (with which JEOL has a development partnership); the second half was a visit to JEOL's research and production facility. Our guide for the whole day was Matsumoto-san, to whom we are deeply grateful.

The Engineering Department at the university has a range of JEOL microscopes including three transmission electron microscopes and one scanning electron microscope. The largest of these microscopes is the JEM-ARM 1250 (pictured right), which is housed in a purpose built complex of three floors. The size of the microscope means that the whole building had to be designed around it, including winch systems and an air cushioned support to reduce vibrations. Further protection from the surroundings is provided by the bundles of wires running round the perimeter of the room in three mutually perpendicular directions. One of the wires in the bundle is used to detect any background magnetic fields that may affect the image quality. The others are then used to try to correct this by applying the reverse field. Even with these protection systems to get the best possible image resolution (isolated from vibrations and e-m interference) the microscope is run at night when effects from passing traffic, building lighting and the electrically powered underground metro are at a minimum. When these precautions are applied the microscope is able to achieve a resolution of 0.1 nm using an accelerating voltage of 1250 kV to produce a magnification of 1.5 million times.

To appreciate the scale of this microscope, here is a closer look at the lower section. The microscope spans three floors; the basement with the pneumatic dampening system is not shown in either photo.



Across the road from this microscope was a special electron-beam writing device. It held a substrate using polymers, then irradiated this with an electron beam. In this way it could make the patterning needed for chip fabrication in 1h whereas the process has previously taken around a week. This machine was located in a Category 1 clean room (less than 1 particle/ft^3) so we couldn't enter it although we could look in through the UV filter windows.

We were given a talk from Ikuhara-sensei and other senior members of the Tokyo University Staff and then a tour of the campus. The different styles of architecture were very interesting to observe around the university ranging from the older building in stone to the ultra modern building in steel and glass. In one place, the expansion of the university had resulted in a new building being built on top of an existing structure. The new structure rested on an exoskeleton of large metal columns, an amazing concept.

We stopped for lunch at the house of a famous Japanese author. The house is now a hotel and restaurant and we enjoyed a delicious bento lunch. JEOL had reserved a room for us there, and so we chatted amongst ourselves. After lunch we went to see the nearby garden with stone lanterns and ponds full of koi fish.

At the research and production facility we were met by the head of European sales, Ishida-san, who gave us a brief introduction to JEOL and its aims.

In 1946 JEOL began its research and was able to complete its first TEM three years later in 1949 (pictured left). In 1956 JEOL was the first Japanese company to manufacture a NMR spectrometer, and 10 years after that in 1966 JEOL was the first Japanese company to produce a commercial SEM. Around the same time in 1966/67 JEOL was the first to develop the UHVTEM (Ultra High Voltage Transmission Electron Microscope) with an operating voltage of 1000 keV.

JEOL currently has a staff of 1,347 worldwide across 80 countries, with about 100 of those being involved in technical roles. It has a working capital of ¥6,740 billion (£30 billion) and an annual turnover of ¥93 billion (£413 million) and an export ratio of 41%.

We saw showrooms where different instruments were set up so that visiting companies and organisations could come and use them before deciding what to purchase. Several of our tutors had visited the factory previously, and it was strange to be talking about them, thousands of miles from University! We were shown around several levels of the factory where electron microscopes and other analytical machines were being made. There were rooms filled with microscopes in various stages of completion – a different atmosphere from research institutions where they are often scarce and treated with a kind of reverence.

After the tour and bus journey back to central Tokyo it was getting late. We decided to try a different type of restaurant this evening, and on the advice of Matsumoto-san, went to a Korean-style restaurant close to our Hostel. Another popular feature in some Japanese restaurants is that you can cook your own food. This may be in the form of okonomiyaki (pancakes cooked on a hot plate), shabushabu (when the ingredients are stewed in a pot of boiling water on each table) or, yakiniku (with gas powered grills set into the table).

The Korean restaurant was of the yakiniku style, and we cooked slices of meat on gas grills – the flames from the burning fat were impressive. Although a barbeque and a few glases of beer isn't traditional Japanese food, it has become more popular in the 20th centuary and rapidly integrated into the culture. As with most foreign food in Japan, the style of this cooking has been changed to the extent that is it is no longer Korean but more "modern Japanese"

The food was delicious, we ate a lot of cooked meat and rice and tried a traditional Korean wine as well as Japanese beer. We had a fantastic evening.

