



The Institute of Materials, Minerals and Mining

**Schools
Affiliates
Scheme**

Issue 19

Spring Term 2005

MATERIALS AT THE ASE MEETING

Hello there and welcome to 2005! Since the last edition of the newsletter I have spoken to around 2,500 people, moved house, spent my Christmas hols decorating, and there's no rest for the wicked...!

We are kicking off the New Year with a special Materials, Minerals and Mining theme day at the ASE conference in Leeds. Thursday 06 January will feature a morning programme packed full of interesting and entertaining presentations. I will be giving a talk very similar to the one I bring into schools, so if you are attending the conference and would like to see the sort of presentation I can offer please come along. After lunch there is a choice of two bookable workshops and in the evening we are hosting a reception at the Royal Armouries. A limited number of tickets for the latter event will be available from our stand in the main exhibition.

In this issue I have decided to focus on the world of Earth Sciences as knowledge in this field underlies materials, minerals and mining engineering. Philip Murphy from the Earth Sciences department at the University of Leeds, who is also involved with the Earth Science Education Unit has provided a wealth of information for this issue, which I hope you will find interesting.

Also featuring in this issue is a not to be missed competition for your students on page 5, a summary of the poster competition (page 3), details of this year's UCAS conventions (page 5) and information about a rather exciting new play on a materials theme on page 7.

I know I always say this, but we do really welcome your feedback, positive or negative. If you have any points you would like to raise, articles for the newsletter or suggestions for new resources please contact us.

Evaluations of my presentations in schools have been coming back thick and fast and am I pleased to report that the comments have been very positive. I am taking bookings from about mid-February and my diary is on page 4. If you would like to book one of the remaining dates please e-mail me.

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Earth Sciences – understanding the ground beneath our feet

Before we can look at mining ores which we can convert into useful materials we must first understand the earth beneath our feet. Earth scientists work in a variety of fields which help us to work out what is going on below us, not just for the purposes of finding new sources of materials. Experts in the geological sciences are also important when deciding where to position a new building – its no good building on unstable land. They are also vital when looking at how land can be regenerated and reused. Here are a few case studies of students that have studied in the Earth Sciences Department at the University of Leeds. More complete profiles are available on their department web-site, <http://earth.leeds.ac.uk>

Jim Wright

Jim is a senior planning engineer for the Oil/Gas and Petrochemicals division of ABB Lummus Global where he mainly works on the construction of oil refineries and other petrochemical complexes.

Jim studied for his BSc in the Earth Sciences department where his strengths were in structural geology, sedimentology and field work. Following this he studied for an MSc in Reservoir Evaluation and Management at Heriot-Watt University.



Sarah Mackay

Sarah studied for her BSc at Leeds and then moved over to Manchester to do her PhD. She is now employed as a principal consultant at URS in Manchester where she manages a team of around 30 people working on contaminated land.

She says the best part of her job is getting to meet lots of people and she also enjoys the variety in her work. There is no typical day for Sarah, sometimes she is at her desk and other she is out investigating contaminated land, climbing down river banks and taking samples.



Steve Freeman

Steve is a consultant in the structural geology consultancy group of RDR. His job entails looking for gold, platinum, palladium, copper coal and chromium.

He studied for both his BSc and PhD in Leeds and explains that his studied and subsequent jobs have allowed him to travel the world. “I have seen some of the world’s most spectacular geology. I have explored for gold 3000m underground in South Africa and 3000m above sea level in the Colorado Mountains of the USA.”



Thanks to Philip Murphy from the Earth Sciences Department at the University of Leeds for providing these profiles.

World Materials Day Final

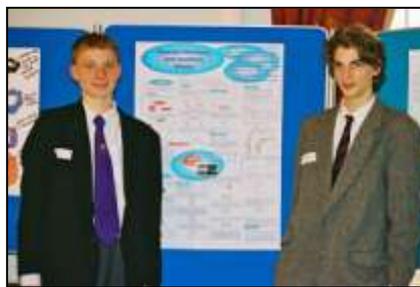
It seems like a very long time since we launched the World Materials Day 2004 Poster Competition back at Easter. The grand final was held at our Head Office in London at the beginning of November, but getting there was a long, hard road. I have to confess to being a little bit worried when we still hadn't received any entries by the beginning of September. However, I should have known that your students had been beavering away during their summer holidays to come up with some truly excellent designs. I was out of the office for a few days around the closing date and I came back to find, what can only be described as, a tower of entries on my desk!

