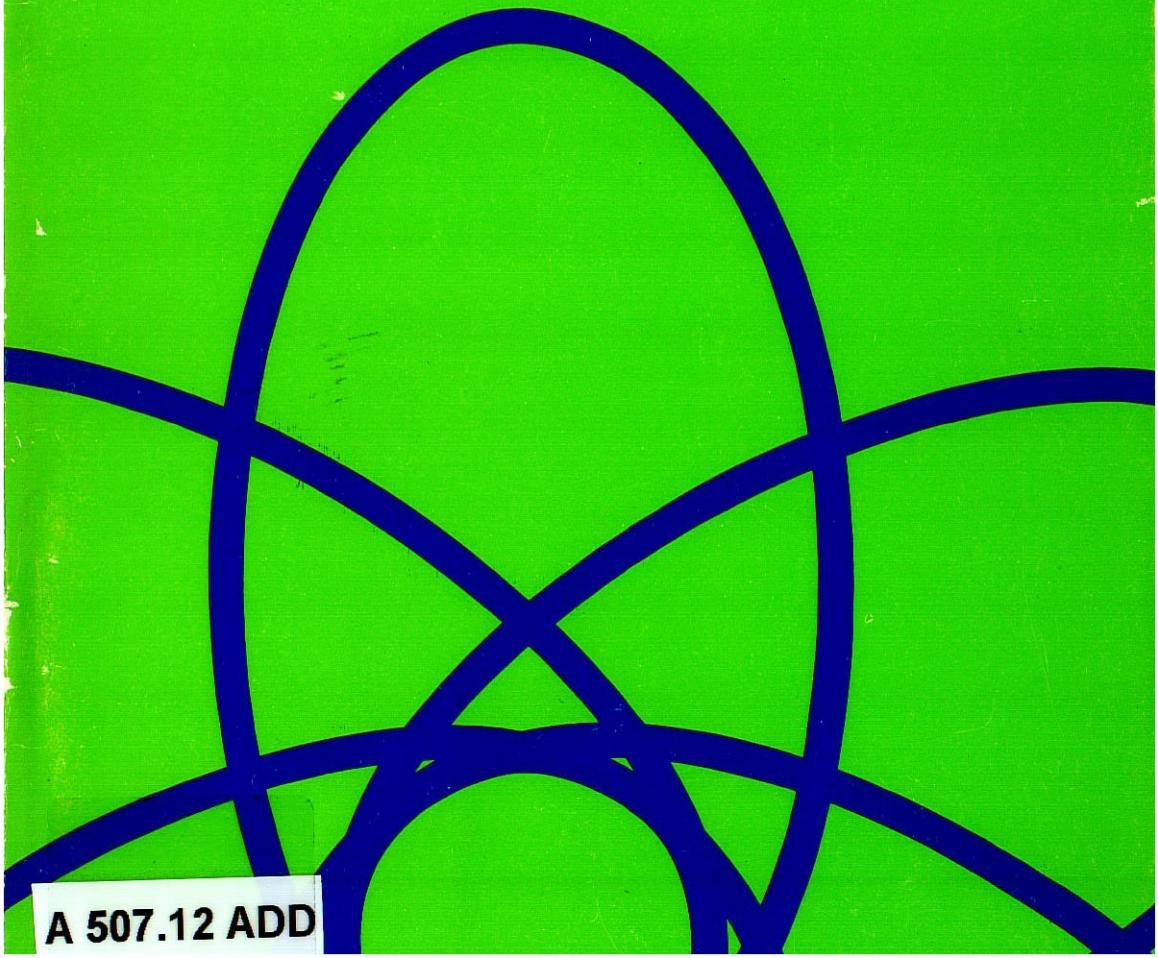
Science In a Social CONtext

TEACHER'S GUIDE



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John Holman

Science In a Social CONtext

Teacher's Guide

compiled and edited by

SUE ADDINELL and JOAN SOLOMON

ASSOCIATION FOR SCIENCE EDUCATION

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Introduction

SISCON, the movement for Science in a Social CONtext, began in 1970 as an association of college and polytechnic teachers of science studies. It included few school teachers since, by the terms of its funding, activities were confined to developing knowledge and materials for teaching at tertiary level. When these funds ran out in 1978, permission was sought to use the name of SISCON, and its scholarly expertise, to develop a school course. The idea received active support and a small financial contribution. This was used to hold a meeting for science teachers from London and the Home Counties at the University of London Institute of Education. As a result, a small group of teachers and educationalists formed a steering-group under the chairmanship of Professor John Ziman, and SISCON-in-Schools was launched.

The first draft of teaching units was sent round to SISCON members for criticism and comment. A second draft was printed by the Haringey Teachers' Centre, limited school trials were started, working meetings were held, and the long process of revision and retrialling began. The present eight books are the result of four more redrafts based on many helpful comments and much work by a number of school and sixth form college teachers who gave their free time and enthusiasm to the project without any recompense other than our very grateful thanks.

Both science teaching and the curriculum have been changing, with more emphasis being placed on the process by which we find out about science, and somewhat less on the body of knowledge. There has also been concern about the small number of girls studying science and the lack of opportunity for free expressive writing. It may be that both of these problems are related to the load of straight factual material which still has to be learnt, and also to an unwillingness to allow pupils to give their own evaluation of the uses and abuses of science.

Science teachers would agree, however, that the impact of science upon society – and *vice versa* – is enormous. There is no aspect of life in western societies which is not influenced by, and in many ways dependent upon, science and technology; and it is also evident that the direction which science takes, as reflected in priorities and

spending decisions, is determined as much by society as by any 'scientific inevitability'.

This course is intended to widen the scope of science teaching by helping pupils to arrive at an understanding of some of the critical interactions between society and science. Topics dealt with by the course include the role of government and industry in science; commercial applications of scientific findings; the role of the scientist in the production of food; the fight against disease; the development of modern weapons; the responsibility of scientists for the outcome of their work; the effects of science and new technologies on people's daily lives.