Day 7 – Cultural Visit to Kyoto

We set out early to catch a Shinkansen (bullet train) to Kyoto. We left the hostel at 7am and took the subway to Tokyo Station, then found the Shinkansen platforms. Our rail passes covered the entire Shinkansen network except the super-express Nozomi line.

Right: Our Shinkansen (bullet train)

The ordinary Shinkansen travel at up to 177mph and the next generation will have a normal operational speed of 200mph. Due to noise pollution and braking difficulties this is unlikely to be superseded until a magnetic levitation train network is built. A maglev train is expected to be running from Tokyo to Nagoya by 2025 at an average speed of more than 220mph. Even in this hi-tech method of travel, the old formality of Japanese custom is preserved: the staff bow as they enter and before they leave each carriage!

Our train departed – exactly on time – and three hours later we arrived in Kyoto.

We decided to have lunch before setting out to explore the old city, and so went to a "ramen" restaurant (thick white noodles in soup) at the station and planned what to see. We split up into groups and set out around midday. Most people saw (in some order or another) the Golden Temple, Kyoto-jo (Kyoto Castle) and the Silver Temple whilst others saw the Pagoda, the old shopping district or the plum blossom at the Kitano Tenmangu shrine.

One of the most famous Kyoto landmarks, the gate to the Kiyomizu dera temple is perhaps one of the most famous. This magnificent structure is only the first of many shrines in the complex.

The Jishu-jinja shrine is dedicated to the god of love and matchmaking. It has two stones 18m apart and if a person can walk from one to the other with his or her eyes closed then this is taken as a good romantic omen. There are many stalls selling talismans and fortune predictions.

Makio (trainee Geisha) and Geisha are becoming increasingly rare in Kyoto. Local tourist tours include "Geisha spotting walks" at dusk when they are most likely to be seen in the streets going to and returning from meetings.

If there is a festival in progress in Kyoto, and particularly during the famous Gion Matsuri, the streets are often full of people wearing traditional clothes. Many shops across Kyoto sell decorative silk Kimono, which can cost thousands of pounds. Of course, to cater for the tourists cheaper nylon versions are also on

sale. We were surprised to find three members of our group wearing kimono and headbands when we met up later that day!

The Kinkaku-ji or Golden Pavilion Temple (right) is a pavilion covered in gold leaf. It was originally built as a retirement home for the Shogun Ashikaga Yoshimitsu in 1397 but was later converted into a Zen temple. The temple has been destroyed by fire several times since then and the current structure dates from 1955. The garden setting and lake are very beautiful, as are the small streams and waterfalls in the surrounding garden.

We enjoyed walking around this temple complex. We could view the Golden Pavilion Temple from various sides but not actually go close to it.

Sadly, those of the group who later went to see Ginkaku-ji or Silver Pavilion Temple later on found that it slightly anticlimactic. Although the titles of the two temples are very similar, the Silver Pavilion has no silver coating. There are many different stories as to why this is the case, but the opulence of the gardens and temple itself seem to indicate that this was probably an intentional choice by the creator and not due to the cost of the 1467 Ōnin War.

Ninomaru Palace (left) forms part of Ninjō- jō castle. The castle was built by Tokugawa Ieyasu in the fifteenth century to be the residence of the Tokugawa Shoguns (the rulers of Japan at that time).

The Palace contains many screen paintings by famous Japanese artists. The building itself is constructed from wood and paper panels – it was very cold to be in during our visit! The "nightingale floors" are an interesting feature. The floorboards rest on metal hooks so that when someone walks on them they give out squeaking sounds. This was originally a security feature to protect the Shogun from assassins.

The palace is surrounded by gardens containing cherry and plum trees. Although we were too early to see the sakura (cherry blossom) some of the plum trees were in blossom. Beyond the gardens is a moat that encircles the castle complex. Presumably, any invaders would have to contend with the turtles and goldfish that we could see lurking beneath the surface.

Despite the various routes and many sites visited we all met up on time in order to get the Shinkansen back to Tokyo! We arrived back in Iidabashi around midnight. We had asked if we could miss the curfew by an hour, and we were relieved to see that the Hostel was still open when we returned.

Day 8 - Free Day and Tour Dinner

Our free day was a chance to explore Tokyo in smaller groups. We were to meet up with students from Tokyo Institute of Technology in the evening for our Tour Dinner.