The competition was split in to two age categories, Class I (aged 13 to 16) and Class II (aged 16 to 19) and teams of up to four pupils had to produce a poster on one of five topics. The posters we received all focussed on four of the available titles: The energy saving house of the future, Modern transport, Bionic Man and Recycling, and entries were split almost equally between the two classes. Judging the posters was one of the hardest things I have ever had to do. The teams had come up with some really innovative designs with three-dimensional displays, flaps to lift to reveal more information and a wealth of interesting art materials! A wide range of abilities had also entered and it was wonderful to see such creativity applied to a science theme. I only wonder where all that creativity disappears to when students go to university! In the end I had to be ruthless and select three winning posters from each age group. These short-listed teams were invited to attend the final in London, where they had to give a short, verbal presentation about their chosen topic. The short-listed teams, shown here with their posters comprised of:

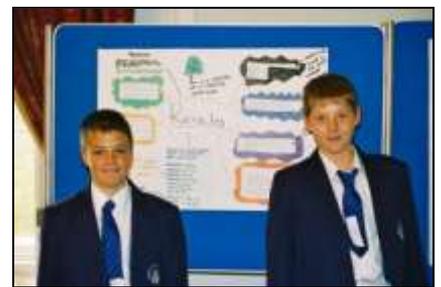
Class I



Melika Bouncir, Claire Cherry, Roseanna Finnigan and Katie Stephens from Carr Hill High School, Preston



Alexander Gaunt and Henry Hughes from the Perse School, Cambridge



Luke Holden and Chris Evans from Carr Hill High School, Preston

Class II



Oliver Proctor, Andrew Patterson Hollie Groome and Hazel Summer (not shown) from Carr Hill High School, Preston



Sarah Bowen and Kamaldeep Ajimal from King Edward VI Hadsworth, Birmingham



Katherine Winter and Mat Cameron from Carr Hill High School, Preston

Final day, 01 November, was nerve-racking for all concerned, not least of which was me! The day had taken a great deal of preparation as the poster final coincided with the judging and presentation of the Institute's competitive prizes for students and technicians. Dave Egner from Corus, Marion Ingle from London Metropolitan University and Garry Hannan from Anglo-American had the challenge of judging

DIANE'S DIARY

Here we go again...! My diary up to the Easter Hols.

6-8/01	ASE Conference, Leeds
12/01	William Parker School, Hastings
13/01	Varndean College, Brighton
14/01	Ridgewood School, Doncaster
19/01	Brigshaw High School, Leeds
20/01	Pocklington School, , N Yorkshire
21/01	Lady Eleanor Holles, Hampton, Middlesex
24/01	Grimsby College, North Humberside
28/01	Helston School, Cornwall
31/01	St Mary's Catholic College, Blackpool
02/02	Farringdon Sports College, Sunderland
04/02	Bath / Bristol Inset
07/02	Balcarras School, Cheltenham
09/02	Moulsham School, Chelmsford
10/02	Cranfield University
16/02	University of Wales, Newport
17/02	Aquinas College
02/03	Leeds Uni / West Yorkshire Setpoint INSET
04/03	<i>Eastleigh Technology Consortium</i>
09/03	Our Lady Queen of Peace School, Skelmersdale
10/03	Techniquest TSN, Cardiff
11/03	Ampleforth College INSET, nr York
14/03	St Aidan's School, Harrogate
15/03	St John Fisher High School, Harrogate
16/03	Framwellgate School, Durham
17/03	Carr Hill High School, Preston
18/03	Queen Ethelburgas College, nr York
21/03	UCAS Fair, Cardiff
23-24/03	UCAS Fair, Exeter
31/03	St Thomas More School, Southend

Still available for Spring term are:

January:	27*
February:	18, 23, 24
March:	03°, 30

* only if on journey from Leicester to Cornwall

° only if on journey from Leicester to Southampton

Summer term dates are going like hot cakes, below are the dates I have left. IF you would like to book please e-mail me at diane.talbot@iom3.org

April:	08, 13, 15
May:	04, 05, 06, 11, 12, 18, 19, 20, 25, 26
June:	01, 02, 08, 09, 10, 15, 16, 22, 23, 24, 30
July:	20, 21, 22

Just in case you like to book well in advance I am also taking booking for the new academic year starting in September. I know there are a number of schools who would like me to come back again this Autumn, I will be contacting you after the Easter hols to confirm suitable dates.

World Materials Day, continued from page 3

the presentations. The Class I talks were up first and the students did a brilliant job! The speakers were all confident and put their chosen subjects across clearly and enthusiastically. I particularly liked the opening to the Recycling talk where the boys introduced their presentation with a short play! After a very nice lunch it was the turn of the older pupils. Again the speakers came across as confident and knowledgeable about their topics. The girls from King Edward VI Handsworth brought along some props and conducted an experiment to demonstrate recycling.

While the judges were off deliberating the short-listed teams and many of the candidates that were nominated for the competitive prizes took part in a light-hearted competition to build crash helmets for eggs. Everyone enjoyed the competition and it was nice to see that everybody was coming up with very similar designs, no matter what age or level of education.

The judges admitted that making a decision was very difficult as the standard of the presentations was so high. In the end there could only be one winning team in each class and the prizes were presented by Dr Bernie Rickinson, our Chief Executive. The winners of the Class I competition were the girls from Carr Hill High School whose poster and presentation looked at the Ec-House of the Future. They each received £15 of Amazon vouchers and the school got a cheque for £250 and SAS membership. In Class II, by complete coincidence, the winners were also from Carr Hill School and they gave the presentation on Transport for the Future. Their prizes were the same as those for Class I. The runner-up schools also received SAS membership and all those taking part got certificates.

So, on reflection the competition was a storming success, especially for Carr Hill High School. For us it was extremely hard work, but thoroughly enjoyable and very rewarding. With students like those that entered I think the future of materials is in safe hands!

Would we do it again?

Watch this space.....!

Reversals of the Earth's Magnetic Field

Dr Andrew Jackson

One of the most enigmatic features of the Earth's magnetic field is the fact that it flips its polarity, so that the north pole becomes a south and vice versa, every so often. This has happened about once every half a million years in the recent past, though there have been long periods (such as for 30 million years in the Cretaceous) when the field didn't flip at all. There is as yet no real understanding of how the field flips its polarity, and in that sense we cannot predict reversals; it is one of the outstanding questions in Earth Sciences at the moment.

However, this much is understood. The Earth's magnetic field is created in the liquid core of the Earth, composed predominantly of iron. The core is undergoing convection, in a similar manner to the mantle, but it is more complicated because there are more forces operating. The rapid rotation of the Earth, coupled with the very small viscosity of the liquid, means rotational (Coriolis) forces are strong, leading to the approximate alignment of the poles with the Earth's rotation axis. But another force, the Lorentz force, which comes about because of the magnetic field itself, influences the fluid flow, and probably has a major effect in combination with the Coriolis force. Numerical models, run on supercomputers, can simulate how the core might work, and these models have occasionally found that the field flips spontaneously. The models also find that the solid, conducting inner core might have a stabilising effect, preventing the field from flipping even more frequently than it currently does. But the real explanation for reversals, if it ever does emerge, will have to wait for future, more sophisticated, models of the dynamo process in the core.

UCAS Fairs 2005

Hopefully there is just enough space here to tell you which UCAS Higher Education Conventions we will be attending this year. A couple are new to this year.

21/03	Cardiff
23- 24/03	Exeter
26-27/04	Newcastle
28-29/06	Liverpool
05-06/07	Sheffield
08/07	London Olympia

If your school is sending pupils to one of these events do tell them to come and find us as we have lots of useful information and samples to handle.

£1,000 to you for your students' thoughts?

If you're wondering whether they're worth that much, how about giving your students the chance of winning £10,000 for their efforts!

The Dan David Prize for Students aims to support education within the UK and specifically to instil a sense of excitement among young people about achievement in Science.

Young people between the ages of 16 and 18, in full-time education are being asked to write a short feature (500 – 1,000 words) to nominate "their living hero" or even an organisation they feel is extraordinary, in the field of Science, Engineering and Technology. Our definition of Science is broad and stretches from Astronomy and Design to Palaeontology and Architecture.

All you have to do is to motivate your students to write a piece and then send as many entries as you can inspire to The Royal Institution by the **closing date of 29 April 2005**.

Our media partner, *The Independent* will be publishing the winning entries both in the national newspaper and on its website – so students might also see their name in print!

The school with the most entries in the competition wins £1,000 and there are five chances for your students to win. And by the way, there are no restrictions on how you or the student might spend the money! The first prize for the students is £10,000, there's a second prize of £3,000 and three further prizes of £1,000.

Endowed by The Dan David Foundation, the **Dan David Prize for Students** is being organised by the Royal Institution as part of their education and science engagement work. It has been inspired by a parallel but wholly independent activity - the International Prize of the same name. In 2005, leading materials scientists have the chance to win one of three prizes of \$1 million! See www.dandavidprize.org for more details.

So start thinking and motivating your students about all those great scientific advances and technological innovations and the people or organisations behind them. You could be making your way to an Award Ceremony in London on 20 June to collect your cheque for £1,000.

For further information contact call 020 7409 2992, e-mail ddprize@ri.ac.uk or look at www.rigb.org/ddp

Keeping in with the Earth Sciences theme of this issue, I thought it might be a good idea to give you a bit more information about courses and sources of teaching support. Philip Murphy, from the Earth Sciences Department at the University of Leeds also does some work with the Earth Science Education Unit and has kindly provided the leaflets enclosed with this newsletter.

Courses in Earth Sciences

Courses in Earth Sciences such as Geology are available at a number of universities across the UK (to find out where you can search in the UCAS web-site, www.ucas.co.uk). However the Earth Sciences Department at the University of Leeds offers courses in Geological Science, Environmental Geology and Geophysics. Their four year degree programmes give students the opportunity to study in Europe or North America for part of their course and give them the chance to gain valuable industrial experience during the long summer vacations. For more detailed information visit <http://earth.leeds.ac.uk>.

The **Geological Sciences** courses emphasise the fundamental processes which determine the formation of rocks, the evolution of the Earth's crust and life in the planet. They also cover applied geology, including surveying for mineral and petroleum resources, and environmental geology. Modules studied include, Mineralogy, Igneous and metamorphic petrology, Sedimentary processes and Geophysics.

The **Environmental Geology** course has two sides. Students are taught how modern and ancient rocks are related and learn how to interpret sedimentary rocks from the present and past to help understand climate change. On the other hand students also learn to apply geological processes and rock properties to a host of environmental situations such as pollution, natural hazards and water resources.

I have to admit that my only knowledge of **Geophysics** comes from watching a chap walk round a field with a probe in Time Team, however this is a fascinating subject area. Geophysicists study the Earth through the application of physical principles and they work in a variety of fields exploring mineral and hydrocarbon deposits, monitoring natural hazards, investigating the Earth's interior and monitoring the movement of the tectonic plates. Modules studied include electromagnetism, quantum physics(!), mechanics, vibrations and of course geology.

Earth Sciences Education Unit

The Earth Science Education Unit is based in the Education Department at Keele University and offers a range of interactive workshops designed to support the teaching of the Earth Science topics in the English, Welsh and Scottish Curricula.

The workshops are run by a dedicated team of 49 enthusiastic specialists located around the UK who are there to inspire you. There is no fee to attend the workshops (you need to cover your travelling costs) and they will provide you with ideas and materials to use in your teaching. The workshops are very highly rated, interactive I am led to believe, great fun!

In England and Wales there are workshops available that cover:

- The Dynamic Rock Cycle (KS3)
- Spot that rock: rock identification and interpretation for beginners (KS3)
- Earth Science out of doors (KS3 and KS4)
- Investigating the changing Earth and atmosphere (KS4)
- The Plate Tectonics Interactive (KS4)

In Scotland the workshops have been running since September 2004 in conjunction with the Scottish Earth Science Education Forum (SESEF). There are workshops available entitled:

- 'Scotland's Journey': the story of the Earth's rocks and internal structure
- 'Science through the window': investigating the science of atmosphere, soil, weathering, erosion and landscape

Developing your knowledge of Earth Sciences will allow you to use the world outside to teach science, provide the context for teaching physical, chemical and biological concepts and inspire pupils with awe and wonder at the magnitude of the Earth's processes.

Steel like you've never seen it before!

Steel is the latest title in the range of musicals from 'Science on Stage'. It will appear at the Royal Concert Hall in Nottingham on March 2nd and at the Linbury Theatre in the Royal Opera House on April 10th.

Science on Stage is operated by two Nottingham teachers with a science and technology background, Dave Quick and Jon Wakefield. As well as writing and producing shows they take science demonstrations and songs to junior and infant pupils. They have been creating and producing science musicals since 1995 with the aim of presenting key ideas in top venues with first-rate technical support, in a way that will engage the non-scientific singer, dancer and spectator.

The play 'Steel' will involve two Nottingham dance schools, a technology college, an adult chamber choir and a rock band! To give you a bit of an idea of the plot, it all begins, in the early days of the planet with our manly hero, the iron atom, on the look-out for a suitable mate. After a short and unsatisfactorily olfactory dalliance with sulphur, the poor girl is left yellow, smelly and forlorn. In the best musical traditions she sings of her heartbreak and grief. He, in the meantime, has wasted no time, having fallen in love with the beautiful oxygen milliseconds after she arrived on the scene. The bond is made and they settle down to live happily ever after.....or so it seems. Deep in the mountains of Kazakhstan, life is just one long ironstone rock. Freedom comes to the Soviet Union, and everything changes, not only for the people, but also for the rocks. After a short period of confusion over the exact meaning of 'strip miners', which would never have happened if some one hadn't made a film called 'Full Monty', our hero lovers learn the hard way just what happens to them when mankind does a bit of mining. They are torn from their once secure lifestyle and to the beat of the blues are sent along misery road into captivity. But they do have each other, at least, until the moment when they have to face the terrifying tower of the blast furnace.

In Act 2 they come face to face with the dark priest of the blast furnace, Father Tuyère (with his slimy sidekick Slagrat). In pursuit of his mission, which is purity for iron, this fallen priest sets about wresting oxygen away from him. Failing to separate the lovers with his torments of fire, he conjures up the terrible carbon crows, the monoxide monsters, whose lust for oxygen is irresistible. Powerful enough to tear her from the arms of iron, the carbon crows do so, without mercy, and bear her away on the winds of the world. Iron is left to a life of slavery. In the work song 'Rattle them Chains' the true nature of service to mankind is revealed. Father Tuyère has, at last, achieved his mission. Iron and oxygen are finally separated.



In Act 3 the situation begins to change when our oxygen heroine, still in the grip of her carbon gaoler drifts into the green forest beyond the western ocean. Here the Celtic swirls of the Lady of the Leaf take them into her grip and oxygen is released from her unholy bondage. The forest takes the carbon crow into the tree where he is imprisoned and becomes part of its fabric, although not before a bit of painful, well-deserved payback.

Oxygen returns to look for her iron atom, and finds him on the battlefield. Joy of discovery sinks to melancholy then right on down to bathos as the iron atom goes from noble self-denial to whinger. Oxygen has to set him right. They come together in the chapel of rust, and after a wedding service conducted under the laws of thermodynamics they sink into happy and eternal obscurity as a tiny flake of rust in the Kazak mud.

Other projects by Science on Stage include Stardance, Twister's Run, Hive, Electric Metal, Little Blue and Salmonella. If you would like more information about the work of these two very enthusiastic, creative teachers please contact David Quick by mailing dquick@arnold-hill.notts.sch.uk.

IOM3 go to D&T

For the first time last November we attended the Design & Technology with ICT show at the NEC near Birmingham. We thoroughly enjoyed the show and it was very different to the exhibitions and careers fairs we had attended before. For me it was great to see such a diverse range of exhibitors showing products ranging from heat treatment bays to sewing machines. Not quite as many freebies as at ASE though!

Thank you to all of you that came and said hello, it was great as always to put faces to names. A warm welcome to those new members that have joined the scheme following the Show. I have to say, many of you were very keen to book visits and my diary has filled up quite considerable since the event.

Hopefully we will be attending again so we'll maybe see you again this November!

ARSENIC



⊕ Arsenic is a steel-grey, semi-metallic element which is often classified as a heavy metal. It is very brittle and tarnishes in air.

⊕ With atomic number 33 and atomic mass 74.92 arsenic has a melting point of 817°C and boils at 614°C (no this isn't a typo, arsenic sublimates on heating).

⊕ Arsenic was officially discovered by Albertus Magnus in the 13th century. However, it is thought to have been known since ancient times. Compounds of arsenic were mined by the early Chinese, Egyptians and Greeks and the name

comes from the Greek *arsenikon* meaning yellow orpiment.

⊕ Arsenic is occasionally found in nature as the free element but is more common in mineral form. The picture to the right shows free arsenic (grey), *realgar* or As₄S₄ (red) and *orpiment* or As₂S₃ (yellow). Other minerals include *arsenolite* (As₂O₃), *arsenopyrite* or *mispickel* (FeAsS) and *loellingite* (FeAs₂).

⊕ On an industrial scale arsenic is produced by heating the mineral in the absence of air, the most common mineral to be used is mispickel. The arsenic condenses out as a solid.

⊕ Deposits of arsenic-containing minerals are found in France, Germany, Italy, Romania, Siberia and North America.

⊕ Arsenic has been used as an alloying addition to bronze to give a lustrous appearance for many centuries. It is also added to lead shot to increase its hardness and sphericity. It is added to special glasses to clarify impurities and is used in pyrotechnics.



⊕ One of the most important uses of arsenic in recent years is as a dopant in solid state devices such as transistors. Minute amounts of arsenic are diffused into the surface of single crystal silicon wafers to produce n-type silicon (arsenic has one more electron than silicon so there is an overall negative charge). When layers of n-type and p-type (doped with a group III element such as gallium) are built up next to each other you can produce the equivalent of components such as transistors and diodes.

⊕ In recent years intermetallic semiconductors based on gallium arsenide have started to find their own applications. It is also used as a laser material to convert electricity directly into coherent light.

⊕ Arsenic was used mixed with gallium and phosphorous to produce the first red LEDs in the 1960s.

⊕ Chromated copper arsenate is used in the pressure treatment of timber. Copper and arsenic are toxic to different types of organisms that attack wood and treatment allows the timber to last for decades.

⊕ Arsenic is a vital trace element for a number of animals including pigs, chickens, goats and rats. On the other hand, white arsenic (the sulphide), calcium arsenate and lead arsenate have been used as agricultural insecticides and poisons.

⊕ Despite now being known as poisonous for humans for many years arsenic and its compounds were taken as medicines. Hippocrates used ointment made from arsenic to treat external ulcers and in Victorian times Dr Fowlers solution (a 1% solution of potassium arsenate in water) was widely used as a cure all tonic. Organic arsenides were among the first pharmaceutical antibiotics.

⊕ Arsenic is a known carcinogen with links to internal and skin cancers. Exposure has also been linked to cardiovascular and neurological disease.

⊕ The poisonous dose of arsenic is just 65mg, whether as a single dose or built up over time. Two of the first symptoms of arsenic poisoning are a metallic taste in the mouth and garlic breath. Signs of acute poisoning include acute abdominal pain, vomiting, diarrhoea, skin changes, depression, renal failure and death!

⊕ Up to 10µg of arsenic are allowed in drinking water, however natural erosion can sometimes lead to large quantities of arsenic being released leading to natural disasters.



This newsletter is written and edited by Dr Diane Talbot, Education Co-ordinator. If you have any comments or articles please contact Diane on 01302 380913, e-mail Diane.Talbot@iom3.org or write to her at the Doncaster address on the front cover