Most of the topics are complex and many are politically sensitive. Teachers need not feel unduly apprehensive about the vast breadth of possible subject matter that may be raised in discussion. The units provide a basic framework for both pupil and teacher and it is very important to realise that no-one is expected to 'know everything'. The teacher's role is to encourage pupils to make reasoned personal decisions about problems which may have several possible solutions; and teachers should see themselves as guides and arbitrators rather than purveyors of the 'right answer'. There is no reason why several members of staff should not operate together, pooling their knowledge for the benefit of pupils.

The course places great emphasis on pupil participation, so teachers need to provide a setting and a focus within which pupils are encouraged to discuss and offer their opinions.

The fact that some of the units raise topics with wide political implications should not be alarming. Sixth form pupils ought to be aware of these; they will soon be voting citizens. The materials in the course give them a chance to see different aspects of many major problems, so that they can reach their own conclusions. It is hoped that by confronting these problems, pupils will learn to be mature and active participants in their technological society.

It is the teacher's job to make sure that varying viewpoints are thoroughly considered; and while it is quite natural for teachers to express a personal opinion, it would be wrong for them to insist that such opinion is necessarily correct. One advantage of team teaching is that a variety of viewpoints held by different members of staff could be presented to a class for discussion.

In conclusion, it should be stressed that this course is not seen as a complete package. Rather, it may be looked upon as a framework into which other topics and other data can be inserted. The units are quite short and need take up only a portion of the teaching time. Teaching may differ substantially from one year to the next, according to the issues of concern to the pupils. The course allows for flexibility and it is hoped that it will provoke constructive thought about the challenging and important human aspects of the interaction between science and society.

Planning Details

WHO IS THE COURSE DESIGNED FOR?

The course is intended:

- for pupils who are of sixth form age or over;
- for pupils who do not necessarily have O-level or CSE level science subjects, but who will have studied a general science course in the first three years of secondary school;
- to be examined, or not, as the staff and pupils see fit
- to be taught as background for pupils taking either arts or science subjects in the sixth form;
- to be taught either wholly or as a part of a General Studies course open to any sixth form pupil.

HOW MUCH TIME IS NEEDED FOR THE COURSE?

If the course is to be examined at either A/O level or CSE level, the *minimum* amount of time needed to cover the course in one year is about *2 hours per week*. Most departments allocate two double periods per week (i.e., approximately 2 × 70 minutes on the timetable). Obviously, pupils will also be required to work in their own time on projects and background reading. It is advisable to have double periods rather than single periods, to allow sufficient time for good discussions to develop in class.

WHO CAN TEACH THE COURSE?

In an ideal world it would be stimulating for both staff and pupils if two teachers could be timetabled simultaneously to team-teach the course. However, such an extravagant arrangement is unlikely to happen except where large numbers of pupils are taking the course.

The more usual arrangement is for one science teacher to be responsible for organising the course and for bringing in colleagues from other disciplines to give a different viewpoint or to teach unfamiliar aspects of the course. For example, if a biologist was in charge of the

course, it might be helpful to invite an historian to discuss the social effects of the Industrial Revolution; and a physicist might be asked to teach the basic technical details of microprocessors.

Some schools might decide to have a sociologist or geographer as the person in charge of the course. The apparent disadvantage of a non-scientist teaching the course can be turned to an advantage when teaching a group of science specialist students, since they may then be required to present scientific evidence and to represent the scientist's view.

The course becomes disjointed if two teachers decide to take the class for half of the allocated time each week, especially if they also decide to teach different units. This arrangement has been found to be confusing and unsatisfactory for both pupils and teachers alike, since the interrelationships and themes which underpin the course can easily be lost. So it is not advisable, for example, for the physicist to teach the unit on the bomb during Monday's lesson, while the geographer takes the unit on pollution for Thursday's lesson.

PROJECTS

A/O level and CSE Mode 3

Candidates of both groups prepare an individually chosen project on a Science and Society theme. They should be given guidance in their choice by their teacher, and further advice while the work is in preparation. The length recommended is between 2000 and 6000 words, and should include a bibliography and a list of people or organisations which have given help. These projects are marked by the school and then moderated by the examination board. Marks are given for (**a**) initiative and sources, (**b**) presentation, (**c**) content, both scientific and social, (**d**) conflict of interest, (**e**) comment and personal evaluation. The highest weightings are given to the last three categories.

It is intended that this project will be researched and written in the pupil's own time, outside that allotted for lessons. It is essential that the subject is carefully discussed with the teacher *before* beginning the work. Topics will only be considered suitable if they have *adequate content of both a scientific and societal nature*.

Project Topics

The following list of *sample project titles* is presented to give some guidance on the selection of suitable topics. It is not intended to be either exhaustive or prescriptive.

1 *Problems of society alleviated by modern scientific advances but creating other problems*, e.g., heart disease; kidney transplants; breast cancer; nuclear energy; noise pollution.

2 *Alternative technology, alternative medicine*, e.g., windmills; community health in the Third World.

3 *'Abuses'* of *technology involving moral issues*, e.g., nuclear weapons; use of animals in scientific experiments; smoking; bottle or breast feeding.

4 *Historical Study*, e.g., vaccination; safety in coal mines.

Topics should have a core of science as well as including social implications. It is important that there should be a balance between these two areas. For some issues it may be difficult to achieve this balance, e.g., alcoholism, euthanasia – may have too little science content; space probes, engines, fast breeder reactor – can be too technical and have too little of the social implications.

EXAMINATIONS

It is possible to enter candidates for either A/O level (JMB) or CSE (Mode 3 LREB). The content of the syllabus is identical and is to be found in Appendix I of this guide.

A/O Level Examination (JMB)

At the time of writing, 1982-1983, this still has the status of a specially approved syllabus, which means that schools and colleges can only enter candidates if they are already JMB centres. However, a working party of the Board has been designing a syllabus for general release along very similar lines. This has now been approved for circulation to subject associations for comment. Assuming a favourable response, it will then be included in the Regulations and Syllabuses for 1985. The first examinations on it will be held in 1984, and a revised syllabus will be available, on request to the JMB, by May 1983.

CSE Mode 3 Examination (LREB)

The CSE examination is a school-based Mode 3, which means that London schools need a purely formal letter of permission from this school in order to use. Apply to:

School of St. David and St. Katharine,
Hillfield Avenue,
London, N8 7DA.

However should your local board not be the LREB, you will need to make your own Mode 3 submission. For this purpose you may use the LREB syllabus provided formal permission has been obtained by writing to the above address.

Format of the Examinations

The syllabus contains eight main sections, which are contained in the teaching materials provided by the SISCON-in-Schools project. The examination papers for both A/O level and for CSE (Mode 3) will largely consist of structured questions on the eight units. A short essay type question will be included on the A/O level paper.

A/O level Candidates

A/O level candidates MUST answer questions on the first TWO units (*Ways of Living* and *How Can We Be Sure?*) and then choose questions from any THREE other units.

There are also TWO COMPULSORY comprehension questions based on extracts from some suitable book or periodical.

Time allowance: 3 hours.

CSE Candidates

CSE candidates will be expected to have studied at least six of the eight units. In the examination, they have a free choice of any **FIVE** questions, which are to be answered on the question paper itself.

Time allowance: 2 hours.

For CSE candidates *only*, there is a *course work assessment*. This is carried out by the school on the basis of about six pieces of work done during the year. This constitutes a further 20 per cent of the mark allocation.

Both examinations will take place on the same date each year.

Allocation of Marks

CSE Examination		*A/O Level Examination*	
Examination questions	50%	Examination	75%
		Oral contributions to class discussion	5%
Course work assessment	20%		
Project	30%	Project	20%
	100%		100%

Ways of Teaching

1 STARTING THE COURSE

There are several ways in which different teachers begin the course.

Teacher A

'I get into Unit I in the third week of term after dipping into all the units for one discussion topic to start off the course. This allows me to link the introductions of Unit I and Unit VIII together, as a 'primitive' world view (with the benefit of hindsight), before starting on Unit I properly.'

Teacher B

'In small groups, the pupils are asked to consider and to make a list of the contributions made by Science to people's lives over the past 300 years. It is suggested that they think about the contributions made to just a few areas, e.g., Medicine, Communications, Food Production, War, and Work. Then, they try to identify the benefits, the risks and the hazards of each scientific advance.'

Teacher C

'The pupils are presented with a list of topics for group discussion. These topics serve as a provocative introduction to the course and also raise issues which are covered in greater detail in the units.' For example:

1 Modern medicines seem miraculous. Only fifty years ago, pneumonia was a killer, so, often, was bronchitis; both these common diseases are now treated with antibiotics. Yet the Thalidomide tragedy, and the problems associated with some new tranquilisers show that medicines can also *cause* illness. What can we do about it?
2 The threat of nuclear war, which could destroy human civilisation, is terrifying. Is it the fault of the scientists who invent the weapons, the politicians who employ them and make decisions, or us, the public, who elect the politicians?
3 Computers can now run factories with fewer and fewer people. This leads to unemployment. Should we do without computers?

4 Is it possible to live a full and satisfying life without work? Could we educate people for this?
5 If we lived in a simpler way, without modern technology, would we be happier or more miserable? Why do people blame technology?

Teacher D

This teacher had a very small group of only six pupils. She decided to start by simply reading the units with them, stopping when issues needed more expansion, or when questions were raised. As a way of introducing the materials, it was most successful, since it allowed the class to go at their own pace until their confidence developed.

2. EXPERIMENTAL WORK

The SISCON course is not intended to be a practical course where experimental work is carried out. In this respect, it is quite different from most science courses. But in several parts of the course, practical demonstrations would certainly add to the pupils' understanding of the issues, e.g., to really appreciate the importance of silicon chips, pupils should melt off the plastic and examine one under a microscope.

3 GROUP DISCUSSION

It can be quite hard to stimulate a productive discussion with a group of sixth formers so that it really *is* a discussion amongst themselves. This is how two teachers in a team structured their lessons to encourage discussion within a large group.

'We had the group for one 2 hour session on Friday mornings, its usual structure consisting of 45 minutes input (via a combination of visual and written materials, video/films or teaching), followed by a student-based activity, often in small groups. Towards the end of the session there would be some kind of plenary session that could carry forward to the following week, if required.

It seemed over the year that one of the most successful methods for involving *all* students in discussion was to divide them initially into groups of four, and then to set a given task or topic about

which discussion points were to emerge. A Group Recorder was usually then appointed and a strictly limited time (e.g., 15 minutes) allowed for discussion, at the end of which Recorders were required to report back to the class as a whole, and the points were collated in turn. It soon became clear that this group work was considerably more effective if we simply left the room, and then returned at the appointed time, as staff presence definitely had an inhibiting effect on the proceedings.'

It seems important to give the pupils a specific task to carry out so that their discussions are structured. One teacher, when beginning Unit II, *How Can We Be sure?*, gave out a set of universal statements to help the pupils to structure an otherwise quite difficult topic.

What kind of universal statements are the following:

a Walking under a ladder always brings bad luck.
b Parallel lines never meet.
c All solids expand when heated.
d Pedestrians have right of way on a crossing.
e All vertebrate animals have a backbone.
f All Abba's songs are good.
g God loves all people.
h Everything is made up of invisible atoms.
i All people are equal before the law.

What *purpose* do these statements serve? Could any of them be wrong?

4 USING FILMS

Using films can become expensive and a headache to fit into one's teaching schedule. However, many LEAs now have their own film and video libraries which offer free loans to schools. And very many films are available free of charge, for example, films produced by large oil or chemical companies, or government information films. Some film libraries, like ICI, are making their films available as video-cassettes for purchase only. So with forward planning it need be neither very expensive nor very difficult to use film as an integral part of the course (see Appendix III for list of film libraries).

Also, it can be interesting to show old films that were made ten or fifteen years ago and to ask a class to reflect on how attitudes have

changed, for example, films about insecticides which were made by chemical companies tended to present these insecticides as wonderful cure-alls which would solve the world food problem. There was little mention then of the detrimental effects that widespread and indiscriminate use of such chemicals could have on the natural environment. Similarly, as the energy crisis developed, even oil companies began to include short sequences on alternative energy sources in their films.

5 USING TELEVISION

One way of encouraging pupils to evaluate science in a social context is to set assignments based on *Tomorrow's World* or *Horizon*, etc. Pupils can be asked to select two or three of the new ideas presented in the programme and to suggest which idea is the most useful or valuable to us. Obviously, there is no one 'right answer' it depends on how they see the priorities of society.

Many programmes in the *Horizon* series are now available from BBC Enterprises. Although the topics are often relevant to the course, the treatment can be too technical for all but the most able sixth formers.

By checking in advance with broadcasting schedules, it is possible to spot a relevant programme and to encourage a class to watch the broadcast as a home assignment. This can then be used as the basis for a discussion in a subsequent lesson.

6 SIMULATIONS AND GAMES

Some of the many commercially produced games can be stimulating for the participants, and can lead to stimulating discussion on the outcome, e.g., games involving the siting of a new town, or a nuclear power station, or proposals for a new mining development in a national park. In such games, the differing attitudes and evaluations of the proposals by the various interest groups can be developed if pupils are well prepared in advance. However, some games prove very awkward to organise, taking too long or too short a time to play, and fail to involve the pupils' attitude towards these issues. They may also require a lot of calculation.

To overcome this, some teachers have devised their own simulation exercises based on local or topical events. Here are two examples.

Re-enacting a Legal Trial

On one occasion we re-enacted a trial which had recently caught the headlines in the press and on television.

A Down's Syndrome baby, with intestinal complications, had been born to parents who, after consultation with the doctor, expressed their wish that the child be allowed to die. The notice on the cot calling for 'nursing care only' was brought to the attention of the organisation 'Life' by one of the nurses. 'Life' then brought a case for manslaughter against the paediatrician, Dr. Arthur.

The mock trial called for a sizeable cast of both sexes:

Dr. Arthur and one medical character witness
Two legal counsel
The parents and a supporting witness (a mother who could speak of the agony of caring for such a handicapped child)
The nurse and the representative of 'Life'
A jury of twelve
The presiding judge (this was a teacher who had recently served on a jury and was keen to pass on his knowledge of legal procedure – in an abbreviated form).

We only had one hour, so all contributions had to be short. The worst passages were the attempts to cross-examine on medical matters: 'Is it true that the baby's intestines were in a mess?' However, the ethical and emotional points came out well, thanks to some excellent characterisations by 'the mother of the handicapped child' and 'the nurse'. I must admit to some barracking, but you could tell that the project had been a success in two ways: First was the deadly silence when 'the foreman of the jury' delivered the verdict, and secondly by the irritated comments of colleagues who reported that they could hardly teach their classes that day because of the heated private arguments about the trial that were still going on!

Public enquiry

In the second simulation, the teacher used a controversial local issue to show how the proposals of different interest groups can be presented.

'The local controversy over the future of Alexandra Palace had reached such a pitch that a public appeal to the Secretary of State for the Environment had been scheduled. It was not difficult to obtain free literature from the two local interest groups and from Haringey Council. Armed with this, we staged our own Public Inquiry. I was a rather unconvincing Michael Heseltine, and traffic, financial and environmental "experts" were appointed for and against the Council's proposals. Feelings ran high, arguments were sometimes a little wild and the final vote was close. I could not be sure that the whole exercise had been worthwhile until a small deputation asked if they could make arrangements to attend the real inquiry in January.'

7 USING MAGAZINES

The New Scientist is a rich source of background material for the SISCON course.

One way of using the magazine in class is to give out three copies of the same issue to three groups. Group One has the task of promoting the scientists' viewpoint. The second group are asked to promote the government's viewpoint, and the third group promote the view of the general public. A suitable article is then chosen for discussion and, after some preparation time, the groups have to defend 'their' viewpoint against the others.

Copyright: a reminder

The copyright law is complicated and teachers need to be wary about infringing it, since prosecution could result.

At present, teachers are entitled to record any television or radio output which is specifically designated for schools. These recordings can be used for three years only. This does *not* include programmes such as *Horizon*, nor *Tomorrow's World*, nor any current affairs programmes. These must not be recorded. Photocopying articles from magazines and books also infringes the copyright law, unless the author has specifically waived copyright.

Unit I Ways of Living

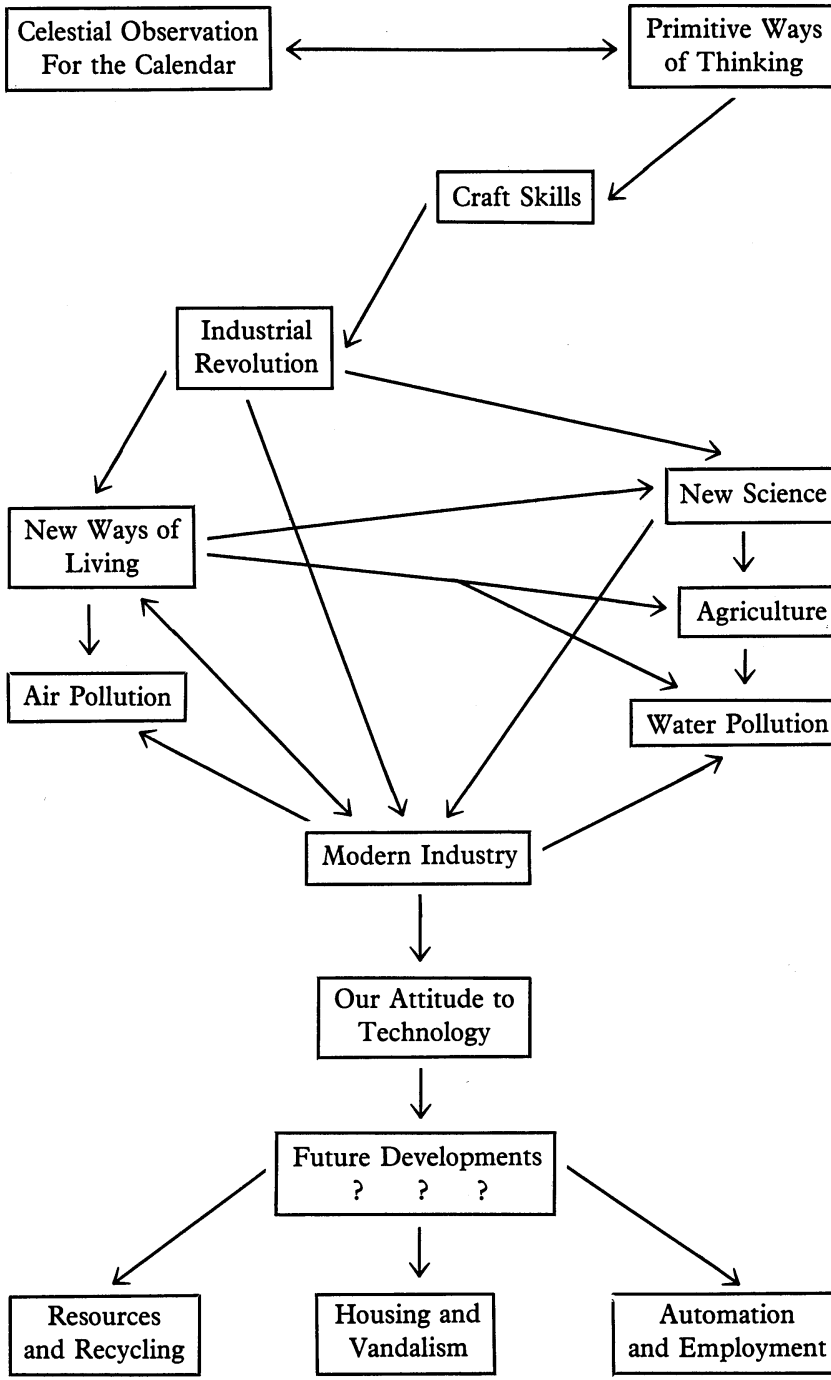
SUMMARY

This unit contains a good deal of environmental material which may be familiar to biologists, but also other environmental issues which are probably new. Its main aim is to show the interconnection between science and technology on the one hand, and the ways of living by society on the other. The important point to note is that each influences the other.

The unit begins with prehistoric astronomy in order to stand back from the present and to see how technology and science serve a community. The next section, which includes astrology, demonstrates the difference between primitive science and our own. Pupils often like to discuss astrology and sometimes conduct a questionnaire on it. The third section comes up to the present day. It shows the effect of technology and of industrialisation on our lives. From this change in living arise new sciences, like ecology. Ecosystems and the balance of nature need to be taught in connection with agriculture and water supply. A demonstration experiment can be carried out at this point to show Biochemical Oxygen Demand in natural waters. The last two sections are concerned with urban living. Air pollution is discussed including the lead-in-petrol issue and there is another demonstration here to show the corroding effects of sulphur dioxide.

The final sections are about the World's dwindling mineral resources and the possibilities of recycling waste, and about the effect on our lives of building technology and high-rise blocks of flats, and of automation in industry.

None of these is covered in great detail. Extracts from the news should suggest either extensions or new topics which demonstrate again the close interaction between science and technology, and our current ways of living.


Celestial Observation For the Calendar
Primitive Ways of Thinking
Craft Skills
Industrial Revolution
New Science
New Ways of Living
Agriculture
Air Pollution
Water Pollution
Modern Industry
Our Attitude to Technology
Future Developments ? ? ?
Resources and Recycling
Housing and Vandalism
Automation and Employment

1 *Spinning a gyroscope* This can be used to illustrate precession with reference to the movement of planets.
2 *Testing samples of water for BOD (biochemical oxygen demand) as an indication of pollution* (This is not strictly a BOD test, which involves a more complicated technique.)

If there is a lot of organic matter in the water, there is usually also a lot of bacteria. The micro-organisms feed on the organic material and rapidly multiply. Oxygen is consumed in aerobic respiration and the water rapidly becomes depleted of dissolved oxygen – so decolouring the methylene blue dye.

Use McCartney bottles with screw tops to collect the water samples. These must be filled *to the brim* so that no air bubbles are trapped inside.

Add 3-4 drops of 0.5 per cent aqueous methylene blue solution to each water sample and carefully screw on the tops. Each bottle must be labelled, kept in the dark and checked for a colour change over 5 days.

Ref: *Ecopack 4 – Water Pollution* 1979 Globe Education
Available through your normal book supplier or direct from Globe Education.

EXTENSION WORK

Books

Nuffield Secondary Science 1971 Longman
Theme 8 The Earth and its Place in the Universe
Theme 1 The Interdependence of Living Things

Nuffield Biology (Revised) 1974 *Text 3* Longman
Living Things and their Environment

Science at Work – Pollution unit 1979 Addison Wesley

Working with Science 1977 Longman Resources Unit
Various useful units, (e.g., Recycling, Pollution, Noise), designed specifically for sixth form use.

These four projects contain standard practical work on ecological and environmental topics, which could be used for demonstrations if teachers wished to extend the work in this unit.

Visits

Also applicable to Unit VIII on Space

London Planetarium Baker Street, London NW1 5LR. Tel: 01-486 1121

Greenwich Planetarium (Educational Liaison Officer) National Maritime Museum, Greenwich, London, SE10 9NF. Tel: 01-858 4422

London Schools Planetarium (for London schools) Wandsworth School, Sutherland Grove, London SW18 5PT. Tel: 01-788 4253

All three planetaria present a variety of programmes designed to cater for specific interests or age ranges. At Greenwich, the Old Royal Observatory contains a fascinating exhibition of the history of astronomy, with particular reference to navigation. At the London Schools Planetarium, there is an excellent Carl Zeiss instrument which is capable of showing some 5000 stars down to the sixth magnitude. The planetarium observatory room is open two evenings a week and those who are keenly interested may participate in observational sessions, using the various telescopes available.

Films (16mm)

Environment in the Balance (30 mins) 1958 Shell Films

Discusses the problem of industrial expansion, population growth and pollution. A useful general introduction, even if a little old.

The River Must Live (21 mins) 1966 Shell Films

Shows the causes of river pollution and some methods used to prevent it happening.

Air Pollution – a medical investigation of one aspect (17 mins) 1972 Central Film Library

The film is mainly concerned with vehicular exhaust pollution and how it affects people.

It Gets into Everything Heritage Series (25 mins) 1975 BBC Enterprises

Examines the conflict between farmers who cannot afford crop losses caused by insect pests, and conservationists who have established evidence that the balance of the environment is threatened by the extensive use of pesticides.

The Shadow of Progress (27 mins) 1970 BP Films
Another film which serves as an introduction to this unit; examines issues like pollution, overpopulation and the demand for finite resources.

Get us Kids out of Here (25 mins) 1976 BBC Enterprises
Part of the Signs of Trouble series on juvenile delinquency. Shows the effect of a depressed urban environment upon the children living on a Liverpool estate.

Rubbish Open University film (25 mins) 1977 Guild, Sound & Vision Ltd.
This deals with the recycling of reusable materials in domestic refuse. The film uses fairly technical jargon but it could be useful none the less. (Guild, Sound & Vision Ltd have recently deleted it from the catalogue with regard to hire facilities and Open University have also deleted it for 1983).

AVA Resources

Wallcharts
It is sometimes possible to borrow slides of the constellations from the public library and from science centres.
The Night Sky Daily Telegraph map. Published by Geographia Ltd., 63 Fleet Street, London, EC4.
Lichens and Air Pollution – Chart and booklet
Available from: Studio 2 Educational, 6 High Street, Barkway, Royston, Herts.

Tape-Strips
Only One Earth Set of 9 tape/strips £37.41
Individually: filmstrip and handbook £4.75; cassette £2.60.
Available from: Visual Productions, The Green, Northleach, Cheltenham, Gloucestershire GL54 3EX.

Sources of information

Bulletin of Environmental Education (BEE)
A monthly magazine for teachers – a guide to the theory and practice of environmental education, with emphasis on the urban scene and ecological problems.
Available from: Education Unit of the Town & Country Planning Association, 17 Carlton House Terrace, London, SW1Y 5AH.

Directory of Environmental Learning and Teaching Aids (DELTA) 1979

A comprehensive listing.

Available from: Council for Environmental Education, School of Education, University of Reading, London Road, Reading RG1 5AG.

DELTA is currently being phased out and replaced by *Environmental Education Resource Sheets* – a series of low cost pamphlets, details of which can be obtained by sending a stamped, addressed envelope to the above address.

Environmental Education – Sources of Information 1981 DES £2.95 (By post £3.19) HMSO

This booklet (84pp) is a guide to the services of over 200 organisations in Britain which are concerned with the environment.

Available from: HMSO, FREEPOST, London EC1B 1DD.

Unit II How Can We Be Sure?

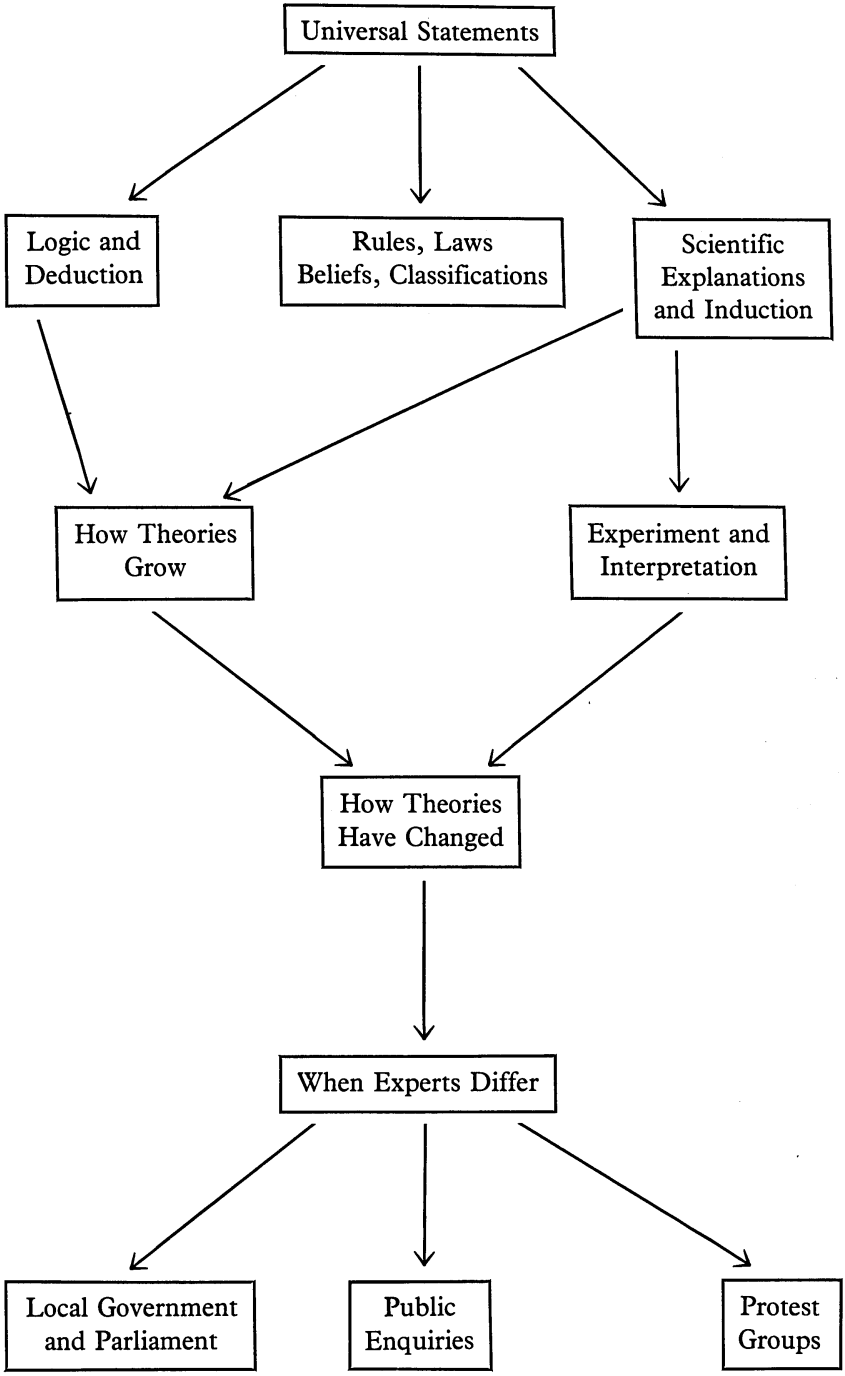
SUMMARY

The ideas discussed in this unit underpin the whole SISCON course. Some teachers prefer to teach this in conjunction with other units instead of tackling the unit as a whole at the beginning of the course. At the end, when pupils have discussed many examples of the way in which science progresses, the unit can be summarised.

Despite its unfamiliarity, the idea of a premiss (or universal statement) from which deductions can be made is not difficult for most children, provided they are given easy examples. It is important to make the point that science does NOT work this way. Any example taken from the history of science – the nature of light (rainbow), plate tectonics, the electron, the discovery of oxygen, evolution – will show the *imaginative* nature of the speculation, the *mechanism* which makes things happen, and the stream of new *experiments* and observations which it generates.

It is a good idea for the pupils to do an experiment, either to examine the movement of pollen grains in water, or to repeat one that they did earlier in school. Even heating an iron bar to show that it expands (and the theory which attributes this to the vibration of molecules) gives them something to latch on to. They soon begin to see that theories are not so much 'proved true' by experiment as used to interpret the observations we make (often they even influence our powers of observation). At this point, it might be possible to direct the pupils' attention to some new theory or experiment which has been reported in the *New Scientist* or on television. From this dimension of uncertainty and movement within scientific explanations, the unit goes on to consider the disagreements between scientific experts who are called upon to give advice on present social issues. It considers the impossibility of assessing future risks and the inevitable personal commitment of such scientists.

The last section of this unit involves citizen participation in decision-making on technological issues at central, local and protest group level. It is important and appropriate for this age group to appreciate the political responsibilities of all citizens. At this stage in


Universal Statements
Logic and Deduction
Rules, Laws Beliefs, Classifications
Scientific Explanations and Induction
How Theories Grow
Experiment and Interpretation
How Theories Have Changed
When Experts Differ
Local Government and Parliament
Public Enquiries
Protest Groups

their school career, young people should feel prepared to become involved, democratically, in controversial issues and not just to sit back and leave it to others.

EXPERIMENTAL WORK

Health Hazard Teachers wishing to carry out the investigation of 'movement' in pollen should ensure that there are no asthma sufferers in the class. Large quantities of pollen can cause an asthmatic attack.

EXTENSION WORK

Films (16mm)

The History of the Discovery of Oxygen (15 mins) 1948 Central Film Library
Arguments for the Phlogiston Theory and its explanations of burning and reduction are well given. An old film, now withdrawn from film libraries, but available from ICI as a video recording.
Available from: Geoff Cox, South London Science Centre, Wilson Road, London, SE5 (Postage outwards and return to be borne by the borrower).

The Wandering Continents (21 mins) 1962 Viewtech
A fairly old black and white film with long, beautiful sections on an expedition across the ice at Spitzbergen to locate old magnetic ore. Theoretical speculation gives rise to experiment which, in turn, provides evidence for the theory.

The Search for Solutions Nine 20 min films in colour USA 1980

Investigation; Evidence; Patterns; Adaptation; Context; Trial and Error; Modelling; Theory; Prediction.

These films are not interconnected in any way, and can be used in any order. The teacher's guide helps teachers to introduce the films and gives suggestions for follow-up work.

The sound quality is poor, but the photography is often beautiful. The films are all American in style and intended for younger pupils, so some teachers may find this inappropriate for their classes. Previewing these films is essential so that the teacher can

adequately prepare the pupils by putting the film into context – otherwise the films might seem vague and pointless.

Free Loan from Phillips Petroleum Film Library, 15 Beaconsfield Road, London, NW10.
Available in batches of threes, sent at monthly intervals. There is an A3 sized teacher's guide of 88 pages.

Reviewed in SSR *62*, 220, March 1981.

Unit III Technology, Invention and Industry

SUMMARY

This unit is not compulsory, as units 1 and 2 are, for the A/O level course. The introduction to the unit tries to bring out the features which help to make a new technology succeed. Then a choice can be made between a case study on Plastics or on Microelectronics. In each of these, there are instances of:

1 lucky chances exploited but not understood.
2 'market pull' due to some other new development within the community.
3 'breakthrough' when some relevant scientific puzzle has been solved.
4 technological research needed to apply the new invention.
5 problems with new production processes.
6 social effects of the new technology – foreseen and unforeseen, good and not-so-good.

Some practical demonstrations will be required to bring the material alive for the pupils. Teaching staff who are not physical scientists will need to consult their colleagues for advice on technical points and experimental demonstrations.

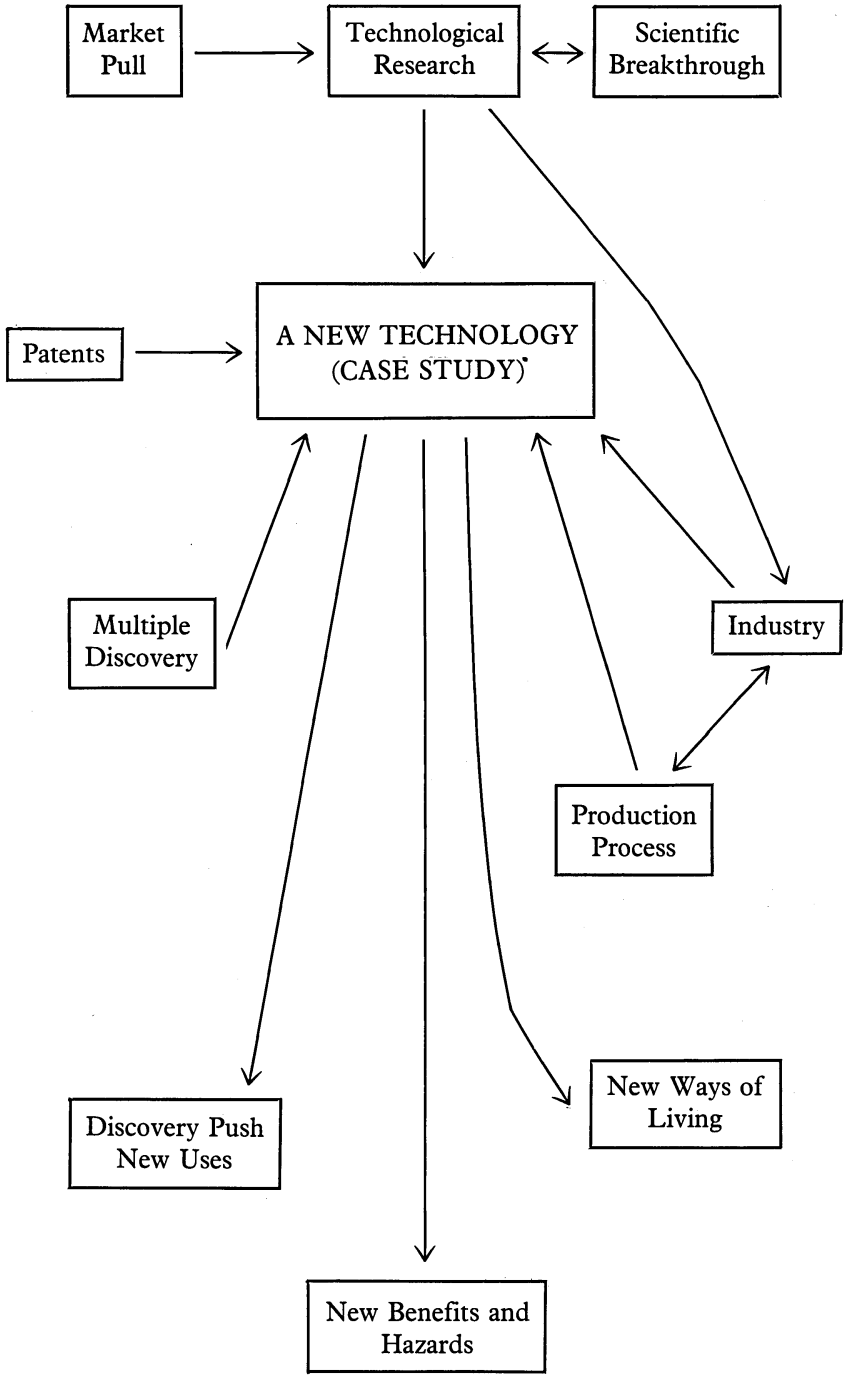
New Scientist is a useful source of exercises on new technologies. Pupils can practise distinguishing between scientific research, technological development and production (or process) development. The term 'R and D' (Research and Development) crops up in newspaper articles, so pupils need to understand what this means.

EXPERIMENTAL WORK

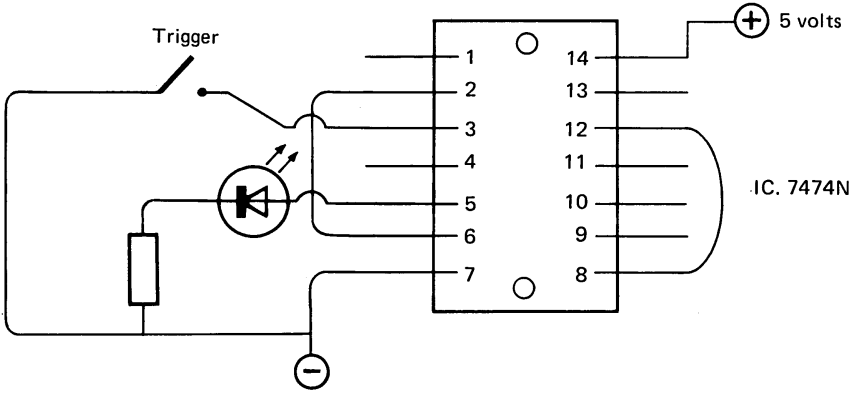
Transistors and chips

It is interesting for students to *examine transistors and chips* under a microscope so that they can fully appreciate their very small size.

To make a binary counter to 'remember' The trigger is activated by pressing quickly on a switch (or by a pulse of current). This turns on


Market Pull
Technological Research
Scientific Breakthrough
Patents
A NEW TECHNOLOGY (CASE STUDY)
Multiple Discovery
Industry
Production Process
Discovery Push New Uses
New Ways of Living
New Benefits and Hazards

part of the chip and the LED lights up. It will remain like that, 'remembering' what was done until the next pulse comes. Connecting 6 to 11 on the other side, terminal 9 will light another LED if it is also protected by a resistance and connected to 7. This is also controlled by the trigger but only when the first LED goes *off*, so it lights up only half as often as the first. In fact this is a 'divide by two' or simple binary counter.



EXTENSION WORK

Books

The Mighty Micro Christopher Evans 1982 Gollancz
Essential if you are doing the microelectronics option.

Disaster at Flixborough V. C. Marshall 1980 Wheaton
Covers the technical explanation for the disaster, its social and financial consequences and a discussion of the roles of government and management in limiting risk. Not too technical for non-scientists.

From Pills to Penicillin – The Beecham Story H. G. Lazell 1976 William Heinemann Ltd

Discussion Topics

The use of the pocket calculator as a social evil.
Social impact of computing systems.
Industrial Revolution – this could be linked with the History Department.

Visits

Fords, Dagenham or British Leyland, Cowley, Oxford to see the use of high technology robots and their effect in a factory.

Coalbrookedale, Ironbridge, Shropshire.
A visit here would be useful to reinforce any work being done on the Industrial Revolution.

Television Series

Will Tomorrow Work? BBC Shown Autumn 1982
These programmes explore the effects of new technology on our lives.

Films (16mm)

The Amazing Laser (28 mins) 1979 Central Film Library
This film examines some of the new possibilities opened up by lasers and shows how the laser is providing the answer to some of the most challenging technological problems.

The Industrial Revolution in England (25 mins) 1965 Encyclopaedia Britannica Films
The transformation of the English economy by a technological revolution is described with reference to three inventions. Hargreaves' spinning jenny, