

The Royal Society of Edinburgh

Conference and Lecture Reports

**Session 1997-1998
(November 1997-October 1998)**

LECTURES

Monday 10 November 1997

'SCOTTISH CUSTOMS IN A WIDER CONTEXT'

*3rd Henry Duncan Prize Lecture by Dr Emily Lyle, School of Scottish Studies,
University of Edinburgh*

Delivered to the First Ordinary Meeting

The lecture dealt with current and relatively recent Scottish customs and, through studying them, made some suggestions about underlying structure and meaning. Three different layers of tradition were established to facilitate discussion, called the Grand Spectacular, The Village Pump and The Deep Well. The Edinburgh Hogmanay celebrations were offered as a well-known example of the first of these. The second level is operative from approximately the sixteenth century to the recent past when customs were carried out in the home or in small-scale face-to-face communities; this level can be approached through historical study based on tape-recordings and written records. The level of The Deep Well has to be postulated since there is no indication that the customs began in the period we can reach by historical methods and it is at this earlier level that abstract thinking about the issues is demanded, which in turn can illuminate our more recent customs.

The first theme taken up in the lecture was the distinguishing of periods of darkness and light in the calendar through conceptual means. In Scottish folk custom, the main evidence comes from The Twelve Days of Christmas (a 'dark' period in which it was thought possible to prognosticate the weather of the months of the coming year) and Beltane, on 1 May, when needfire was lit to signal the opening of the summer half of the Celtic year. The underlying concept appears to be that of reversing cyclical time according to which, at the end of a year, it is necessary to have a ritual expression of the idea of reversal so that time, in idea, can reverse itself in such a way that the beginning is again reached, so allowing a new year to begin. This concept of a reversing cycle of time, rather than the more familiar one of a circling cycle, is posited as the one on which the structure of the traditional calendar is based.

A second theme was that of limited good. A number of customs presuppose the view that there is only a certain amount of prosperity available and people take action so as to secure the prosperity leaving the rival or rivals to suffer dearth. A major instance of this is seasonal ball-playing in Scotland. In Kirkwall, the tradition is still remembered that, if the Uppies (from the upper part of town) win, the farmers will have good crops and, if the Doonies (from the lower part of town) win, it will be a good fishing season, with the implication that it is impossible for both sides to have a successful year. Other instances considered were the notion of 'the cream of the well', when taking water from a well at an auspicious time secured good fortune but only for the person taking it, so that others were left without, and the custom of 'the last sheaf', by which the success of a particular farm in bringing in its harvest was celebrated. This secured prosperity for that particular farm but the sheaf or other symbol was sent to a neighbouring farm that had not yet completed its harvest and signalled the idea that it would suffer dearth in the coming year. The lecture ended with the suggestion that this duality in the handling of prosperity and dearth in custom may take its rise from an early stage of the organisation of society which was based on a system of alternation and reciprocity, and called for further study of these matters.

Professor Barrow thanked Dr Lyle for a lecture that had ranged widely over the topic and presented many useful perceptions and concepts, some familiar and many new and fruitful. He found particularly pleasing Dr Lyle's use of the categorisation of customs into 'the grand spectacle', 'the village pump' and 'the deep well'. Scotland's culture was rich in the last two in particular, although events such as the Border Ridings and the Old Firm Match clearly belonged in the first.

He further commented on how interesting he found the notion of recontextualisation of customs, citing as an example how Halloween had been recontextualised into a children's festival of turnip lanterns and guisers, and in more recent times, Americanized into illuminated pumpkins and cries of 'trick or treat'. Professor Barrow concluded by highlighting Dr Lyle's fascination with the calendrian aspects of customs. As a historian he noted that the English parliament first met on the 13 January (i.e. Hillary) while the Scottish Parliament first assembled on 2 February (ie Candlemas). Would such calendrian customs be perpetuated when the new Scottish Parliament was constructed?

Monday 1 December 1997

'LIFE AND DEATH OF THE TYROLEAN ICE-MAN: DEDUCTIONS FROM PLANTS'

Professor James H Dickson,

Division of Environmental and Evolutionary Biology, University of Glasgow

Delivered to the Second Ordinary Meeting

Dr Dickson began by stating that in September 1991 an extremely well preserved corpse was found melting out of the ice at 3,210m above sea level in the Otztal Alps less than 100m on the Italian side of the frontier with Austria. It proved to be that of a well-dressed and well-equipped male who had lived about 5,000 to 5,300 years ago in the late Neolithic period. Directed by Professors S Bortenschlager and K. Oeggl of the Botanical Institute of the University of Innsbruck, there have been various botanical studies of the Iceman's wooden equipment, including the contents of a birch bark container, his bast cape, his grass-insulated shoes and his sewn hide clothes which during conservation yielded sparse cereal remains and numerous moss fragments. Among the mosses are species which the Iceman had brought from low altitudes. The crucial species are *Neckera complanata* and *Neckera crista* which in the Tyrol grow in abundance only up to 1,500m above sea level., usually on shady, base-rich rock in woodland (Dickson, J. H. *et al* 1996. *Proc. R. Soc. London B* 263, 567-571.) There have been highly informative analyses of the pollen and coarse plant remains from small samples extracted from his colon (Dickson, J. H. 1997 *J. Bryology* 19, 449-451.) It is now beyond reasonable doubt that the Iceman's home lay to the south of the death site, probably in the nearby Vinschgau, and not to the north. Apart from traditional archaeological comparisons, the botanical evidence alone, including that of the present and past chorology of the *Neckera* spp, is very strong.

There are ongoing studies of the plant debris including many moss and liverwort fragments extracted from samples of the shallow mineral sediments accumulated in the rocky hollow in which the corpse had lain. These plant remains will enable detailed vegetational reconstructions to be made and, from these, inferences on climatic change will be drawn.

Three volumes of Iceman studies out of a projected nine have already been published. Volume 4 is in an advanced stage of preparation. It is entitled 'The Iceman and His Natural Environment' and will contain many biological contributions which throw much new light on the Iceman's life style, environment and ethnobotany.

After the lecture, Professor Dickson fielded a lively series of questions which touched on many subjects, including the diet and lifestyle of Utsie, the reasons why he may have died in such an inaccessible place and the nature of the insulation in his boots. The diversity of the subjects of the questions indicated the extent of interest that the lecturer had excited while the effective and satisfactory way in which he demonstrated that Professor Dickson has an encyclopaedic knowledge of his subject of research.

A formal vote of thanks was given by Professor David Ingram who praised Professor Dickson for presenting a lecture which had such a great impact and made the audience feel that they had participated personally in the fascinating archaeological investigation. Professor Dickson had applied the traditional techniques of the naturalist to investigate the archaeological problem with great effect. Professor Ingram reminded us that in much of the current science, novel innovative techniques had enabled exciting advances to be made in all fields of research, but he emphasised the need to retain an interest in the traditional approaches because they too could still be used appropriately today as Professor Dickson had demonstrated so elegantly in this lecture.

Monday 12 January 1998

'BLASPHEMY, HERESY AND FREEDOM OF SPEECH DURING THE 300 YEARS SINCE THE HANGING OF THOMAS

AIKENHEAD'

The Reverend Andrew Hill, St Mark's Unitarian Church, Edinburgh

Delivered to the Third Ordinary Meeting

'Blasphemy - speaking ill of someone or something or some being - is a slippery concept defined more by context and manner than it is defined by essence.

1997 was the 300th anniversary of Britain's last religious execution - the Edinburgh hanging in 1697 of Thomas Aikenhead for blasphemy. It was also the 20th anniversary of Britain's last successful

blasphemy prosecution - against *Gay News* in 1977. The story of Aikenhead is recounted because of its special local (Edinburgh) significance.

Rooted in the God-centred world views of the ancient world, blasphemy against God or the gods was thought to invite divine retribution, social disaster and public disorder. Socrates and Jesus are the ancient world's most famous examples. Christianity broadened the scope of blasphemy control to include Jesus and the Bible. The early Christian church regarded heresy, the choice of the 'wrong' Christian faction, as the worst form of blasphemy.

Protestant states, such as Scotland and England rediscovered blasphemy and treated their dissenters as blasphemers. New civil blasphemy acts were enacted and early Unitarians, deists and alleged atheists were frequently their victims. However the growth of toleration and individualism, and the increasing secularisation of society and the privatisation of religious faith gradually lessened the impact of blasphemy control. In Scotland, as an offence at law, blasphemy was dead by mid-nineteenth century. In England it staggered on until the early twentieth century, re-emerging for a swan-song when Mary Whitehouse successfully prosecuted *Gay News* in 1977.

However Britain's increasingly multi-cultural and multi-religious community raises new issues of the equality or inequality of faiths before the law; and of the clash between the predominantly individualistic emphasis of the indigenous community; and the more societal emphasis of many immigrants. These issues were highlighted by the reaction among British Muslims to the 1989 publication of Salman Rushdie's *The Satanic Verses*. British Muslims were surprised to learn that (a) there was no protection for their faith in British law; and (b) that British Christians were, on the whole, ready to abandon what protection they still had.

Five directions have been suggested:

1. Reverse the current trend in favour of a British/Christian society. This is not acceptable.
2. Restore equality before the law by abolishing the English common law offence without replacement. This is popular among the indigenous British community but less so among immigrant communities.
3. Extend the current situation to include those of all faiths. This requires the impossible task of defining 'religion'.
4. Introduce a new offence of incitement to religious hatred. This would satisfy those for whom religious self-definition is important while at the same time safeguarding free speech. This is favoured by the government but presently shelved.
5. Wait and see the effects of incorporating the European Convention of Human Rights into British law. This has some merits since the convention recognises the relative nature of freedom.

A free society is a friendly society, one which has developed ways of facilitating friendship - good manners, conventions, common sense. These are as important as any legislation'.

A wide ranging discussion followed the lecture. There was a strong spirit of tolerance and understanding in a free exchange of views on the need to ensure equality between religious and racial groups within the United Kingdom, both in terms of religious sensitivity and in social and economic opportunity. The concepts of polarisation between individualistic attitudes adopted by most of the indigenous population and a more societal outlook accepted by most groups of immigrants was explored with regard to the problems of adaptation from village to urban life in many recent immigrant groups. It was clear that there were no easy solutions to the diverse problems of attitudes towards the religious beliefs of others, although it was emphasised that moves towards a more friendly society will facilitate the development of mutual tolerance.

The Rt. Rev. Bishop Conti moved a vote of thanks. He emphasised the progress that had been made in the indigenous population of Scotland by listing the offices of the persons sitting together at the top table during the recent celebration to mark the 250th Anniversary of the founding of *The Press and Journal*. This newspaper was founded at the time of Culloden when the Vicars Apostolic were being hounded or even imprisoned for their religious beliefs. It would have been unthinkable that members of the traditionally Protestant civic, political, academic and military establishment could be seen in the company of a Roman Catholic Bishop, far less than to enjoy each others company at a public dinner. Bishop Conti reiterated the views of Pope John XXIII that 'Error has no Rights, but He that is in Error has Rights'. On behalf of the Society, Bishop Conti thanked the Rev Hill for a stimulating lecture with the message that the linkage of friendship and freedom will lead to increase in human dignity and self-respect.

16 February 1998

'SUBSIDENCE ON THE SEABED: CHALLENGES OF THE EKOFISK OIL FIELD'

Dr Peter Broughton F Eng, Phillips Petroleum Co., Norway

The Royal Academy Of Engineering/Royal Society Of Edinburgh Lecture

Held at Strathclyde University, Glasgow

It was appropriate that Dr Broughton, who leads a team concerned with subsidence mitigation, should talk to both Societies about the Ekofisk Oil Field, the first major oil discovery in the North Sea.

Since 1971 this field has yielded about 1,350 million barrels of oil and 8 thousand billion cubic feet of gas with a combined value of at least £27 billion. This has benefited not only the Norwegian economy but also the economies of countries (UK and Germany) with land based terminals at the end of the distribution network.

As a result of the removal of oil and gas from the chalk reservoir, about 3,000m below the seabed, there has been significant subsidence which is predicted to increase to 16.5 metres. To mitigate the effects of subsidence many techniques have been evolved. Dr Broughton chose to focus on the jack-up project, the Ekofisk Protective Barrier and the more recent Ekofisk II Development project. He discussed their pros and cons and referred to the possibilities of technology transfer to other projects.

20 February 1998

'COMBATTING RURAL POVERTY IN DEVELOPING COUNTRIES'

Baroness Chalker

The problem of rural poverty world wide is enormous. 1.3 billion people exist in severe poverty (income less than \$1 per day) – three quarters of these people live in rural areas of the developing world. Two thirds of the rural population of sub-Saharan Africa lack access to potable water and 40% are chronically undernourished.

These conditions have arisen from many causes of which the more important are :-

1. Neglect of infra-structure in rural areas, due to urban bias amongst local politicians and an unfavourable trade environment for agriculture. The problems are exacerbated by lack of management capacity in local government.
2. Political belief that modernisation of the national economy can succeed without consideration of the agricultural economy has threatened agrarian stability. This pattern of operation has been seen as expedient due to the lower rates of return on agricultural programmes.
3. Lack of rural finance means that small farmers cannot purchase seeds and fertilisers in time for the next season because of late payment for the previous season's crops.
4. Because of inadequate transport much of the produce tends to be carried by hand to the markets. Improved medical services are allowing a continued population growth, while there is little uncultivated land available for agricultural development. In many areas the water reserves are becoming progressively depleted. Together, these factors form a recipe for famine and disaster. Moreover, ill controlled forestry is being followed by soil erosion.

Many of these factors could be alleviated by new initiatives in aid and by political reforms. However it is important to remember that women play a disproportionately large part in the rural economy. These women are usually poorly educated so a major contribution to the rural situation could be made by setting up education programmes directed at girls aiming at improvements of the methods of farming and of the running of the family. There are indications from pilot schemes in Pakistan, Kenya and Bangladesh that well managed micro-financing can improve the profitability of small farmers. These successful leads have resulted in the Partnership for African Capacity Building Programme of the World Bank which is obligated to establish sustainable development of local community-based schemes. Regional co-operation schemes crossing national boundaries have great potential to promote sustainable rural development and local management of natural and cultural resources.

Lastly the results of agricultural research will stimulate productivity, provided that a knowledge of the results of such research can be made accessible to the rural people of the developing lands.

2 March 1998

'THE PEOPLING OF PREHISTORIC IRELAND'

Professor Michael Herity, President, Royal Irish Academy, Dublin

Delivered to the Fourth Ordinary Meeting

The lecturer introduced the outline of a new appraisal in the light of recent discoveries of the important episodes in the story of prehistoric Ireland from its Mesolithic beginnings about 7000 BC to the pre-Christian Iron Age, which ends with the arrival of Christianity and St Patrick about 400 AD. Beginning with the early Christian period the lecturer suggested that many or most of the ascetic missionaries who came to Ireland followed a celibate ideal and therefore hardly contributed to the gene pool. He noted the possession of a written Bible and of the decrees of Church councils by a literate group as a source of doctrine and as a guide to behaviour marked this group off from all earlier prehistoric groups.

He began his account of prehistoric Ireland by noting briefly the potential of the island in terms of its position, off the Atlantic coast of Europe and neighbouring Britain on the west, and its resources in climate, soils, minerals and plants, together with a range of post-glacial fauna, which did not at first include cattle, sheep and goats, nor the horse. The Mesolithic (population less than 10,000), beginning with the arrival of post-glacial immigrants about 7000 BC, was followed after 4000 BC by a succession of important upland Primary Neolithic farming traditions (population more than 50,000) from the Atlantic façade of Europe, which were represented also in the west and south-west of Scotland. Domesticated cattle, sheep and goats were imported to Ireland at the beginning of the Neolithic period, together with cereals, and the population increased greatly. Communal burials in megalithic tombs, specifically 400 Court Tombs, was general. An extraordinarily powerful and sophisticated group built Passage Tombs like Newgrange, emphasising the economic strength of the Irish Primary Neolithic on which they were founded.

The burial of individual males in the prime of life in stone cists under round earthen burial mounds was introduced to the east of Ireland later in the Neolithic, apparently from south-east and central Europe via Denmark. This marked a fundamentally new society organised around a male king. Hilltop and promontory fortifications, the horse and the wheel were associated; new ornamented pottery styles manifested concerns with a new, solar religion. The Irish Sea and the river-valleys and lakes of the north and east of the country became important. Neolithic culture was at its most variegated at this stage, Primary Neolithic modes living on to coexist with those of the Later Neolithic (population growing from 75,000). Kingly organisation continued into the Bronze Age, which manifests an increasing concentration of wealth and a developing technology in metal, including gold. There is a tendency for the nodes of settlement to be situated close to the sources of the metal and there are widespread contacts with west, central and Mediterranean Europe.

