Thirty
Fifth

LONDON INTERNATIONAL YOUTH SCIENCE FORUM

1993

LONDON INTERNATIONAL YOUTH SCIENCE FORUM 1993

Founded by the late Philip S Green, MBE in 1959, the Science Forum aims to give a deeper insight into Science and its applications for the benefit of all mankind and to develop a greater understanding between young people of all nations.

10 DOWNING STREET
LONDON SW1A 2AA

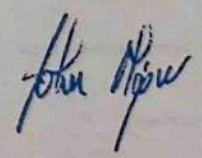
THE PRIME MINISTER

There has never been a more exciting time to embark on a career in science and technology. Science permeates every aspect of our lives. The pace of new discoveries accelerates every year. New understanding about how our world works or how our bodies and minds function enable us to enrich our quality of life.

With knowledge and understanding comes responsibility, however. Never before have scientists faced as many difficult ethical choices. I find that young scientists are acutely aware of these issues and are fully willing to discuss them between themselves and with others.

Over the past year science has become an important issue of public debate in Britain. We have been seeking ways of improving the quality of scientific input in our decisions within government, and ways of boosting the impetus that science and technology can give to wealth creation.

I hope that the current excitement and debate in the scientific community in Britain will provide an excellent background to the 1993 London International Youth Science Forum.



March, 1993

INTERNATIONAL SPONSORS

Australia
CRA National Science Summer School

Austria
Ministry of Education & Culture

Bahrain
University College of Bahrain
Bahrain School
British Council

Belgium
British School of Brussels

Bulgaria
British Association for Central & Eastern Europe

Canada
Manitoba Schools Science Symposium
Memorial University, Newfoundland
Youth Science Foundation

Cyprus
English School, Nicosia

Czechoslovak Republic
British Association for Central & Eastern Europe

Estonia
British Association for Central & Eastern Europe

France
Ecole des Mines, St Etienne

Germany
Stiftung Jugend Forscht

Greece
Athens College
Moraitis School
British Council

Guernsey, States of
Pharmac Consultants

Hong Kong
British Council

Hungary
British Association for Central & Eastern Europe

India
British Council

Indonesia
Bandung Institute of Technoloty
British Council

Ireland
Royal Dublin Society

Israel
Weizmann Institute

Italy
United World College of the Adriatic, Trieste

Japan
British Council

Kuwait
Kuwait Foundation for the Advancement of Sciences

Latvia
British Association for Central & Eastern Europe

Lithuania
British Association for Central & Eastern Europe

Luxembourg
Ministry of Education

Malaysia
BP SE Asia Pacific

Malta
NSTS Youth & Student Travel Service

New Zealand
Royal Overseas League

Norway
Norwegian Young Scientists

Oman
Sultan Qaboos University
British Council

Peru
International School of Geneva, La Chataigneraie

Poland
British Association for Central & Eastern Europe

Portugal
British Council
Calouste Gulbenkian Foundation
St Julian's School

Puerto Rico
Ministry of Education

Romania
British Association for Central & Eastern Europe

Slovak Republic
British Association for Central & Eastern Europe

South Africa
Foundation for Education, Science & Technology

Spain
British CouncilFundation Educativa Francisco Torio

Singapore
Ministry of Education
BP SE Asia Pacific

Sweden
Forbundet Unga Forskare

Switzerland
Stiftung Schweitzer Jugend Forscht
International School of Geneva (La Grande Boissiere)

Taiwan, Republic of China
British Taiwan Cultural Institute

Trinidad and Tobago
Holy Name Convent School, Port of Spain, Trinidad

Thailand
British Council
Institute for the Promotion of Teaching Science & Technology
Science Society of Thailand

Tunisia
British Council

United States of America
Academy of Applied Science Junior Science & Humanities Symposia
Department of Energy

Venezuela
British Council

Zambia
British Council

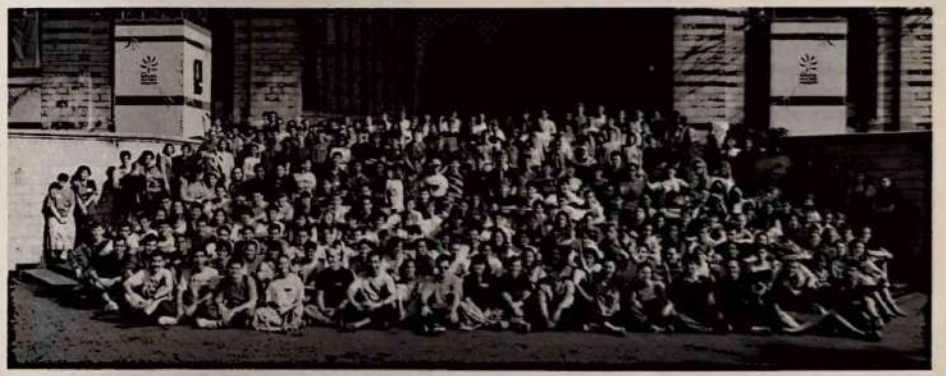
Zimbabwe
RTZ Corporation
Surrey County Council

The British Council

The British Council is the principal sponsor of international participants.

This list was compiled on 1 March, 1993 and is therefore incomplete.

LONDON INTERNATIONAL YOUTH SCIENCE FORUM 1992



The following countries were represented

Australia
Austria
Bahrain
Belgium
Bulgaria
Canada
China
Colombia
Cyprus
Denmark
Egypt
France
Germany
Greece
Hong Kong
Hungary
India
Indonesia
Iran
Ireland
Israel
Italy
Japan
Jordan
Kuwait
Luxembourg
Malaysia
Malta
New Zealand
Norway
Oman
Phillipines
Poland
Portugal
Puerto Rico
Romania
South Africa
Spain
Singapore
Sweden
Switzerland
Taiwan
Tanzania
Thailand
United Kingdom
United States
Venezuela
Vietnam
Zambia
Zimbabwe

UNITED KINGDOM SPONSORS

Local Education Authorities

Belfast Education and Library Board
Buckinghamshire
Central Region
Dyfed
Gwynedd
Mid Glamorgan
North Eastern Education & Library Board
Shropshire
Southern Education & Library Board
Western Education & Library Board

Colleges and Schools

Birmingham: King Edward VI Camp Hill School for Girls
King Edward VI School, Edgbaston
Brockenhurst: Brockenhurst College
Canterbury: Simon Langton School for Girls
Clydebank: Bell College
Grantham: The King's School
Letchworth: Fearnhill School
Liverpool: St Edward's College
St Albans: Beaumont School
Totton: Totton College

Commercial and Industrial

Aitchison Charitable Trust
BAT Industries plc
British Gas plc, West Midlands
British Petroleum Company plc
BP Chemicals Ltd, London
BP Exploration Ltd, Easington
BP Exploration Ltd, Uxbridge
BP Oil Ltd, London
BP Research & Engineering Centre, Sunbury
British Telecommunications plc, Southampton
Du Pont (UK) Ltd
Esso Petroleum Company Ltd
Exxon Chemical Ltd
Fife Industry Committee
Grantham York Trust
Joseph Lucas Charitable Trust
3M Health Care Ltd
Pfizer UK Ltd
Roche Products Ltd
Severn Trent Water plc
Shell Research Ltd
Sittingbourne Research Centre
Southern Water plc

The International Contact Trust has offered part scholarships towards participation fees in a number of cases.

This list was completed on 1 March, 1993 and is therefore incomplete.

BP

BP is the principal sponsor of participants from the United Kingdom

THE ROYAL INSTITUTION OF GREAT BRITAIN
21 ALBEMARLE STREET, LONDON, W1X 4BS

TELEPHONE: 071-409 2992
FAX: 071-629 3569

From Sir John Meurig Thomas, FRS
Fullerian Professor of Chemistry

'London is the epitome of our times and the Rome of today.' Thus wrote the great American poet and essayist Ralph Waldo Emerson over a hundred years ago. London is still a great and fascinating city, especially for the intending scientist and engineer. Think of all those intellectual giants who have lived and worked here, and reflect awhile upon some of man's great discoveries made in London and its environs.

The range and depth of the scientific work now being pursued within a hundred mile radius of the centre of this ancient city – an area that accommodates more than seventy percent of the nation's population – is enormous. Part of your pleasure as a participant in our International Youth Science Forum is that you will be exposed to this rich diversity of scientific endeavour. You will also enjoy mingling with friends from over fifty countries, and thereby establish many lasting friendships.

We delight in welcoming you here at a particularly exciting period in the expansion of our scientific knowledge.

John Meurig Thomas

Sir John Meurig Thomas
President, London International Youth Science Forum

ACKNOWLEDGEMENTS

The Science Forum offers its thanks to all those who so generously assisted in the planning and preparation of the 1993 meeting, and in particular to:

The Council and Stafff of the Institution of Electrical Engineers for providing premises and facilities for lectures and seminars

The Lecturers and Speakers whose contributions are invaluable

The Academic, Commercial and Industrial organisations, Research Establishments and Museums which have arranged visits and Lectures.

The Biochemical Society, Sittingbourne Research Centre, and Unilever Port Sunlight Research Laborarory which have provided Specialist Lecturers and Seminar Leaders for the first time.

The Wardens, Bursars and Staff of College Hall and International Hall where participants are accommodated

Chef in a Box Ltd, and Mr Michael Warner for assistance with catering arrangementsCapital Group Travel, and Mr Peter Campling for coach transportation

Circuit Micro Systems Ltd, and Mr David Evans for computer programming and backup

British Airways plc for its generous assistance with travel facilities for participants from a number of overseas countries

Cathay Pacific Airways Ltd for assistance with travel facilities for participants from Hong Kong

Air Malta for assistance with travel facilities for participants from Malta

The Great Britain Centre for Eastern and Central Europe for its support and assistance with recruitment

The British Council, the principal sponsor of overseas participants, for its generous support, assistance and unfailing courtesy in so many countries.

All those who have assisted, and who are not included in this list, whose support has made the organisation of the Science Forum possible.

LONDON INTERNATIONAL YOUTH SCIENCE FORUM 1993

The Prime Minister has written of the difficult and ethical choices which face scientists today. Our President, Sir John Meurig Thomas wrote of the many facets of scientific endeavour you will encounter at the Science Forum.

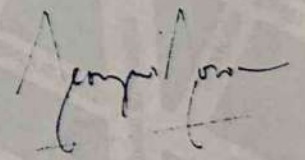
These considerations will affect you too in your future working life. Understanding the attitudes and aspirations of others will be crucial to your own role in the development of science.

One of the greatest advantages to be derived from participation in the Science Forum is that it provides a unique chance to meet and exchange views with other scientists at the beginning of their careers, from over fifty countries.

In a world torn by strife and mis-understanding, so often based on prejudice, it is surely important to remember that the points of view of others merit respect and may be as worthy as one's own beliefs, and that the greatest scourge of all is man's inhumanity to man.

Generations of scientist before you have found that their discoveries had the greatest significance when developed in an atmosphere of tolerance and respect.

I hope you will find that the programme of the Science Forum, and all that it can give you, will be characterised by these same qualities.



George McGowan
Director
London International Youth Science Forum

SCIENCE FORUM STAFF

Chief of Staff
Michelle Gallagher

COLLEGE HALL
Malet Street
London WC1E 7HZ
Tel : 071 636 8982

Host
Ewan Jack

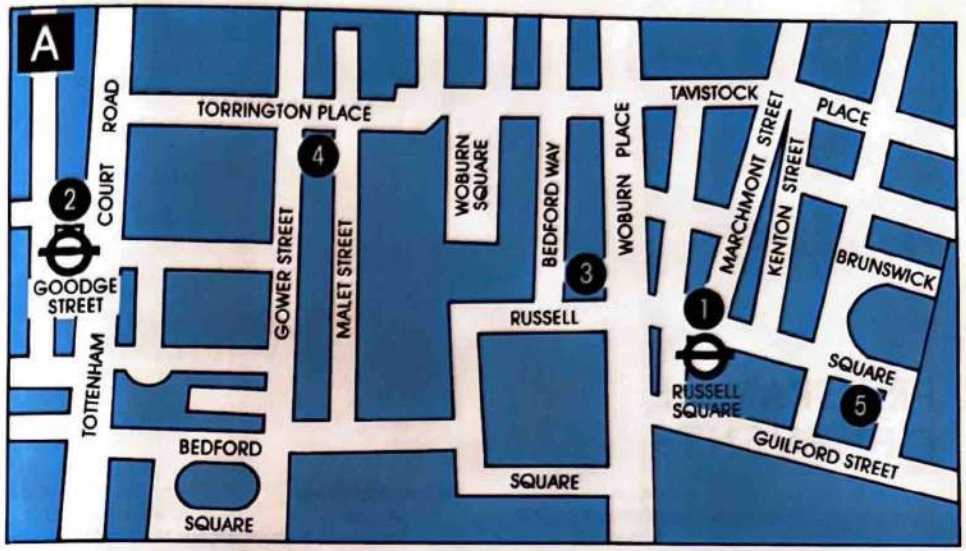
Deputy Host	Clair Conaghan
Programme Assistant	Stefano Lenti
Counsellors	Claire Hawker Mark Shaner

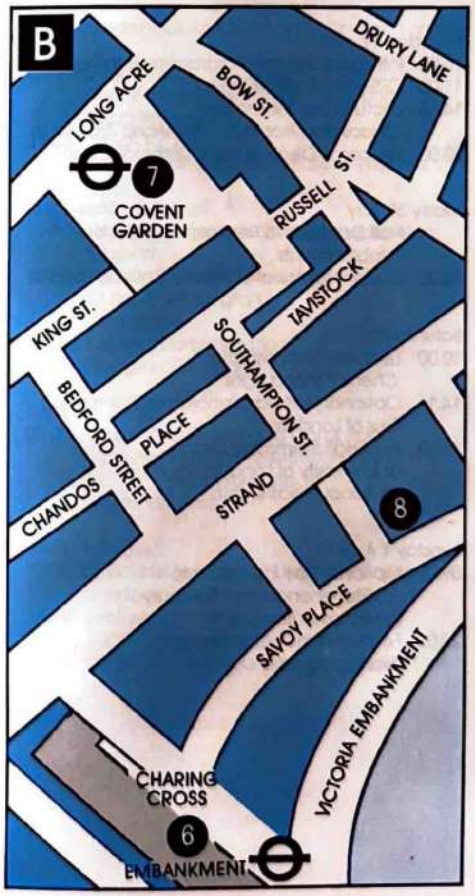
INTERNATIONAL HALL
Brunswick Square
London WCIN IAS
Tel : 071 837 0746

Host
Roberto Lenti

Deputy Host	Rhian Hayward
Programme Assistants	Nick Raphael Stacy Williams
Counsellors	Joseph Derilo Lassaad Essafi Jacquelyn Irving Stephen Nex Mark Shuttleworth

The resident staff of the Science Forum is selected from former participants. Membership of the staff team is by invitation only.





MAP A (University Precinct)
1 Russell Square Underground Station (Piccadilly Line)
2 Goodge Street Underground Station (Northern Line)
3 Airbus Stop (service to and from Heathrow Airport)
4 COLLEGE HALL
5 INTERNATIONAL HALL

MAP B (Covent Garden & Strand Area)
6 Embankment Underground Station (Northern Line)
7 Covent Garden Underground Station (Piccadilly Line)
8 INSTITUTION OF ELECTRICAL ENGINEERS

MAP C (Marble Arch Area)
9 Marble Arch Underground Station (Central Line)
10 CARISBROOKE HALL

PROGRAMME OF EVENTS

Wednesday 28 July
Arrivals
Welcome & Orientation in Halls of Residence

Thursday 29 July
10.00 Introductions and Programme Briefing*
11.00 OPENING CEREMONY*
14.15 Lecture/Demonstration*
'Chaos and Fractals in the World Around Us'
20.00 Welcome Disco at the Carisbrooke Hall

Friday 30 July
Half Day visits to Research & Industrial Establishments
20.00 Student Topics at University College London

Saturday 31 July
10.00 Lecture/Demonstration*
'Chemistry and Light'
14.15 Optional Half Day Panoramic Sightseeing Tour of London
16.30 Inter Hall Swimming Gala at University of London Union
Optional Theatre Visits

Sunday 1 August
09.00 Optional Day Excursions to
(a) Stonehenge and Salisbury
(b) Portsmouth
20.00 Feature Film in College Hall
'Blazing Saddles'

Monday 2 August
10.00 Specialist Lectures*
14.15 Lecture/Demonstration*
'Split Brains - Split Personalities'
20.00 Student Topics at University College London

Tuesday 3 August
Day Visits to Research and Industrial Establishments
21.00 Topics for Tonight
(informal discussions in Halls of Residence)

Wednesday 4 August
09.30 Group Photograph at the Natural History Museum
10.00 Visits to Scientific Museums at South Kensington
14.15 Seminars*
20.00 Lecture/Demonstration*
'Images from Space'

Thursday 5 August
08.00 Day Visit to Oxford and Cambridge
Morning: Visits to University and Research Establishments
Afternoon: Free

Friday 6 August
10.00 Specialist Lectures at University College London
14.15 Lecture/Demonstration*
'AIDS - The First Ten Years'
20.00 International Cabaret at Carisbrooke Hall

Saturday 7 August
10.00 Lecture/Demonstration*
'Colour is Fun'
14.15 Inter Hall Rounders Match in Regent's Park
Optional Theatre Visits

Sunday 8 August
09.00 Optional Day Excursions to
(a) Hampton Court and Windsor Castle
(b) Brighton
20.00 Feature Film in College Hall
'Kind Hearts and Coronets'

Monday 9 August
10.00 Seminars led by Former Participants*
14.15 Lecture/Demonstration*
'The Shape of Things to Come'
20.00 Songs of Home - folk songs in College Hall

Tuesday 10 August
10.00 Participants' Forum*
14.15 Lecture/Demonstration*
'The Immune System and its involvement in Cancer Diagnosis, Therapy & Management'
16.00 CLOSING CEREMONY
20.00 Farewell Disco at the Carisbrooke Hall

Wednesday 11 August
Departures

**Events marked thus take place at the Institution of Electrical Engineers, Savoy Place, London WC2R 0BL*

PRINCIPAL LECTURES & DEMONSTRATIONS

Thursday 29 July 4.15 *'Chaos & Fractals in the World Around Us'*
Dr Gareth H McKinley, BA MA(Cantab) PhD
Assistant Professor of Engineering Sciences,
Harvard University, United States of America

The apparently irregular and random behaviour of many natural biological and physical systems is often described as chaotic and is considered to be beyond simple mathematical description. However, over the last fifteen or so years mathematicians and physicists have come to realise that underlying the apparent randomness lies a high degree of mathematical order. A process may be completely deterministic, ie governed by simple differential equations, yet its outcome can remain completely unpredictable in advance. This lecture will introduce some of the basic mathematics used to describe such nonlinear processes, including the concepts of *limit cycles* and *strange attractors* together with simple computer-based simulation techniques which can represent the result of chaotic processes as *fractal objects*, or geometric shapes with a fractional dimension. The wide variety of natural processes which can be described with these concepts will be illustrated with examples drawn from the fields of chemistry, physics and medicine.

Saturday 31 July 10.00 *'Chemistry and Light'*
Dr Andrew Mills, BSc PhD GRSC
and Dr Peter Douglas, BSc PhD
Department of Chemistry, University of Swansea

The aim of the lecture is to increase the awareness of the audience of the importance of photochemistry in our modern world. The lecture begins with a series of illustrations to show how light may be generated electrically, thermally and chemically. In some cases light can generate light and this is demonstrated by the luminescence of everyday objects such as plastics washing powders and drinks. We then look at the uses of chemistry and light and highlight its applications in medicine, communications, electronics, photography and plastics through a series of demonstrations. Finally we consider ways in which sunlight, an alternative source to fossil fuels,can be converted into electricity or a chemical fuel with *state of the art* devices.

Monday 2 August 14.15 *'Split Brains – Split Personalities'*
Dr George Savage, BSc PhD
Department of Physiology, Department of Basic Medical Science
Queen Mary & Westfield College, University of London

We take it for granted that the two sides of our bodies are virtually identical. Some organs like the heart lie to one side of the midline, however, and often the closer we look the less symmetry we see.

The human brain, on the other hand, does look symmetrical. Despite this, it was realised as long ago as 1836 that the two halves of the human brain do not function identically. We shall look at what modern work has shown us of such differences. Because the two halves of our brain work differently, they must continuously be kept in contact, so that we have the experience of being single personalities.

Our main sense organs, the eyes, send information to the brain and from the information they provide, we form maps and models of the world outside. In order to build up a picture of the world as a whole, we require some link between the two halves of the brain, to fuse the two half world maps into one whole. This integration is done by way of *commisures*, which are bands of nerve fibres running across from one side of the brain to the other.

Earlier this century, in an attempt to alleviate disease, neurosurgeons first split the major commisure between the two sides of the human brain. Surprisingly, there were few obvious effects, and some surprisingly simple tests show us that in such a person we have two separate systems (or should we call them . . .sonalities?) with which to communicate. Do they have separate memories, characters and consciousness?

Wednesday 4 August 20.00 *'Images from Space'*
J. Islwyn Thomas, BSc
Defence Research Agency, Carnborough

Observing objects dates back to the cave man but keeping a record of the observations arose out of photography developed during the First World War (1914-1918). These prints now seem archaic when compared with modern methods of satellite observation. Digital images have replaced the traditional photographs. Meteorological Earth resources satellites such as Landsat and Spot enable scientists to monitor changes in our environment.

The lecture will demonstrate the many applications of satellite images.

Friday 6 August 14.15 *'AIDS - the first 10 years'*
Dr Miguel Forte, LicMed(Lisbon) DTM&H(London) PhD (Birmingham)
Consultant in Infectious Diseases
Santa Maria Hospital, Lisbon, Portugal

Several explanations, not all of them very scientific, were put forward for the pathogenesis of this disease when it appeared mainly in a few specific high risk groups.

In 1983-1984 research groups in France and in the United States discovered the Human-Immunodeficiency Virus (HIV.) This virus became the youngest member of a long recognised, but little known family of retroviruses. The members of the family possess the unique ability of handling genetic materials backwards and produce diseases in animals and humans, mainly cancers

The HIV1 and HIV2 are particularly lucky viruses in the fact that in the evolutionary distribution of pathogenic mechanisms, they were given the best chances of eluding the very elaborate and effective defence mechanism against infection – the Immune System.

By attacking the controlling centre of the immune defence HIV produces a disease which opens the way to unusual infections during the several stages along a path that may lead to death. In causing death of the infected host it ultimately fails, killing what supports its own existence.

Our effort in the fight against the virus has many facets, ranging from the clinical prevention to the medical and psychological support of those already affected.

Saturday 7 August 10.00 *'Colour is Fun'*
Dr Arthur Tarrant, PhD, FInstP FCIBSE CPhys CEng
Honorary Fellow, University of Surrey
assisted by Mr K J George, MIScT

The precise specification of colour is vital to many branches of science and industry, and particularly the consumer industry; just as we have been able to specify engineering dimensions with tolerances, so we have to be able to specify colour with tolerances. But colour is not just a physical thing like the diameter of a crankshaft, it is a psycho physical phenomenon which occurs as our eyes and brain try to make sense of the physical signals that come into them.

The lecture will describe the processes by which a specification of a colour can be achieved, and will go on to examine some of the many factors that may affect the appearance of colours. It will indicate how a plain commercial problem can on analysis offer an intellectual challenge of the highest kind to scientists and will convey something of the delight of the scientist who works in this field.

Monday 9 August 14.15 *'The Shape of Things to Come'*
Professor Brian F G Johnson, FRS
Professor of Inorganic Chemistry, University of Edinburgh
President Elect London International Youth Science Forum

The shape of a molecule is a subject of intense scientific research, both from the academic and the industrial point of view.

The purpose of the lecture will be twofold :

1 To illustrate the way in which ideas of shape have developed over the centuries.
2 To show how this view pervades modern chemistry.

Tuesday 10 August 14.15 *'The Immune System and its Involvement in Cancer Diagnosis, Therapy & Management'*
Dr Richard O'Kennedy, BSc PhD MIBiol MIBiolI DipFS DipC DipCS
Head of School of Biological Sciences
Dublin City University, Ireland

The immune system is a vital part of the body's defence mechanism, that detects and destroys disease and removes *worn out* components. Recent advances in research on cancer have highlighted the role that the immune system plays in the detection, development and elimination of tumour cells. This lecture will examine these studies and describe how we can use components of the immune system to detect, localise and destroy malignant cells and tissues. For example, scientists have now managed to manipulate the immune response so that antibodies can be produced, labelled with drugs, toxins or pharmaceuticals and targetted to tumours. It is also possible to produce a range of antibody derivatives that may provide novel ways of detecting and treating cancer. New sensors are also under construction that allow the detection of tumour-related molecules secreted by cells, which have been characterised and may act to destroy or inhibit tumour growth. By combining basic knowledge of the molecular events occuring in cancer development and immunological approaches the potential for understanding and treating cancer can be greatly increased.

All of the above events take place at The Institution of Electrical Engineers, Savoy Place, London WC2R

SPECIALIST LECTURES

Monday
2 August

10.00

Lecture A

'Ecstasy or Agony? Potential Neurotoxic Effects of the Psychoactive Drug Methylenedioxymethamphetamine (MDMA)'

Dr Marcus Rattray, BSc PhD
United Medical & Dental Schools, Guy's & St Thomas's Hospitals, London

The psychoactive drug 'ecstasy' (methylenedioxymethamphetamine) is a widely used illegal substance, but the consequences of its effect on people are not well known. Over the past decade evidence has accumulated from studies on animals that this drug may be a potent neurotoxin. Upon administration of between four and eight high doses of the drug the level of a chemical, serotin, drop to very low levels. Nerves which contain serotin become broken and abnormally swollen. Since many thousands of young people regularly use this drug, it is clearly important to determine what the long term effects actually are.

In this presentation, I will describe the ways in which ecstasy is thought to produce its psychoactive effects, and how the drug may cause death of nerve cells. As well as introducing the role of the chemical neurotransmitter serotin, in the function of the brain, my presentation will include details of recent work from my own laboratory, where we study the ways that drugs influence the activation of genes in specific types of nerve cells. I will also discuss the problems and similarities of extrapolating findings from animal studies to humans.

This lecture has been arranged by the Biochemical Society

Lecture B

'Exploration of the Solar System'

Professor Alan Johnstone, BA MSc PhD
Mullard Space Science Laboratory, University College London

Over the last 30 years most of the large bodies of the solar system have been visited by spacecraft from Earth. They have revealed a richness and variety of worlds which are fascinating in their own right but which, when compared with the Earth help us to understand much better our own place in the Universe. Amongst the discoveries there have been many new planetary satellites, volcanoes, both alive and dead; massive canyons, hostile atmospheres; methane seas; and radiation almost as intense as in the heart of a nuclear reactor. I will review these discoveries and attempt to draw some conclusions about their implications for the Earth.

Lecture C

'Elementary, my dear Watson'

Martin L Perkins, MA(Oxon) CMath FIMA FRSA
Senior Master and Head of Mathematics
St Olave's Grammar School, Orpington

'Mathematics' said Bertrand Russell 'may well be defined as the subject where we do not know what we are talking about, neither whether what we are saying is true.' In this lecture we shall be considering together the roles of logic and other rational processes in extending and confirming our knowledge. We will cover reasoning and inference – how much we can safely assume? – looking at formal methods and the contributions of John Venn and Lewis Carroll. We shall look at the differences and similarities between scientific proof and mathematical proof and examine more closely some methods of proof. We shall consider deduction, induction and proof by contradiction, for, as Sherlock Holmes would remind us, 'when you have eliminated the impossible, whatever remains, however improbable, must be the truth.'

Approximations to the truth, and even lies will lead to a consideration of fallacies, false proofs and paradoxes, starting with the Greeks such as Zeno and Epimenides and coming through to the twentieth century and Russell. We shall include in our discussion, logical paradoxes, paradoxes of the infinite and visual paradoxes. As Tweedledum remarked: 'Contrariwise, if it was so, it might be, and if it were so, it would be; but as it isn't, it ain't. That's logic.'

Lecture D

'Proteins, Stuctures and Molecular Properties'

Dr Sheena E Radford, BSc PhD
Centre for Molecular Studies, University of Oxford

The size and the apparent complexity of typical proteins may make the understanding of their role and biological function a seemingly impossible task. However, once a few principles of protein structure are grasped, proteins can be comprehended and even admired, and their biological properties can be rationalised.

The first step is to recognise the individual building blocks which make up a protein and to become familiar with their properties. Next we will look at how these units are linked in the finished protein.

We will then review several known protein structures and see how Nature uses certain functional domains in many proteins and how the same basic framework is used in a variety of proteins with many different functions. We must also realise how important the shape of the protein is to its eventual function.

Finally, we will discuss one of the currently most exciting areas in the study of proteins. 'How do these large and complex structures take up their correct shape?' and will look at some of the latest results from research in this area.

All of these Lectures take place at The Institution of Electrical Engineers, Savoy Place, London WC2

Friday
6 August

10.00

Lecture D

'Can We Afford High Tech Medicine?'

Dr Frances M B Catman, MB BS FRCP FRCR
Department of Radiotherapy & Oncology, King's College Hospital, London

Advances in medical treatment are constantly newsworthy. The public is led to expect more and more from the medical profession. Doctors and research workers find new techniques and the possibilities of new treatments stimulating and satisfy their desire to help their patients.

This has considerable implications for both developed and third world countries. The costs of care rise continuously as we can offer more treatment to patients. Doctors are drawn away from practising medicine in poorer countries to working in those countries where high-tech treatment is more widely available. How should we decide to spend our resources? How can we ensure that those resources are diverted to the areas of greatest need? Should medical advances be rationed and how should this be done?

The presentation will examine examples of medical advances and different ways of rationing resources in various parts of the world.

Lecture E

'Codemakers versus Codebreakers – An Introduction to Cryptography'

Professor Fred C Piper, BSc PhD ARCS DIC FIMA
Royal Holloway & Bedford New College, University of London

For centuries armies, governments and spies have been exchanging secret information over insecure (public) channels. The art (or science) of inventing secret codes is called cryptography while the science of breaking them is known as cryptoanalysis. In this lecture we shall look at some aspects of this fascinating 'duel' between the codemakers and the codebreakers and, in particular, look at the effect which computers have had on both sides.

The use of cryptography has broadened from its traditional (somewhat mystical and glamorous) arena and has spread to the financial and commercial sectors. Thus, in addition to discovering secret information, the codebreakers are now trying to rob banks and/or raid databases containing personal information about us. There is no doubt that cryptography now impinges on all our lives.

Lecture F

'Fossils, Evolution, and the Origin of Species'

Dr Peter R Sheldon, BSc
Department of Earth Sciences, The Open University, Milton Keynes

Fossils – the remains of ancient animals and plants – give us a historical perspective on evolution that cannot be obtained from a study of living organisms alone. Fossils are more easily found than most people realise and, unlike most progress in science today, significant discoveries are often made with little more than a hammer and chisel. The lecture will begin with illustrations of a wide range of fossils, and we shall see how organisms often get preserved in rocks for hundreds of millions of years.

One of the hottest debates in evolutionary biology concerns the pattern of change by which new species evolve from their ancesters. Until the mid-1970's it was generally believed that if a fossil record was complete we would see a continuous series of gradual changes between successive forms of life. The theory of punctuated equilibrium challenged this picture of gradual evolution. It was proposed that evolution took place in remarkable jumps, with new species appearing suddenly and then persisting with little or no change before becoming extinct. We will look at some of the latest evidence in this debate, including work on trilobites, beautiful extinct marine creatures distantly related to the crabs and lobsters of today. A recent general model suggests a surprising relationship between patterns of evolution and different environments.

We will end by discussing a variety of intriguing mysteries of evolution that remain to be solved in the years ahead.