As in Kyoto, people went in all directions and saw all sorts of different things! One group went to Harajuku to see the "cosplay" – each weekend lots of the teenagers from across Tokyo come to the area to dress up in strange vaguely gothic clothing and hang out.

Left: Harajuku Fashion

Right: A Shinto wedding in Meiji Park

We saw a lot of contrast in Harajuku. The modern area with the Starbucks, cosplay and clothes shops was just a moment's walk away from a park containing the beautiful Meiji shrine. We took a stroll around the shrine and surrounding park and were surprised to see a Shinto wedding in progress even though the area was still completely open to the public. Shinto and Confucianism are the dominant religions in Japan.

For lunch, we met up with a former DPhil student of Oxford Materials Department, Dr. Milica Todorovich, who is now a post-doc at the National Institute for Materials Science (NIMS) in Tsukuba. Meanwhile, other groups were exploring the various cultures of the Senso-ji Shrine in Asakusa, the sprawling Electric Town in Akihabara and the various delights of Disneyland-Tokyo! It is surprising, but these three different sites are all strong parts of Japanese contemporary culture.

The Senso-ji shrine is Tokyo's oldest temple and is somewhat of a national symbol of peace and rebirth since its restoration after the Second World War.

Akihabara Electric-Town is a strange place, a covered market for electronic components sprawls across the Akihabara district between seven story electrical stores. This area lives up to the stereotype of hi-tech Japan: many of the consumer goods on sale would not reach Britain for months at least.

Tokyo Disney is rather self explanatory. However, as a friend remarked to me, if you really want to spend an afternoon in the same way as a young Japanese person and experience typical contemporary life then this is the place to go!

In the evening we met up in Shinjuku for the Tour Dinner. We had reserved tables at a shabu-shabu restaurant. We all met up with four Japanese students from Tokyo Institute of Technology (TiTech) whom I had met the previous summer. Sadly Professor Mizuta, my main contact at the university, was in the process of moving to the UK and it was not possible to arrange a larger student get-together. We all met at the "dog statue" outside Shinjuku station – a popular local meeting place. Why anyone ever chooses to meet here is curious – the statue is *tiny* – about the size of a brick – and so difficult for people new to the area to find. It is also the preferred rendezvous point for perhaps a hundred people at any one time and this further complicates the matter.

It is worth going to Shinjuku in the evening just to watch the crowd. There are hundreds and hundreds of people going to and from the station and generally milling around. Then there are the bright lights of the shops, cafes, restaurants and Karaoke bars – many of these! Touts meander through the crowd wearing puffy silver jackets and trying to take you to a particular karaoke bar or club. The feeling is decidedly vibrant and embodies much of the culture of modern Tokyo.

Our restaurant was on the fifth floor above an arcade, a typical set-up. We took off our shoes at the door and were led through to an empty room. Large metal pots of water were brought to the table and placed on gas burners. We then used two touch-screen tablet PCs to order the food and although there were a few pictures on the menu this still involved a lot of guesswork. The food was brought through – raw strips of meat and vegetables, bowls of rice and soy sauces. We dipped the ingredients into the boiling water and then into the sauce before eating it – I don't think that this style of cooking would survive health and safety regulations back in the UK!

The menu was "tabehodai to nomehodai", all you can eat –based and all you can drink. This worked well because it took a lot of trial and error to find out what we liked!

We ordered a variety of different meats – the TiTech students helped us to translate what they were but we still didn't understand all of them! We also ordered a variety of different drinks ranging from Japanese beer to sake to plum wine

Named and shamed! Karaoke (left) is a totally different activity in Japan compared with the UK. You book a small room with friends and then can order fast-food and drinks. Songs are selected on the music system from a catalogue as thick as a telephone

directory, with a wide range from The Sex Pistols to Disney classics.

Day 9 – Last Day in Japan

Our last day in Japan started in an interesting fashion. Some people had gone on to the nightclubs in Roppongi after Karaoke the previous night, and because of the hostel curfew had not yet been to sleep. Others, myself included, had decided to try out a "Capsule Hotel" – where you rent a "Capsule" for the night. We spent a less than comfortable night in the coffin-like boxes (right) each of which contained a futon, light, alarm clock and television. Someone in our group snored.

Some people got up as early as 5am in order to see the Tsukiji fish market at its busiest. Six mornings a week there is an auction of fresh tuna for the sushi and sashimi restaurants in Tokyo. High quality tuna is highly sought and the best tuna command a very high price. In a different part of the market the fish are cut up with enormous knives and electric band-saws. Tuna are huge, as you can see from the photo (left) a frozen section of a single fish is as big as a human.