From the year 1000 BC on (population growing from 100,000) a powerful Later Bronze Age society was marked by high technological achievements, in gold for personal ornament, and in bronze for sheet-metal cauldrons, for warlike trumpets, spearheads, swords and shields, and for sickles, many of these cast in clay moulds. Society was obsessed with the panoply of battle and with the provision of ramparted defences like Dun Aenghusa in the Aran Islands. Some individuals amassed great hoards of gold and bronze, like the Great Clare Gold Find. Kings and potentates indulged in communal feasting. Lake-dwellings became common. Later, wooden roads were built through the growing bogs. Ceremonial centres like Tara, Cruachain and Eamhain Macha, where a great circular timber hall was built in 94 BC, which were inhabited by royals from the very dawn of history, had their beginnings in the Later Bronze Age. Wooden gods and goddesses were replaced by a pantheon of iconic stone gods like the Janus figure on Hoa Island, attesting a religion broadly similar to the Gaulish, phallic pillars, some ornamented all over with La Tène designs, like the Turoe Stone, attest a fertility religion. Iron technology and this La Tène Celtic art in bronze and gold appeared in the centuries immediately before Christ, this art became even more influential after the arrival of Christianity.

The lecturer addressed the problem of the introduction of Celtic language. Archaeologists and linguists have dated this by a backward look from the historic, beginning about 500 AD. On the continent we know of barbarian (Celtic) groups on the fringes of the Classical world north and west of the Alps from records in Classical written sources as early as the 6th century BC. Celtic culture, and therefore language, has been in many minds exclusively associated with the early Iron Age, defined by technology as well as culture: the Hallstatt, the earlier of the two classic Celtic iron-using

cultures, is estimated to begin about 650 BC in central Europe by reference ultimately to written history. Celtic culture and language have hitherto been defined as exclusively Iron Age in Ireland.

A major problem recognised is the scarcity of early Iron Age material in Ireland. The model presented in the lecture, of a catharsis in the Later Bronze Age at about 1000 BC leading to an early Iron Age by gradual steps, provides an alternative model arising out of the Urnfield of central Europe, and allowing early connections with Galicia on the one hand and Mitteleuropa on the other.

The Royal Irish Academy now wishes to embark on a programme to establish a genetic history and geography of Ireland through the study of ancient DNA. Soon, it is hoped, a growing set of DNA data, highly specific, will begin to tell us in exact terms about the biological characteristics of ancient human remains from Ireland and Britain and from Europe. Until now, culture-historians have allowed themselves the luxury of making generalisations about the arrival of new peoples and the establishment of new cultural traditions largely on the basis of archaeological and linguistic information. New and more carefully formulated generalisations based on cultural evidence will act as stimuli to the geneticists and provide a model against which interpretations of early data from DNA programmes can be tested.

In thanking the speaker, Professor Proudfoot praised Professor Herity's shrewd assessment of the current state of thinking and his ability to weave a good story. These qualities were the result of a lifetime of careful thinking and a mastery of the Irish evidence on which his theories were based. Professor Proudfoot admired the insouciance of the lecturer in his courageous linking of DNA profiling and archaeological data. He concluded by welcoming the strengthening of links between the Royal Irish Academy and the Royal Society of Edinburgh.

EDINBURGH INTERNATIONAL SCIENCE FESTIVAL, 1998

As in the previous year the Society, in association with the Caledonian Research Foundation and Scottish Natural Heritage, contributed three presentations to the Science Festival.

Monday 6 April 1998

'RENEWABLE ENERGY IN THE WESTERN ISLES: THE EXAMPLE OF ISLAY'

Professor Ian Fells, F.Eng, FRSE, Fells Associates, Newcastle-upon-Tyne

Thursday 9 April 1998

'SCOTLAND: OUR ENVIRONMENT AND THE WORLD'

Professor Aubrey Manning OBE, FRSE, ~

Formerly Professor of Natural History, University of Edinburgh

Thursday 16 April 1998

'DNA PROFILING: THE CRIME BUSTER'

Dr David Werrett, The Forensic Science Service, Birmingham

With current interest in renewable energy and the Society's notable and longer term involvement, through Professor Salter, with wave energy it was appropriate for Professor Fells to talk about the realities of renewable energy in relation to a fragile island economy.

The island of Islay is environmentally sensitive. It is an important bird sanctuary on the western seaboard of Europe and, because of this interest, attracts significant numbers of 'green' tourists. This is a key issue that has to be taken into account when considering steps to encourage the retention and enhancement of the island's population which is otherwise dependent upon agriculture and the whisky industry.

The economy of Islay is dependent upon a secure, reasonably priced supply of electricity: a fluctuating supply creates problems for computing and teleworking of which are of increasing importance to remote communities. A variety of energy related initiatives have been identified –

- a commercial prototype shoreline wave energy device
- a storage device to improve network power quality using new flywheel technology
- a 3MW cluster of wind generators
- a developmental wind powered distillery
- electric transport
- use of industrial, agricultural and domestic wastes to generate fuel gas
- demand side management initiatives for domestic, agricultural and industrial users.

These are some of the elements of a model experiment with the aim of transferring expertise to the local community for technologies that prove to be sustainable, cost-effective and environmentally friendly.

On 9 April Professor Fells' talk was followed by a tour de force delivered by Professor Manning in his own inimitable and charismatic way. In tackling '*Scotland: Our Environment and the World*' he started with the premise that, in combination with breathtaking advances in technology, environmentalists have presented society with an entirely new vision of the world. Some of the implications of this vision have been identified but most have probably not yet come to the surface. However in Professor Manning's view the biological and technical problems pale into insignificance compared with those of our own attitudes and perceptions of the earth which supports us. He made a very strong plea for conservationists, and the rest of society, to focus attention on the achievement of consensus in relation to significant problems/abuses that are clearly unsustainable: it is no longer appropriate for conservationists simply to parade long lists of intractable problems. To come to terms with the realities of the day, those concerned with the conservation of not only Scotland but also the world that has to mean us all – must turn to the social sciences and, at the same time, recognise that they will evade the necessity to face the immediate issues at their peril. The case for the acceptance of the concept of human ecology could not have been made more strongly.

Renewable energy and human ecology are high on the political agenda as is biodiversity. On 16 April Dr David Werrett concentrated on a particular aspect of biodiversity and a particular use of the knowledge gained from his exploration. He focussed on the identification of variation within the human population using DNA profiling, a technique that has advanced very greatly from the days of Oswald Avery (1944) and Watson and Crick (1953). With the subsequent discovery of polymorphisms in the 60s and 70s DNA profiling entered the forensic arena in 1985. Dr Werrett gave an insight into the technological advances – there are at present 5 distinctive technologies – but also gave equal emphasis to their exploitation. He was at pains to emphasize the statistical uncertainties attached to identifications made by matching DNA profiles and perhaps unexpectedly stressed that, in forensic practice, DNA profiles are extremely powerful tools for establishing innocence: they also greatly help in preventing investigations of unreliable leads. Notwithstanding, DNA profiling is a technique of positive value to forensic practice. It is and should be used to help corroborate evidence obtained by traditional methods of detective investigation not only of high profile incidents – sexual and violent – but also the myriad of lesser offences including burglary. Its potential is enormous and ever growing as techniques are refined and knowledge is shared internationally.

Friday 22 May 1998

*'THE AMERICAN PHILOSOPHICAL SOCIETY AND ITS EARLY YEARS'
Judge Arlin Adams, President, the American Philosophical Society
Delivered to the Fifth Ordinary Meeting*

Although he was not the first person in the American colonies to harbour the thought of an association to be devoted to scientific and humanistic endeavours, it is clear that Benjamin Franklin – one of the first Honorary Fellows of the RSE - was the principal founder of the APS. In its early work the American Society reflected the spirit of its prototype, the Royal Society of London and, indeed, established its international reputation with the publication of its observations of the transit of Venus in 1769 in the Royal Society's *Philosophical Transactions*.

In the early years of the American Republic, the APS was the principal learned society in the US and often served as a national library, museum, and academy of sciences. The members felt their obligation to promote science and learning in all possible ways ranging from the provision for 'the Education of Youth' to discoveries in new and applied science such as ships' pumps, vegetable dyes and street lighting. Thomas Jefferson, who was simultaneously President of the USA and of the Society, called on it for advice.

The Society remained dedicated to Franklin's broad ideal of 'promoting useful knowledge' and reports of the Society's 1843 Centennial meeting illustrate that its interests were broad-gauged, impressive by modern standards and full of promise for the future. Today it conducts its work with renewed vigour in five areas: mathematical and physical sciences; biological sciences; social sciences; humanities; the arts, learned professions and public affairs. The APS is the oldest scholarly publisher in the US and has a world-class library that includes a copy of the Declaration of

Independence and much of the work of Charles Darwin and Madame Curie. Foremost, it continues to recognise excellence with election to a membership that now includes approximately 700 intellectual, business and world leaders. Well over 200 members of the Society have received the Nobel Prize.

In his absorbing and cogent review of the origins and early members of the American Philosophical Society, Judge Adams highlighted many parallels, both past and present, between our two societies and alluded to the special kinship engendered by our mutual efforts to 'promote useful knowledge'

In the course of the discussion after the lecture from Judge Arlin Adams, comparisons were made between the working of the programmes and the financial support of the American Philosophical Society and the Royal Society of Edinburgh. Dr Waterston gave an informative vote of thanks in which he emphasised the similarities between the sister institutions and made many historical parallels between the historical origins and contributions to the academic and cultural lives of the nations of USA and Scotland.

Monday 1 June 1998

'SPACE AGE GEOMAGNETISM – A TOOL FOR PROBING THE EARTH'S DEEP INTERIOR'

Professor Kathryn Whaler, Dept of Geology and Geophysics, University of Edinburgh

Satellite measurements of the geomagnetic field have revolutionised studies of geomagnetism. Since we believe dynamo action in the predominantly iron liquid outer core of the Earth generates the field, this has implications for its dynamical state and thermal history. MAGSAT was the most important satellite, because it measured three orthogonal components of the field, not just its strength. In its seven month lifetime, it gave a detailed picture of the field over all but the polar regions. In contrast, the network of permanent magnetic observatories provide the temporal coverage needed for geomagnetic studies, although their spatial distribution is far from ideal. Going back even further in time, measurements of declination (angle between geographic and magnetic North) and inclination (angle a freely-suspended magnet makes with the horizontal) were regularly made for navigational purposes. The combination of all available data provides a rich source of information on geomagnetic field evolution over more than three centuries.

Mapping the field at the Earth's surface shows the familiar dipole, or bar magnet-like pattern, but looking instead at the core-mantle boundary (CMB) reveals far more detail. Unfortunately, this extrapolation is an unstable mathematical process which can, however, be successfully overcome by *regularizing* the solution, finding a model that not only fits the data, but also has, in a well-defined mathematical sense, minimum structure. Questions of *resolution* – what size is the smallest feature we can believe? – then naturally arise: the answer clearly depends on the surface (and near-surface for satellites) data coverage. MAGSAT's dense coverage in 1980 essentially defined a standard against which earlier models could be compared: since we can trace features from the 1980 map back in time, it gives us confidence that the earlier models, which did not benefit from satellite data, nevertheless reflect the CMB field.

The geomagnetic field changes by *advection* – rearrangement of the field by the outer core flow – and *diffusion* – its creation and destruction. On our decades to centuries timescale, diffusion should be negligible, meaning that magnetic field lines move with the fluid and can therefore be used as tracers of the CMB flow. In fact, the data themselves provide a consistency test for this *frozen-flux* assumption, and calculations suggest it is reasonable. However, this does not allow us to calculate CMB flow uniquely. Three different uniqueness-reducing assumptions have been proposed; again, we can test them against the data. Many features of the inferred CMB flow are robust to which additional assumption is made, which is interpreted to mean that the flow is determined by the data, not the extra assumption.

The velocity maps derived show the expected features – a band of westward flow straddling the equator in the western hemisphere, responsible for the 'westward drift' of the field there, and slower flow beneath the Pacific, where field changes are smaller. In addition, we find little overturning motion, consistent with dynamo action being concentrated deeper in the core, and flow almost symmetric about the equator, compatible with a predominantly dipole field. A balance primarily between Coriolis and buoyancy forces, with magnetic forces of only secondary importance, is feasible in the outer core. Small departures from this would set up flow constant along cylinders centred on, and parallel with, the rotation axis. If we determine such a flow geomagnetically, we can calculate the time-varying angular momentum of the core, which turns out to be an excellent

match to the mantle's known angular momentum changes. In fact, we can also go on to show that electromagnetic core-mantle coupling can explain the angular momentum exchanges dynamically. These are some examples of geomagnetism indicating the state of the Earth's deep interior.

Professor Kenneth Creer then proposed a vote of thanks to Professor Whaler for her very interesting presentation of a difficult subject.

13 and 15 October 1998

THE ANALYSIS OF GENOMES: PAST, PRESENT AND FUTURE

*Professor Maynard Olson, Department of Medicine, University of Washington, Seattle
Caledonian Research Foundation Prize Lecture delivered at the University of Dundee on 13 October
1998 and at The Royal Society of Edinburgh on 15 October 1998.*

It is less than 50 years since the discovery of the structure of DNA solved one of biology's great mysteries – the mechanism by which living organisms store and process information. Now, we have the ability to analyze this information completely in all organisms – including the human – and to study its variation between and within species. This lecture examined several questions about this newly developed ability. What are the conceptual and technical roots of genome analysis? How is the analysis of genomes changing the way we study biology? What are the future opportunities? Finally, the lecture addressed the still larger question of the significance of the Human Genome Project for human culture.

In a vote of thanks to Professor Olson, Professor Peter Downes, said that big science used to be the preserve of subjects such as nuclear physics, astronomy and the exploration of space. Problems in biology could be solved sometimes by individuals but inevitably by relatively small teams of scientists working with comparatively small budgets. The power of molecular genetics and in particular recombinant DNA technology began to change all that from the 1970s to the present day and beyond. It is astonishing to think that within the first few years of the new millennium the sequences will be known of all the genes which are required to produce a human being. Maynard Olson has been a key player at the heart of this transformation in biology. There are three major facets to this: the first is technological, the second political and the third ethical. To move from the ability to clone and sequence individual genes to sequencing whole genomes required the vision to see the possibilities and the motivation and innovation to develop new techniques. To move from sequencing single prokaryotic genomes to yeast, to man required the ability to mobilise resources that were previously unprecedented in biological research; and resources have been mobilised on an international scale.

But what of the ethics? Who should be responsible for creating the guidelines within which molecular biologists should operate? Early in the recombinant DNA revolution the National Institutes of Health in the USA produced guidelines which Sidney Brenner has described as in parts 'plainly absurd'. In his book '*Loose Ends*', a collection of articles produced for the Journal, *Current Biology*, he stated 'the guidelines required that the pathogenicity of the organism providing the DNA be taken into account; thus DNA from the malaria plasmodium required higher containment for cloning than DNA from *Tetrahymena*. Nobody was allowed to consider how the original pathogenicity might be reconstituted from a bunch of DNA clones, and, if one took this seriously, lion DNA would need more stringent containment than pussycat DNA, lions being much more pathogenic for humans than their domestic cousins. It took quite a long time to convince people that the best way to deal with a dangerous virus would be to clone it and lock it up in *E.coli* or lambda bacteriophage rather than working with the virus itself'. Such absurdities can only be avoided if scientists themselves participate fully in the ethical debate. We are truly fortunate that scientists such as Maynard Olson are playing their part in formulating policy for the Human Genome project and its outcomes. For the post-genomics era will have to deal with an ethical revolution as important as the revolution in biology itself.

26 October 1998

PEOPLE, PROSPERITY AND THE SCIENCE BUDGET

*Sir John Cadogan, CBE, FRS, FRSE, Hon.FEng. Director General of Research Councils, Office of
Science and Technology, London.*

Delivered to the Statutory General Meeting

Sir John explained that in total the Government was investing about £2.33 billion in the science and engineering base, in basic and strategic research and training in the universities and Research

Council institutes. £1.33 billion was being provided for prospective funding under peer review of projects funded by the Research Councils (the Science budget), while the remaining £1 billion was being provided for infrastructure and people, and allocated to departments in block grants by the four Higher Education Funding Councils. His thesis was that the Science budget and the science and engineering base which it supports, underpins our national efforts in the creation of prosperity and improving the quality of life. In addition to being crucial to key priorities in health, environment, transport, education, social issues, agriculture and food, defense, and the whole of industry, the Science Budget also provided people through its support of postgraduates, postdoctoral researchers, and internationally distinguished scientists. Most young scientists go into business, industry, health etc. and apply their knowledge gained during training and transfer this knowledge to users.

Sir John went on to emphasise that the role of the Science Base was not to slavishly follow the dictates of the research users. Research scientists by the nature of their work explore the unknown, and all the important discoveries which had changed the world this century had arisen from indirect research. None of those breakthrough discoveries were predictable in advance, and indeed many pundits of the day had argued that such developments were either not possible, or if they were feasible, then there was no market for them. It was important to recognise that research opens doors to entirely new markets and activities, and the prize goes to those who understand this and position themselves to take advantage of it. Innovation arising from basic and strategic research is essential for competitiveness.

In May 1997, Government announced that it was abandoning the previous yearly budget process and replacing it with a Comprehensive Spending Review which, depending on the answers to six searching questions, would provide funding for the next three years. These questions were:

1. What is the contribution of the Science Budget to Government's Objectives?
2. Why are we spending this money?
3. Do we need to spend it?
4. What is it achieving?
5. How effective is it?
6. How effectively are we spending it?

This was an opportunity for Science to show not only that the Nation is getting a very good return for its Science Budget, but that spending more would give an even greater return. Since their reorganisation in 1994 the Research Councils had been working hard to put a greater proportion of funds into the hands of researchers rather than administration, and refocus their activities in line with Foresight priorities. They were now asked to provide a "warts and all" self analysis of the strengths, weaknesses, opportunities and threats, and a wide range of industrialists, Foresight Panel Chairman, Learned Societies and the CBI were asked to comment on these, with positive results. An assessment of the importance of each of their 58 major programmes to Government Objectives was also produced, and Government Departments were asked for their views, again with positive results.

The timing of the Comprehensive Spending Review had come at a critical time for UK science, as the infrastructure was beginning to crumble just when huge opportunities and demands for underpinning science and people were emerging. The most significant of these opportunities was the explosion in information about the structure of the Human Genome, which was an area where the UK was in the lead. The world would be a different place post genome, and the UK had a great chance to take the lead in developing and exploiting it, through its world class capability in the entire field of biomolecular sciences, and a first class pharmaceutical industry well connected with our science base.

Sir John concluded by noting that the case for Science had been argued well, and the Treasury and Government accepted it in grand style, by providing an extra £1 billion over three years, the percentage increase in the Science Budget being the highest of all Government Departments. Added to this is a most imaginative partnership between Government and the Wellcome Trust, which lead to a further injection of £400 million by Wellcome into the area of biomedical research. At a stroke, Government had radically increased the rate of funding via the Science Budget, which will enable the UK to remain excellent, as it must do if it is to continue to win. The UK would never beat the rest of the world by cost cutting alone. Excellence in research, technology and innovation was the only way.

CONFERENCES AND SYMPOSIA

8 December 1997

'DID MALTHUS GET IT RIGHT?'

Debate in the Rooms of the Royal Society of Edinburgh

The debate was introduced by Professor P N Wilson, who restated the problem highlighted by Malthus in 1798, namely that there is a growing imbalance between human population growth and world food supply. If left unchecked this would imply that ultimately the size of the human population would be limited by the availability of food.

Professor N W Simmonds gave his view that Malthus was a very dull socio-economist who had had one brilliant insight, expressed in a few key sentences.

Professor Simmonds pointed out that the world population is now 6bn and set to increase to 11-12bn. He made it clear that the world problems cannot reasonably be considered in simple arithmetic terms, since at the present time half of the world population is hungry and there is intermittent starvation in the poorer regions. By contrast there is an abundance of food in the wealthier nations.

Authorities in the richer nations have dodged the main issue for the last 50 years by concentrating almost exclusively on promoting improvements in agriculture, while overlooking the main issue which is that there will ultimately be a finite limit to the world production of food.

Given the availability of sufficient energy, the richer countries will be able to cope with the progressive imbalance, but the impact will be catastrophic in Africa.

Tropical food crop yields from peasant farming are very poor by temperate standards, but the larger estates are more effective, if politically less acceptable. It is not yet known whether the huge, and increasing, yield-gap is bridgeable or inevitable.

It is unlikely that the world food production could feed more than one of a series of successive population doublings, given a productive land mass of 1bn ha and an anticipated maximum yield of 5.5 t of grain per ha. Moreover the most productive course will be to set up permanent and stable food cropping throughout the arable land – shifting cultivation and stock rearing would be much less efficient. The theoretical improvement of food yields will be limited by many adverse factors such as pollution, availability of fertilisers, application of good farming practices, effectiveness of marketing food in good condition, family planning and many socio-economic factors.

Professor A W G Manning stated "Yes, I believe Malthus did get it right". Of course he didn't foresee the advances of technology and agriculture which have bought us a couple of centuries leeway, but the old crunch remains. We COULD feed the present 5 plus billion and even the inevitable (barring disasters) doubling, but this assumes much more foresight, luck, and rationality than our species in its modern societies shows any sign of possessing. If we got it to work, it would in any case be at the expense of many of the living organisms with which we share the planet at present. As a biologist you will not expect me to feel happy at the prospect of a world for our successors which has no large wild mammals, for example. There is much good news on the population front at the moment. Birth rates are declining rapidly in many South American and Asian countries and there are even some success stories from sub-Saharan Africa. Because we have concentrated our attention on population GROWTH we have regarded the problem as being 'out there' in the developing nations. This ignores the gross disparity in resource consumption such that the rich 20% of the world's people consume 85% of the resources, e.g fossil fuel. Professor Manning regarded the developed world as already grossly OVER-populated. Nothing could be better for our future generations and as a psychological boost to the developing nations (showing that we mean business when we talk of 'sustainability') than for the population of Britain and other rich nations to be allowed slowly to decline over the next century. Nor would this require compulsory sterilisation! Merely a recognition of our situation in an overpopulated world and a sustained effort to live up to the old Family Planning Association's slogan, 'Every child a wanted child' - by which we mean wanted in the fullest sense and from before conception! Population control is not anti-human, but completely the opposite.

The slogan of the Optimum Population Trust is, 'More humanity with fewer humans'

Professor J J McCutcheon then described the principal demographic factors relevant to the question. He used a range of slides to highlight certain key statistics and to illustrate major trends. The following were among the main points discussed.

At present infant mortality rates in the poorest regions (currently around 10%) are on average some ten times those in the more developed countries. Even when allowance is made for the geographical spread of medical knowledge and scientific advances (with corresponding improvements in health), it is likely that in the middle of the next century the greatest infant mortality rates are likely to be still five times the lowest rates.

Although overall fertility rates have decreased significantly for many years, across the world as a whole, the total fertility rate is currently still in excess of 3 births per woman. Even if this rate were to reduce over the next 50 years to a long-term level of 1.6 births per woman, the world population in the year 2050 would be some 50% greater than in 1990. (More significantly perhaps, a long-term total fertility rate of 2.6 would imply an increase of some 125% in the world population over the next 60 years.)

Over the past 40 years, again for the world as a whole, average life expectancy at birth had increased by around 17 years for males and by nearly 19 years for females. (The 'gap' between the figure for females and that for males has grown steadily over the period.) Over the first half of the 1990s the average values (across the entire world) for life expectancy at birth were 62.4 years for males and 66.5 years for females. The difference between life expectancy at birth in the most developed regions and in the poorest areas was still in excess of 20 years.

The relative distribution of population between regions is changing significantly. In 1950 more than 20% of the world population was in Europe and less than 10% in Africa. It is likely that by the year 2050 this position is likely to have reversed itself, with the African population then being double that of Europe and around 20% of the world total.

A lively discussion followed the debate in which many important points were raised, including the importance of limitations to water supply and the impact of epidemics in man and of unexpected outbreaks of plant diseases. The participants were warmly thanked for stimulating such an active debate.

23 January 1998

RSE WORKSHOP : 'COPING WITH CARIES – CAN NEW TECHNOLOGY HELP?'

This workshop held in the Society's rooms examined the issue of caries from a number of perspectives :

The Research Perspective

There is a patient perspective and a public health perspective and to make progress these two must be linked in future. In addition to new technology, there is also much old technology that is helpful but is inadequately used. It is useful to recognize differences in patient groups, and the socio-economically deprived groups are a priority; however, low risk groups should not be neglected. There are potential benefits in information technology (IT): diagnostic and treatment data can be integrated with X-ray and other images and with quantitative data from measurements that monitor progress or regress of lesions. New developments in IT and new technology should be made in conjunction with a joint programme including input from clinicians and patients. There is a need for clinical decision support systems to help utilise the information. The transfer of research results into practice to date is inadequate in dentistry as it has been in medicine (dental examples include the lack of take up of FOTI and inappropriate use of bitewing radiography). In developing a more evidence based future for dentistry, the evidence which exists on how to implement research findings should be applied.