Lecture G

'The Implications of Symmetry and Spectroscopy for DNA Drug Interactions.'

Dr Alison Rodger, BSc(Sydney) MA(Oxon)
Physical Chemistry Laboratory, University of Oxford

We all respond to the beauty of French cathedrals, and of the flowers in our gardens. Underlying our recognition of the beauty of these things, is their shape and symmetry. Symmetry is, in addition to being aesthetically pleasing, a useful tool in many chemical problems. Many molecules have high degrees of symmetry, including reflection planes and rotation axes. As the symmetry of a system is determined by the symmetry of its measurable properties, anything we can observe about a system has at least the symmetry of the system. This imposes restrictions or 'selection rules' on the way a molecule behaves.

In this lecture we shall look at some types of symmetry and also at the corresponding asymmetries. By looking at the fauna and flora of our world we can see many natural examples of symmetry on a macroscopic level. On a molecular level we have to rely on less direct means of determining a molecule's symmetry. A variety of spectroscopic techniques,including infra-red, X-ray crystallography, nuclear magnetic resonance and circular dichroism have proved particularly useful. Once the symmetry of a system is known, a number of deductions can immediately be made about its spectroscopy and reactivity. We shall consider some examples of this.

All of these Lectures take place at The Department of Engineering, University College London, Torrington Place, London WC 2

SEMINARS

Wednesday 14.15
4 August

Seminar 1 *'David Edward Hughes, FRS - Radio Waves and the Microphone.'*
Ralph Barrett, CEng MIEE

In 1879 David Hughes would have been found walking the pavement near London's Oxford Circus, holding an earphone to his ear. Using a needle and a coke detector he was listening to signals from a clockwork interrupter sending device, 500 yards distant, in his Victorian house. It was the world's first radio transmission.

Hughes had discovered radio waves nearly twenty years before Marconi. 'The whole atmosphere would have a momentary invisible charge, which became evident if a microphonic joint was used as a receiver with an earphone.'

The Globe newspaper recorded 'Hughes's experiments were virtually a discovery of Hertzian waves before Hertz, of the coherer before Branly, and of wireless telegraphy before Marconi. The clock had been held back twenty years.'

London born, American educated, Hughes invented a synchronous printing telegraph which made him his fortune. He then devoted himself to science, and after settling in London in 1857 he invented the instrument he named the microphone. 'It does for sound what the microscope does for vision.' He invented the metal detector; it was used to look for the bullet in President Garfield's body.

With numerous demonstrations, we will look at the work of Hughes and the principles of his inventions.

Seminar 2 *'Space Astronomy'*
Dr Graziella Branduardi-Raymont, PhD
Mullard Space Science Laboratory, University College London

Scientists in virtually all branches of astronomy make use of instruments in space to learn more about the Universe. Space is a harsh environment, satellites go through tough ground preparations, and are tested to the limit of destruction, to ensure they will survive launch and an extended life in orbit; precise ground calibrations are the key to the success of a satellite mission, if we are to disentangle with confidence the mysteries of the cosmos.

Once in orbit, reliable and frequent communications are the vital link by which commands are sent to configure with instruments for observations and useful data are retrieved. This is only the starting line for the space astronomer. The Universe is just beginning to unravel.

This is a fascinating, often personal, account of how space astronomy is carried out, and of some of the most recent and exciting astronomical discoveries. The focus is on some of the most energetic, violent and exotic objects in the Universe. The most dense stars, where energy production is more efficient than in nuclear reactions; the explosive death of stars; the mysterious power house in the active, ever changing nuclei of galaxies; the immense energies stored in the hot gases embedding galaxies in clusters; ultimately, the origin and fate of the Universe.

Seminar 3 *'Who Needs Nuclear Power?'*
Harry A Cole, CEng MIEE
Formerly of UK Atomic Energy Research Laboratory, Harwell.

Present and future world energy requirements are discussed and compared with the world's current resources. The relationship between standards of living and energy and consumption is considered and comparisons made between the richest and poorest countries in the world.

The political, economic, social, environmental and safety aspects associated with burning of fossil fuels (coal, oil, gas) are discussed and comparisons made with alternataive forms of energy and the introduction of conservation measures.

Reneweable energies (sun, wind, waves etc) are introduced and an assessment made of their likely impact on future energy requirements. Energy density, reliability and predictability are discussed and comparisons made with the established sources of energy. The present world nuclear power programme is reviewed and comparisons made between the installed nuclear generating capacities of various countries. Different reactor types are briefly discussed and an introduction given to the expressions 'nuclear fuel cycle,' 'reprocessing,' 'burn up,' and 'plutonium production.'

The seminar ends with a discussion on nuclear accidents, waste disposal sites and the relationship between nuclear power and nuclear weapons.

Seminar 4 *'Sebum, Stains & Surfactants: The Chemistry of Washing'*
Dr Christopher C Jones, BSc PhD CChem MRSC
Unilever Research Port Sunlight Laboratory

With 500 million articles washed every day, laundering clothes is arguably the most frequently deliberately carried out chemical process. The nature of the process has changed throughout history and today it varies widely around the world. The cleaning of articles involving a vast range of articles involves a vast range of science including physical chemistry, oxidation chemistry, photochemistry and biochemistry. This key elements of the underlying chemistry will be discussed to give an insight into the scientific complexity of a modern washing product.

This Seminar has been arranged by Unilever Research Port Sunlight Laboratory.

Seminar 5 *'Hello, who have we here?'*
Dr David Lowe, MB BS MD MRCPath MIBiol
Department of Histopathology, St Bartholomew's Hospital Medical School

In forensic medicine, the full identification of human tissues and secretions needs input from many scientific services. These include biochemistry to identify proteins, molecular biology to investigate DNA, haematology to type bloodstains, and histopathology to show a microscopic picture of the tissues and allow them to be examined for damage by poisoning, drowning, strangling and other untoward events. The most basic variable is the sex of the patient.

Relatively simple examinations of bones has allowed us for years to distinguish the remains of human beings from those of other animals and to determine the sex, weight and approximate height of a person, whether alive (using x-rays) or deceased. Some of the person's life history may also be apparent. New techniques of DNA fingerprinting permit almost certain identification of a person from any secretion that contains cells. It is now easier than ever to tell a man from a woman!

The ways of identifying a person will form the basis for discussion in the seminar and the practical session will include examples of bones, x-rays, DNA analyses, and blood grouping for participants to try their detective skills. The six ways of defining sex will become apparent.