It is difficult to describe in words the scale of the Tsukiji market. Some figures give a rough idea: over four hundred different types of seafood are sold at the market from (live) shrimp and eels to fugu, the poisonous blow fish. Around two thousand tonnes of seafood are sold every day with a daily value of over six million pounds. All of this seafood (and more from two other fish markets in the city) is then consumed in Tokyo on a daily basis.

Those who had been to the fish market then either went shopping for presents to take home or went back to the hostel to bed! In Japan it is customary to bring a small gift "omiyagi" back for family and colleagues when one returns from a trip. Different regions often have a large amount of merchandise on sale for exactly this purpose. Amusingly, stations around Tokyo often sell souvenirs from many different places. This serves two useful purposes: firstly forgetful people can buy the necessary gifts when they arrive back in Tokyo and secondly that people who have not actually been on business trips can buy a suitable alibi!

Our motivation for shopping was much more straightforward. The most popular gifts for friends and family seemed to be paper fans, rice-sweets and the occasional bottle of sake. Cute key rings and t-shirts were close runners up.

A small group of people took a train out of Tokyo to visit the nearby town of Kamakura. Kamakura is famous for many reasons: it has a magnificent firework show once a year where tens of thousands of people sit on the beach and watch the fireworks being set off from the boats off-shore and from the nearby water. There is a "Daibutsu" or Great Budda statue, the second largest such statue in Japan. Kamakura also has one of the best burger restaurants in Japan, and indeed the world.

The Materials Science background of the trip makes it impossible not to make some comments about the Daibutsu (above). The statue is over thirteen metres tall but weighs only around 93 tonnes. This is because it is hollow, and made of cast bronze plates carefully pieced together. Two panels in the back of the statue open up, though whether this is to prevent the air inside the structure from pressurising as it heats up during the day and deforming the statue or just to provide some natural light for everyone who pays the ¥20 (10p) entry fee to go inside the statue I am unsure. The statue survived a Tsunami in the fifteenth century that destroyed its surrounding temple and so the "natural light" explanation is the most likely one.

We had a delicious lunch at the Kua'aina restaurant which is part of a Hawaiian chain. Hawaii is slightly more than midway between Japan and America has a similar climate to the southern islands of Japan. This restaurant overlooks the white sand of Kamakura beach but the chilly spring weather made indoor seating much more comfortable.

After lunch we visited a few of the smaller temples in the centre of town and then walked slightly further afield to see the Tōkei-ji shrine. Traditionally it was difficult for women to divorce their husbands and this shrine had been a place of refuge for women who were abused by their husbands. After staying for three years at the shrine, the women would be officially divorced.

We saw, to our delight, sakura blossoming in the garden surrounding the shrine. Although it was still cold, and the sakura season would not come to the area for perhaps another week, we had found a tiny area where the conditions were warm enough for the cherry trees to flower. It felt that, just as we were leaving, the beauty of spring was coming to Japan.

Day 10 – Return to Oxford

We left Iidabashi early and took the Express train to Narita airport. We handed back our rented mobile phones and started the slow progress of getting through the airport. A few members of the group cast longing glances at some PS3 consoles on display in the duty free section, the console hadn't been released in the UK yet.

Because of the time-zone changes we landed in Heathrow on the same day as our departure. At the airport the group dispersed – the majority caught the bus back to Oxford whereas others caught buses and trains.

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There are a great number of people and also several organisations without whom this trip would not have been possible.

I would like to thank everyone who has been involved in this project. A considerable amount of work went into organisation and many barriers were overcome. Despite a few students losing important documents (and despite almost losing a few students!) the trip ran smoothly.

Organisation

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Hosts

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The Worshipful Company of Armourers and Braziers kindly sponsored us again this year. We are extremely fortunate to have such a supportive repeat sponsor.

This is the first year that the Worshipful Company of Founders have been involved with the trip. We are very grateful for their support and hope they might continue to support projects run by the Department of Materials in the future.

The Sasakawa Foundation is devoted to building relationships between the UK and Japan. We hope that they approve of this use of their funding. Not only was the trip culturally eye opening to participants but it created many scientific and personal links.

We are also supported by Department of Materials who think that this trip is a good use of funds – I hope that nothing will change their mind!