The Practitioner's Perspective

At present research information is not oriented towards General Practitioners. Practitioners perceive a need to monitor caries activity and the rate of change of lesions. Practitioners like new technology and gadgets, but there is a danger that much time and money can be wasted if these do not contribute to clinically improved and cost-effective care. Information on new technology solutions should be accessible, unbiased and unprejudiced. The present UK dental remuneration system is seen by some as inadequate. This is difficult to change but the financial aspect should not be ignored as it was seen as a recurring barrier to the delivery of modern appropriate care. A standard

for IT systems is needed to exchange and transfer information and facilitate local audit and research as well as allowing patients to have copies of their records. New technology should be used with underutilised old technology to achieve health gain for patients.

The Patient's Perspective

Patients should be involved in judgements and decisions, or at least this involvement should be offered and stimulated. Good communication and information is a key to achieving this. Therefore a good dentist-patient relation is essential, but differences in expertise and viewpoint should be respected and the wide variation in patients (and dentists) must be recognised. The use of IT may help to empower patients by giving them access to their records and to other recommendations for care. Some caution is needed before the traditional 'trusting' model of patient/professional relationship is changed, as the change may be unpredictable.

It was concluded that the next steps to be taken were; to objectively and systematically evaluate old and new technologies; to undertake the task together: researchers, practitioners and patients; to develop solutions that are in line with the philosophies and approaches that are sought from all three groups and to develop solutions that are easily implementable using the research evidence in this area.

25 February 1998

RSE WORKSHOP : 'OPEN QUESTIONS IN PARTICLE PHYSICS'

Sixty-two particle physicists gathered for the third annual RSE workshop on Particle Physics. This meeting focussed on the future, looking at questions we know how to pose but where the answers are not clear. Particle Physics has developed over the years by a creative tension between theory and experiment. Perhaps the most satisfying triumphs of the human mind are those where reason has suggested that Nature must follow a certain course if it is not to be internally contradictory, and when experiment has subsequently showed that this course is indeed followed. One can think back to Maxwell's Electromagnetic theory as an example of a triumph of this kind.

In the first presentation Prof W J Stirling (Durham) showed us why the present theory of particle physics, which is so successful in its description of phenomena, is graced only with the title of Standard 'Model'. It has mathematical elegance and rigour yet contains arbitrary and unnatural features. The universality of the gravitational force suggests that this is the correct theoretical starting point, and yet it is monstrously weaker than the electromagnetic or the nuclear force. This creates a stress in the theory which requires modification once the energy is raised just above what we can currently access, and the CERN Large Hadron Collider (LHC) is being built to investigate this. The most compelling ideas on the origin of mass originate from Edinburgh physicist Peter Higgs. There are formulations around this, such as supersymmetry, which again indicate new phenomena to be observed at the LHC. The theorists have passed the torch to the experimenters. Present theories fail at LHC energies. If there is not to be nonsense, there must be something new.

Prof K J Peach (Edinburgh and CERN) discussed the asymmetry between matter and antimatter. The Big Bang must create matter and antimatter equally, and yet we observe a stable universe exclusively of matter. Antimatter is transient and rare (although useful in for example PET scanners in hospitals). Some mechanism is therefore required to have eliminated most of the antimatter early in the universe's development. The problem was posed in mathematical form by Sakharov and a solution suggested some 25 years ago by Kobayashi and Maskawa. Experiments indicate that their solution appears to be followed in nature. Prof Peach laid out the theoretical and experimental situation in matter-antimatter oscillations.

Two papers presented by Dr P Teixeira-Dias (Glasgow) and Dr P P Allport (Liverpool) described Higgs-particle hunting techniques in use today at the Large Electron-Positron collider at CERN, and the methods to be used at the LHC in search for Higgs and supersymmetric particles. Dr V del Duca (Edinburgh) arrived with perfect timing from a carnival in Rio de Janeiro to give a talk on Quantum Chromodynamics in the High Energy Limit, and Mr M Heyssler (Durham) described calculations of a new phenomenon – the so-called radiation zeroes in processes where a direct photon is emitted. At certain angles there can be completely destructive interference between the radiation patterns emitted by initial and final state particles.

Finally, Prof S Cooper (Oxford) described some of the mysteries surrounding the origin of the highest energy cosmic rays. Particle Astrophysics deals with the observation and explanation of these

phenomena. She described the techniques used for observing such particles and the handful of identified sources. One, the active galactic nucleus (Mrk421) has shown pulses whose intensity can double in 15 minutes. The source must therefore be smaller than the diameter of the earth's orbit. Above 10^{16} eV gamma rays can propagate only limited distances across space, as they can annihilate on the cosmic microwave background radiation to produce electron-positron pairs. We therefore need to turn to neutrinos to look for higher energy sources. Underwater arrays are used (at Lake Baikal, with new proposals elsewhere) to look at muons caused by neutrinos coming up through the earth. The Amanda experiment at the South Pole uses ice as the detecting medium. Extensive air-shower arrays are an alternative technique and have yielded the highest energy events seen to date. At present we are limited by poor statistics and little systematic knowledge. Efforts around the world to build new detectors of adequate size are underway, and in three to five years we should have much better knowledge of this unpredictable regime.

12-13 March 1998

'CELLULAR ENGINEERING'

An International Conference organised by

the Royal Society of Edinburgh and the Caledonian Research Foundation

'Cell Engineering' can be defined as the making of useful things from and with cells or their components. This meeting focused on the use of cell engineering to engineer the repair and reconstruction of human and animal tissues damaged by disease, accident, wear and ageing. The international group of speakers reviewed some of the most promising developments in the subject.

Three main themes were discussed.

1. The ways in which formers (scaffolds) and other types of topographic feature can be used to control the position, orientation and activities of cells.
2. The use of micro- and nano-fabrication techniques to make these structures and formers that can be used to control cell behaviour in repairing tissues. Professor Knoll (Max-Planck Institut, Mainz) told the meeting about the potential for using polymers that mimic the surface of the cell for engineering cell - substrate communication and about the use of FET devices in this field. Professor Ueno (Tokyo) reviewed the use of magnetic methods for microstructuring materials while Professor Hubbell (Zurich) and Dr Britland (Bradford) explained how patterns of chemical groupings might be formed on surfaces – usually by printing methods capable of sub-micron resolution. Professor Wilkinson (Glasgow) showed the meeting how microstructuring of surfaces could be achieved by new embossing methods, capable of nanometric precision. Professor Curtis (Glasgow) reported results showing the extreme sensitivity of cells to very small structures and suggested how cells could 'measure' such structures.
3. Most time was spent considering the special requirements for rebuilding specific tissues. Tendon, cartilage, bone, blood vessels, skin, liver and muscle were discussed by the following individuals respectively: Mr J Crossan (Glasgow), Professor Archer (Cardiff), Professor Downes (Nottingham), Professor McIntire (Houston) and Professor Nerem (Atlanta), Professor Bereiter-Hahn (Frankfurt), Dr Gaylor (Strathclyde), Dr Clark (London), Professor Partridge (London) and Professor Valentini (Boston). In general these presentations all recognised that it was not enough simply to put the right cells in the right place – in most cases it is necessary to find ways of 'replaying' some of the events of development, so that the cells take up the right relationships to each other. This might be done using various biomaterials as scaffolds or 'training areas' for the cells, or by applying mechanical forces or inserting appropriate genetic material.

The use of cell engineering techniques as tools for fundamental research in cell biology was also discussed. Many of these are particularly relevant to developmental biology, for example, the paper by Britland on the control of nerve cell position and connection is directly relevant to our knowledge of the development of the nervous system. Both McIntire and Curtis commented on the changes in gene expression produced by external or internally generated mechanical forces. Partridge gave detailed consideration to the changes in gene expression or genome content that needed to be produced for effective rebuilding of skeletal muscle.

April 17 1998

'FORENSIC APPLICATIONS OF DNA PROFILING'

When first introduced into the public consciousness in the 1980's DNA profiling was known as DNA fingerprinting because of the concept that it provided a unique pattern for each individual. The immediate public perception, perhaps stimulated by claims of certainty involving numbers of astronomical magnitude, was sceptical. This meeting, supported by Commercial Union, was aimed primarily at legal, police and forensic professionals. It demonstrated that the field has moved forward both technically and in terms of its perception and application in the courts.

Since the criminal law in Scotland and England now permits the taking of mouth swabs for DNA analysis purposes over three hundred thousand samples from accused persons and scene of crime specimens have been accumulated and the power of the approach demonstrated by more than 15,000 'hits' from scene of crime samples to the data bases (Andrew Brown). The Scottish effort started later but is now increasing rapidly (Douglas Pearson). These approaches require factory scale automated procedures, rigorous quality control and zero error rates. Future challenges in this area will come from the need to use yet smaller samples and, driven by this, the need to be able to apply new methodology to old material (David Werret).

The presentation of this information to juries is a complex area in which presentations by expert witnesses can easily give rise to incorrect interpretations of the meaning of the results. Mathematical approaches (Bayesian or likelihood ratio) may in future have a part to play in presenting evidence but for the moment their use is controversial and certainly difficult to present to the jury (Colin Aitken, Jim Lambert and Ian Hamilton). Scottish law - unlike the English system - requires corroboration and in some cases there will be no evidence other than that derived from a hit in a DNA. With current approaches to DNA profiling it is expected that 'hits' will be generated with increasing frequency as the database size increases. Not all of these will be due to the same source of the DNA, highlighting the importance of these considerations of sufficiency (Alastair Campbell).

Great Britain probably has one of the most highly developed systems for the acquisition and use of DNA profile information. In large part this is because the concept was invented here by Alec Jeffries but also because British society has been tolerant of the privacy issues raised. In the United States the system is fragmented between different authorities and it is likely that human rights issues would be raised by attempts to unify the system (Barry Scheck). In this country we seem willing to accept the generation of databases containing large numbers of DNA profiles as part of the crime-fighting process but we should not forget that crime is predominantly a social problem which needs to be addressed from many directions (Alan Miller). From this conference it emerged that DNA profiling was a highly effective contribution to this process which was now handled in a more sensitive and satisfactory way, both technically and in the courts, than was previously the case.

24 April 1998

'MARINE ENVIRONMENTAL EDUCATION'

Despite the crucial importance of the sea and its resources to Scotland, there is a widespread lack of understanding of the marine environment. To address this paradox the Council of the Scottish Association for Marine Science (SAMS) held this conference in association with the Royal Society of Edinburgh, Scottish Natural Heritage, Scottish Environment Education Council (SEEC), Scottish Consultative Council on the Curriculum and Scottish Environment Protection Agency. It received financial support from Shell U.K. and the National Heritage Fund.

Prior to the conference, the Organising Committee prepared and distributed a booklet summarising marine environmental education initiatives in Scotland, the U.K. and parts of continental Europe. The Conference itself was opened by Lord Sewel, the Environment Minister in the Scottish Office. He emphasised an holistic approach to the wise management of the sea and the sustainable use of its resources. He was followed by Professor Lie who placed the need for understanding on a global scale. Sir William Stewart brought the conference back to Scotland's own coasts and waters, before a panel of those who use the sea, or are responsible for its management, debated the need for information, understanding and the support of official policy and public opinion.

Environmental education – *Learning for Life* – should be a life-long experience, at all levels of education, formal and informal. Following the example given by Professor Grassle of what is being done collaboratively by universities and schools in the United States, contributions were given in relation to educational provision at different levels in Scotland using various channels of communication.

Professor Smyth, who was responsible for *Learning for Life*, a report published in 1993, reflected on the Conference debate to the fact that the Conference was the beginning of a process of improvement re-iterating that a concerted effort is required to increase awareness of the importance of the sea to the lives of present and future generations. It was, in conclusion, recommended that:

1. An educational partnership should be created through the good offices of the Scottish Office Education and Industry Department.
2. A networked database should be created, along the lines already being discussed by the Scottish Environmental Education Council and the Scottish Science Library; the marine component being provided by the Scottish Association for Marine Science.
3. Scottish Natural Heritage and the Scottish Environmental Education Council should co-ordinate the educational programmes of coastal fora.
4. The Government should invite the Scottish Consultative Council on the Curriculum to provide practical guidance on how aspects of marine environmental education can be embedded in the curriculum recommended for Scottish schools in relation to pupils 5–14 years-old and beyond.
5. SEEC and SAMS should monitor at the end of five years the progress of these initiatives and review all that happens in the field of Marine Environmental Education.

26 April 1998

ROBERT CORMACK BEQUEST MEETING

The 1998 Cormack Astrophysics Meeting took place at the Royal Observatory Edinburgh. The programme consisted of fifteen contributions, three of which were Cormack prize talks. A Poster Session was also arranged. Following on from these sessions a Robert Cormack Bequest Lecture was held in the Swann Lecture Theatre, University of Edinburgh. The lecture entitled 'Meteorites: the poor man's space probe' was delivered by Professor Colin Pillinger, FRS, Planetary Science Research Institute, The Open University. In a highly stimulating lecture Professor Pillinger discussed issues including: 'How can meteorites be used to explore the Solar System?' 'What do the Martian meteorites tell us about the origin of Life?' Both the Astrophysics Meeting and the Lecture were well attended including a high number of young researchers from throughout Scotland.

28 May 1998

'THE ASSESSMENT AND MANAGEMENT OF SERIOUS DISEASE'

A successful seminar, in the series of Biomedical Seminars funded by the Scottish Office Department of Health, was held on risk assessment for serious disease. In the morning session the state of the art of genetic and environmental risk assessment was reviewed. The conclusions were threefold: first, that although the explosion of technological development has revolutionised gene identification and made it easier than measuring the environment, modifying the environment is easier than modifying human genes; second, that using biomarkers as part of epidemiology will make the identification of environmental associations much easier; and, third, that the current interest in modelling genetic risk in families with high prevalence of a genetic condition must be matched by modelling of environmental exposures (which include diet and other 'behaviours' as well as the physical environment). In sum, there needs to be a shift of research focus to gene-environment interactions and that has implications for the types of research methods to be used.

The afternoon session focussed on how uncertainty about risk is managed by different people and agencies. People vary in perceptions of risk and reaction to information as much as they vary genetically and environmentally. We shall never have, and may not want, complete certainty about risk of future disease; the basis of action is probabilities. For example, the insurance industry needs certainty about population frequencies of diseases to set its overall estimates and probabilities but operates well on uncertainty about individual risk. However, especially within health, care we need to know more about how individuals perceive and act on knowledge of personal risk. Public health strategies must balance the ethical issues of offering information such as through screening programmes, whose purpose is to identify risk, only if it can be modified with consequent net benefit to the participants.

In conclusion, the need for a medium to long term research strategy was underlined, because there is often a long timespan between identifying a gene or an exposure and the adverse health outcome that may result.

7 and 8 August 1998

'TOBACCO MOSAIC VIRUS: PIONEERING RESEARCH FOR A CENTURY'

Arranged by the Society in association with the Royal Society and with help from the Association of Applied Biologists, British Society for Plant Pathology, Texas A & M University and others.

This symposium immediately preceded the 7th International Congress of Plant Pathology which was held in Edinburgh. It marked the 100th Anniversary of Beijerinck's pioneering observation that the cause of tobacco mosaic was a novel kind of infectious agent. This discovery proved, however unlikely, to be of immense significance not only for the investigation of plant diseases but also in medicine and veterinary pathogen. It led to the establishment of the science of virology. Ever since research on tobacco mosaic virus (TMV), tobamovirus as it is now called, has been at the forefront of many key discoveries in virology, molecular biology and other fields of endeavour as shown by the headings of the different sessions of the symposium – *particle structure* including self-assembly and disassembly; *genome organisation, infectivity and evolution*; *host-virus interactions* including the study of early events in virus infection and the movement of TMV from cell to cell; *genetic resistance and biotechnology* touching upon virulence and avirulence.

Many of the key figures of earlier years contributed with overseas speakers from Australia, France, Japan, Russia and USA. At a special evening lecture a fellow countryman of Beijerinck's, Dr L Bos of The Netherlands, ensured that the audience did not go away with the idea that Beijerinck was narrowly focussed: he showed that the discovery of viruses was only one of his many contributions to microbiology. The excellence of the symposium ensured that the International Conference had a hard act to follow – it rose to the occasion.

15-16th September 1998

'MOLECULAR GENETICS IN ANIMAL ECOLOGY'

UNIVERSITY OF ABERDEEN, SCOTLAND

With the support of the Natural Environment Research Council, the symposium 'Molecular Genetics in Animal Ecology' was held at the University of Aberdeen. The purpose of the meeting was to present to an audience of peers the progress of the 'Molecular Genetics in Ecology Initiative' created in 1994 in the Department of Zoology and co-funded by the University and the Natural Environment Research Council. The most important message to emerge from the two days of presentations and exchanges among delegates is that molecular practitioners and ecologists now speak each other's language, and collaborate on a wide range of ecological and evolutionary studies. This was reflected in the fact that the symposium attracted 120 delegates from 15 countries, and in the range of studies presented. The invited papers will appear together in one issue of *The Biological Journal of the Linnean Society* in September/October 1999.

Ecological methods will increasingly incorporate genetic assays. The identification of species by genetic means has been conspicuously successful. Papers by Elizabeth Barratt (Institute of Zoology), Tim Littlewood (Natural History Museum), Les Noble (University of Aberdeen) and Catherine Walton (University of Leeds) reliably identified species of bats, flatworms, snails and mosquitos, respectively, that were identical by the criteria of traditional systematics. This development has important implications for the study of ecological processes involving species interactions because these processes may be mediated not by one species but by complexes of currently undescribed species, each having different effects on the process. This conclusion applies equally to studies of biological control and vector ecology. As a demonstration of the utility of genetic identification at the lowest taxonomic level, Dorothea Sommerfeldt and John Bishop (Marine Biological Association, Plymouth) won the poster prize with their study of genetic chimaerism in a colonial ascidian.

A major goal of molecular ecology is the study of dispersal over ecologically relevant time scales. Genetic methods are potentially able to estimate dispersal: within generations by genetic tagging of individuals and between generations by the identification of parent-offspring pairs. However, progress has been uneven largely because of technical factors. Per Palsbøll (University of Wales-Bangor) presented results of a large-scale study in which over two thousand individual humpback whales were identified, and their long-distance movements detected, by microsatellite analysis of skin biopsies. In contrast, the use of truly non-invasive samples (hairs and faeces) attracted a certain scepticism that has hitherto found little expression in the scientific literature. Reliability was questioned by Mike Bruford (Institute of Zoology), John Dallas (University of Aberdeen) and Pierre Taberlet (Université de Grenoble) who emphasised the need to estimate rates of incorrect and failed

genetic typing. Effectiveness and generality were also questioned. Dr Taberlet claimed that product-rule calculations for the rate of chance matches between full siblings are between one and three orders of magnitude too optimistic. Consequently, the reliable individualisation of close relatives may not be feasible in some populations high on the conservation agenda, due to prior losses of genetic polymorphism. Despite these reservations, ecologists interested in population trends will in many cases be able to calculate indices of density from the number of distinct genetic profiles or parent-offspring pairs.

The majority of presentations focussed on structure within and between populations. This is where the synergy between ecology and molecular genetics is at its most dynamic. Genetic data are being used to assess the basic processes underlying within-population demography. Demographic concepts are modifying the classical theory of population genetics concerning between-population structure. The timescale over which dispersal and mechanisms of adaptation can be studied has been dramatically increased, thanks to concepts borrowed from molecular evolution.

Individuals may use their full dispersal capacity without incurring costs or losing benefits, in which case both immigration and emigration will make a large impact on local demography. Alternatively, the combined costs of dispersal and benefits of staying put may be sufficiently high to create the spatial aggregation of lineages. In the former scenario, ecologists should strive to estimate rates of immigration and emigration despite the major logistic difficulties of doing so. In the latter scenario, ecologists may in some cases need to modify the way they use life tables to include pairwise interactions that affect fitness, such as kin-biased altruism. Two presentations supported the latter scenario. Alison Surridge (University of East Anglia) described a situation typical of mammals. Groups of European rabbits only hundreds of metres apart remained genetically differentiated through the strong tendency of females to stay where they were born (= natal philopatry). The implication is that the costs and benefits involved in female dispersal must be considerable. Stuart Piertney (University of Aberdeen) described a situation typical of birds in which males are the philopatric sex. Kin clusters were frequently observed in male red grouse holding territories on one moor. Such social structure could have important demographic consequences given that the number of territories determines the number of breeding pairs. The aggregation and subsequent breakdown of kin clusters could drive population cycles in red grouse if territory acquisition is mediated by altruistic interactions among male kin.

Ecology has traditionally dealt with short time scales: very few long-term datasets cover more than fifty generations. This is likely to change as ecologists adopt the use of gene tree and molecular clock concepts. It is now possible to reconstruct evolutionary trees of populations that cover the life span of an entire species and beyond. What kinds of ecological processes could be studied using such gene trees, and over what time span? The presentations by Maarit Jaarola (Lund University), Godfrey Hewitt (University of East Anglia), Wendy Stewart (University of Aberdeen) and Eric Verspoor (Fisheries Research Services, Marine Laboratory) suggested that it is sometimes feasible to identify the geographical sources of range expansion during highly deterministic environmental changes such as deglaciation. But what about more recent range expansions that have no obvious environmental determinant? The posters by John Benzie (Australian Institute of Marine Science) and Anna Goostrey (University of Aberdeen) suggested that genetic data could identify sources of recent highly-mobile colonisers. The latter study showed that immigration from continental Europe, not a change in nesting habits of residents, has been the catalyst for the formation of inland colonies of cormorants in the UK, which has occurred only since 1981.

What can molecular genetics tell us about adaptation? For many researchers, this is the Holy Grail of molecular ecology. There may be a long road ahead, but encouraging signs are emerging from many studies. Once again, it is the ability of genetic data to identify long-term trends that often provides the key to success. Louis Bernatchez (Université de Laval) presented a striking case of divergence in life history traits among post-glacial populations of whitefish within the same lakes. He suggested that trophic specialization was the main selective force involved. Moving to a 50-year time scale, Christine Chevillon (Université de Montpellier) gave a fascinating account of the changing genetic adaptations that underlie the evolution of insecticide resistance in *Culex* mosquitos. The potent combination of dispersal and selection has resulted in the worldwide spread of resistance alleles. However, continued resistance in treated areas does not imply that evolution has stopped. Resistance alleles that impose a high selective cost in the absence of insecticide were replaced by a new low-cost resistance allele. Terry Burke (University of Sheffield) described a negative result of

testing the 'good genes' hypothesis for extra-pair paternity in house sparrows. Unexpectedly, he reported that the tendency to develop large sexual ornaments was transferable from foster fathers to their unrelated nestlings. Josephine Pemberton (University of Edinburgh) described how lifetime reproductive success in male Soay sheep, estimated using genetic markers, was highly dependent on the level of competition for matings. Even ram lambs as young as seven months old were able to obtain many matings under the right circumstances. Lastly, the poster by David Coltman (University of Edinburgh) described how population crashes in Soay sheep selectively eliminate the most inbred individuals. He suggested that the selection process is mediated largely through parasitism by intestinal nematodes. In summary, molecular genetic data appear to be useful general-purpose tools for studying a wide range of adaptive mechanisms and fitness-related processes.

Many delegates commented that the symposium was timely, and that they had thoroughly enjoyed it. Overall, the symposium was judged a great success in highlighting the value of synergy between ecologists and molecular geneticists. The strength of this synergy should be tested by revisiting the subject after an appropriate interval, perhaps five years.

29 September 1998

WORKSHOP: 'USING GENETICS TO CONTROL SHEEP DISEASES'

This research workshop, sponsored by the Wellcome Trust, brought together two themes; the control of sheep diseases and the role of genetics. It was particularly apposite because of the importance of sheep production in Scottish agriculture and the interests of the RSE in the epidemiology of BSE in cattle.

Central to the meeting were the challenges and benefits to be derived from the use of genetic improvement vis a vis chemicals, antibiotics and 'biologicals' as realistic and sustainable tools for the control of sheep diseases. There were keynote addresses on the current status of development across a range of disciplines that approach the same problem from different perspectives. In particular it was demonstrated how epidemiological methods were complementary and integral to both pioneering work being undertaken at a molecular level in laboratories and observations made in the field.

The meeting attracted a distinguished audience which led to vigorous debate in the lecture room and during coffee and meal breaks. These discussions signalled the beginning of a much needed forum in Scotland on animal health issues.

The organisers of the Workshop, Dr Bishop, Dr Stear and Professor McKellar are to be congratulated for providing an informal, pleasant and constructive atmosphere, facilitating the development of the forum.