Seminar 6 *'How to Assess the Environmental Effects of Pesticides'*
Dr Robin Toy, BSc PhD
Shell Research Ltd, Sittingbourne Research Centre

Pesticides are integral to most agricultural systems. They are used because they are toxic to fungi, insects and plants that are regarded as pests, but their toxicity means they have the potential to affect the wider environment, including non-pest species.

In this seminar we will discuss the investigations that are conducted during the development of a new pesticide to determine its potential to affect the environment. In such an investigation the challenge is to design studies that are appropriate to the properties and intended use of the pesticide. In addition, the research must be cost-effective and therefore the tests must be appropriate to the stage of development of the product. A testing programme therefore involves choices as to the sorts of tests that can be conducted and as to the specific design of individual tests.

In this seminar, the types of tests that are used to determine the environmental effects of pesticides will be introduced and we will discuss the design of a testing programme. We will then discuss how the results of such a programme are used to make hazard assessments and the consequences of such assessments.

This Seminar has been arranged by Shell Research Ltd, Sittingbourne Research Centre.

Monday 10.00
9 August

Seminar I *'The Physiology of Human Behaviour. What is known and what are the Perspectives'*
Ariane Bazan, Bachelor in Biology (Participant in 1986 and 1988)
PhD Student at Ghent University Hospital, Belgium

Stimuli are continually produced by man's natural environment. After being conceived by his sense organs, they eventually lead to a pattern of motor performance (such as eye, lip, and hand movements,) which we generally designate as 'behaviour patterns.' Associated events in the brain link these incoming (sensitive) and outgoing (motor) pathways. Indeed when neurons are activated simultaneously, they form a *network*, encoding sensitive information as a primary image of the perceived environment. Access is then gained to previously encoded networks and the neuronal activity shifts to associative areas, resulting in a new representation of 'reality' via a process of 'internalisation.' During decades, psychologists approached these cerebral events in terms of immaterial concepts. Nowadays, advances in neurobiology show us that underlying tissue structures and physiological pathways are entirely responsible for bringing forth a specific behaviour pattern to given stimuli. Schematically, three parameters determine the internationalisation process.

1 Genes are responsible for setting the principal features of a general and individualised pattern of neurological organisation.

2 During development, redundant neuronal and synaptical communications are eliminated via a process called 'epigenesis through selective stabilisation.'

3 Finally, a memory of past experience will facilitate certain synaptical connections.

It will be my aim to illustrate the physiological events underlying each of these stages.

Seminar II *'Water Use in Hill Slope Agroforestry Systems - Problems and Possibilities'*
Nicholas Jackson, BA(Hons) MSc British Council Research Fellow, 1990-91 (Participant in 1984)
Research Office, Institute of Hydrology, Wallington, Oxfordshire

In many parts of the Tropics forests are being cleared or degraded at a rapid rate, mainly to satisfy the basic subsistence needs of poor rural communities. Monitoring studies in the Sahel & East Africa shows a considerable reduction in woody cover in the past 30 years. Fuelwood provides 63% of the total energy consumption of developing African countries. One possible solution to the resulting problem of land degradation and desertification is the use of multipurpose tree species (MPT's) in agroforestry systems. These are able to fulfil several roles simultaneously - improving soil stability and fertility, providing shade, fodder and firewood.

The presentation will comprise data from field trials of agroforestry species in Israel and in Kenya, looking at potential uses of such species in improving productivity and water use efficiencies. The problems of implementing scientific recommendations at a local level will be discussed in the seminar.

Seminar III — *'Feline Immunodeficiency Syndrome'*

Judith Purdy, BVSc MRCVS (participant in 1985)
Department of Agriculture, Vererinary Science, Northern Ireland

The feline immunodeficiency virus was first recognised in the USA in 1987, during investigation into the causes of chronic immunosuppression in cats. It belongs to the lentrivirus family which also includes the HIV virus.

Examination of stored blood has shown that the FIV was around for many years before being recognised. The disease is now found worldwide and is the subject of much interest both from the veterinary profession and from those involved in HIV research, since there is an obvious comparison to be made.

The mode of transmission is thought to be via saliva inoculated into the animal by biting although research is ongoing concerning other possibilities.

The disease syndrome is rather vague due to the prolonged incubation and the variety of clinical signs determined by the nature of the secondary infections passing at the time. Diagnosis is more specific using ELISA technique for antibody detection and culture of the virus itself.

Unfortunately no specific treatment is available as yet and supportive therapy is all that can be offered. The advent of an antiviral drug capable of killing lentiviruses will be of enormous medical and world health importance and we must look to the scientists of today and tomorrow to find the solution.

Seminar IV — *'At the Speed of Light'*

L James St Ville, BA(Cantab) AMIEE (Participant in 1986)
Project Leader, GEC Marconi Research Ltd.

In the age of optical communications, are the days of electronics numbered? Is the time for all-opical processing upon us?

Since the development of high quality optical fibres in the 1960's we have all become used to the concept of communication with light. It is a most efficient and economic medium. Large volumes of information can be transfered at higher rates using a link that is cheaper, lighter and smaller than conventional cable. But many modern systems are ultimately limited by the shortcomings of electronics, as optical information is converted into electrical signals for switching, amplification and display.

Many researchers are looking at methods of including gain, modulation and processing using optical technology alone. Devices such as the distributed feedback laser Mach-Zehnder inter-ferometer, Febry-Perot etalon and the digital optical switch are the building blocks of these systems.

The Seminar will be looking at the state of current technology. We will enter into a discussion as to the limitations of electronics in composition with optics and will ask if the electronic computer will soon become obsolete.

Seminar V — *'Business and Science: The Unholy Alliance?'*

Nigel L Lee, MEng(Hons) ACCI MBA CIM (Participant in 1984)
Business Manager, Dwr Cymru plc

What do we think about when we think about business? Towering glass office blocks, Wall Street and Gordon Gecko, pin striped shirts and outrageous salaries?

Think again! Fifty years ago a letter travelled by ship from London to Tokyo. Today the Mitsubishi Corporation headquarters receives 4.5 million words every day from around the world. Scientific development and new technology change every facet of life. Consumer electronics sophisticated 16 Valve engines, optical fibres, computer aided design, even the humble washing powder is the product, and the victim of frenetic innovation.

What role does business play in these innovations? For every one product that reaches the market place as a success, between sixty and one hundred ideas and concepts will be rejected. Even when a product makes it 'to market' the chance of its failing is around 40%. So why bother with 'New Product Development (NPD) at all?

Victor Hugo once stated *'Nothing in the world is so powerful as an idea whose time has come.'* Understanding and improving the link between the laboratory and the market place has *never* been so important.

In the seminar we will discuss the process of 'New Product Development' and its relation to business strategy. We will talk about the management of the NPD process by drawing on many examples in a variety of industries, and together we will identify the problems along the tortuous path from test tube to test market.

Seminar VI — *'Hello, Is there anybody out there?'*

Matthew Rabinowitz
Co-Terminal Degree Student in Electrical Engineering & Physics, Stanford University, United States of America (Participant in 1990)

Where does space end? When did time begin? From what is matter derived? How can we exist in four geometric dimensions . . . Well, quite honestly, I have not the faintest idea. In fact, I don't feel at all bad about my ignorance, because no matter how hard or how long we think of these fundamental questions, we are thinking in a vacuum. It seems that man lacks the neural connections fully to conceive of the answers. However, man has managed to overcome the limitations of human perception, and capture the answers anyway, in a mathematical web of conjectures that comprise modern physics. The Theory of Relativity and the mind-boggling consequences thereof focus our attention on the philosophical foundations of physics. In this seminar, by considering the relationship between the mind of man and the mind of nature, along with some simple Maths, I hope to made the relativistic perceptions of space, time and matter as commonplace as laws of classical mechanics.

From there, the seminar will consider the qualitative features of general relativity, as we look at the models by which we describe the fate of collapsing stars, black holes, and the methods used to discover more about them experimentally. This seminar is not a full scale mathematical onslaught of relativity . . . if it were, I certainly wouldn't be giving it! Rather, it may be considered a journey into the stranger realms of physics and the universe. The tour package contains some philosophy, some simple maths, and some pretty pictures of the cosmos. You will leave the seminar, I hope, with a feeling for space-time, an idea of what to expect if you ever fall into a black hole, and what to expect from friends if it should happen to them with you around.

HALF DAY VISITS TO INDUSTRIAL, RESEARCH AND UNIVERSITY ESTABLISHMENTS

Friday, 30 July

British Broadcasting Corporation,
  BBC Television Centre
British Gas plc, South Eastern Gas, Croydon
Chester Beatty Research Institute
  Institute for Cancer Research
City University Department of Aeronautics and
  Mechanical Engineering
Imperial College of Science, Technology & Medicine
  Department of Chemical Engineering
King's College London
  Chelsea Department of Pharmacy
  Department of Biophysics
Royal Naval College Greenwich
  Department of Nuclear Science & Technology
Royal Hospital of St Bartholomew's
  Department of Histopathology
University College London
  Department of Chemistry
  Department of Electrical & Electronic Engineering
Wellcome Museum of the History of Medicine
Wellcome Centre for Medical Science
Zoological Society of London Institute of Zoology,
  Department of Veterinary Medicine

DAY VISITS TO INDUSTRIAL AND RESEARCH ESTABLISHMENTS

Tuesday 3 August

BP Research & Engineering Centre,
  Sunbury on Thames
Esso Petroleum Company Ltd/Exxon Chemical Ltd
  Esso Refinery, Fawley
National Institute for Medical Research,
  Mill Hill, London
Nuclear Electric, Dungeness
Pfizer Ltd, Sandwich
Royal Botanic Gardens, Kew
Royal Air Force, Institute of Aviation Medicine
Royal Marsden Hospital, Sutton Surrey
RTZ Exploratory Bristol & SS 'Great Britain'
Rutherford Appleton Laboratory, Didcot
Shell Research Ltd, Sittingbourne Research Centre
Smith Kline and Beecham, Welwyn
Unilever Port Sunlight Laboratory, Merseyside
University College London
  Mullard Space Science Laboratory,
  Holmbury St Mary

VISITS TO OXFORD AND CAMBRIDGE

Thursday, 5 August

Cambridge
University of Cambridge
  Department of Chemistry
  Department of Engineering
  Physiological Laboratory
British Antarctic Survey
St John's Innovation Centre

Oxford
University of Oxford
  University Botanical Gardens
  Department of Engineering Sciences
Oxford Scientific Films Ltd

Details of the above visits are included in the 'Notes for Participants' printed separately.
Participants should select which visits they wish to join and indicate their preference on the form provided.

STUDENT TOPICS

Participants who wish to give a paper based on a project or investigation they have undertaken will be allocated a period during one of the sessions listed below. Papers will be grouped by category and a schedule giving summaries and details of presentation times will be circulated at the beginning of the Science Forum.

Friday 30 July
20.00 University College London
Engineering Building, Torrington Place,
London WC1
Lecture Theatres : G6, 421, 422, 508

Monday 2 August
20.00 University College London
Engineering Building, Torrington Place,
London WC1
Lecture Theatres : G6, 421, 422, 508

TOPICS FOR TONIGHT

Tuesday 3 August 21.00 **Informal discussions led by Science Forum staff.**

COLLEGE HALL **'Technology - Will we live to experience it?'**
introduced by Roberto Lenti

INTERNATIONAL HALL ***'Life — what is it, and why?'***
introduced by Ewan Jack

MUSEUM VISITS

The visits will be preceded by a group photograph which will be taken on the steps leading to the Main Entrance of the Natural History Museum.

Wednesday 4 August
10.00 Natural History Museum : Life Space Galleries
Cromwell Road, South Kensington,
London SW7

10.00 Natural History Museum :
Earth Science Galleries
Exhibition Road, South Kensington,
London SW7

10.00 Science Museum
Exhibition Road, South Kensington,
London SW7

SOCIAL PROGRAMME

Thursday 29 July
20.00 Welcome Disco
Carisbrooke Hall, Seymour Street, London W2

Saturday 31 July
16.30 Inter Hall Swimming Gala
University of London Union, Malet Street,
London WC1

Sunday 1 August
20.00 Feature Film : *'Blazing Saddles'*
College Hall, Malet Street, London WC1

Friday 6 August
20.00 International Cabaret
Carisbrooke Hall, Seymour Street, London W2

Saturday 7 August
14.15 Inter Hall Rounders Matches,
Regent's Park, London NW1

Sunday 8 August
20.00 Feature Film : *'Kind Hearts and Coronets'*
College Hall, Malet Street, London WC1

Monday 9 August
20.00 Songs of Home :
International Folk Song Evening
College Hall, Malet Street, London WC1

Tuesday 10 August
20.00 Farewell Disco
Carisbrooke Hall, Seymour Streete,
London W2

London International Youth Science Forum
PO Box 159
London SW10 9QX
United Kingdom
Tel: 071 373 4568
Fax: 071 835 1070

36th LONDON
INTERNATIONAL
YOUTH SCIENCE FORUM
27 July to 10 August 1994