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IS THE GRASS ALWAYS GREENER?

Presidential Address by

Mr B D Beeson

Delivered on 2 October 2006

In April 1953 my father and I walked the herd of cows from their home at Welford to the Hollies Farm, Frolesworth, some 13 miles; at the time animals were regularly walked to the local market. In recent years with increased traffic and open plan gardens it has become essential to use a cattle trailer to move animals a quarter of a mile from the farm to a field on the edge of the village. This is just one small change that I have seen in over 50 years of farming and my father in his lifetime saw many more.

In this evening’s lecture I intend to look at the changes in British agriculture from the beginning of the 20th century to the present day, covering his and my experiences in farming.

My grandfather, Joseph Beeson, started farming in the early 1900s with his brother Fred at The Chestnuts in the village of Arnesby. A few years later he rented Hubbards Farm, Ashby Magna. With the break up of the estate in 1918 he was able to purchase it. The introduction of Estate Duty in 1894, the fiscal threats to landowners in the 1909 Budget and the death of many landowners in the First World War further encouraged the sale of estates, often to sitting tenants. In Great Britain during the 1890s, between 85 and 90% of agricultural land was farmed by tenants, declining to 82% by 1922. By 1950 only 62% of land in the UK was tenanted, falling to 39% by 1980. In the following years until 1995 between 60,000 and 90,000 acres per year returned to the landlords, since when this trend has reversed with around 35,000 acres a year returning to the tenanted sector.

My father was one of six children. He was born in February 1909 and when old enough helped to milk the cows before catching the train to go to school in Leicester, milking them on his return in the evening. As today, prices were low and after my father left school in 1925 he and his sister Jessie started a milk delivery round in and around the south side of Leicester. Later my grandfather introduced waxed cartons instead of bottles for the doorstep delivery, for his day quite innovative. Some milk was made into butter and cheese for the family’s own use and any surplus was sold, they also kept a few pigs for home consumption and a small flock of hens provided all their eggs. The pigs, milk and poultry together with home-grown vegetables and rabbits shot on the farm, meant that providing food for the family was not a problem particularly during the two world wars. Crops grown included oats, wheat, kale and mangolds, the majority of which was used to feed the animals. All of this was typical of thousands of small farms until the 1950s.

When we came to The Hollies as well as the dairy cows and beef cattle, we had sheep, hens and a few pigs, not much different from Grandfather’s day. My mother kept hens which ran loose around the orchard. Later the hens were loose-housed in a large shed and the eggs were sent to an egg packing station in Leicester for distribution to shops. The pigs were kept purely for our own consumption of ham and bacon. We grew crops of wheat, oats, barley, mangolds, kale and grass for grazing and hay.

All these crops were grown to provide feed for the animals and any surplus of wheat and barley sold. After the harvesting of the cereal crops the straw would be baled for either feed or bedding for the animals. In the fifties we only had one small grass paddock next to the farm and, as the pasture was on the outskirts of the village, cows were taken along the village street morning and evening throughout the grazing season.

During the sixties the development of new housing in Frolesworth with open plan gardens where previously there had been high walls and hedges caused conflict between the farming community and the newcomers. The problem was solved in 1972 by an exchange of fields with a neighbouring farmer giving us extra
grazing land behind the farm and removing the need for this twice daily journey along Main Street.

50 years after moving to The Hollies there was still a milking herd and store cattle but no pigs, sheep or hens. Mangolds and kale have disappeared from our rotation but wheat, oats, barley and grass for grazing and silage remain. The farm has become more specialised concentrating mainly on milk but beef cattle and cereals are still produced. On many farms specialisation resulted in milking herds disappearing completely. The 1960s saw a swing away from small milk producers with many farmers ploughing up the grassland and changing to the production of cereals and other crops. No more early starts to the day and no cows to be milked twice a day seven days a week resulted in an easier lifestyle. As arable farmers, they were able to relax a little during the winter months after the harvest had been safely gathered in and next year’s crops had been sown.

My father loved ploughing and when he began it was with horses and a single furrow plough. To plough one acre of land took at least a day during which the ploughman walked about 11 miles. When my father stopped aged 79 he was using a 5-furrow reversible plough pulled by a high powered tractor complete with air conditioning and radio.

The 1914/18 war had a profound effect upon the agriculture of this country. In order to provide food for the nation it became necessary to plough up an extra 3 million acres of grassland. Farmers had already lost a large proportion of their young labourers to the war and they had only sufficient horse strength to deal with their existing acreage of arable land. The government therefore took steps to purchase every tractor that was available. These tractors would plough an average of 15 acres of land per week, about three and a half times as much as one man and a pair of horses. But there was no instant change from horses to tractors; horses were not phased out until after the Second World War.

The binder was developed in 1831 and was pulled by 2 horses. After cutting, the sheaves were stacked into stooks which were made up of six or eight sheaves stacked against each other three or four on either side to dry. This could be a painful job as there were no herbicides to kill the weeds and the thistles could be quite sharp.

Later the sheaves were taken to the stack yard of the farm or left in the field where they were stacked and the roof thatched to protect them from the winter rain. Threshing the corn involved a small army of men, who travelled from farm to farm with the threshing drum.

In the 1940s combine harvesters came to this country from America. These have developed into the enormous machines we see today with 30 foot cutting units. One man operates it with systems controlling the height of the cutter bar and grain loss monitors; some now have radar for steering alongside the crop, the ultimate system being one steered by satellite navigation. As the crop is cut the yield can be monitored across the field and the information fed into a computer back in the farm office. Having produced a yield map of the crop, the information can be programmed into the fertiliser application system for the following year’s crop, again linked to a satellite system. With the high price of fertiliser, the ability to automatically vary the amount being applied can lead to considerable savings.

Arable farming in the early days relied on a system which left some land fallow. In those days sprays were not available to take out weeds from the standing crops, hence the need to have as clean a seed bed as possible prior to sowing. Sowing widths were much wider so that harrowing to remove any weeds in the cereal crops was possible.

Today the cultivation and sowing equipment is often combined into one unit thus reducing the number of passes needed to sow the seed. These combinations of cultivation equipment and seed drills are carried by high horse powered tractors (costing anything up to £180,000 and seed drills costing £20,000+) cultivate the ground and sow the seed at the same time.

The driver of today’s seed drill can switch off specific seed pipes, creating 2 lines across the field which are known as tramlines; the footpath walkers among you will have no doubt seen them on your travels. The public’s awareness of environmental issues and the need for farmers to apply fertiliser and chemicals both efficiently and cost effectively has brought about these tramlines which are seen in most arable crops today.
Crop rotation is as important as ever and as a mixed farm we have a rotation of a 2 year grass ley followed by 2 wheat then 1 barley plus the occasional crop of oats and back to grass. These grass leys not only create a break crop but are used to make silage to feed the animals in winter. The advantage of our mixed farming system is that because we have animals, manure is available to spread back onto the land prior to sowing the next cereal crop, thus reducing, but not removing the need for artificial fertilisers which in turn saves money as the current price of nitrogen is £155 per tonne.

In the early 1900s one ton of wheat per acre would have been considered a very good crop. From the 1950s with the introduction of new varieties, new systems of cultivation, the use of nitrogen fertiliser, yields have improved dramatically, so today in a good year yields of 4 tons-plus are common. Over the years a major switch from spring to autumn sowing has taken place; this too has helped to increase yields, the downside being that the crop needs more attention to control weeds and diseases throughout this longer growing period. The price of wheat in 1900 was around £6 per ton the equivalent of about £360 today. The price of wheat in the 90s was around £120 per ton, today it has fallen to around £78.

During this period of growth within the arable sector the countryside has seen extensive changes, with hedgerows being removed to enlarge fields making it easier to manage these much larger machines. The downside from my point of view to these changes was the loss of trees. Over the years we have planted up odd shaped corners in fields and small copses have been established not only to the benefit of the environment but also the wildlife.

In the 1950s cows were milked in a traditional cow shed with cows being tethered two to a stall with a row down each side back to back. The milking machine bucket would be placed between the two cows and each cow milked in turn and when the bucket was full emptied into a churn or carried to the dairy and cooled. Over the years the milking systems were upgraded and in 1992/93 we invested in a new 1300sq ft building to house all the cows, complete with a state-of-the-art milking parlour. Throughout the winter the cows are housed inside but from April to October they are out to grass. The food ration is topped up with extra feed through out-of-parlour-feeders as they are no longer fed while being milked.

As the cow enters the milking parlour she passes through a curtain, a transponder then identifies her and sends her information to the monitor. The monitors record the milk yield and identify low food intake and below-average milk yield; all this is controlled through a computer housed in the farm office. The milk goes through a plate cooler into a refrigerated bulk milk tank in the dairy next door and is collected every other day by tanker, a far cry from 10 gallon milk churns. The herd had now reached 130 and was milked by one man but in this computer controlled parlour he could actually manage 200, in contrast to the days of hand milking when one man would milk 12 cows.

A cow produces a calf each year and in order to give her a period of rest she will usually cease to be milked after 305 days; in the early 1950s a good dairy cow would give around 1000 gallons during this period. Since then animal genetics have advanced at an incredible rate so that 3300 gallons is often the norm. This increase in milk yields owes a lot to the introduction into the UK of the Holstein cow, which are pure milking machines!

Over the last 100 years the advances in the breeding of animals has been remarkable with breeds such as Charolais, Belgian Blue and Limousin coming from the continent which, crossed with our native breeds, have produced some wonderful beef animals although our own native breeds are now making a comeback.

You will realise that with each cow having a calf each year and a milking herd of 130 that is hopefully 130 calves. All the Friesian heifer calves are kept to be added to the herd in 2 or 3 years after they in turn have calves. The Friesian bull calves and beef cross calves are reared for beef and sold as yearlings to other farmers to finish.

With the advent of BSE the industry took a huge knock. With the export of animals banned the value of animals crashed and it has taken years to get the public’s confidence back into eating beef. During this time we had 28 cases. Some farmers suffered not only financially but also emotionally as they saw their life’s work destroyed. Because of the fear of this
dreadful disease being passed to humans all animals born before 1996 have had to be incinerated.

In order to keep track of animals more efficiently the government introduced a system of cattle passports, which followed the animal from birth to death and if the passport is lost the animal cannot be sold. Government influence over farming is nothing new; as I mentioned at the beginning, government policy was largely responsible for the break-up of large estates during and after the First World War. County War Agricultural Executive Committees (the ‘War Ag’) were run regionally by committees of local farmers who decided which fields were to be ploughed up. Following the Second World War food was in short supply and still rationed until the 1950s. The farming industry was encouraged to grow as much as possible and the government introduced grants to help with land drainage, buildings and horticulture.

After we joined the Common Market you will recollect that Europe subsidised output with price support, resulting in over-production. This led to the creation of huge surpluses of butter, milk, beef, cereals, wine and other products. In order to cope with these mountains and lakes, quotas were introduced; we were affected by the imposition of a milk quota and the introduction of set-aside on the arable land.

With the introduction of milk quotas in the early 80s the industry saw a big change; at this time we were paid 26p per litre for milk, which has now fallen to around 17/18p per litre. Dairy farmers are leaving the industry at such an alarming rate that milk production is below the national quota. Another result is that the number of cows in the national dairy herd which had been steadily increasing from 1.9 million in 1900, to 3.3 million in 1983, started to decrease; by 1999 it had fallen to 2.4 million and is still declining. There are some 12,000 producers at the moment and if that figure drops below 10,000, and there are signs that it might, the industry will have major problems in supplying the nation; much larger imports would seem to be inevitable.

Recently the introduction of Integrated Administration and Control System, commonly called IACs, gave subsidies to arable farmers, causing the advent of the so called barley barons with large areas of cereals. This system has been superseded by yet another called single farm payment which gives all landowners the opportunity to register their land whether arable or grass. As you will have read in the press the system has failed with many farmers not receiving their payments for 2005/06 on time, causing some of them financial difficulties. In order to receive money through the single farm payment system farmers have a 27-page document to fill in each year.

Every aspect of what we produce, whether cereals, beef or milk, comes under strict scrutiny and rightly so, for food is a necessity for us all and it needs to be produced to the highest standard. There are schemes for farm-assured milk, grain, beef and lamb and unless you are a member you will have difficulty in selling your product. On the dairy and beef side we have to keep records of births and deaths, their food rations, the cleanliness of the environment in which they are housed, and that the stocking density of animals is within the guidelines as set by Defra.

The vet also produces a herd health plan. Any of the agencies, either government or industry based, can visit unannounced and they do. During 5 weeks in spring 2005 we had visits from 4 of these bodies, 2 by appointment and 2 dropped in. There will always be a few who let the industry down but the majority of farmers act responsibly in the care of their animals and the countryside.

To further encourage care of the countryside and provide accessibility the government has given financial incentives. One such scheme is the creation of permissive footpaths, which run for a set period and can be extended.

In 2005 a new environmental scheme was introduced to help farmers protect the landscape for the good of all. Farmers have to decide what the priorities are for their farm, such as hedgerows, trees, beetle banks etc.

The changes that have taken place during the 20th century have had a great impact on the rural population and the nature of the villages themselves.

The workforce in 1901 was 1.3 million, 8% of the national workforce, declining 100yrs later to 593,000, 2.1% and the numbers continue to fall.
During the 1939-45 war women were brought onto the farms, many from the towns and cities, to supplement the workforce. With the shortage of men to work on the land these women were a blessing to the farmers and in some cases were swept off their feet by the farmer himself.

During this period farming was still very labour intensive and it wasn’t until the 1950s that mechanisation really took off. After the war former German and Italian prisoners worked on the land and we had 2 Italian and 1 German. In 1953 Franz was one of the 6 full-time people working on the farm but by 2006 this had reduced to 3. However, the use of contractors for specific work had increased.

Farms had a major impact on villages where they not only employed large numbers of the inhabitants but also dominated the street scene with the farm houses fronting the main street and their land running back from the buildings and fanning out into the countryside. 50 years ago Frolesworth was truly a farming community; there were 7 farms on the village street and 8 others within the parish. Farms are considered to be a nuisance in villages with their noisy machinery and smelly animals; consequently today none of the remaining farms of the parish are based on the village street. With the pressure on farm incomes, farmers have diversified into other enterprises such as storage, the conversion of barns to homes, offices and conference centres.

So, back to the question (Is the grass always greener?)

Looking back over 50 years, farming has given me a healthy lifestyle but in my view it was the 1980s that were the best. There were good financial returns for your efforts and if one commodity was down the others remained high, the great advantage of a mixed farm, unlike today when all prices are down. There was money to invest in improvements such as I have spoken about. There was much less paperwork and less hassle and I could concentrate on what I enjoyed most, looking after the animals and cultivating the land without the likelihood of getting farmer’s lung from the dust of yesteryear and having joints abused by the lifting of heavy weights.

The grass really was greener then.
DEVELOPMENT OF THE PEACEFUL USE OF NUCLEAR ENERGY: A JUSTIFIABLE OBJECTIVE?

Peter Riley, Chartered Engineer and Academic Lawyer

Lecture delivered on 16 October 2006

Introduction

The Government has decided to explore the replacement of existing nuclear electric generating capacity after consulting widely, including the Public, the Sustainable Development Commission, the Health and Safety Executive and Non-Government Organisations. This has been forced by concerns about climate change; the obvious risks of being reliant on imported oil and gas; the conclusion of the Committee on Radioactive Waste Management; and the reasonable performance of nuclear power around the world.

It is likely that the Government will take a view that may encourage a move towards maintaining nuclear electric generation at its current level of around 20% of national capacity, allowing the phased replacement of the magnox stations (the nuclear power stations built in the 1950s) by building a series of Generation III reactors. We can expect to face a decade of assessments and enquiries with public involvement in: a Strategic Environmental Assessment; an Environmental Impact Assessment; Planning Enquiries; and Nuclear site licensing consultations.

The Health and Safety Executive have advised that an efficient process would be to have a single standard design of nuclear power station that would allow a two stage approach to licensing: a generic application that would consider the science, technology, safety and economics; and specific planning applications for each location.

The style of reactor that might power the next generation of nuclear power station in the UK will be subject to the requirement of ‘Justification’ under the Justification of Practices Regulations and the Government might be encouraged to accept public debate of that obligation rather than the decide and declare route.

The intensive inquiry by the Committee on Radioactive Waste Management, set up by Government three years ago, has endorsed the deep geological disposal solution for existing waste with interim storage during the 40 or so years while such a facility is being built. The Committee consulted widely and the importance of its finding is not so much the solution but the process by which it came to its conclusion. Its guiding principles being: to be open and transparent; to uphold public interest by taking full account of public and stakeholder views in decision-making; to achieve fairness with respect to procedures, communities and future generations; to aim for a safe and sustainable environment both now and in the future; and to ensure an efficient, cost effective and conclusive process.

The precedent set by the process demands that a new style of reactor, seen as a new class of practice, should be subject to determination by the Secretary of State only after similar public consultation. Such consultation would open the practice to the wider question of sustainability meeting a number of government objectives:

- to satisfy the requirement of ‘practicability’ in that it prudently uses natural resources and maintains high and stable economic growth and employment;
- to promote social progress that recognises the needs of everyone in that it is not ‘harmful to health’, is ‘safe and secure’; and
- to afford effective protection of the environment.

Concerns about nuclear weapons, terrorist acts, persistent low-level radiation and the disposal of radioactive waste must be adequately satisfied.
Nuclear electricity is practicable

This has been established by the fact that a significant proportion of electricity generated in major areas of the world is from nuclear energy. The International Atomic Energy Agency (IAEA) reported that one sixth of the world’s electricity in 30 countries was produced from nuclear energy. Practicability also implies that nuclear power can be produced economically; that improvements can be made to minimise waste and decommissioning clean-ups; and that while it may not be practicable at this time in remote locations, it can be adapted for practicable use to provide power and clean water to countries that have technology, infrastructure, political and geographic challenges. A recent study has shown that the UK has a strong capability in many of the areas required to support a new nuclear build programme.

The price of nuclear electricity is directly affected by the high capital depreciation caused by the costs of construction, influenced to a large extent by the discount rate. To counter this, future reactor systems will have to reduce capital costs and construction programme times by increasing factory assembly, modular construction, longer operating lives up to 60 years and smaller units. Many existing plants across the world already have lifetime extended to 60 years. Taking into account the efficiency improvements in future nuclear fuel cycle and electricity production, the plentiful supply of uranium for which there is only a military alternative use, the efficient use of land and minimal fuel transport cost, it would be imprudent to discount nuclear electric on practicability and economic grounds.

Nuclear electricity is not harmful to health and is safe and secure.

Much is known about the medical and environmental effects of radiation and because of that radioactive materials are better regulated than any other pollutant. The allowable exposure to radiation of workers is based on knowledge of the harm caused by radiation and is two orders of magnitude below that known to cause harm to tissue. Under predictable accident conditions the public would only be exposed to radiation 1000^6 of that known to cause tissue damage.

Worker exposure to radiation is regulated under the Ionising Radiations Regulations that enforce working practices and exposure constraints and limits based on recommendations made to international, regional and national governments by the International Committee on Radiological Protection, an organisation independent of national or commercial interests that has been in operation since 1928.

Releases to the environment that may come into contact with the public are regulated so as not to cause harm by the Radioactive Substances Act that requires authorisation for the storage or release to the environment of radioactive materials. Exposure of the public to radiation from a nuclear process, excepting medical procedures, is limited to less than half the average level of natural radiation in the UK.

The design of nuclear reactors is such that the PWR as built at Sizewell has four barriers to the escape of radioactive materials: the fuel cladding; the reactor pressure vessel; the concrete and steel containment; and the steel outer containment. Protection of the power station from external harm is implicit in its design and construction; the containment is such that as well as preventing the escape of radioactive materials it must withstand the effects of climate, credible earthquake and external forces such as the impact of military and civilian aircraft.

Safety of nuclear materials goes beyond the question of security of power stations. There is undeniable risk of radiation release from the illicit use by terrorists in a ‘dirty bomb’; however, the use of new or used fuel from a nuclear power reactor would require a high degree of knowledge, high risks and a low probability of success.

Energy Security, keeping the lights on, is the most important consideration. It is evident that nationally, even if only for short periods, the loss of electrical supplies would cause harm in particular to the elderly and infirm. To prevent such interruption to the power supply it is necessary to have reliable backup to vulnerable sources of supply such as wind and imported gas. Nuclear energy proved its value in this role when it contributed to avoiding loss of electrical supplies during the industrial unrest in the coal industry.
A nuclear reactor operates on the basis of refuelling on a 1 – 2 year cycle, which means that no offsite supplies of fuel are necessary during that period and in some cases even longer periods where advance stocks are held. It is important that there is adequate base load electrical generating capacity to cater for the energy needed to cater for the effects of climate change, for example to move low-lying towns, build barriers, to pump water and in the future to generate hydrogen for transport and to desalinate water. The wide geological availability of uranium, its low cost of resource replenishment, and low cost to the customer as a component of final generation costs make it a significant future source of energy.

**Nuclear Electricity affords effective protection of the environment**

The use of nuclear energy enables the reduction in carbon dioxide, sulphur dioxide and nitrogen oxides in the atmosphere; it contributes to medical, agricultural and industrial activities; it makes possible the production of hydrogen to contribute to cleaner transport; it slows the depletion of gas, oil, coal and wood resources, reduces land use and minimises fuel transport. It also provides the possibility of energy and clean water to alleviate poverty in undeveloped areas of the world.

The accumulation of waste is not to be feared; conditioned and packaged high and intermediate-level waste, including that from decommissioning, arising to the year 2100 is known and is a total volume about the size of Wembley Stadium or five Albert Halls. The careful and open deliberations of the Committee on Radioactive Waste Management have resulted in the recommendation of a safe and practicable long-term solution. Even so the currently stored radioactive waste, used fuel and radioactive materials as presently stored do not present a radiation hazard to the public; the annual radiation exposures due to discharges from the UK sites are well within regulatory limit.

**Proliferation of nuclear weapons and materials**

This is a major concern that must also be tackled in the justification argument but the view that having new nuclear power stations will lead to more nuclear weapons is false; weapons grade materials are produced without the need for electrical power generating reactors. The greatest risk of nuclear weapon proliferation is that countries will follow similar development of weapons, as did the USA, Russia, UK, France, China, India, Pakistan and Israel without access to external help.

The Non-Proliferation Treaty offers peaceful nuclear technology and the advantages of nuclear electricity, medical, industrial and agricultural applications to States that need them on condition that they do not develop nuclear weapons. This has clearly worked in the majority of States that have taken advantage of the arrangements. A particular success is the case of Libya where an active nuclear weapons programme has been disbanded in favour of practical assistance from IAEA Member States in a programme of peaceful use of nuclear energy.

There are examples of failure such as North Korea and threatened in Iran; nevertheless the safeguards system has identified them. The Non-Proliferation Treaty requires the destruction of all weapons. A small step in this direction has been made under the ‘Megatons to Megawatts’ programme where the equivalent to 9000 nuclear warheads have so far been recycled into fuel for power plants; nevertheless, some 27,000 warheads still exist.

For such safeguards to continue to be effective, however, it is implicit that nuclear services including nuclear electricity be available as a benefit to the State eschewing nuclear weapons and that in turn means that the UK amongst other States must continue to support the peaceful use of nuclear energy by adopting new developments.

**Summary**

The decision to recommence the development of nuclear electricity in the UK rests with Government; however, public opinion and international politics affect that decision. In the meantime it is necessary to keep the opportunity of using nuclear energy available. Clean and secure nuclear electrical supplies have operated with an exemplary health and safety record over the past 50 years. There is every reason, in my view, why a new generation of reactors should be built here in the UK with public confidence. The Government have promised a White Paper for the end of the year. This could be the Green Light of generic justification.
References


The Regulations transpose into UK law the justification requirements of the European Directive 96/26/Euratom of 13 May 1996, which protect the health of individuals against the dangers of ionising radiation.

ii These points are taken from ‘A Better Quality of Life’ CM 4345, DETR 1999.


iv IBM Business Consulting Services, (2005), An evaluation of the capability and capacity of the UK and global supply chains to support a new nuclear build programme in the UK.

v Modular construction allows a multiunit power station made up from standard modules, each capable of independent operation and so allowing a small unit size, say 150 MWe to be used in areas with less energy density and for a staged build of larger stations where there is greater demand.


vii For a detailed analysis of this problem see, Dr Christopher Watson, Nuclear Terrorism, Nuclear Future Vol 1, No. 3, May/June 2005.


VICTORIA PARK LEADING TO NEW WALK, LEICESTER

Dr Helen Boynton, Writer and Researcher in Geology

Lecture delivered on 6 November 2006

Helen Boynton is the author of several books on local history, including one on Victoria Park, published in 2000. She kindly contributed an illustrated article to the Transactions: “The History of Victoria Park”, Transactions of the Leicester Literary & Philosophical Society, Vol. 96, 2002, pp 22-25. This lecture was based on that article, to which readers are referred.
A SEVEN POINT GRID FOR LITERARY GREATNESS

Dr Jane Mackay, Lecturer in Literature and the Founder of Literature Live

Lecture delivered on 20 November 2006

Sponsored by De Montfort University

For the last six years I have been lecturing widely, as a free lance here and in America, on writers of the calibre of Shakespeare, Tolstoy, Hugo, Conrad and many more. Recently, while preparing talks, I have been struck by similarities – not between the lives of the writers which naturally vary widely- but between the processes they go through to get to a point where they can convey great truths about the human condition. I was so impressed by this pattern that I looked again at over 50 writers and found they all go through a similar process. Seven clear stages emerged through which all have to pass to achieve stature in the work. Actually the seven point grid which surfaced works for excellence in any field, but I am concentrating on what I know most about, the field of literature.

There is a fashion today to claim that it is not possible to grade writers. I so firmly do not believe this. All the great writers on whom I am going to draw knew when they had achieved something and when they had missed it. They write to each other…e.g. D.H.Lawrence to E.M.Forster, Henry James to Conrad, and in their letters they discuss their achievements, or failures, in the most scrupulous way.

Great writers have the ability to connect to their time and place and pull down for us unseen qualities from that time, anchor them in such a way that they become permanently accessible to the rest of us. Shakespeare said that the task of the poet was: “to give to airy nothing a local habitation and a name”. (A Midsummer Night’s Dream). He is talking about anchorage of essences, so that they are then available to everyone. Ideas which breathe into the poet, or writer, from the ether… ‘inspiration’ is an outside /inside thing!

I have given names to each stage and I hope the pattern will become clear as we go on a journey together.

1. BUILDING THE BANK: OR ACCUMULATION...

All the great writers are compulsive readers from a very early age and they establish a huge bank of vicarious knowledge from which they can later draw. They are, in almost every case, not only well read in their own country’s literature but in other areas of knowledge … philosophy, history, the sciences. They all have a huge hunger to ‘know’. Benjamin Franklin said that ‘Genius without education is like silver in a mine’. The extent of their reading is phenomenal. They also have an awe at what is available for them to know. They never cease adding to that bank, and are reading until, in most cases, the actual day of their deaths. One example, since she is ‘local’, is George Eliot, who banged at the door of knowledge until she broke it down. She was reading in the sciences, in medicine, astronomy, geology, theology. When as a young woman she translated Strauss’s Life of Jesus’ from the German, she learnt Hebrew so that she could check his references. Reading Darwin with George Lewes, she wanted to apply the principles of natural selection to human nature.

Also D.H.Lawrence, Conrad, Tolstoy, Stevenson…there is no instance when the extent of their early reading does not take your breath away. It is a myth that inspiration lands on the unprepared mind. Most of them manage to access the work of the ‘Hermetic Tradition’, but that oh Best Beloved, as Kipling would have said, is another story for another day. They are all aware of the intellectual climate or zeitgeist of their age.

So the starting point for the assessment of greatness has something to do with the immensity of the canvas they are able to handle. Reaching for the great truths of human nature and incorporating these into the fabric of the work in such a way that human life is
assisted and illumined. None of the great writers I will be drawing on came to achievement easily or quickly. It is crucial to understanding them to realise that their greatness has, in part, to do with what was available for them to know...the huge table of plenty that gave them the range of what could be learnt and accessed. You need the broad spectrum of what is available before you can then select within it what it is you want to work with, if the truth about the human condition is your aim. In a way, you are what you know.

2. SELECTION: They then are able to select and reject from within this bank what they need, in order to say what they want to say about the human condition in their own particular time and place. There is also a great concern to render ‘truth’ and a responsibility to get it right. This stage has to do with the quality of the questions they are asking themselves. The Tolstoy questions are ‘Why are we here?’ ‘What am I?’ ‘What is the purpose of life?’ Chekhov commended Tolstoy for fulfilling the artist’s supreme duty...exploring ‘the correct way of putting the question’. He went on to say,’ a court must put the questions correctly, but it is up to the jury to decide, each according to his own taste.’ It is the privilege of the readers of these great minds to serve on that jury.

The letters to friends, the content of their diaries and the evidence in the work, show that they are compulsive about rendering truth. George Eliot says this: ‘If Art does not enlarge men’s sympathies, it does nothing morally, and the only effect I ardently long to produce by my writings is that those who read them should be better able to imagine and feel the pains and the joys of those who differ from themselves in everything but the broad fact of being a struggling, erring human creature’. They retain what they feel is useful from within the bank of knowledge and reject what is not appropriate for what they want to render about their particular time and place. They select only what is useful for what they want to say. The personal stamp which they put on the work comes out of nationality, religion, personal genetic and family traits, but they are also tied in to the issues alive at the time.

As an example, DUALITY is being discussed widely at the end of the 19th Century. We are all capable of the best or worst, the highest and lowest. There are different renderings of this in Stevenson, Wilde and Conrad, all overlapping in time and drawing on the same material, but rendering its truth differently. R L Stevenson, ‘The Strange case of Dr Jekyll and Mr Hyde’...opposites within one man who changes physically from one to the other. Wilde in ‘The Picture of Dorian Gray’ where Dorian uses his beauty to deflect opinion from his crimes, but his portrait carries the imprint of his every crime including those of thought. Conrad takes us into the ‘Heart of Darkness’ and shows us our own. He is always fascinated by the point at which a good man can be broken. Each writer is giving us his/her take on the thinking of the times, but each has an individual voice about the great truths being discussed.

3. WEAVING: They are able to make a weave of this information in order to hold what is coming into them.

Joseph Conrad said that the best storytellers tell from the ‘outside to the inside’. Great writers draw down an essence that is then accessible to the rest of us. It is the preparation done in the first two stages that then makes it possible for them to choose well what is of relevance to their own time and place. Inspiration does not land on the unprepared mind. It has better things to do.

4. COMPASSION: They share a great compassion for the human condition. They love their characters throughout whatever struggle they give them to endure. Often main characters don’t succeed in that struggle...Hamlet...it’s not whether a man succeeds materially that matters but what he has stood for and what he has stood against. Shakespeare has huge compassion for Hamlet who has the courage to look into what Yeats called the ‘abyss of himself’. Hamlet fails in the play but we are made to love his effort. Conrad takes his characters into the ‘heart of darkness’, often their own darkness, and lovingly brings them home knowing themselves better. This does not always reflect in their personal lives. Tolstoy and Dickens were not the best of husbands. Loving the human condition doesn’t necessarily mean being nice to your wife!

Francis Bacon in his ‘Essays’ puts this imperative beautifully...that when you stand on the ‘hill of Truth’, you can see ‘the errors and wanderings, and mists and tempests in the vale below...so always that
this prospect be with pity’. In other words your achievements must not make you arrogant towards those not able to get to what you have got to. The compassion is often expressed in their campaigning for social change...Steinbeck, Marquez, Neruda, Primo Levi, Tolstoy, Dickens and Zola.

5. PERSISTENCE. All the great writers show tremendous persistence in the face of sometimes terrible resistance. Dostoyevsky, condemned to death, then taken in chains by sledge into exile, over 1000 miles in the bitter cold of a Russian winter...but it doesn’t stop him. Lawrence, Hardy, Huxley had books publicly burned. They don’t stop. Oscar Wilde’s arguably best work is written in prison. Tolstoy is excommunicated and becomes more determined to have his say. George Eliot has to endure the ostracism that went with her decision to live for over 20 years with a married man. A more truly moral lady it would be hard to find. Chekhov, Lawrence and Stevenson write while haemorrhaging and are each dead by 44.

Even when dying they are still working...Lawrence reviewing a book by Eric Gill and reading ‘The life of Columbus’. Chekhov is writing ‘The Cherry Orchard’ in a race with death. The other word that I would put with this stage is ‘industry’...the work goes on regardless!

6. VISION AND CONNECTION: They have great vision and all of them experience, at different periods in their very different lives, illumination as a result of spiritual crises of great severity. Dickens has his at 12 years of age, George Eliot throughout her life, Conrad when he is about 30 and is nearly dying in the Congo, and Tolstoy at nearly 50 when he is unable to find God, and although happily married has to hide ropes on his farm for fear of hanging himself. They all go through what St John of the Cross called a ‘dark night of the soul’. There are many recorded instances of this in letters. In the cases of Bunyan and Milton almost the whole work is about the dark night of the soul. This is from George Eliot: “There are unseen elements which often frustrate our wisest calculations...which raise up the sufferer from the edge of the grave...such unseen elements fill up the margin of ignorance which surrounds all our knowledge with the feelings of trust and resignation.”

About ‘CONNECTION’, there has been so much said by so many...so a short series of quotes to affirm this. Even scientists have respected the influence of outside inspiration. Johann Kepler said, ‘The roads by which men arrive at their insights into celestial matters seem to be almost as worthy of wonder as those matters themselves.’

Alfred de Musset said that creation was ‘not work, it is listening’. Emily Bronte said that each creative writer ‘owns something of which he is not always the master and which at times works for itself’. Thackeray confessed that sometimes it seemed ‘as if an occult power was working my pen.’ Dickens said that when he sat down to write ‘some beneficent power showed it all to me.’ Tchaikovsky, just to put in a word from another discipline, said that the overpowering force of the inspired mood was such that ‘if it lasted any length of time without a break no artist could survive it’

There are hundreds of such records of the way that inspiration lands on imagination. The beloved Blake said of certain of his works that ‘the authors are in eternity’.

7. IMMOVABLE ADHERENCE: After the spiritual crises a ‘knowing’ seems to come into them that they had been unable to access from searching in books or looking for a ‘brain’ way of explaining existence. And with this knowing comes a firmness of purpose that attends all they do thereafter, and supports their further efforts, so that the whole previous template range becomes deeper and more meaningful with everything else they write. They feel a sense of responsibility to the essence of inspiration. Jane Austen is writing the day before her death, Blake is sending out for a new pencil on the day he dies, and D H Lawrence is reading and writing up to the day before his death. The dying Tennyson is searching in the bedclothes for his copy of Shakespeare, which his son puts into his hand.

SUMMARY: ‘Great’ writing requires huge effort to master as much of the table of plenty as possible. It requires a high intention for the truthful rendition of experience, so that the selection of what is relevant is done as well as possible. It requires great compassion for the human condition...I suspect that the compassion comes partly from the humility of being in acceptance of inspiration. It requires
conscious will and determination in the face of, often, terrible opposition. It requires a spiritual dimension, often reached at great personal cost...the ‘dark night of the soul’ which either takes you out of the game or makes you infinitely stronger in the certainty of a great creative force that has saved your life, and to which you owe something in return. And there is no way you can abandon that ‘gift’ once given.

This is a tiny starter into looking at ‘what it takes’ to render inspiration with respect for one’s gift... a gift is ‘given’! ...and devotion to its invisible potency.

There is a wise saying that we become what we do. If a writer adheres to a duty and loyalty to what has breathed into him, then eventually he or she can do nothing else. They do what they have become. And they honour truth in their art above all else.

I realize that I have referred to very few writers, but that is the nature of this evening and the constraints of time. Also I need to reiterate that I believe that this grid works for excellence in anything...music, painting, and all aspects of achievement in all branches of the sciences.

And finally that the grid is not linear...once the first stage of accumulation is attempted, then the grid changes, in a dance almost like the figure 8, as the bank changes through selection, as the spiritual dimension deepens and as the effort increases. The problems are not overcome, or if some are overcome, then new and more complex ones arise.

So to end with Blake, to whom the human body was awesomely beautiful, because it contained the lineaments of an informing spirit, the ‘celestial body’, in effect. Blake says, ‘if the doors of perception were cleansed everything would appear to a man as it is, infinite. For man has closed himself up, till he sees all things thro’ narrow chinks in his cavern’. The Platonic analogy is clear.

Great writing relieves our isolation because it illuminates our human condition and gives us permission to have a range of feelings that we might otherwise have thought were ours alone. It brings comfort, companionship and consolation, and reveals the visible and invisible history of times and places far removed from our own. It is the cheapest and most satisfying way to travel. But great truth is universal in any time.

Unlike Blake I have never seen fairies, or angels, or the ‘daughters of Inspiration’ sitting in the trees. But, thankfully, I know a man who can. So let me end with him,

‘All things exist in the human imagination...amid all the contradictions, incoherences, wild assertions, this principle – that the conceptions of the mind are the reality of realities, that the human imagination is an eternal world, ever expanding in the bosom of God.’
In the early years of her career, Spark lived in London, then in New York from 1963, where she relished the sophisticated and cosmopolitan life of a great city. In 1968 she moved to Rome, which initially held a strong appeal for her for similar reasons. She had close links with the expatriate community and participated fully in its social life; but as a Catholic convert she was also greatly attracted and stimulated by the ancient city of Rome itself. The eleven years she spent in Rome were very productive; she published seven novels, including *The Driver's Seat* (1970), *The Abbess of Crewe* (1974) and *The Takeover* (1976), all of which differed significantly in character from her earlier works. Rome, however, gradually lost its appeal; the streets were less safe, they were dirtier and more violent, and the city was often in the grip of strikes.

During the mid-1970s she spent progressively less time in Rome and more in a dilapidated former priest's house in Tuscany, near the village of Oliveto, in the hills to the south-west of Arezzo. This house was the home of her friend, the painter and sculptor Penelope Jardine. It became Spark's main residence from 1980, by which time it had been substantially renovated and modernised, but initially it provided rudimentary accommodation which was in sharp contrast to the metropolitan comfort to which Muriel Spark had been accustomed. Spark's new life in the deep countryside provided a new stimulus. The Takeover was a transitional book, completed during this transitional period in her life and providing some intriguing insights into her changing state of mind. The Only Problem was published in 1984; over the ensuing twenty years she published a further five novels, an autobiography, and collections of poems and short stories.

In an interview which she gave in 2001, she said: “Going to Italy was the best thing I ever did, for my living, and peace of mind.” Whilst she was not the sort of person to settle anywhere, it is fitting that she ended her days in Tuscany, in 2006.
THE MAGIC OF OXYGEN

Dr M.G.Batham and Dr R.Janes, Department of Chemistry, The Open University

Lecture for Schools delivered on 13 December 2006
Sponsored by The Leicester Mercury

For the past 5 years Mike Batham and Rob Janes of the Chemistry Department at the Open University have presented The Magic of Oxygen in a variety of venues including schools and colleges, theatres, museums and have contributed to numerous science festivals. Their talk which can be tailored to suit school (all ages) or family audiences, has received funding from the Royal Society of Chemistry and the Royal Institution of Great Britain. Some of the most recent performances have included Cardiff Science Festival 2005, Harrow School, University of Southampton, Christmas Family Lecture, Oxford Aim Higher, National Science Week event, 2006, and now, The Leicester Literary and Philosophical Society, where they delivered their lecture in the University of Leicester’s Rattray Lecture Theatre before a large audience of students from local schools.

The Magic of Oxygen was all about the weird and wonderful properties of atoms and molecules, with a specific focus on oxygen. Mike and Rob talked about its discovery, introducing the audience to the work of Joseph Priestley and Carl Wilhelm Scheele, and re-created one of the experiments of the former. The catalytic decomposition of hydrogen peroxide was demonstrated in the form of “the genii from the teapot” and the use of hydrogen peroxide as a rocket propellant and as part of the defence mechanism of the Bombardier beetle were described.

The chemical and physical properties of oxygen were discussed, including a look at the magnetic properties of liquid oxygen, demonstrations of combustion – the burning £10 note and the accelerated burning of ethanol by the in-situ production of oxygen from the reaction of potassium permanganate and hydrogen peroxide – aka the goblet of fire. The talk continued with plenty of flashes and bangs as some explosive mixtures were conjured up during a discussion of the properties of oxidising agents which led to a demonstration of the production of fire from water. The physical properties of gases were also demonstrated, including a demonstration of Boyle’s Law using marshmallows and a vacuum pump.

The talk also looked at the chemistry of explosives, in particular the role of oxidising agents such as chlorates, and finally all the chemistry covered in the talk was found being utilised to good effect in the latest self-contained breathing apparatus.
A great deal is already known about the causes of coronary heart disease (CHD). Genetic factors make an important contribution, as do several acquired risk factors. These include smoking, high cholesterol, hypertension, obesity, diabetes and stress. Recently, even early life experiences have been implicated: low birth weight and “catch-up growth” increase the risk of CHD. All of the foregoing factors are cumulative. Nevertheless, there are several aspects that remain unclear.

For example, although CHD is an age-related disease, it is not known why there is such a wide variation in age of onset, even in individuals with similar risk factor profiles.

We began by investigating the hypothesis put forward by A.M. Olovnikov in 1973, that the earlier occurrence of some age-related diseases may reflect premature biological ageing, and today I would like to present some of our findings in relation to CHD.

We are all aware of chronological ageing; we all know how old we are in terms of years and months, but we are also ageing biologically. The relationship between the two may well be linear. However, some individuals may age at a slower biological rate than their chronological age, while others may age much faster.

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Although I have illustrated the point in a slightly jocular fashion, biological ageing is an extremely important concept which we can understand in terms of its molecular basis. To do so, we must consider chromosomes and telomeres.

A chromosome is a long piece of DNA which contains many genes, regulatory elements and other
sequences. A telomere is a region of highly repetitive DNA at the end of a linear chromosome that protects it. Every time chromosomes are replicated the DNA complex is incapable of replicating all the way to the end of the chromosome; if it were not for telomeres, this would quickly result in the loss of vital genetic information, which is needed to sustain a cell’s activities. In humans, the telomere protective ‘cap’ consists of a simple sequence of nucleic acid bases: TTAGGG (T for thymine, A for adenine, G for guanine), repeated thousands of times. In young healthy cells, the telomere sequence is long, but the telomeres progressively shorten as cells divide. Senescence of the cell occurs when the telomere reaches a critically short length. The shortening is described quantitatively in terms of loss of base-pairs (bp).

Nowadays there are laboratory techniques which enable us to estimate telomere length, expressed as Terminal Restriction Fragments (TRF). In a pilot study we compared 10 patients with severe triple vessel coronary heart disease, and 20 age/sex-matched normal controls. As expected we saw the age-related decline in TRF length with age in both the cases and the controls. But after adjustments for age and sex the cases had a mean TRF length some 300 bp shorter than controls. As the average base-pair loss is around 35bp/year, the mean TRF length in cases in similar to that in controls approximately 8.5 years older.

While the pilot study provides an insight into a potential role for the telomere in CHD, the small study size meant we were unable to take confounding risk factors into account. So to address these issues we undertook a much larger second study.

In this study we examined the relationship between telomere length and risk of premature myocardial infarction. We recruited 203 patients with a history of a myocardial infarction before the age of 50. All of the cases were at least 3 months from their event, and in a clinically stable condition. The controls were 180 age-gender matched people with no history of CHD.

We found that there is considerable inter-individual variation in length at any given age. However, detailed analysis of the data showed a clear partitioning between cases and controls such that, at any given age, cases have a significantly shorter telomere length than controls. Looked at another way, and taking the age-related decline in telomere length into account, what we have found is that, on average, at any given telomere length, controls are 11.3 years older than cases. This represents a considerable difference in biological age between the groups, despite the young chronological age of the cohorts.

To look into the possibility that the difference in telomere length between cases and controls may be due to the effect of other CV risk factors, we examined the effect of these risk factors on mean TRF length, and found that the observed degree of telomere shortening is independent and associated with a 3-fold increased risk of having a premature myocardial infarction.

Our findings and hypothesis open up several further questions that are testable.

Ongoing and planned studies in our group include:

1. Analysis of the association of telomere length with risk of myocardial infarction in a large prospective study to exclude the possibility that shorter telomeres occur secondary to having CHD.

2. Examining the relationship between telomere length & familial risk, by studying healthy individuals with divergent family histories.

3. The association of telomere length with other markers of vascular ageing.

To address the first of these issues we have just completed the largest prospective study to date examining the relationship of telomere length with CHD. For this we had access to material and data from WOSCOPS (West of Scotland Prevention Study), a large primary prevention study using statins. In WOSCOPS around 6000 previously healthy middle-aged men with an elevated cholesterol level were randomised to either receive a statin (which lowers cholesterol) or a placebo. Over the course of the next 5 years 580 subjects developed new CHD. We had BASELINE DNA from 484 of these subjects who developed CHD, and matched these with DNA from 1058 controls subjects who did not develop CHD. As we might expect, certain characteristics such as hypertension and diabetes were higher in those who
became cases compared to those who did not. Allowing for these factors, baseline telomere length in the WOSCOPS subjects who developed CHD was again shorter than the controls. Allowing for the age related decline in telomere length, subjects who developed CHD was similar to controls approx 9 years older. This finding from a prospective study is in remarkable agreement with our previous estimates and excludes the possibility that shorter telomeres are a consequence of the disease.

In WOSCOPS, treatment with statin reduced the risk of CHD by about 30%. Unexpectedly and perhaps more excitingly from a clinical perspective, we found that this benefit was only seen and indeed was greater in those subjects at increased risk based on their telomere length. Those with the longest telomeres had no benefit despite an equal lowering of cholesterol. This provides more evidence for a link between telomere length and CHD risk.

An association does not, of course, always mean a causal relationship. However, data are emerging directly relating telomere dysfunction to atherosclerosis-related changes (atherosclerosis is the deposition of fatty substances on artery walls). Studies in cells in culture have shown that inducing senescence through inhibition of TRF2, a critical telomere-related protein that stabilises the telomeric structure increases the production of proteins involved in atherogenesis. In contrast, introduction of a telomerase catalytic component (which protects telomeres from shortening) significantly extended the life span and inhibited the functional alterations associated with senescence. There is therefore a mechanism that can explain the association of shorter telomeres with CHD.

Telomere lengths vary greatly between individuals. So what regulates telomere length? There is strong evidence from our work, as well as those of others, of strong genetic determination, possibly explaining as much as 80% of the inter-individual variation in telomere length. There is also evidence that the rate of age-related decline in telomere length is increased by some of the risk factors for CHD such as smoking, obesity and diabetes by increasing a cellular process called oxidative stress. There is also the possibility that telomere length can explain the association of being born small and CHD as the catch up growth required will tend to aggravate telomere attrition.

Our telomere hypothesis therefore has the potential to bring together several different strands of the known aetiology of CHD under a unifying mechanism. This is very exciting and opens several avenues of further research which we are currently exploring.

I would like to end by acknowledging the members of my research team and especially Dr Scott Brouilette who has performed the studies and the British Heart Foundation, Medical Research Council and Jules Thorne Trust who have supported the work.

“Every man desires to live long, But no man wishes to be old.”

Jonathan Swift, author & satirist, 1667-1745.
THE SIXTH EXTINCTION?
WHAT DINOSAURS CAN TELL US ABOUT THE MODERN BIODIVERSITY CRISIS

Professor Norman MacLeod, Palaeontology Department, The Natural History Museum, London

Joint Lecture with the Geology Section delivered on 29 January 2007

Much has been made of the fact that global changes in temperature, sea-level, marine currents, and climate patterns are resulting in biodiversity changes. Hardly a day goes by without word that a species has disappeared from an area where it was formerly known to occur in abundance or has inexplicably appeared in an area well outside its traditional range. Even more concerning are reports suggesting that an extrapolation of the changes taking place in many species predict their extinction in a few years’ time. While the loss of any species, much like the loss of any individual, is a cause for regret, this regret needs to be tempered by the realization that extinction, like death, is a perfectly natural process. Indeed, the overwhelming majority of all organisms that have ever lived are extinct. The most reliable empirical record of extinction available for study is the fossil record and it is to that record we must turn to place our current concerns over global biodiversity changes into an appropriate context.

Over the past 550 million years the intensity of extinctions measured as a percentage of the biota present within each stratigraphic stage has waxed and waned repeatedly (Sepkoski 2002, Fig. 1).

Two patterns are evident in these data. The first is a separation between extinction-intensity peaks, the so-called ‘mass extinctions’, the inter-peak or ‘background extinction’ intervals. The second is a marked decline in the intensity of ‘background extinction’ intensities through the Phanerozoic—the ‘background extinction gradient’. Any complete accounting of extinction as a geological phenomenon must include explanations of both patterns.

The pattern of extinction peaks has received the most attention both historically and over the last 25 years.
Historically, five ‘mass extinctions’ have been recognized: the end Ordovician (Ashgillian), Late Devonian, (Frasnian-Fammenian), end-Permian (Changsingian), end-Jurassic (Norian), and end-Cretaceous (‘K-T’ or Maastrichtian). The magnitudes of these extinctions range from 16-51 percent of marine families, 47-69 percent of marine genera and (est.) 76-95 percent of marine species (Raup and Sepkoski 1984; Jablonski 1995). Extinction-intensity estimates for terrestrial plants and animals are of lower quality, but comparable magnitudes. Interestingly, despite these high figures, the ‘big-five’ mass extinctions account for only 5-10 percent of the total number of Phanerozoic extinctions. Background extinction rates are only 0.5-2.0 species per year, yet these intervals account for 90-95 percent of all extinctions. Compared to these admittedly much longer-term estimates, documented extinction rates since 1600 (Eldredge 1998; Lomborg 2001) and rates extrapolated from recent historical data (see Lawton and May 1995 and references therein) are decidedly modest. Whatever happened in the past and whatever its causes, modern extinction rates are hard-pressed to achieve geological background-extinction magnitudes, much less those of true mass extinctions.

The origin of mass extinctions, especially the very well-documented Maastrichtian extinction have been something of a cause célèbre among scientists in general. In a review paper Mike Benton (1990) tabulated no less than 60 different reasons offered by intellectuals and academics of all stripes as to why dinosaurs alone became extinct, many published in the peer-reviewed literature. The search for a cause of the Maastrichtian extinction event intensified even further after a team led by Luis Alvarez (Alvarez et al. 1980) identified anomalous concentrations of the rare-earth element iridium (Ir) in a K-T boundary clay layer from a section near Gubbio, Italy. Subsequent analyses demonstrated the ‘Ir anomaly’ to be present in all K-T sections and cores judged complete (as well as many known to be incomplete, see MacLeod and Keller 1991). This suggested the input of extraterrestrial material at or near the K-T boundary consistent with an impact of a 15 km (diam.) bolide. Shortly thereafter Jack Sepkoski and Dave Raup (1982) claimed the extinction record exhibited a regular 26 million-year periodicity. This claim implied an extraterrestrial cause for all extinction peaks in the last 250 m.y.

Over the past 25 years much has been said and written about mass extinction causes. While all positions have their adherents, most practitioners, especially most palaeontologists, have been uncomfortable with the idea of a short-term event (c. 1-10 years) causing either the Maastrichtian extinction event or mass extinctions in general. A large number of lines of empirical evidence support this position. For the Maastrichtian extinction event, detailed consideration of the biostratigraphic evidence has long shown extinctions occurring below, at, and above the boundary horizon which, in complete sections, has been placed at the Ir anomaly. Even gross sampling by reference to secondary compendia shows a variety of extinctions patterns for different groups of organisms that, when summed, paint a picture of extinction intensities accelerating through the last few stages of the Cretaceous, culminating in a Maastrichtian peak, and then being reset in the lowermost Palaeogene.

For planktonic foraminifera (the best studied Late Cretaceous fossil group), biogeographic and morphotype-based ecological analysis both support this interpretation as do data from other ‘classic’ mass extinction groups such as ammonites (Marshall and Ward 1997) and dinosaurs (Archibald 1996). Moreover, this pattern is also consistent with a long-term decline in Late Cretaceous sea-surface temperatures (with attendant global climatic affects), as well as pronounced sea-surface temperature fluctuations in the late Maastrichtian. This, in turn, is consistent with an extinction mechanism-rich Late Maastrichtian environment that played host to a c. 80-100m fall in eustatic sea-level and the eruption of over 1 million km³ of basaltic lava on the Indian subcontinent, in addition to at least one major bolide impact. At present there is no good reason to suspect any causal link between these global change mechanisms, yet all were undoubtedly features of the late Maastrichtian environment. The ecological signal in these biotic data is complex and therefore consistent with complexly interacting, multiple driving mechanisms. The picture that is emerging is one of elevated Maastrichtian extinction intensities superimposed on an increasing trend and caused by repeated, multi-causal, global disturbances leading to massive habitat shifts over a very long ecological time interval. This model stands in opposition to the popular, largely media-driven account of a short, sharp, massive perturbation over a short time interval.
alter which the environment went back to ‘normal’ (e.g., the ‘bad weekend’ scenario, see Alvarez 1997). At the moment the modern environment is experiencing the latter sort of event, caused largely by human-generated disturbances on a variety of scales. So long as these affects can be mitigated or at least stabilized over a scale of decades to centuries the biodiversity effect could be minimal. However, if these changes become quasi-permanent features of the planet’s environment (i.e. persisting over millennia) the evidence of the fossil record suggests the biodiversity consequences could be severe.

Attribution of general causes from specific historical cases will always be problematic, as David Raup (1991) pointed out.

“There is no way of assessing cause and effect [in historical data] except to look for patterns of coincidence, and this requires multiple examinations of each cause-and-effect pair. If all extinction events are different the deciphering of any one of them will be next to impossible.” (p. 151).

Data for other extinction events are not as detailed or comprehensive as those available for the Maastrichtian event. Nevertheless, the timing of these extinctions, and the timing of the various causal mechanisms is known, at least to the stage level (Table 1).

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Table 1. Stage-level associations between extinction intensity peaks and various putative causal mechanism time series

from the coincidental association of distinct causal time series. Note that within the last 260 m.y. there have been three major extinction peaks (Changsingian, Norian, Maastrichtian). In each case the stage containing the extinction peak has coincided with an LIP event and a sea-level lowstand. Monte Carlo simulation analysis indicates this association is sufficiently unusual to indicate statistically significance (MacLeod 2005) even though the time-series match between sea-level lowstands and extinction peaks per se is not. These results indicate that sea-level fluctuations, while not causing extinctions themselves, place the biosphere under increased (lowstands) or decreased (highstands) susceptibility to extinction pressures exerted by other mechanisms, especially if the lowstand is sudden and of sufficient magnitude to drain large epicontinental seas. In the case of the modern situation it is important to note that the last time sea level stood as low was during the Chansingian extinction.

Finally, the background gradient in extinction intensity has been seen as a continuous pattern that stretches over the entire Phanerozoic. Traditionally this pattern has been explained by the ‘pull of the recent’ (Raup 1972, 1978). However, inspection of
this curve, supported by trend analysis (MacLeod 2002), indicates the presence of a complex structure within the background extinction data, with the Cambrian-Donlyn interval exhibiting no gradient, the Carboniferous-Triassic interval exhibiting a strong gradient, and the Jurassic-Recent interval exhibiting a greatly weakened gradient. These results suggest the biosphere has passed through a series of time-ordered phases with respect to overall extinction susceptibility. Accordingly, it is interesting to focus on the inter-phasic transition intervals and note that the Late Devonian corresponds to the first appearance of forests and deep soils in terrestrial environments and the Late Triassic corresponds to the emergence of the modern phytoplankton groups in the oceans. Both these biotic innovations had important dual physical and biotic affects through changes in the nature of the carbon cycle and the elaboration (and thus stabilization) of food webs. While the comparatively low levels of Cenozoic extinction intensity do not eliminate the possibility of mass extinction in the modern biota, they do suggest that mechanisms are present to dampen the effects of all but the most profound global disturbances.

References


PROSPECTS FOR MULTICULTURALISM AND COMMUNITY COHESION

Ted Cantle

The Leicester Mercury Lecture delivered on 12 February 2007
Sponsored by The Leicester Mercury

Most western democracies have been ‘multicultural’ for some 50 years and have gradually developed and extended equal opportunities programmes and anti-discrimination legislation over that time. Despite this, many of our minorities are amongst the most disadvantaged section of our community and still experience prejudice and unequal life chances. Segregation, a term which has taken on different meanings, is not being broken down and may even be getting worse and we are now encountering a rise in inter-ethnic conflict, based upon separate identities, which are more readily reinforced by transnational and diasporic affinities. The gradual integration and cohesion of society has been set back and there are new questions about the value of multiculturalism, and its impact on civic and social solidarity.

Multiculturalism and Identity

The concept ‘multiculturalism’ is certainly no longer adequate to describe the extent and nature of diversity, and Trevor Phillips, Chair of the CRE, has called for it to be ‘scrapped’ because of the way it has been used a means of legitimising separateness and division. ‘Multiculturalism’, however, did succeed in emphasising that ‘difference’ should be respected and celebrated, rather than feared. In that sense, it was helpful as a means of tackling racist views and confronting prejudice. But it has also been used as a ‘justification of a wide range of differences: economic, political, social, cultural, physical, etc. and conflates concepts of nationality, national identity and group and personal affinities. Over the years it has done little to promote any sense of commonality and to help build bridges between different communities.

Many proponents of multiculturalism have become so used to resisting attacks on minorities that they will defend all differences automatically, as though cultural attributes are ‘natural’ and are all worthy of defence (and even though they may have supported more liberal principles in another context, which would have undermined these differences). People are not made up of genetically defined groups and the ethnic, faith and other boundaries that we create, and defend, are almost entirely socially and politically defined. The idea of ‘people like us’ is a dangerous concept, which even liberal commentators have been guilty of using, and having broken down the myth of separate ‘races’, we are in danger of creating ‘primordial’ faith and ethnic divisions.

In reality, there are many different conceptions of both majority and minority cultures and as much variation within ‘cultures’ as there is between them, some may even lack the coherence to be called a ‘culture’ and what do we mean by ‘culture’ anyway? But when identity is instrumentalised and it is under threat, and this can be in respect of either the majority and minority groups, we fall back on an exaggerated, almost stereotypical, view of ourselves. We inevitably emphasise our differences rather than what we have in common.

The search for identity, then, is like chasing shadows and much greater emphasis should be placed on how we actually relate to each other, allowing relationships to grow. This should develop in the form of a common sense of belonging and is not restricted to ‘common culture’. Society also grows from political interaction, between the state and individuals and between individuals themselves. The ongoing debate about expenditure priorities, the extent and nature of welfare provision, the regulation of the local environment and the economy as a whole, as much as the everyday discourse of social activities builds a political unity – even if only a framework within which we can disagree. Social and political capital and the sense of trust upon which
they depend, can only be built by dialogue and exchange. The once derided notions of citizenship and community are beginning to be re-asserted, and the concept of nationality, as opposed to the more ephemeral notion of national identity, should also take it place in the lexicon of cohesion. Our nationality, together with membership of our local ‘state’, must provide a basis for political discourse and often the only means by which we can contribute to an international and wider debate.

**Segregation and Separateness**

However, the historic pattern of settlement means that the possibilities for such interaction are limited. The development of ‘multiculturalism’ since the Second World War, has reinforced, rather than broken down, the many forms of segregation and separation. One of the most surprising statistics, is that in 1961, London contained 47% of the BME (Black and Minority Ethnic group) population and the West Midlands conurbation 14%, and some forty years later the figures are almost exactly the same. A small proportion of the BME population has moved into predominantly white areas over the years, but the areas with a high concentration of minorities have generally been reinforced by new migrants and have also suffered from ‘white flight’, with the same pattern remaining – the expected gradual integration has simply not happened.

The fact is that whilst Britain describes itself as a multicultural society, most people do not live in multicultural communities. Even though most of the ethnic minority population live in London and a few other regional capitals, the white population dominates most of the rest of the country, with areas such as the north-east, Wales and the south-west being almost exclusively white. And in areas that are more mixed, the separation is often just as evident, with most towns and cities divided on a neighbourhood basis. ‘White flight’ means that cities are losing some of their white population to suburban and rural areas and, meanwhile, the BME community is growing because of inward migration and natural factors. The different populations are then becoming more concentrated, and more divided.

The term ‘segregation’ is often used to describe this separation but it is not wholly appropriate, as it would suggest that divisions have been imposed by law. Clearly, there is no such regime in force, but ‘self-segregation’, in which some people prefer to live in an area dominated by their own ethnic or faith group, is also not adequate. Locational choices are often constrained by socio-economic factors, the lack of appropriate social and cultural facilities, the availability of suitable schools and, most of all, by real concerns about the lack of safety and security in other areas. Given that the areas ‘preferred’ by minority groups generally contain the poorest housing and have the worst overall environment, it is hard to believe that they are the consequence of a free choice.

Many of these ‘segregated’ communities are so dominated by particular groups that the possibility of contact with the majority population or another minority group is very limited. These ‘parallel lives’ do not meet at any point, with little or no opportunity to explore the differences and to build mutual respect, let alone to see them as enriching our communities. Meanwhile, racists can easily spread myths and false rumours and use this ignorance about each community to demonise minorities. That is not to say that we should attempt to go in the opposite direction towards some form of total integration or ‘assimilation’. Some degree of “clustering” for each group is essential, if we are serious about preserving cultural identity. A critical mass of each community will also be necessary to support different places of worship, shops and social facilities.

The ‘layers of separation’ need to be examined in each case, but in general, we should expect to see a much greater sense of commonality – or integration – at the political and economic level, whilst maintaining and promoting a separation at the cultural level to allow diversity to flourish.

There are real practical difficulties to overcome too and, in particular for the many white children growing up in all-white parts of the country, who have no experience of the multicultural society of which they are a part. Many do not meet people from BME backgrounds until they go to university – and they are still a minority of their peers. Community cohesion has to be directed at them too and it will require some imagination to realise, for example, the way in which Wigan, a largely white area, has teamed-up its young people with youngsters in multicultural Leicester.
Vision - A Shared Sense of Belonging

Sharing experiences is not sufficient, and will not develop, unless there is also a shared vision and sense of purpose. The way in which different cultures are supported often means that difference is reinforced, rather than based upon commonalities. As societies become more diverse, there is an increasing need for common values and a greater sense of national solidarity. This is difficult given that our notion of diversity has moved on significantly from just a handful of principal minorities to embrace a much larger number of communities; over 300 languages are now spoken in London schools.

The nature and pattern of difference is also on a new level with a wider range of people from eastern Europe, Africa, the Middle East and every corner of the globe creating new ‘domains of difference’, both between the host community and the new migrants and between minorities. Indeed, we have created a culture in which each different group feels that it is being unfairly treated in relation to the other and believes that it is in competition for jobs, housing and public services. Moreover, each group feels that its identity is at risk and under pressure.

There is a danger that we just focus on ethnicity or faiths, or even just one, the Muslim faith which has been the centre of attention. However, this is a much more complex problem and we have to address the fear of difference more generally. This means investing in education programmes, breaking down the barriers between groups and building bridges between communities at the institutional level and in neighbourhoods and wherever people meet.

This is very much about helping people to come to terms with diversity and seeing it as an enrichment of their community, rather than as a threat. This means that we should not dismiss negative perceptions too lightly as ‘racist’ or prejudiced and that we should try to understand the causes and also deal with the real competition over resources and ensure that conflicts are addressed in an even handed and transparent way.

This also means a much more difficult debate about ‘commonalities’, rather than simply focussing on difference. We have promoted difference in so many respects: encouraging separate schools for different faiths, housing provision for minorities, a wide range of separate cultural, arts and sports programmes, regeneration schemes based on different communities, separate employment training schemes etc., all for laudable reasons, but they have generally failed to promote the things that all communities have in common. As a defensive mechanism to racism and discrimination, the focus on difference may have been justified, but we now have to redress the balance and challenge areas of difference that conflict with wider societal interests, more vigorously promote a common language and active citizenship, rather than relying upon ‘peaceful co-existence’.

The equalities agenda still has to be reinforced, not simply to ensure fairness and social justice, but also as a means of promoting interaction, understanding and respect. In this sense, racial equality and community cohesion programmes come together and are mutually reinforcing. However, we need a more positive approach to breaking down segregation and ‘parallel lives’ not only interacting in our daily lives, but also in as part of a political entity, with a common interest in the direction and development of the state. Local authorities therefore need to understand and anticipate the dynamics of change within their local community and to be ready to respond with a strategy which promotes interaction and integration in both new and existing neighbourhoods, whilst preserving cultural diversity.

Ted Cantle is the author of Community Cohesion: A New Framework for Race and Diversity, published by Palgrave Macmillan
ALEXANDER WALKER: AN OBSESSIVE COLLECTOR

Richard Cork, art critic, historian, broadcaster and exhibition curator

The Partnership Lecture delivered on 19 February 2007

Although the British have often been voracious art collectors, they focused most of their acquisitive passions on the past. Wealthy aristocrats returned from the Grand Tour fired with an appetite for classical art and the Renaissance. Their response to contemporary art was, on the whole, far more muted. Even Samuel Courtauld, who amassed such an exceptional array of French paintings from Monet to Cezanne, bought dead artists rather than taking risks with the living.

Today, the British are finally casting off their traditional mistrust of the new. But most of our collectors still compare poorly with their equivalents in Germany, Italy or the USA. That is why Alexander Walker’s collection in the British Museum makes such a spectacular and hugely heartening display. Over 200 works on paper, the biggest and most significant modern bequest received by the Museum’s Department of Prints and Drawings for over half a century, reveal for the first time the full, astonishing range of Walker’s purchases. How on earth did he manage to display them all in his modest Maida Vale home?

When I knew Alex best, as a warmly appreciative colleague on the Evening Standard in the 1970s and early 80s, he had only bought a fraction of the work exhibited here. He invited me round to see the collection, and his pride and pleasure in the pictures were gratifying to behold. But it had not yet filled every available surface of his bachelor flat, and I then had no inkling that he would go on to acquire such an open-minded, exhilarating and distinguished range of images during the final 20 years of his life. Mind you, I might have guessed. After Alex emerged from his incessant daytime previews in the cinema, he would, invariably hurry off to the galleries. Whenever we met, he would be alive with enthusiasm about a current exhibition and eager to hear about any discoveries I had made. Sometimes, out of the blue, he would phone me. “Richard, it’s Alex”, he would say in his distinctively crisp Northern Irish accent, asking me what I thought of a particular artist: “I’ve just seen something marvellous, and I’m wondering whether to buy it.” Every time he rang, the artist in question would be quite different — in age, nationality and style. They reflected the broad, ever-changing nature of Alex’s restless and perpetually inquisitive vision. But our ensuing conversation was always, on his part, thoughtful and freighted with insights. He took art very seriously and, by degrees, the images he acquired took over his entire flat.

Alex rejoiced in the sheer diversity of his collection. A Keith Vaughan inspired by the great elegiac line from Cymbeline, “Fear No More the Heat of the Sun”, was hung next to a frontal view of a frowning anguished face by Chuck Close. Vaughan had been the first artist Alex ever purchased, back in 1964 only a few years after Lord Beaverbrook made him the Standard’s film critic. Still young, and lacking the financial resources he commanded in the later stages of his career, he found the Vaughan in a backroom at the Marlborough Gallery. It cannot have been very expensive, and the choice marked Alex out as an old-fashioned neo-romantic by temperament. But his “eye” was already excellent: Vaughan never did anything more direct and heartfelt than this group of mourners bending, Pieta-like, over the youthful body in their arms.

Soon enough, Alex moved on to artists of his own generation or younger. And unlike so many British collectors, he became wholly unafraid of extreme abstraction. The most exuberant cluster of images in the British Museum show was produced by Bridget Riley, who was born only one year after Alex. He probably saw her first solo show in 1962, and recognised there the emergence of a single-minded brilliantly assertive new talent. So maybe his acquisition, of an ink and collage study for “Blaze”, a painting displayed in her landmark, early exhibition, reflected his memory of this early, excitement. At any
rate, it is one of the most dynamic and arresting works in the collection and Riley’s inscription on the large sheet of paper conveys her determination to make the final Blaze painting even more visually dazzling: “All angles as acute as possible.”

On the crowded walls of Alex’s flat, the Rileys would have threatened to knock out any other artists displayed next to them. He placed some in his bedroom, and rejoiced in Riley’s ability to “pop my eyes open with their concertina’d waves when I wake up.” But he revelled in the most heretical juxtapositions. Nor did he care if important works ended up jostling for room in places where grander collectors, with far more elevated ideas about impressing their guests, would never have thought of hanging art. “Arcs from Four Corners”, a sumptuous multi-part work by Sol LeWitt, was hung above the draining-board and next to the stove. Judging by the video-tapes and magazines stacked on the cooker’s electric rings, Alex did not believe in making meals at home. So the images surrounding the stove must have been saved from harmful exposure to heat, bubbling food or boiling water.

The bathroom, however, was quite another matter. Here, alarmingly, Sean Scully’s magisterial “Abstract Landscape” and Rachel Whiteread’s “Pink” were hung above the bath. Whiteread’s work, a tough yet seductive ink and gouache taking as its springboard the herringbone pattern of the parquet floor in her Berlin flat, looks especially vulnerable to any steam rising from the nearby hot taps or shower spray. But Alex, who must have loved looking at such a potent image while he washed and shaved, saw no reason why art should be prevented from accompanying his daily ablutions. And he was right; the British Museum assures me that no harm ever came to the pictures in his bathroom. A notably fastidious man, he would have known just how to prevent any damage befalling the work in his care.

As he grew older Alex removed himself still further from the neo-romanticism of his youth. “I almost always buy abstract works now” he declared in 1993, while admitting that his most audacious purchases could cause him problems at the outset: “I sometimes risk buying a ‘difficult’ picture to challenge and change me”. Many of the finest images in his bequest are by minimalist masters as rigorous as Agnes Martin, Robert Ryman and Brice Marden. Even so, Alex never sold any of his earlier, figurative acquisitions, and believed that everything he had ever bought for his collection possessed its own validity.

Besides, his accelerating involvement with abstraction never rigidified into a chilling orthodoxy. He always remained open to the rewards of figurative art at its most bracing. A row of closely scrutinised Lucian Freud etchings prove that, even as late as 1996, Alex responded to the rewards of work rooted in direct, penetrating observation. And in 2000 he bought a charcoal drawing of a hooded head by Philip Guston, an artist who had alienated many of his supporters by breaking free from Abstract Expressionism and returning, for his last and finest phase, to the figurative preoccupations of his youth. Alex’s appreciation was heightened by his awareness that “Hooded” had been drawn in 1968, at the very beginning of Guston’s fruitful late obsession with the Ku Klux Klan theme. He delighted in acquiring work that marked a creative turning point, and once declared that “I have a penchant for pictures that catch the artist’s moment when self-research found a new form.”

Discovery of that kind lies at the centre of Alex’s collection.

References
1 The Partnership lecture was sponsored by the Leicester Literary & Philosophical Society in support of the exhibition “Matisse to Freud” held at the New Walk Museum, Leicester from 27 January to 18 March 2007
2 The works are on open access in the Study Room of the Department of Prints and Drawings in the British Museum. Full details are on the British Museum website: www.thebritishmuseum.ac.uk
Unfortunately, agricultural pests are not so beautiful and, in some ways, not so interesting as are these wonderful moths in the family Arctiidae. However, the aphids, which comprise the main insect pests for arable agriculture, and many horticultural crops in northern Europe and Britain, have a very interesting chemical ecology, which is the generic name given to chemical communication between organisms. So, for example, the black bean aphid, *Aphis fabae*, which you will see commonly in your garden, can destroy completely a crop of field beans. The bird-cherry-oat aphid, *Rhopalosiphum padi*, attacks cereals and, in doing so, transmits virus diseases. In both the Latin and common names of this aphid, we see two types of plants represented. The summer, or secondary, host is a cereal crop (oats, barley or wheat), whilst the primary, or winter, host is *Prunus padus*, the bird-cherry. Sexual forms of the aphid mate in the autumn on the winter (primary) host, eggs are laid and these overwinter to emerge in the spring. The young aphids feed and mature on the new spring growth of the bird-cherry and then migrate towards the summer (secondary) host, a cereal crop. If the winged adults also have access to grasses infected with barley yellow dwarf virus, then they can transmit this very important pathogen, which encourages a very large insecticide use by farmers.

Aphids can have two different morphologies as, for example, when they are coming together in the autumn to mate. The female, which arrives on the primary host as a winged form, is produced by live

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**PHEROMONES AND OTHER SCENTS FOR THE ALLEVIATION, WORLDWIDE, OF MANY PEST PROBLEMS IN PLANT, ANIMAL AND HUMAN HEALTH**

Professor John A. Pickett CBE, FRS, Rothamsted Research, Harpenden

*Lecture delivered on 26 February 2007
Sponsored by the Royal Society of Chemistry*

Pheromones and other scents are perceived by animals using their olfactory organs. For moths, these are highly developed and in male moths you can see large, highly adapted, plumose antennae with which the male moths find the females by detecting their sex pheromones. The term “pheromone” is used exclusively where there is communication between members of the same species, and these very small amounts of chemicals are known by that term whether the signal comprises a single compound or a mixture of components. It is possible to use pheromones to alleviate pest problems in many situations worldwide. In using such signals, it is interesting to note that, although evolution has played an important part in their development, the organisms involved are not always perfectly adapted. Some time ago, we were able to identify the sex pheromones for the scarlet tiger moth, *Callimorpha dominula*, and the cinnabar moth, *Tyria jacobaeae*, both in the family Arctiidae. These turned out to be one and the same compound. The two species are normally temporally and geographically separated. When they are brought together under artificial circumstances, the female tiger moth, emitting a sex pheromone identical to that of the cinnabar moth, causes the male cinnabar moth to attempt to copulate. The offspring are not able to procreate, but this illustrates the fact that we can, perhaps, ourselves enter the situation and thereby interfere with communication via pheromones and other scents for our own purposes. The chemical itself, which is (3Z,6Z,9S,10R)-epoxyheneicosadiene, exists as this particular isomer and, as such, would be expected to be very specific, but the biosynthetic pathway by which this compound is created has certain basic requirements. This means that only certain alterations in the basic structure can be provided by the biosynthetic routes in place, and so we find, in this example, two moths employing the same pheromone.

Unfortunately, agricultural pests are not so beautiful and, in some ways, not so interesting as are these wonderful moths in the family Arctiidae. However, the aphids, which comprise the main insect pests for arable agriculture, and many horticultural crops in northern Europe and Britain, have a very interesting chemical ecology, which is the generic name given to chemical communication between organisms. So, for example, the black bean aphid, *Aphis fabae*, which you will see commonly in your garden, can destroy completely a crop of field beans. The bird-cherry-oat aphid, *Rhopalosiphum padi*, attacks cereals and, in doing so, transmits virus diseases. In both the Latin and common names of this aphid, we see two types of plants represented. The summer, or secondary, host is a cereal crop (oats, barley or wheat), whilst the primary, or winter, host is *Prunus padus*, the bird-cherry. Sexual forms of the aphid mate in the autumn on the winter (primary) host, eggs are laid and these overwinter to emerge in the spring. The young aphids feed and mature on the new spring growth of the bird-cherry and then migrate towards the summer (secondary) host, a cereal crop. If the winged adults also have access to grasses infected with barley yellow dwarf virus, then they can transmit this very important pathogen, which encourages a very large insecticide use by farmers.

Aphids can have two different morphologies as, for example, when they are coming together in the autumn to mate. The female, which arrives on the primary host as a winged form, is produced by live
birth and is wingless. When she reaches maturity, she raises her legs from the leaf and releases a sex pheromone into the air. This attracts the males, which are produced a little later on the secondary host. The males have large wings with which to fly to the female and, to detect the pheromone which she releases, they have elongated antennae. It is on the third segment of the six-segmented antenna that we find the organs which allow the male to respond to the pheromone. We can place electrodes into these organs to detect the neurophysiological responses and, if we take samples of the pheromone from above scent-releasing females, we can put this sample onto a gas chromatograph, separate the components and investigate their activity using preparations from the male antenna. This has allowed us to identify the pheromones for a number of aphid species. These are simple monoterpenoid compounds in the cyclopentanoid series. They have a degree of sophistication in that one of the compounds has 4 chiral carbons, i.e. carbon atoms with bonds that show right- or left-handedness, and since there are 2 alternatives, then $2^4 = 16$ isomeric possibilities.

Not only do these pheromones attract aphids, and various colleagues around the world are developing ways to use them against aphids, but they also attract parasitic wasps, or parasitoids, which lay eggs inside the aphid’s body. The larvae develop within the aphid, eventually pupate and then come out of the aphid (similar to the emergence of the monster in the “Alien” film series), whereupon they eventually mate and find other aphids in which to lay their eggs. These wasps are plentiful in Nature and, by using the sex pheromone, we can bring them into the crop at an earlier stage than usual, so that they can effect much more useful control of aphids by being there before the aphid population builds up.

We can also identify pheromones for insects that carry disease to ourselves and to our farm animals. Mosquitoes in the genus *Culex*, which spread the vectors for lymphatic filariasis, a symptom of which can be elephantiasis, and carry the disease known as West Nile virus, have a pheromone which we have identified as a simple fatty acid product, $(5R,6S)$-6-acetoxyhexadecanolide. This pheromone is used by gravid female mosquitoes to mark an egg-laying site as safe, because the pheromone is only produced after the eggs mature. We can synthesise this compound and have successfully field-tested the synthetic product around the world. It is now in commercial production in the US, where it is sold to stop mosquito outbreaks before they occur. Recently, with various collaborators, we have also identified the sex pheromones, in this case produced by males, for the New World sandflies. The sandflies in the *Lutzomyia* genus carry leishmaniasis, particularly in Brazil. Different regions have the same species, *Lutzomyia longipalpis*, but using different pheromones. These are much more sophisticated compounds, in the class of homosesquiterpenes, and as a consequence are very difficult to synthesise. However, using the essential oil from the bigroot geranium, *Geranium macrorrhizum*, a garden plant which can be grown commercially, we can cheaply produce the pheromone, which is now being developed for field use.

Unfortunately, not all insects that cause us problems use pheromones. Some use chemicals, or scents, that have effects similar to those of pheromones but which are not employed in intra-specific communication. These are generically termed “semiochemicals” and, for cattle flies, the semiochemicals that are most valuable are those
associated with host location. We found, working with Danish and Dutch colleagues, that cattle within a herd of Holstein Friesians showed a wide variation in fly loads between individual animals. The fly loads were found always to be the same for individual cows, and we traced the phenomenon to the volatile chemicals that those individual cows produce. We have been able to identify these compounds and one in particular, 6-methyl-5-hepten-2-one, can be presented as a slow-release formulation on the back of an attractive cow, immediately reducing the fly load to that expected on an unattractive cow. This is counter-intuitive: in the past, it had been suspected that unattractive animals were producing reduced levels of attractants, but now we find that cattle which are unattractive are producing extra chemicals, which we can deploy as repellents. We have been able to do the same for the interaction between human beings and mosquitoes, and between human beings and the Scottish biting midge. Again, we found individuals showing very low attractiveness to these insects. Volatiles were collected from volunteers lying within aluminiumised plastic bags. We have been able to analyse these volatiles, again using electrophysiology coupled-gas chromatography, and from the people who are unattractive, we consistently found some chemicals at higher levels. We have identified these and can put them onto people’s arms, reducing attack by the Scottish biting midge.

In Africa, subsistence farmers usually intercrop their maize or sorghum with beans or other edible crops. However, we argued that, if we could find plants which were repellent, these could be used as intercrops and, as long as they were of some value, for example as cattle forage, then farmers could be encouraged to grow them, providing a means of controlling the pests in addition to the trap crop. We immediately found an excellent grass for this purpose, the molasses grass, *Melinis minutiflora*. Planted between rows of maize, this grass potently repelled the stem borer moths from the plots, to the extent that it protected the maize crop extremely well. On-farm, farmers were very pleased with the results, both in terms of this repellency and the aforementioned attractancy in protecting their crops from stem borers, and we call this system the “push-pull” or “stimulo-deterrent diversionary” strategy. Of course, the farmers lost the use of some land that they would normally have planted to maize, because of the space taken up by the trap crop. However, the intercrop could fit in between the maize rows and we found that molasses grass only needed to be grown in a ratio of one row to four rows of maize. Overall, the yields planted under the push-pull system were much better, even compared with the plots comprising a monocrop of maize. We then had to find out why this was happening. We quickly discovered that the Sudan grass and the Napier grass were so much more attractive than the maize because they were producing a large amount of attractant chemicals.

We initially investigated which plants would be highly attractive to these pests and which would not be at all attractive. We did this by establishing, in

triplicated plots, a grass nursery at icipe’s field station at Mbita Point, on the banks of Lake Victoria. Two grasses emerged as very good potential trap crops. One was the Sudan grass, *Sorghum sudanensis*, the other Napier grass, *Pennisetum purpureum*. These are both highly attractive and more attractive than the crop plant, maize. We felt that if these could be grown as trap crops around the plots of maize, then they could protect the crop and, indeed, we proved this to be true in the mid 1990s, also establishing that local farmers could do this on-farm.

Working with colleagues at icipe and other agencies within Africa, we have attempted to tackle the problem of insect pests in resource-poor farming, where maize and other cereals are grown at subsistence production levels. The insects attack these crops by boring into the stems, giving low yields and causing the crops to fall over. These pests are called “stem borers” and comprise a number of moths recently introduced into Africa with maize, but also species which are indigenous, colonising local grasses and cereal crops such as sorghum and millet.

We initially investigated which plants would be highly attractive to these pests and which would not be at all attractive. We did this by establishing, in

*Transactions of the Leicester Literary & Philosophical Society.*
compounds that were physiologically active, but which were not present in the attractive grasses. These we showed to comprise two chemicals, (E)-ocimene and (E)-4,8-dimethyl-1,3,7-nonatriene, compounds we knew to be produced by maize and other plants when damaged by pest attack, and which were already known, in other situations, to be very potent attractants of parasitoids. Indeed, we found, in both the Lake Victoria and Kitale regions, that increased parasitism had occurred, even though there were fewer stem borers in the maize. So, because of the presence of the molasses grass intercrop producing particular chemicals, not only was the maize giving the impression that it was under attack, thus deterring the moths, but it was also attracting in parasitic wasps. This pest-controlling system is very popular with farmers, not only because of the crop protection it provides, but also because of the production of cattle forage. The farmers have given their own name to this strategy. They preferred, rather than calling it “push-pull” that they should say “pull-push”, in Kiswahili “vuta sukuma”, and that is how the system is known.

The farmers also wanted the choice of having an edible bean legume as an intercrop, but we could not find one that showed a repellent effect. We did, none the less, find a cattle forage legume that would repel the stem borers and so we started to use that in the push-pull situation. This legume is in the Desmodium genus, either silverleaf, Desmodium uncinatum, or greenleaf, Desmodium intortum. During these field trials, we started to notice something very unusual: where the Desmodium plants had been sown, there was greatly reduced infestation of the crop by the African witchweed, Striga hermonthica. This is a parasitic weed in the family Scrophulariaceae, related to the snapdragon or antirrhinum, which causes considerable damage to the roots of maize or sorghum plants, often completely destroying the crop. When the weed eventually appears above the soil, having fed on the vascular system of the host plant, then it produces leaves, flowers and sets its seeds, which are produced in tens of thousands and can remain dormant in the soil for up to 20 years. However, with Desmodium as the intercrop, infestation of maize by Striga was almost completely suppressed. We proved this to be an allelopathic effect, a type of semiochemical signalling but within a plant/plant system. Because these plants are legumes, there are benefits to the soil from nitrogen fixation; also, by covering the ground, as we were doing with this intercrop, then some Striga control would be expected. However, there was a very potent additional effect. Water leaching from soil in which Desmodium was growing was itself enough to prevent Striga attacking maize and, by chemical fractionation, we found that there were two components to the activity. Part of this was a series of germination-stimulating chemicals, but we also found some inhibitory chemicals, which prevented the development of the Striga after germination so that it could not attach to the roots and colonise the host plant. We tracked down the chemistry of this by nuclear magnetic resonance spectroscopy and mass spectrometry, and have found that a series of rather unusual C-linked glycosides are responsible for the inhibitory effect.

We are now trying to understand the genetics so that we can breed for this trait, or transfer the genes into beans so that the farmers’ dream of having an edible legume that would control both stem borers and Striga may start to come true. In the meantime, the farmers are very avidly adopting this approach and we are using all kinds of media by which to transfer the technology. Local language pamphlets, farmers’ drama groups (where they enact the control of Striga and stem borers with intercrop and trap cropping), a storyline in the radio programme “Tambea na majira” (which is very similar to our own series “The Archers”), have all meant that we now have many regions using push-pull. In some regions, farmers are using this system almost exclusively and we always see an improvement in yield. Quite often, the farmers will also maintain fields under their old cultivation regimes, where they have very poor yields and where we can see the difference, and of course this difference can be used to demonstrate the new strategy to farmers from other areas. Indeed, as we have moved from Kenya into Uganda, it has been very valuable to have farmers travelling across the border to help each other.

Finally, there are many colleagues who have helped with this work at Rothamsted, and I would like to thank all of these, but I must particularly thank my colleagues at the International Centre of Insect Physiology and Ecology in Kenya, particularly Dr. Zeyaur Khan and Professor Ahmed Hassanali.
In 1985 there arose, simultaneously and independently in three places around the world, a notation for juggling tricks. The notation was incomplete, since not every trick could be described, and like many notations, it was not immediately apparent to the uninitiated how to read it. For those who understood it, however, it was instantly obvious that it was right. Somehow the notation managed to capture the essence of those tricks it described, and the fact that the same notation arose in more than one place at once showed that its time had come, and it was, quite simply, the notation.

Since then the notation, now known as “Site Swap” notation, has become fairly well-known in juggling circles. Reactions were initially somewhat mixed. In juggling, as with music, there are those who study the works produced by others, there are those who produce their own, and there are those, the juggling equivalent of the jazz musician, who feel that while it may be of use to some, juggling has a soul, and should not be trapped, caged, and prevented from varying from one single form. Over time, however, the notation has gained acceptance by the majority, and it is now considered a useful tool for the communication of tricks, incomplete though it is.

First steps: make juggling simpler

It is impossible to show in written form the infinite variety of juggling tricks that can be performed. Some have the arms moving sinuously past each other, somehow managing to toss, catch and carry three balls, never more than one per hand at a time, always moving over and past each other. Others have the hands largely stationary with the balls, rings, clubs, fire-torches or chainsaws spinning to various heights, seemingly none the same. Such variety can never fully be captured, and there is always room for the performer’s own interpretation of the basic moves, the underlying patterns. The Site Swap notation describes the trick that is the basis on which variations can then be built.

To make precise the limitations we place on ourselves, we state a specific set of rules that must be obeyed. These rules seem terribly restrictive, but within the resultant framework we will find that there is structure that can be exploited. The rules we use are as follows:

1. We only juggle balls.
2. Only one ball is thrown or caught at a time.
3. The hands stay on their own side of the body.
4. Throws happen inside shoulder width.
5. Catches happen outside shoulder width.
6. Throws and catches happen at a fixed speed.
7. The hands alternate.
8. The hands are full for half the time.

We will not attempt here to explain or justify these rules. Instead we will describe the practical results, and show why they are of interest both to jugglers and to mathematicians.

Investigating the consequences

To investigate the consequences of the rules, let us look at juggling three balls, and let us start with a further simplification. Assume for now that we not only obey the rules, but also insist that every throw must be identical.

Some quick experimentation soon shows that this then forces each ball to be thrown in sequence, for otherwise there would be variations in the timings. We start by throwing ball A with the right hand, then ball B with the left, then ball C with the right. Now we have to make a throw with the left hand and it must be ball A. Each ball is thrown every third throw, and from this we can conclude three things. The first is that it will work, the second is that the balls don’t go in the
is that it will work, the second is that the balls don’t go in the expected “Big Circle” seen on every popular picture of a clown juggling, and the third inescapable conclusion is that the balls are forced to change hands.

Do the same thing with four balls and we discover now that the balls cannot change hands. If we juggle four balls with every throw the same, and subject to our rules, we end up juggling two balls in each hand, independently, but asynchronously.

With five balls they once again cross, with six balls again it becomes half in each hand. These are unavoidable consequences of our rules. With each ball being thrown in exactly the same way, each ball is forced to take its turn. With an odd number, that means that each ball will alternate hands, but with an even, each ball will have to come back to the same hand.

To make it easier to examine what’s happening in a juggling pattern we make use of a diagram such as Figure 1. In this diagram the vertical lines represent the hands, the horizontal lines show the beats of the music to which we are juggling, and the lines bouncing back and forth between the hands represent the balls. Figure 1 shows the three ball cascade, the pattern with three balls in which every throw is the same.

We can see clearly now how the balls weave around each other. Indeed, if a ribbon is attached to each ball, and the other ends of the ribbons held some distance away, juggling this pattern will plait the ribbons.

Diagrams such as Figure 1 are called Space-Time Diagrams because they show both space and time on the same chart. Jugglers call them Ladder Diagrams, for obvious reasons.

**NB** The sequence starts at the top of the ladder, with time progressing downwards.

If we look at how long each ball spends in the air, an obvious pattern emerges. With three balls, each ball is thrown every third throw, and since it spends one beat of time in the hand it must therefore spend two beats of time in the air. Similar reasoning gives us the following table:

<table>
<thead>
<tr>
<th>Number of balls</th>
<th>Beats between throws</th>
<th>Time in the air</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

... and so on

The central column here is called the “Cycle Time,” and turns out to be the single most important idea in the development of the theory of juggling. From this table we can, should we choose, deduce what the physical throw heights must be and derive formulae for how hard we must throw. This, however, is not the most interesting direction to take.

Consider now what happens if we are juggling four balls in the pattern where all of the throws are the same. Every ball goes into the air, comes down, gets held in the hand, and then goes off into the air again. If any single throw is too high, or too low, the pattern is ruined.

However, if one single throw is made as if for one instant we were juggling five, and the very next throw is made as if we were juggling only three, what happens? The first throw is higher, stays in the air for a beat longer, and comes down in the other hand. We would expect it to clash with another ball landing at that time in that hand, but that has been pre-empted. The ball with which it would have collided is the very ball that has been thrown low and to the other hand. The timing has conspired to allow the two balls to exchange places in the pattern. They have swapped their landing sites, and hence the name for the notation, Site Swap.

This rather unlikely pattern is annotated by writing down the cycle times of the throws involved: ... 4 4 4 5 3 4 4 4 ... showing that in the middle of an infinite sequence of throws with cycle time “4”, we do a “5” followed immediately by a “3”, as shown in Figure 2.
There are other possibilities. Here is a table of such sequences.

<table>
<thead>
<tr>
<th></th>
<th>a:</th>
<th>4 4 4 4 4 4 4 ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>b:</td>
<td>... 4 4 4 5 3 4 4 4 ...</td>
<td></td>
</tr>
<tr>
<td>c:</td>
<td>... 4 4 4 5 5 2 4 4 4 ...</td>
<td></td>
</tr>
<tr>
<td>d:</td>
<td>... 4 4 4 5 5 5 1 4 4 4 ...</td>
<td></td>
</tr>
</tbody>
</table>

The fourth of these sequences, ..., 4 4 5 5 1 4 4 4 ..., was, incidentally, discovered by writing down exactly this sequence of sequences. The first three were already well-known to the juggling community, and given the clear and obvious progression, the fourth really ought to be a juggling trick, and it is.

But what does it mean to have a cycle time of 1? By referring to our table above we can see that the air time is always one less, so that implies that a throw with a cycle time of “1” should have an air time of “0”. Does that make sense?

Yes it does. Try to “juggle” (“manipulate” might be a better word) only one ball so that each hand is full for exactly half the time. The ball must effectively teleport between hands, and we do this simply by passing the ball from one hand to another. We cheat slightly, technically we are breaking rule 6, but in principle it can (almost) be done.

What does pattern “d” look like? In the middle of juggling two balls in each hand we must suddenly launch one high and crossing, and the next high and crossing, and the next high and crossing. For a moment we are effectively juggling 5 balls, but it can’t go on. We only have one ball left, and we want to make two more throws. So we cheat, and slide the remaining ball directly into the other hand. The other three come down, and we are once again juggling 4 balls in the standard pattern.

To see this for yourself you can either find a tame juggler, or you can obtain one of the many computer juggling animation packages [see footnote 1] and get that to do the juggling for you.

We have used our model to create a method of inventing juggling tricks. Not all sequences of numbers are valid, legal juggling tricks. This can form the basis of an investigation: which sequences work, which ones don’t, and why? Using the space-time diagram can assist in the understanding of the ideas, but using an animation package helps even more.

The following process is guaranteed to create sequences that work.

<table>
<thead>
<tr>
<th>Write down any set of consecutive numbers:</th>
<th>5 6 7 8 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Now write them down in any other ordering:</td>
<td>6 8 5 9 7</td>
</tr>
<tr>
<td>Take the number of balls to be juggled:</td>
<td>3 3 3 3 3</td>
</tr>
<tr>
<td>Juggling trick = Row 3 plus row 2 minus row 1:</td>
<td>4 5 1 4 1</td>
</tr>
</tbody>
</table>

There are several things to spot about this table. Just one example: the numbers in the final sequence always average to the number of balls in the juggling trick. It works even if you start with negative numbers.

The real questions are:

- How does it work?
- Will it always work?
- Can we get every possible valid trick?

The answers are yes, yes and not really, but sort-of. We’ll leave you to explore why those are the right answers.

**Conclusion:**

In closing, it is worth reviewing the processes that take place during the presentation. Most of the
are following the idealised scientific process. By three-quarters of the way through they have seen the distinction between models and the reality they represent, recognising that models are intended to help us understand the reality. They have also have seen what happens when things go wrong!

Towards the end of the presentation I generally find that several of the audience are asking “Why?” and “Does it always work?” which gives me the ideal opportunity to investigate justification and its close friend - proof. The power of a proof is that it can show that something must happen, can never go wrong, no matter how many examples you try. It lets me draw the distinction between proofs that are enough for everyday use and proofs that allow for the most bizarre situations. Thus we can see how mathematical proofs relate to everyday proofs; their similarities and their differences.

In short, this presentation gives literally dozens of starting points for investigations, proofs, projects and understanding. More than that, it shows that mathematics isn’t just arithmetic, and isn’t only in the classroom. It emerges in the most unlikely places. Juggling, for example.

Footnote: The Juggling Information Service can be found at http://www.juggling.org and contains a very large repository of information about juggling and related material. Unfortunately it is not currently being maintained, but one can find several juggling animation packages there. Another resource is: http://www.jugglingdb.com

The author’s own package, Juggle Krazy, is available, as is a description of the Site Swap notation aimed at jugglers, at http://www.solipsys.co.uk
WHY ARCHITECTURE SHOULD BE OF HIGH QUALITY, SIGNIFICANT AND CHALLENGING

Michael Wilford, CBE, Architect

The Peach Lecture delivered on 19 March 2007

Firstly, it might be helpful for me to set out my understanding of what constitutes architecture and my opinion on its current predicament. I am not a critic, theorist or academic but a practising architect.

Architecture

Architecture is a social art that belongs to every citizen. It influences every human being and the memory of every nation. It expresses individual and collective culture as well as society's priorities and values. It is a spiritual mission similar to music or poetry and the foundation of civilised societies.

The origins of architecture lie in ritual, projecting outwards parts of the human psyche to be mapped in space and so experienced with greater intensity. Man has always built with aesthetic intention, not only to provide physical shelter. Representing the tastes and attitudes of generations, architecture forms the built stage for human activity and invests man's constructed realm with meaning.

Architecture should be a bridge across time, recognisably rooted in the past while optimistically facing the future. It provides a rich resource of precedence and types to study. Through an informed and intuitive understanding, contemporary architecture can evoke history without compromising authenticity and achieve a contemporary sense of place, time and continuing tradition.

We should interpret by analogy rather than by imitation, thereby transforming and re-charging the meanings of the past. Modernity is not the enemy of history but, by definition, can be nothing but evolutionary. I believe buildings should not only surprise and be teasingly enigmatic but also establish meaningful relationships with users and the rich and diverse fabric of the city or landscape of which they form part.

The best architects continuously innovate and develop their understanding of the scientific, aesthetic and social aspects of the art.

The current predicament and the future

John Summerson in a 1957 RIBA lecture concluded that, at that time, what distinguished modern architecture from architecture of the past were the relationships between functions and their technological realisation. For him these were the new and sole determinants of architectural form. To look for other kinds of expression, he insisted, would be to fall back upon history. He was describing an architecture of omission, unable to engage with history, allusion, context or aesthetic sensation.

A few years later the young Fabians produced a booklet entitled ‘Architecture: Art or Social Service?’ which postulated the opposite view. Their optimistic assumption was that art would subvert the social obligations of architecture and the inevitability of objective design. Unfortunately this was readily translated by others into an inverted commercial equivalent in which the art of architecture was perceived to work against the client’s economic interest.

So during this period architects developed a form of presentation to clients in which all issues could be reduced to function, technology and economy. In certain circumstances this method continues in use today.

The evolution of ‘high tech’ had much to do with this ethos because it appeared to give similar meaning to both aesthetics and technology. It seemed to have cast off all the cultural baggage of architectural tradition to create purely technological solutions to social and business needs. Its technological accountability therefore protected aesthetic intentions that did not need to be declared.
Fortunately it later became apparent that the functional and technological programme did not translate in some objective way into a design. It was realised that an architectural language was required to mediate in this process of translation and that good design was aesthetically motivated.

Similarly, post modernism’s original impulse had been to ameliorate modern architecture’s failures by re-connecting with history, people and the city. But it became an opportunistic camouflage for the mean spirited and cheap utilitarianism into which most modern architecture had degenerated.

Peter Buchanan writes ‘With objective reality increasingly untenable as a notion, the pendulum has perhaps swung too far towards the subjective. Reality is now deemed personal and so arbitrary and relativistic. It has become a shallow subjectivity concerned merely with surface and representation. Grand narratives, universals and hierarchies are rejected, leading to a mix of tolerance and nihilism in which every point of view is equally worthwhile or worthless.

The inevitable outcome is an array of narrow approaches founded on different arbitrary realities such as deconstructionism, minimalism, post-modernism, high tech, etc. referred to earlier.

However, a more relevant architecture is emerging through globalisation, electronic communications, the environmental crisis and a quest for sustainability. The new epoch encapsulates its essentials in a new reality in the form of a dynamic and multi-layered process. This achieves a higher, more complex and ultimately more fulfilling synthesis of the dualism of objective and subjective which has plagued modernism for so long.

High Quality


Quality can mean different things to different people. It is not about the amount of money invested or quality of materials but the manner in which they are employed.

It is a term which is cynically manipulated by politicians. Within the architectural profession and, I imagine in other fields, there were high hopes of a Labour government after their ’97 election victory. It was believed that there would be a change from financial to social priorities in which high quality design would play a major role. The first reality check came when they embraced the PFI, PPP and Design and Build systems of building procurement which they had inherited from the Tories.

We hear repeated protestations from the Government of the importance of high quality design in their vast school, housing and hospital building programmes. We are hearing it currently in connection with the 2012 Olympics and Thames Gateway projects. The reality is very different. It is shocking that the Bishop of Rochester recently felt compelled to publicly express concern about the lack of strategy to ensure a sense of community in the Thames Gateway development, citing the imposition of the Canary Wharf development into the established Isle of Dogs communities as a lesson apparently unlearned.

The Government preaches to us as architects and designers, using words that echo the representations made by institutions such as the RIBA to the Government Ministers concerned. Such sermons imply that the design professionals alone are responsible and have the power and influence to ensure high quality design. The politicians habitually abrogate their responsibility to give a genuine lead and to inspire – in design as in so many other areas of responsible government.

I read recently an interview with Nicholas Hytner in which he quotes Tony Blair, a regular visitor to the theatre, admitting that the money needed to permit the arts to flourish was a drop in the ocean but he couldn’t sell that idea to the tabloids.

There is an increasing homogeneity of ambience and experience in current hotel, airport, hospitals retail and railway station design, such that they become interchangeable. They appear to be cloned. All take on the appearance of commercial retail centres, some with train platforms, or aircraft gangways attached. The floors, walls, ceilings and lighting are the same wherever you go. Conglomerates such as Ikea, Wall Mart, B & Q, etc. are lowering spatial and material
standards to that of temporary industrial warehouses. It is sad and telling that Richard Rogers won the RIBA Stirling prize last year for an airport in Madrid rather than his work in the UK.

Of course, budgets and value for money are critical and should be satisfied but the often repeated fallacy about high quality design is that it is prohibitively expensive. In fact it represents only approximately 2% of the lifetime cost of a building. The social benefits of high quality design in housing, schools and hospitals have been demonstrated. Enlightened developers recognise that well designed housing, offices and retail centres achieve higher returns. What legacy do we want to provide for future generations?

Significant

[Significant: Important. Notable. Expressive or indicative of something. Something which conveys or expresses meaning.]

In the First World, the industrial age and the first post-industrial information age, characterised by objective production, technology and work, are already being followed by what is called the Conceptual Age. This new age prioritises human skills that the machine or computer cannot replicate such as creativity, establishment of meaning, aesthetic discrimination and emotional response; all part of what we commonly think of as culture.

The Conceptual Age is characterised by people engaged in, and making their living from, many forms of creativity and cultural pursuits. These depend on empathy to sense and make connections between social/ecological and intellectual/emotional issues and to achieve a more balanced relationship between ‘doing’, as exemplified in work and production and ‘being’, concerned with the subjective, the experiential and aspects of meaning in human life.

Cultural institutions are recognised as increasingly important as places to enjoy and hone the human faculties prioritised in the Conceptual Age and so also our capacities for ‘being’. The architectural challenge when building for such institutions is to reconnect art and culture with the larger civic life from which they emerged but have become somewhat disassociated in recent times.

Architecture of the emerging epoch must satisfy our physical, social and psychological needs. It must be sustainable, benign in its impact on the biosphere and bring improved quality, and equality, of life. It must impart the deep satisfaction of living in harmony with nature and the depths of human nature.

Challenging

[Challenging: Invitation to a contest. A summons to fight or duel. Calling to account. To question. To invite critical action.]

Architecture should be provocative and stimulate both users and observers out of any complacency or ambivalence about buildings. It should encourage them to rethink their preconceptions. It should also raise awareness of their surroundings and engender respect and ownership of their buildings.

We live increasingly in a culture dominated by technology, consumerism and celebrity. A balance has to be achieved between fitness for purpose and event architecture in which the building itself becomes the principal motive for the visit. We now have the star architect phenomenon in which every city must have at least one International Building Icon.

A compelling building can enhance a city if symbolising or commemorating something worthwhile but today they so often commemorate nothing more noble than the architect’s creativity or client’s ego. Disruptive of a contiguous urban fabric, they fail in the contemporary task of re-stitching the city and recreating a sense of place. Belonging only to the present they also fail to be a bridge across time, recognisably rooted in the past while optimistically facing the future.

A rebellious gesture is meaningful only against a background of expectation and accepted conventions. Innovation is fun but when everybody is innovating, then nobody is innovating because they are all doing the same thing. The only innovator at that point is the person who is not innovating. Buchanan asks whether the current rash of iconic buildings represents architecture’s nadir? Are they merely ‘sunset effects’ that mark the passing of an age with caricatured exaggerations of its now irrelevant characteristics?
It is curious that the public’s sense of an appropriate contemporary architectural style can be so heavily influenced by the manifestations of earlier aristocratic and autocratic societies. This anachronism is made even more striking when there exists a simultaneous acceptance of contemporary automobile, aeronautical and communication technologies with the popular appeal of pseudo Georgian homes and Tudor hypermarkets. However, truth and significance are not provided by the conventions of appearance.

Architecture as a pragmatic art cannot be about style. The battle of style arises substantially from a deep suspicion of change with which modern architecture is associated, particularly negative change, as exemplified by characterless post war housing, banal commercial development and wasted opportunities in the creation of meaningful public space. Confusion between style and quality continues to undermine the development of a truly contemporary architecture and a distinction has to be made between them in the architectural debate.

The fundamental values of utility, continuity, authenticity and sustainability are what characterise significant architecture rather than a particular aesthetic.

Concluding remarks

My emphasis has been on public cultural buildings which form the main body of our work but I believe my comments apply equally in varying degrees to all other building types.

Design is an invisible process and it is perhaps understandable that the public have difficulty in comprehending the evolution of the design of a building and the architect’s potential contribution to society. We have always striven to practice architecture as an art which, as the most accessible and symbolic of the arts, encourages public appreciation through its contribution to quality of life. Whilst reconciling our parallel obligations to client and society, we are conscious of the profession’s responsibility to increase the public’s awareness of good architecture.

Each of our projects emerges from a long and painstaking process. We strive to find an original architecture that is convincing on every level. Each building is singular, the product of a new search; our buildings are complex and, we hope, moving and inspiring.

An appropriate relationship between our sense of history, the need for stability in our surroundings and the dramatic changes urged upon us by science and technology is as critical now as it has ever been. The arts of literature, drama, music and painting can individually propose appropriate balances but the architect is more constrained. His power and responsibility are often confused in the public mind with developers, planners and other parties over whom the architect often has little influence and no control.

The majority of our urban work involves the insertion of public buildings into established physical contexts and movement patterns. The projects derive their form and character not only from the immediate functional and physical constraints of the brief and site, but also through the incorporation and definition of new plazas, courtyards and other open spaces to enrich the character of the public realm and provide an appropriate setting for the new building. We also intend that they stimulate a fresh interpretation and commentary on the complexities of the cities in which they are located.

Our objective is to transform pre-existing situations into a rich dialogue between past and present without the use of ingratiating historic pastiche or undue deference to the status quo.

We believe a building should be sufficiently rich in its form and detail to provide a series of layers through which the visitor can progressively discover and enjoy the building. People who use and view our buildings have rarely been ambivalent in their reaction to them and we hope to continue to stimulate positive reaction amongst the public at large as well as from the cognoscenti.

No architect, however imaginative, can pursue values that are not shared by his client and the community or within the budget. Significant architecture can only develop from a joint commitment to quality and an understanding of the constraints within which architects have to work. An informed and enthusiastic client can make a significant contribution to the design process. Behind each of our buildings is a
particular individual or group who have taken the time to involve themselves in our work, made the effort to comprehend our ideas, supported us by sharing in the risks and, above all, maintained their confidence during the difficult process of turning initial ideas and diagrams into architecture. Our most successful and highly regarded buildings are those based on a relationship of mutual trust and respect with the client.

We are striving to enrich contemporary architecture with a vitality that fuses the Modern Movement’s ideals of abstraction, functionality, clarity, integrity and economy with the more traditional qualities of form and space in order to convey a sense of historical continuity. We are also seeking to maintain a connection between suitability for purpose and beauty as part of a broad and profound search for a robust contemporary architecture which contributes both to the evolution of the city and our culture.

RE-INTRODUCTION OF BIRDS AND MAMMALS

Roy Dennis, M.B.E., Consultant Highland Ecologist

Joint lecture with the Natural History Section delivered on 26 March 2007

Roy Dennis gave an illustrated talk, from a Scottish perspective, on the re-introductions of the sea eagle, red kite and osprey over recent decades. He outlined the exciting prospects for the future in the UK, including mention of Rutland Water’s successful contribution to the resettlement of ospreys and how these projects were stimulating enormous interest in wildlife in general.

His talk was followed by a detailed look at the mammals that Britain has “lost” over the centuries and how bringing them back could restore a much better balanced ecosystem, including recent news and views on the re-introduction of beaver, wild boar, elk, lynx, wolf and brown bear.

A lively discussion followed.

Roy Dennis is a well-known field ornithologist and wildlife consultant in the Scottish Highlands and Honorary Director of the Highland Foundation for Wildlife.

He is a specialist in raptor conservation and re-introductions in the UK and abroad, having been involved in the sea eagle, red kite and osprey projects. He is a keen advocate of restoring the beaver, lynx and other “lost” mammals to our countryside as well as more bird species. He is a writer, broadcaster and lecturer.
PROGRAMME FOR THE 2006-2007 SEASON

Except where indicated all lectures were held in the Art Gallery of the New Walk Museum, Leicester, on Mondays at 7:30 pm

2 October 2006
IS THE GRASS ALWAYS GREENER?
Presidential Address
Open meeting followed by a social gathering
The Lord Mayor was present

16 October 2006
DEVELOPMENT OF THE PEACEFUL USE OF NUCLEAR ENERGY: A JUSTIFIABLE OBJECTIVE?
Mr Peter Riley
Chartered Engineer and Academic Lawyer

6 November 2006
VICTORIA PARK LEADING TO NEW WALK, LEICESTER
Dr Helen Boynton
Writer, Researcher in Geology

20 November 2006
A SEVEN POINT GRID FOR LITERARY GREATNESS
Dr Jane Mackay
Lecturer in Literature
(Sponsored by De Montfort University)

4 December 2006
MURIEL SPARK IN TUSCANY
Professor Martin Stannard
Professor of Modern English Literature,
University of Leicester
(Sponsored by The University of Leicester Bookshop)

13 December 2006 (Wednesday)
THE MAGIC OF OXYGEN
Dr Mike Batham & Dr Rob Janes
Chemistry Department, The Open University
Held in the Rattray Lecture Theatre
(Sponsored by The Leicester Mercury)

15 January 2007
OLOVNIKOV’S CLOCK AND CORONARY HEART DISEASE
Professor Nilesh Samani
Professor of Cardiology, University of Leicester

29 January 2007
THE SIXTH EXTINCTION? WHAT DINOSAURS CAN TELL US ABOUT THE MODERN BIODIVERSITY CRISIS
Professor Norman MacLeod
Keeper of Palaeontology, Natural History Museum, London
(Joint Lecture with the Geology Section)

12 February 2007
THE LEICESTER MERCURY LECTURE
PROSPECTS FOR MULTICULTURALISM AND COMMUNITY COHESION
Mr Ted Cantle
(Sponsored by The Leicester Mercury)

19 February 2007
THE PARTNERSHIP LECTURE
ALEXANDER WALKER: AN OBSESSIVE COLLECTOR
Mr Richard Cork
Art critic, historian, broadcaster and exhibition curator

26 February 2007
PHEROMONES AND OTHER SCENTS FOR THE ALLEVIATION, WORLDWIDE, OF MANY PEST PROBLEMS IN PLANT, ANIMAL AND HUMAN HEALTH
Professor John Pickett
Rothamsted Research, Harpenden
(Sponsored by the Royal Society of Chemistry)

12 March 2007
JUGGLING: THEORY AND PRACTICE
Dr Colin Wright
Solipsys Ltd.
(Sponsored by the British Association for the Advancement of Science)

19 March 2007
THE PEACH LECTURE
WHY ARCHITECTURE SHOULD BE OF HIGH QUALITY, SIGNIFICANT AND CHALLENGING
Mr Michael Wilford
Architect
Held in the Ken Edwards Building,
University of Leicester
Followed by a reception

26 March 2007
RE-INTRODUCTION OF BIRDS AND MAMMALS
Mr Roy Dennis
Consultant Highland Ecologist
(Joint lecture with the Natural History Section)
Ladies and Gentlemen, another year has passed and our season of lectures is over until the Autumn. I have enjoyed my year as President for which I thank you, the members. I believe that whatever we do in life we should not take ourselves too seriously and an element of fun is one way of making people feel welcome.

My thanks go to the Life Presidents, Vice Presidents and the members of the Council for their advice and support throughout my year in office.

Mrs Hilary Lewis & Dr Geoffrey Lewis our Programme Secretaries, have yet again put together a excellent series of lectures. I also wish to thank our sponsors: De Montfort University, the Leicester Mercury, the University of Leicester Bookshop, the Royal Society of Chemistry and the British Association for the Advancement of Science. Without their continued support the Society would be the poorer not only financially but also because they broaden our horizons with the variety of topics covered.

No society can be successful without the hard work of its officers and Dr Mary Hamill our Hon. Secretary has kept me on the straight and narrow for which I am grateful.

After a brave fight during 2006 Mrs Patricia Silver passed away in October and I place on record our thanks for her great support over many years as Membership Secretary of the Society.

Earlier this year we were saddened by the death of Mr John Higginbotham who was President of the Society in 1993/94.

My year of office would not have been possible without Mr Michael Kirk taking over as Treasurer; with the death of Mrs Silver he also took over the task of Membership Secretary for the remainder of the year. I am very grateful to him for taking on both of these positions.

Subject to the wishes of the members, Mr Kirk is willing to remain as Treasurer and my wife and I are willing to serve as joint Membership Secretaries.

Both the Geology and Natural History Sections as usual provided very interesting speakers and I am delighted that there continues to be such good cooperation between them and ourselves.

The Annual Schools Lecture again proved to be a popular event; entitled “The Magic of Oxygen”, it had all the bangs we have come to expect.

Mr Nick Gordon and his team at the museum have been most helpful throughout the year. The scanning of the photographs of past Presidents is due to be completed by July this year and we are grateful to Mr Gordon for putting this work in place.

The Bennett Fund for Research awarded a grant to Mr B.E.Ellis of The University of Leicester, Geology Department towards the cost of field work in Snake River Region. USA.

The Bi-Annual Peach Lecture took place at Leicester University and was given by Mr Michael Wilford an architect of international repute. This was organised by Mrs Alwyne Dean who together with Mrs Hilary Lewis arranged a very successful dinner which followed. We are fortunate to have the facilities and help of the University.

Finally, I thank my wife Joan and her helpers for providing hospitality, thus allowing members to enjoy a post-lecture chat and further discussions with the speakers.

David Beeson.
ANNUAL REPORT OF THE GEOLOGY SECTION

OFFICERS 2006/2007

Honorary Life President: Dr Bob King
Honorary Life Vice-President: Dr Trevor Ford O.B.E
Chairman: Mark Evans
Vice-Chairman: Dr Joanne Norris
Secretary: Dr Joanne Norris (Temporary)
Treasurer: Eileen Johnson
Field Secretary: Helen Jones
Publicity Officer: Dr Mark Purnell
‘Charnia’ Editor: Graham Stocks
Webmaster: Dennis McVey
Student Representative: Lara Blythe

Committee

Prof Richard Aldridge Co-opted: Margaret East
Dr Roy Clements Kay Hawkins
Dennis Gamble Robert Tripp
Andrew Swift

Chairman’s Report, given at the AGM on March 23rd 2007

Mark Evans, Section C Chairman 2006-7

As I look back over the past year, my second as your Chairman, it seems that we crammed a lot into it. Following the AGM in March 2006, we reconvened for the summer field meetings. Our first outing in May was to Welton-le-Wold, Lincolnshire, where John Aram showed us a varied series of Pleistocene deposits wherein a number of hand axes were found in the ‘60s and ‘70s. Unfortunately, heavy rain in the afternoon made us call a premature end to this meeting. Our next outing was an evening tour of Leicester to examine the city’s varied building stones, led by Albert Horton.

Our annual weekend excursion was to the Mendip Hills of Somerset under the leadership of Andrew Swift. We based ourselves in the small picturesque city of Wells, and visited several sites in the local Carboniferous, Triassic and Jurassic. A baking hot morning in Coleman’s Quarry at Holwell examining the famous fissures was alleviated by a welcome lunch at the nearby Bear Inn. On the Sunday we had the chance to view the De la Beche Unconformity between the Carboniferous Limestone and the Inferior Oolite in Vallis Vale, newly decorated by paintballing local youths! In July we visited Horsehay Quarry, near Duns Tew, Oxfordshire, to see the local Middle Jurassic sequence. The visit was led by Jane Worrall and Ian Brewer of the Oxfordshire Geology Trust, with our own John Hudson making comparisons to the succession at Ketton. August’s trip to the Gault of Munday’s Hill Pit, Bedfordshire, was nearly a non-starter as leader Chris Andrew had the wrong date in mind. However, all came good in the end, as Dennis Gamble dashed off to fetch Chris while Mike Howe filled in. We made a joint trip to the Caledonian intrusives of Croft Quarry in September with the Warwickshire Geological Conservation Group, who also provided a minibus. The trip was very ably led by John Carney from the BGS, and the quarry company provided very knowledgeable escorts. Our final “field” meeting was the customary museum visit, which this year took us to the Oxford University Museum of Natural History. Our host Derek Siveter made us most welcome and showed us some of the “gems” normally hidden away in this great treasure house.

We began the winter programme of talks at the University of Leicester at the beginning of October, when Karolyn Shindler recounted the fascinating life of pioneering fossilist Dorothea Bate. This was followed by an update on the 2004 Indian Ocean tsunami and its aftermath by David Tappin of the BGS. Unfortunately our next meeting had to be rearranged at the last minute as John Hutchinson of the Royal Veterinary College was suddenly taken ill, and couldn’t talk to us about the biomechanics of dinosaurs. Mark Purnell and your chairman provided replacement talks on fish tooth microwear and plesiosaurs respectively. Mark Stephens of the University of Leicester’s School of Archaeology and Ancient History gave us a briefing on the local work of the National Ice Age Network, and Alex Page of the University’s Department of Geology told us about graptolites behaving badly! We rounded the year off with a very enjoyable cheese and wine evening at New Walk Museum.
After the Christmas break, we heard about recent work on Leicestershire’s geological sites from Graham Walley of the County Council. This year’s Member’s Evening was well supported, with contributions from Trevor Ford, Andrew Swift, John Dickinson and Bruce Smith. Ian Smallley of the University’s Geography Department told us of his latest observations on loess deposits in Serbia, and Mick Cooper of Nottingham Museums recounted the story of the restoration of the historic mineral collection of Chatsworth House. Finally David Unwin, a recent arrival at the University’s Museum Studies Department, infected us with his passion for pterosaurs. The Winter Programme came to a close with the AGM, and the Chairman’s Address, in which I went on a lightning tour of the palaeontology of our area.

This year’s Parent Body Lecture was an outstanding event. We secured the services of Norman McLeod, Keeper of Palaeontology at the Natural History Museum, who put forward his theories on the significance of mass extinctions. We decided to mark the 50th anniversary of the discovery of Charnia (the fossil) by making it and the Precambrian biota of Charnwood Forest the subject of this year’s Saturday Seminar in March. In partnership with the University’s Department of Geology we obtained funding from the “Local Heroes” initiative run by the Geological Society and Geological Association. This helped to bring over some keynote speakers from overseas, and our local experts were also on hand to recount the tales of palaeontological discovery. The meeting was also sponsored by Aggregate Industries and the BGS, and the Museum hosted a civic reception after the seminar to round off the day in style. The final happening of the Section’s year was the publication of the new edition of the “Building Stones of Leicester” by the East Midlands Geological Society, in association with ourselves. Members Albert Horton and Diana Sutherland have updated “Mac” Whitaker’s original text.

Finally I would like to thank all who have served on the Committee this year. Although too many to mention, I would like to single out two in particular. Once again Joanne Norris did an outstanding job as both Vice Chairman and temporary Secretary, and I’m sure she will continue in this manner as she takes over the Chairmanship. Graham Stocks stood down as ‘Charnia’ editor after many years. On behalf of the Section I would like to thank Graham for all his hard work over the years. His well-crafted editorials were always entertaining and enlightening, and we hope that he will continue to be a regular contributor in the future.

Summertime Programme 2006

**Sunday May 21st 2006.**
Welton-le-Wolds, Nr. Louth, Lincolnshire. Ice Age deposits and Early Man.
Leader: John Aram, (Geologist).

**Wednesday June 7th 2006.**
Building stones of Leicester.
Leader: Dr. Albert Horton (Leicestershire).

**Friday 23rd – Sunday 25th June 2006.**
A weekend in the Mendips: Carboniferous and other deposits.
Leader: Andrew Swift (LLPS Geology Section and Digitimage, Leicester)

**Saturday July 8th 2006.**
Horse Hay Quarry, Duns Tew, Banbury, Oxfordshire.
Leader: Jane Worrall, (Oxfordshire Geology Trust).

**Saturday August 5th 2006.**
Leader: Chris Andrews, (Bedford Museum).

**Saturday September 9th 2006.**
Croft Quarry, Croft, Leicestershire.
Leader: Dr John Carney (BGS, Keyworth).

**Saturday October 21st 2006.**
A behind the scenes tour of Oxford University Museum of Natural History.
Leader: Prof. Derek Siveter, (University of Oxford).

Winter Programme 2005 – 2007

2006

**Wednesday October 4th**

**Wednesday October 18th**
Dr David Tappin (British Geological Survey): The Indian Ocean tsunami 2004 – the catastrophic event.
Introduction

The Leicester Literary and Philosophical Society Section C (Geology) in conjunction with the University of Leicester and Leicester Museums and Galleries presented a symposium on Leicester’s fossil celebrity: Charnia and the evolution of early life. Charnia and Charniodiscus were the first ‘Ediacarans’ to be recognised as the macroscopic remains of Precambrian life, even before the significance of the famous Australian biota was realised. (Ediacarans are bizarre extinct multicellular organisms which may, or may not, be the first fossil animals). This symposium highlighted the global importance of the Ediacaran biota from Charnwood Forest.

2007 and 2008 mark the 50th anniversaries of the discovery and description of the biota, so it is an ideal time to celebrate Charnia and the Charnwood Ediacarans. The Charnwood fossils continue to generate controversy and debate, and the latest hi-tech methods are providing exciting new insights into
their evolutionary significance. This and other exciting science was presented during the symposium by distinguished speakers and researchers from Australia, Canada, Ireland, and the UK.

An exhibition of local and international Ediacaran fossils called ‘Charni@50’ was held at Leicester’s New Walk Museum and Art Gallery from 11 March – 15 April 2007. The exhibition was opened at an evening reception which commenced directly after the close of the symposium. The reception, sponsored by the British Geological Survey, also launched a new geological map and book of Charnwood Forest. Light refreshments were provided at the reception.

The symposium and exhibition were sponsored by the Geological Society’s Bicentenary ‘Local Heroes’ initiative, Geologists’ Association, Aggregate Industries Ltd. and the Leicester Geologists Alumni Society. The symposium was also part of National Science & Engineering Week.

The symposium, exhibition and reception was organised by Mark Evans, Chairman of LLPS Geology Section and Senior Curator (Natural Sciences) at New Walk Museum and Art Gallery, Leicester; Dr. Joanne Norris, Vice-Chairman of LLPS Geology Section; Dr. Mark Purnell, Publicity Officer of LLPS Geology Section and Research Fellow at Leicester University; Prof. Richard Aldridge, LLPS Geology Section Committee Member and Professor of Geology at Leicester University; Dr. Roy Clements, LLPS Geology Section Committee Member and Dr. John Carney, District Geologist (East Midlands), British Geological Survey. The organisers would like to thank those members of the Geology Section who have contributed to the organisation of the events.

**Programme**

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<td>Assemble</td>
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<td>09.30</td>
<td>Opening remarks</td>
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<td>Mark Evans, Chairman, Leicester Literary and Philosophical Society, Section C (Geology)</td>
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<td>Welcome</td>
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<td>Prof. Robert Burgess, Vice Chancellor, University of Leicester</td>
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<td>09.35</td>
<td><strong>The discovery of Charnia masoni</strong></td>
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<td>Prof. Roger Mason, China University of Geosciences, Wuhan, Hubei, China</td>
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<td>09.55</td>
<td><strong>The discovery and naming of Charnia and Charniodiscus</strong></td>
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<td>Dr. Trevor Ford, Dept. of Geology, University of Leicester, UK</td>
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<td>10.05</td>
<td><strong>Further discoveries of Charnian fossils</strong></td>
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<td>Dr. Helen Boynton, Leicester, UK</td>
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<td>10.20</td>
<td><strong>Geological setting, environment and age of the Charnwood biota</strong></td>
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<td>Dr. John Carney and Dr. Steve Noble, British Geological Survey, Keyworth, UK</td>
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<td>10.50</td>
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<td>11.20</td>
<td><strong>Sequencing the Neoproterozoic</strong></td>
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<td>Dr. Dan Condon, NERC Isotope Geoscience Laboratories, Keyworth, UK, and Prof. Sam Bowring, MIT, Cambridge, Ma, USA</td>
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<td>11.50</td>
<td><strong>The Great Divide: Life on Earth before and after the Ediacaran transition</strong></td>
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<td>Dr. Nicholas Butterfield, University of Cambridge, UK</td>
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<td><strong>The Ediacaran Diaspora: Diversity of the Ediacara Biota in South Australia</strong></td>
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<td>Dr. James Gehling, South Australian Museum, Adelaide, Australia</td>
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<td>14.15</td>
<td><strong>Life after Snowball: The Mistaken Point Biota and the Origin of Animal Ecosystems</strong></td>
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<td>Prof. Guy Narbonne, Queen’s University, Kingston, Ontario, Canada</td>
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<td>15.00</td>
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<td><strong>Chair:</strong> Dr. Mark Purnell</td>
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<td>15.30</td>
<td><strong>The Charnwood Biota as seen from Arctic Russia – Ediacarans and their environments</strong></td>
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<td>Dr. Dima Grazhdankin, University College Dublin, Ireland</td>
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<td>16.00</td>
<td><strong>Towards a new evolutionary framework for the Ediacaran biota</strong></td>
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<td>Prof. Martin Brasier and Jonathan Antcliffe, University of Oxford, UK</td>
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<td><strong>Close</strong></td>
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<td>18.00</td>
<td><strong>Reception and Exhibition Opening at New Walk Museum and Art Gallery</strong></td>
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Abstracts

The discovery of *Charnia masoni*

Professor Roger Mason, China University of Geosciences, Wuhan, Hubei, China

Reginald Sprigg discovered the Ediacara fauna that includes frond-like forms of the genus *Charnia* in the Pound Quartzite of the Flinders Ranges north of Adelaide, Australia in 1946. Sprigg reported occurrences of strange fossils to his old university at Adelaide and published descriptions, but met with little interest. In April 1957, I went rock-climbing in Charnwood Forest with two friends, Richard Allen and Richard Blachford (‘Blach’), fellow students at Wyggeston Grammar School, Leicester. I was already interested in geology and knew that the rocks of the Charnian Supergroup were Precambrian although I had not heard of the Australian fossils. Richard Allen and I agree that Blach (who died in the early 1960s) drew my attention to the leaf-like fossil holotype now on display in Leicester City Museum. I took a rubbing and showed it to my father, who was Minister of the Great Meeting Unitarian Chapel in East Bond Street, taught part-time at University College (soon to be Leicester University) and thus knew Trevor Ford. We took Trevor to visit the fossil site and convinced him that it was a genuine fossil.

His publication of the discovery in the Proceedings of the Yorkshire Geological Society established the genus *Charnia* and aroused worldwide interest. Martin Glaessner’s use of the genus name shows that Trevor’s publication pre-dated his systematic description of the Australian Ediacara biota. I was able to report the discovery because of my father’s encouragement and the enquiring approach fostered by my science teachers. Tina Negus saw the frond before I did but no one took her seriously. The study of the Ediacaran biota has never been one of the Earth Sciences’ “hot” research topics but progresses steadily over the years, providing a counter example to the theory that science advances by a succession of publicised breakthroughs.

The discovery and naming of *Charnia* and *Charniodiscus*

Dr Trevor D. Ford, Dept. of Geology, University of Leicester, Leicester LE1 7RH

The events following Roger Mason and friends’ discovery of *Charnia* will be outlined. I named the fossils after Charnwood Forest. With no described fossils to compare them with, I made a tentative assignment to Algae, but within months Martin Glaessner of Adelaide University published a note in *Nature* comparing *Charnia* with impressions found in the Ediacaran strata of South Australia. He referred them to the Pennatulacea, sea-pens, distant relations of corals. Though not proven this is still a widely held interpretation. Dating is still uncertain but most opinion places the *Charnia* horizon at about 550-570 Ma.

Further discoveries of Charnian fossils

Dr Helen Boynton, 7 The Fairway, Oadby, Leicester

After the initial discoveries of *Charnia masoni* and *Charniodiscus concentricus* between 1957 and 1963, the Precambrian story in Charnwood Forest of fossils didn’t continue until 1975 when I took an Adult Education class on fieldwork. It was during that summer and the following five years we discovered the fauna at four further locations in Charnwood. By 1995 the main genera of the Charnian fauna had been named, i.e. *Bradgatia linfordensis*, *Charnia grandis*, *Blackbrookia oaksi*, *Ivesheadia lobata*, *Shepshedia palmata* and *Cyclomedusa cliffi*.

In the last ten years more fossils have been found, or reinvestigated, including those from the original *Charnia* quarry, where the fossils are now found on at least two bedding planes, and include a number of specimens of *B. linfordensis*, a large *B. aff. linfordensis* (about 1 metre long), several more discs (one is c. 19 cm in diameter) and worm-like trails of knotted stems.

From specimens and photographs in Leicester Museum, Leicestershire County Council and the authors’ own collection from the old Cliffe Hill Quarry, reinvestigation has shown that most of the
discs named *Cyclomedusa cliffi* (Figure 1) and thought to be medusoids, are in actual fact holdfasts, some of which show emerging stems that bifurcate. These are actually discs of *Charnia*-like organisms. One specimen appears to be like *Charnia concentricus* with a disc and thick plaited stem which bears a mass of faint bush-like fronds. The bedding planes, on which these fossils were found, have probably long since been quarried away and it is now very difficult to gain close access to the remaining bedding planes in the quarry.

In 2003, an organism which can only be described as having affinities with *Blackbrookia oaksi* was discovered (Figure 2). It shows a disc with a small frond emerging and alongside a thicker branch bearing a number of lateral branches.

In conclusion it can be noted that each fossiliferous locality in the Precambrian of Charnwood Forest has its own particular suite of fossils.

**Figure 1:** Slightly ovoid disc of *Cyclomedusa cliffi*, with an outer irregular raised ring and a small asymmetrically placed boss with a knotted stem emerging from it.

**Figure 2:** *Blackbrookia (?)* showing disc with small stem with fronds emerging with a large stem bearing lateral branches to the right side (a cast is now at BGS).

### Geological setting, environment and age of the Charnwood biota

**Dr John Carney and Dr Steve Noble, British Geological Survey, Keyworth, Nottingham, NG12 5GG**

At first glance, the total area of less than 40 km² occupied by the ‘basement’ rocks of Charnwood Forest seems trivial when compared to the extent of Precambrian terrains elsewhere in the World. Such considerations are, however, outweighed by the significance of the Charnian Supergroup for British Precambrian geology, and globally, for the evidence it continues to contribute towards deciphering the nature of the Ediacara biota. There is in fact a lot of ‘geology’ here, because the Charnian rocks have been compressed into a rather tight anticlinal fold, the hinge of which plunges to the south-east. Thus if one traversed from the oldest Precambrian rocks, exposed in the northern core of the anticline, to the youngest on the flanks and ‘nose’ of the structure, a thickness of some 3.5 kilometres of strata would be passed through.

Not surprisingly, the Charnian rocks have attracted the attention of eminent geologists and in his 1947 ‘swan song’ volume on Charnwood Forest, Prof. W. W. Watts was able to summarise publications stretching back to 1790. A benchmark in this research must be the work of J. B. Jukes and his mentor, Prof. A. Sedgwick, who between 1833 and 1837 elucidated the anticlinal structure of the Charnian rocks and hinted at their volcanic origin. The naming of the Charnian units really started with Watts himself, while working with the British Geological Survey in the early 1900’s. Many elements of his nomenclature were incorporated into the formal lithostratigraphy established in the 1979 thesis of John Moseley, and in a subsequent paper by the latter author and Trevor Ford in 1985.

The study of stratigraphy is basically about naming different rock units, helping to produce colourful geological maps, and informing about the vertical and lateral relationships of these units, but it does not say much about their environments or the processes that formed them. In Charnwood Forest this has been a problem, because the rocks present attributes that are at first sight contradictory. For example, the well-developed stratification in many parts of the
succession is typical of sedimentary rocks, whereas in virtually all microscope sections the examined grain constituents of mainly rock fragments and crystals, point to a wholly volcanic origin. It is therefore accurate to say that the Charnian Supergroup is mostly a volcaniclastic succession. This is an ‘umbrella’ term for bracketing strata containing varying proportions of material derived directly from processes associated with explosive volcanism (pyroclastic in origin), as well as from processes that eroded pre-existing volcanic successions (epiclastic in origin).

To deduce the environmental setting of Charnian volcanism it is necessary to employ James Hutton’s principle of uniformitarianism: the scientific law stating that the geological processes taking place in the present operated similarly in the past and can therefore be used to explain the origin of rock sequences. All of the Charnian rocks have chemical compositions that can be matched to rocks erupted from modern island arc systems, such as the Caribbean, which overlie a subduction zone. Moreover, the spectacular, boulder-rich rocks in the Maplewell Group of north-western Charnwood Forest (Figure 1) must have been erupted extremely violently perhaps as pyroclastic flows similar to those recently observed on the Caribbean island of Montserrat (Carney, 1999; Figure 2). Pursuing the analogy further, it is probable that the Charnian volcanoes were largely submerged, allowing fragmental material either eroded or erupted from them to be preserved as sedimentary layers on the surrounding sea floor.

The Charnian volcaniclastic strata can also reveal much about the water depths in which their Ediacaran fossils finally came to rest. Close examination of exposures shows a scarcity of features like cross-bedding or ripple marks, which generally indicate deposition in relatively shallow, wave or current-agitated conditions. Thus much of this succession, being unaffected even by storm-waves, was probably deposited at depths in excess of about 50 metres. Those sedimentary structures that do occur include: parallel bedding or lamination, normal grading, load structures and slump-induced disruption of bedding. They suggest the repeated action of submarine debris flows and turbidity currents that carried sediments down the slopes leading to their eventual sites of deposition on the sea floor.

Some U-Pb radiometric age dates have been obtained for the upper part of the Maplewell Group, which contains the main Ediacaran fossil horizons. They indicate an age of 566-559 million years for this interval, which is in keeping with ages obtained for the Ediacaran biota worldwide. Work is now being undertaken to firm up these ages, and also to obtain more determinations from the lower c. 2000 metres of Charnian strata. It now seems possible that the Blackbrook Group, which is the oldest exposed Charnian unit, may date back to about 600 million years. There may be implications for Ediacaran evolution here, because rocks just above the exposed base of the Blackbrook Group reveal enigmatic, fossil-like impressions that could be precursors to some of the organisms represented within the main Ediacaran assemblages.

**Sequencing the Neoproterozoic**

Dr Dan Condon¹ and Prof S.A. Bowring²

1. NERC Isotope Geoscience Laboratories, Keyworth, NG12 5GG, UK
2. EAPS, MIT, 77 Massachusetts Avenue, Cambridge, Ma 02139, USA.

Understanding the links between environmental change and biological evolution during the Neoproterozoic centre around our ability to precisely correlate and sequence disparate stratigraphic sections. Relative ages of events can be established within single sections or by regional correlation using litho-, chemo- and/or biostratigraphic markers. However such chronologies do not allow testing of the synchrony of units, the validity of correlations or determining rates of change/duration of events. At present, a major limitation to our understanding of the Neoproterozoic is the dearth of accurate and high-precision dates. The recent increase in geochronological constraints suggests much progress remains to be made.

The determination of ‘absolute’ age constraints for Neoproterozoic successions can be achieved using a variety of geochronological techniques. These include U-Pb dating of either zircon from volcanic rocks (to directly date the horizon sampled) or detrital zircon (to constrain the maximum age of the horizon sampled) and whole rock approaches using Re-Os, Pb-Pb and Lu-Hf decay schemes. The database of geochronological constraints for the Neoproterozoic is growing but of variable quality and subject to multiple interpretations. For example, whole rock dates depend on the assumption that a suite of samples all have the same initial ratio and have evolved through time only as a function of different parent/daughter ratios and that the date reflects either precipitation of carbonate/phosphate (Pb-Pb, Lu-Hf) or enrichment of parent isotope during deposition/early diagenesis (Re-Os). These assumptions are often difficult to evaluate in many cases, however, Re-Os dating of black shales shows considerable promise. In addition, U-Pb geochronology data are derived from both isotope dilution thermal ionization mass-spectrometry (ID-TIMS) and sensitive high-resolution ion microprobe (SHRIMP), there are important differences between the techniques. While it is tempting to use all available geochronological data in compilations irrespective of decay scheme, accuracy and precision, this can result in misleading inferences.

Considerable progress has been made in the past decade on the calibration of Neoproterozoic time. Although the number, timing, duration and possible synchrony of ‘Cryogenian’ glacial episodes still remains poorly constrained there is growing evidence for at least two glacial-cap carbonate sequences during the 760 to 700 Ma interval, one at ca. 635 Ma, and a final one at ca. 582 Ma. The base of the Ediacaran Period is formally defined at the base of the Nuccaleena (Marinoan) cap-carbonate as exposed in Enorama Creek, Flinders Ranges, South Australia. Correlation of its distinctive cap sequence coupled with high-precision U-Pb (zircon) ages from Namibia (within the glacial Ghaub Formation) and Southern China (within the cap-carbonate to the Nantuo tillite) indicate synchronous termination of the Marinoan glaciation at ca. 635 Ma. The top of the Ediacaran Period/base Cambrian Period is also not dated at its type locality. However U-Pb zircon dates on ash beds from Oman and Namibia constrain it to be ca. 542 Ma. During the Ediacaran Period the short-lived Gaskiers glaciation occurred ca. 582 Ma and the oldest known Ediacaran fossils, (*Charnia*-type fronds from the Drook Formation which have strong affinities with assemblages from Charnwood Forest in the Avalon zone of central England) first appear within 4 Ma of deglaciation. When all well-dated sequences containing Ediacaran fossils are considered in the context of global chemostratigraphic correlation schemes, a number of major conclusions can be drawn. At ca. 570-551 Ma, the global carbon cycle underwent a major reorganization consistent with progressive oxidation and remineralization of the organic reservoir. At about the same time, and suggestive of a link, the first complex trace fossils as well as the stem group mollusc *Kimberella* are found in White Sea sections. Weakly calcified metazoans, such as *Cloudina* and *Namacalathus* appear ca. 548 and continue to the Ediacaran/Cambrian boundary where they are inferred to have become extinct. It is clear that our understanding of the relationships/feedback loops between biology, the carbon cycle, and climate will require a much more highly calibrated record.
Outstanding issues centre on the number, synchronicity and durations of glacial deposits, the exact age of the oldest metazoan fossils, the relationship of non-cap carbonate $^{13}$C excursions to evolutionary change, and the validity of molecular clock estimates for the timing of animal evolution, and the global significance of the Gaskiers glacial event and the first appearance of megascopic Ediacaran fossils. Future work will focus on using the highly calibrated record to understand developmental and environmental controls on evolution that preceded the Cambrian explosion, including a precise and accurate temporal framework for the period from ca. 1000-750 Ma in order to integrate proxy records (isotopic, lithostratigraphic and palaeomagnetic) to evaluated causal relationships and rate-dependent effects responsible for the transition into the Cryogenian.

**The Great Divide: Life on Earth before and after the Ediacaran transition**

Dr Nicholas J. Butterfield, University of Cambridge, Cambridge, CB2 3EQ, UK

The Earth has supported an active biosphere for at least the past 3500 million years, but the obvious fossil record is limited to just the last ca. 530 Ma. This Phanerozoic record documents a wealth of large scale (macro)evolutionary patterns, such as mass extinction and adaptive radiation, and sheds important light on the functioning and potential fate of the modern biosphere: not only is the present the key to the past, but the past can be the key to the present. In this seemingly uniformitarian light, the macroecological and macroevolutionary “rules” of the Phanerozoic have commonly been extrapolated uncritically into the much deeper, Precambrian record.

Study of the Precambrian fossil record over the past few decades has yielded an abundance of prokaryotic and eukaryotic fossils, but the emerging patterns differ fundamentally from those of the Phanerozoic. Prior to ca. 630 Ma, not only were all organisms effectively microscopic, but diversity appears to have been fundamentally lower and evolutionary turnover fundamentally slower than at any subsequent time. The principal signature is of profound evolutionary stasis and no measurable extinction, over hundreds of millions of years.

All this changed with the onset of the Ediacaran, which begins with the first measurable radiation in

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**Figure 1:** A conceptual view of the macroecological differences between the pre-Ediacaran and post-Ediacaran marine biospheres, and the transitional Ediacaran. The disparity curve is derived from acritarch data and estimated number of intracellular cell-types, and ecosystem stability from estimated rates of evolutionary turnover. The spikes in ecosystem stability following Phanerozoic mass extinctions are inferred from observed and modelled recovery times. Biomass spectrum very broadly tracks disparity through this interval except during mass extinctions, which are characterized by the loss of large organisms but not cell-types. Also shown are the occurrences/age ranges of pre-Ediacaran eukaryotes, and the Cryogenian and Ediacaran glaciations (triangles). Note that the Ediacaran/Cambrian boundary as depicted here (at ca. 530 Ma) differs from the IUGS-ratified position (at ca. 542 Ma).
the whole of the fossil record, followed closely by the appearance and relatively rapid turnover of Ediacaran macrofossils, the first sedimentary trace fossils and the first biomineralized macrofossils. Thus, the Ediacaran marks a fundamental shift towards macroevolutionary patterns typical of the Phanerozoic.

There is no shortage of hypotheses to explain the shift of evolutionary dynamics at the beginning of the Ediacaran, but most of these (e.g., Snowball Earth, meteorite impact, global oxygen increase) fail to provide a proximal explanation for the observed phenomena. I will argue here that the key innovation was the evolution of Eumetazoa – i.e., diploblastic and triploblastic animals with a differentiated gut and nervous system – and their unique impact on ecology and evolution. Unlike all other types of organisms, eumetazoans are capable of building multi-tiered trophic structures, and driving the morphology-based co-evolutionary arms races that give the Phanerozoic biosphere its peculiar character – not least large organismal size, complex behaviour, biomineralization, high diversity, high standing biomass, rapid evolutionary turnover, dynamic (in)stability, mass extinction, biogeographic partitioning, and eukaryote-dominated primary productivity. As such, the history of life on Earth can be divided into two, more-or-less mutually exclusive phases, separated by the (newly ratified) Ediacaran Period (see Figure 1 above). It was during this critical, 100 million-year transition that animal-based ecosystems were developed, along with the peculiarly uniformitarian rules of Phanerozoic macroecology and macroevolution.

The Ediacaran Diaspora: Diversity of the Ediacara Biota in South Australia

Dr James G. Gehling, Nature Sciences, South Australian Museum, North Terrace, Adelaide, South Australia 5000. [ gehling.jim@sa.gov.au ]

Did animals evolve on deep seafloors only to emerge onto continental shelves in the late Ediacaran? The newly defined and named Ediacaran Period acknowledges the global distribution of fossil assemblages of the unique Ediacara biota. Confined to the late Ediacaran, about 575-542 Ma (million years before the present), fossil associations of the Ediacara biota can be considered to represent an evolutionary succession that was curtailed but not entirely extinguished at the base of the Cambrian (see Figure 1 below). Recent discoveries in South Australia, Newfoundland, Russia and China suggest that characteristic Ediacara fossils had long time ranges and global distributions for which there is little equivalence in the younger fossil record.

The Global Stratotype Section and Point or “golden spike” for the base of the newly defined Ediacaran Period was designated at the base of the Nuccaleena Formation in the Flinders Ranges National Park, South Australia (Knoll et al., 2006). This carbonate formation of apparent global distribution, that “caps” the so-called Marinoan tillites, represents the melt-down of the last “snowball earth” event in the Neoproterozoic Era (see Hoffman et al., 1998). The end of “snowball” set in train environmental changes leading to the evolution of large, multicellular life forms on Earth. The 4 km thick Ediacaran succession in South Australia is succeeded by 2-3 km of Early to Middle Cambrian sediment in the Flinders Ranges and Mount Lofty Ranges of South Australia. Fossils are apparently absent from the lower half of the Ediacaran succession in this region. A marker horizon, produced by the local Acraman impact ejecta blanket, defines the mid-Ediacaran level in this succession, above which large spinose organic-walled microfossils first appeared (Grey, 2005), and finally the first animal fossils. The Ediacara fossil assemblage in the Flinders Ranges, while dominated by shallow marine benthic communities, also includes some of the classic Ediacara forms from the Charnwood and Mistaken Point assemblages of the Avalon Province, as well as forms previously known only from the Nama assemblage of southern Namibia (Gehling et al., 2006). In South Australia, the Ediacara biota is first encountered as an assemblage in prodelta sediment at the top of the Wonoka Formation (Haines, 1998). The better-known and most diverse assemblage is 500 m up section, in the Ediacara Member of the Rawnsley Quartzite. Up to 500 m of barren sandstones of the Rawnsley Quartzite separate these Ediacara assemblages from the base of the Cambrian in South Australia (Gehling, 2000).

At a new site on the western margins of the Flinders Ranges, my colleague Mary Droser and I, with the help of many volunteers, have been excavating serial fossiliferous surfaces in strata deposited near wave
These reveal remarkable changes in composition from bed to bed, that reflect both ecological differences and modification by the burial events. In deeper water environments, at the heads of incised submarine canyons, event beds preserve assemblages dominated by single species but also include previously unknown taxa (Gehling et al., 2006). Large organisms stripped by storms from shallow marine environments were preserved as three-dimensional moulds and casts in massive sand flows swept down into these canyons. Fossils include giant fronds, discs, fractal and sack-shaped organisms of unknown affinities, some of which are closely related to the older fossils of the Avalon Province, while others were previously known only from the younger Namibian assemblage.

It appears that the Ediacara biota had its origins in deep water settings of the Avalon Province before expanding into shallow marine settings as oxygen levels rose to critical levels around 560 million years ago (Canfield et al., 2006). In the younger parts of Ediacaran successions (from 560–542 Ma), in Russia, western Canada and the USA, Namibia, China and Australia, we see the emergence of small motile organisms that began to leave their marks as traces in seafloor microbial mats while coexisting with the more archaic discs, fronds, vanes and mat-like Ediacara organisms that had been around since 575 Ma (Narbonne, 2005). The affinities of the enchanting Avalon organisms of the Charnwood and Mistaken Point assemblages may forever remain obscure due to the apparent extinction of most of these forms by the end of the Ediacaran. The sheer diversity of body plans in the Early Cambrian fossil record suggests the existence of Ediacaran stem groups to animal phyla. If we wish to understand animal evolution, attention should be focused on the concurrent appearance of Ediacara trace fossils with body fossils that were probably animals from the ancestral lines of arthropod, mollusc, lophophore and worm-like forms, including some with the earliest mineral skeletons.
Although it is the giant Ediacara forms that have transfixed us, the key innovations are to be found in the small bilateral, conical and tubular forms, and the traces of their activities, in the latest part of the Ediacaran (Jensen et al., 2005). Just as small Cretaceous mammals diversifed in the Cainozoic, the progenitors of the Cambrian explosion were likely the small, bilateral Ediacara forms that have remained all but unnoticed amongst fractal, frondose and mat-like giants.

A key to our new discoveries has been a change of field-work methodology. Instead of making collecting forays, we are excavating and re-assembling beds for the purposes of palaeoecological study. The results have been spectacular in demonstrating a marked increase in diversity of Ediacara taxa, evidence of unexpected bed-by bed heterogeneity, an unappreciated dominance by simple tubular and serial forms, and the existence of contrasting taphonomic windows preserving remarkable new three-dimensional fossils. The cooperation of local landholders, indigenous elders, tourism operators, and teams of dedicated volunteers have made our continued study possible, and enabled us to conserve field sites for continuing research. Recent Heritage Listing of Ediacara fossils at Nılpına has come with funding from the Australian Commonwealth Government for putting security systems in place, and for ongoing management and interpretation of the site for the benefit of future researchers and the regional economy. In the long run, nature-based tourism will replace traditional dry-land farming as the more sustainable industry in outback Australia. While fate has offered a handful of palaeontologists the unique experience of realizing the earliest known impressions of animal communities on Earth, posterity will judge how well we conserve these relics in their natural context for future appreciation, rather than the wisdom of our current interpretations.


Life after Snowball: The Mistaken Point Biota and the Origin of Animal Ecosystems

Prof Guy Narbonne, Department of Geological Sciences and Geological Engineering, Queen’s University, Kingston, Ontario K7L 3N6 Canada

The first formal description of Ediacaran fossils was Billings’ (1872) naming of Aspidella terranovica from Newfoundland, but these simple discs were pronounced as inorganic by Walcott and were forgotten until their resurrection as the attachment discs of Ediacaran fronds more than a century later. Ten years after the seminal discoveries at Charnwood Forest, a diverse assemblage of complex Ediacaran fossils was discovered at Mistaken Point in the Avalon Peninsula of Newfoundland. Like Charnwood Forest, Mistaken Point represents a deep-water turbiditic assemblage with the fossils preserved on upper bedding surfaces beneath beds of volcanic ash. All of the major taxa in Charnwood Forest – the fronds
Charnia and Charniodiscus, the bush Bradgatia, and the discs Ivesheadia, Blackbrookia, and Aspidella – are present at the genus or even species level. Mistaken Point is unique in exhibiting numerous surfaces littered with hundreds to thousands of complete fossil specimens, including at least 10 taxa that are not known from Charnwood.

Ediacaran fossils in Newfoundland occur above the glacial tillites of the Gaskiers Formation, which is dated at 580 Ma and probably represents the last of the Neoproterozoic “snowball” glaciations. The world’s oldest Ediacaran fossils, indeed the oldest large and architecturally complex eukaryotes known anywhere, are fronds of Charnia up to 2 m in length that postdate the Gaskiers glaciation by less than 5 million years. Recent geochemical studies of iron speciation by Don Canfield and his colleagues indicate that the end of the Gaskiers glaciation was marked by a sudden infusion of oxygen into the world’s oceans, perhaps because the melting glaciers produced nutrients that caused blooms of photosynthesizing micro-organisms. It seems likely that this increase in oxygen levels was the trigger that permitted life to get big, and that ultimately resulted in the animal-dominated ecosystems of our modern world.

Due to tectonism, the quality of preservation at Mistaken Point is not normally quite as good as in Charnwood Forest. A marked exception to this occurs near Spaniard’s Bay, where undeformed, three-dimensional fronds in mudstone exhibit a resolution of features less than 0.03 mm. These fossils exhibit complex fractal branching patterns and a modular construction that typify the rangeomorphs, a failed experiment in the Neoproterozoic evolution of multicellular life. More than 75% of all species and individuals of Mistaken Point fossils are rangeomorphs.

Mistaken Point fossils were preserved in place as “census populations” that provide a unique opportunity to study the ecology of rangeomorph communities. Ecological studies at Mistaken Point show that rangeomorphs exhibited tiering patterns and spatial distributions remarkably similar to those of modern and Phanerozoic filter-feeding animals. There is no evidence of potentially mobile bilaterians in the fossil assemblage or of any bioturbation in the sediments, implying that these assemblages consisted entirely of sessile organisms. Nor is there any evidence of macropredation, scavenging, or herbivory among any of the organisms. These ecological innovations would have to await the later evolution of skeletons and brains that culminated in the Cambrian “explosion” of animal life.

The Charnwood Biota as seen from Arctic Russia – Ediacarans and their environments

Dr Dima Grazhdankin, School of Geological Sciences, University College Dublin, Belfield Dublin 4, Ireland; and Institute of Petroleum Geology and Geophysics, Koptug Avenue 3, Novosibirsk 630090, Russia

The earliest known communities of large organisms are represented by the extinct Ediacara-type animals exceptionally preserved in rocks of late Precambrian age (580-535 million years). Within this range there is a clustering of three distinct fossil assemblages: the Avalon, Ediacaran and Nama biotas. The Avalon biota of Newfoundland consists of closely related problematic fusiform, frondose and plumose organisms characterized by their diagnostic fractal quilting. The Ediacaran biota is best known from the classic localities in the Flinders Ranges of Australia. It is also the most diverse assemblage characterized by segmented and non-segmented fossils with bilateral and trilateral symmetry. The Nama biota of Namibia comprises an assemblage of forms, the most exotic to mainstream biology, dominated by serially quilted body plans. The Avalon, Ediacaran and Nama biotas have been interpreted either as a direct fingerprint of evolution, as the product of geographic provinciality, or as an artefact of selective preservation.

In fact, careful analysis of sedimentary rocks and distribution of associated Ediacara-type fossils in remote localities of Arctic Russia clearly demonstrates that the Avalon, Ediacaran and Nama biotas were globally distributed and coexisted in different environments. These biotas represent ecological guilds on a global scale, with Avalon-type biotas distributed in deep marine habitats, Ediacaran-type biotas inhabiting microbial substrates in shallow marine prodeltaic settings, and Nama-type biotas found in river-mouth bar shoals (Figure 1). This in turn reveals a marked degree of environmental sensitivity.
and ecological specialization in first communities of large-size organisms, which rapidly explored various environments, ranging from shallow-water deltas to deep-water shelf, and maintained this ecological disparity, with limited overall change, for more than 30 million years.

How were the Ediacaran communities structured and how did they function? Were they like modern communities or different? Fossil evidence suggests that Ediacaran ecosystems operated on a different type of infrastructure which is not typical for modern animal communities. First, the overall diversity of Ediacaran-type organisms, with an estimated 110 species, appears to be strikingly low when compared to modern ecosystems, but the Ediacaran community structure nevertheless exhibits a marked degree of stability and integrity. Second, in modern ecosystems larger areas normally contain more species than smaller; however this major ecological rule of species-area relationship does not apply to Ediacaran communities. Because structural stability of modern marine communities is thought to be maintained by high species richness, the mechanisms responsible for maintaining the integrity of the Ediacaran biota are, therefore, puzzling. The answer probably lies in extreme heterogeneity and patchiness of Ediacaran communities: the number of species, as well as population densities in Ediacaran communities vary considerably between different sites. This could be a result of intense competition, although low-diversity low-biomass communities could be a result of inhabiting harsh environments.

Where does the Charnwood biota fit in this scheme? The Charnwood Forest fossil assemblage consists of 5 identifiable taxa: *Charniodiscus concentricum* Ford, 1958; *Charnia masoni* Ford, 1958 (=*Charnia grandis* Boynton and Ford, 1995); *Bradgatia linfordensis* Boynton and Ford, 1995; *Ivesheadia lobata* Boynton and Ford, 1995 and *Cyclomedusa davidi* Sprigg, 1947. The specimens described as *Pseudovendia* Boynton and Ford, 1979, *Shepshedija* Boynton, 1999 and *Blackbrookia* Boynton, 1999 are pseudofossils. The species *Charniodiscus concentricum* is represented by a single deformed specimen which was uprooted by current action and transported to the place of final burial. Therefore, it is not characteristic of the Charnwood Forest community. *Charnia masoni* was unusual among Ediacaran organisms in being a generalist species with broad ecological tolerance. Both *Bradgatia linfordensis* and *Ivesheadia lobata* are typical species of low-diversity communities in deep-water shelf environments, as are the discoidal fossils *Cyclomedusa davidi* representing microbial colonies. Accordingly, the Charnwood Forest fossil assemblage should be reconstructed as an Avalon-type low-diversity low-biomass Ediacaran community.

**Towards a new evolutionary framework for the Ediacaran biota**

**Prof Martin D. Brasier***, **Jonathan B. Antcliffe**, **Richard Callow** and **Duncan McIlroy**

1 Department of Earth Sciences, Parks Road, University of Oxford, OX1 3PR

2 Department of Geology, Memorial University of Newfoundland, St John's, Canada

Fifty years have now passed since the providential discovery of *Charnia masoni* and *Charniodiscus concentricus* in Charnwood Forest by Roger Mason and their prompt description by Trevor Ford in 1958. But what exactly is *Charnia*? And just how was it related, if at all, to the great explosion of animal fossils at the base of the Cambrian? Do these fossils represent ancestors of the great animal phyla, as Martin Glaessner and the Australian school have for long argued? If so, there would seem to have been at least some kind of long fuse to the radiation of invertebrates in the Cambrian that followed. Or were the Ediacaran fronds actually members of an extinct grade of organization, as Dolf Seilacher and the European school now maintain? That could mean that the Cambrian explosion was very abrupt indeed.
Our group at Oxford has been studying the growth and evolution of the Ediacara biota as part of a larger project on the nature of the Animal Ancestors in the fossil record. We have found that two new tools are useful in helping us to understand how these strange creatures lived and grew (e.g., Antcliffe and Brasier, 2007). The first approach involves getting the maximum amount of information out of the fossils themselves using new photographic and laser scanning techniques. This allows us to build a virtual map of each major fossil type, that can then be viewed and rotated in three dimensions. The second approach involves using these new data to pick out the different growth stages and work out the nature of the generative zones (growth tips) and, if possible, the life cycle. We have now applied these new techniques to bedding planes in Charnwood Forest and to key Ediacaran fossils from Charnwood, Newfoundland, Australia, the White Sea and Namibia, including *Ivesheadia*, pizza discs, rangeomorphs, spindle animals, *Charnia*, *Charniodiscus*, *Bradgatia*, *Dickinsonia*, *Swartpuntia* and related forms.

Laser-based conservation of key fossil sites in England and Newfoundland is now being planned.

We will show how laser scanning of fossils is now able to test, critically, various hypotheses put forward for modes of growth, feeding strategy, and levels of oxygen uptake on the seafloor in late Precambrian times.

We will use these data to explore major changes in the position and number of the generative zones through ontogeny and phylogeny (Brasier and Antcliffe, 2004) and to test models for the evolution of the Ediacara biota and the origins of the animal phyla. These studies are now well advanced.

We shall argue that it is the ‘infolded’ nature which is a distinctive (possibly unique) and little understood characteristic of the group Charniomorpha. The presence of folding, and its significance within related taxa such as *Ivesheadia* (complete spindle animal?) through to *Dickinsonia*, will be discussed.

ANNUAL REPORT OF THE NATURAL HISTORY SECTION

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Webmaster          A. Bevington
Section Recorder   Dr. W. R. Morris

This year’s two committee meetings have been well attended, with some discussion on how to attract new members, John Tinning is designing a leaflet to promote the society. The summer programme was devised by a sub-committee of Richard Iliffe, Doreen Thompson, Sue Walton, Monica Gillham, Pat Reighway and Alison Gregory. There was a good variety of venues but attendance was down on previous years with only an average of eight members attending. Thanks are due to Jan Dawson for her Winter programme of very interesting speakers, all of which were well attended. Thanks also to Doreen for her work as Minutes Sec. Peter Thompson has taken over from Jean Cooper as our representative on the Parent Body Committee and we thank him for that.

We thank Dorothy Phillips for all her work in producing the weather reports for the newsletter. Alison Gregory and Pat Reighway have for many years provided the refreshments at the indoor meetings which we thank them for, they would now like someone else to take on this job. Sue Walton and Ann Pinnock will take it on for the time being but any members who would like to help would be most welcome. We also thank Alan Bevington for his work on the web site and Jean Cooper for providing the splendid buffet following the AGM. Indoor Meetings are now held in the Lord Mayor’s Room which seems to suit the needs of most members and speakers.

Mrs S Walton
Mrs D Thompson
Winter meetings were held at fortnightly intervals to hear the following speakers. The average attendance was 36.

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>January 4th</td>
<td>Living on the Edge</td>
<td>Dr Derek Lott</td>
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<tr>
<td>January 18th</td>
<td>The Lives of British Woodpeckers</td>
<td>Phil Rudkin</td>
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<tr>
<td>February 1st</td>
<td>Wildlife at Watermead</td>
<td>Dale Osbome</td>
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<tr>
<td>February 15th</td>
<td>Falklands Wildlife</td>
<td>John Tinning</td>
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<tr>
<td>March 1st</td>
<td>Leics Rare Wildflower Heritage</td>
<td>Peter Gamble</td>
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<tr>
<td>March 15th</td>
<td>All About Caterpillars</td>
<td>Dr Paul Waring</td>
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<tr>
<td>March 20th</td>
<td>Joint Meeting with the Parent Body</td>
<td>Prof John Parker</td>
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<tr>
<td>March 29th</td>
<td>A.G.M. Social Evening and Demonstration</td>
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The Origins of “The Origin”:
What Henslow Taught Darwin

The Summer Programme of outdoor field meetings was as follows:

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<tr>
<th>Date</th>
<th>Location</th>
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<tr>
<td>April 22nd</td>
<td>Attenborough Nature Reserve NR</td>
<td>Sue Walton</td>
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<tr>
<td>May 6th</td>
<td>Paxton Pits NR</td>
<td>Richard Iliffe</td>
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<tr>
<td>May 20th</td>
<td>Cribb's Meadow</td>
<td>Jenny Harris</td>
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<tr>
<td>June 3rd</td>
<td>Watermead Country Park</td>
<td>Monica Gillham</td>
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<tr>
<td>June 17th</td>
<td>Naturescape Wild Flower Farm</td>
<td>Steve Woodward</td>
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<tr>
<td>July 1st</td>
<td>Lea Meadows</td>
<td>Sue Walton</td>
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<tr>
<td>July 19th</td>
<td>Croft Hill</td>
<td>Doreen Thompson</td>
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<tr>
<td>July 29th</td>
<td>Stanford Reservoir</td>
<td>Karen &amp; Karl Letten</td>
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<tr>
<td>August 19th</td>
<td>Foxton Locks</td>
<td>Ray Morris</td>
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<tr>
<td>September 9th</td>
<td>Dimminsdale</td>
<td>Tony Squires</td>
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<tr>
<td>September 30th</td>
<td>Hambleton Peninsula</td>
<td>Jan Dawson</td>
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<tr>
<td>October 15th</td>
<td>Prior's Coppice-fungus foray</td>
<td>Richard Iliffe</td>
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<tr>
<td></td>
<td>Joint Meeting with the L.P.S.G.</td>
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Winter Meetings began again on October 11th with a Members’ Slide and Exhibition Evening, followed by

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>October 25th</td>
<td>The Price of a Rose</td>
<td>Dr David Harper</td>
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<tr>
<td>November 8th</td>
<td>Making Sense of Solitary Bee and Wasp Assemblages</td>
<td>Dr Mike Archer</td>
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<tr>
<td>November 22nd</td>
<td>Thirty-fourth Sowter Memorial Lecture</td>
<td>Dr Tony Fletcher</td>
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<td></td>
<td>Lichen Hunting in Scotland</td>
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<tr>
<td>December 6th</td>
<td>Dragonflies of Leics and Rutland</td>
<td>Ian Merrill</td>
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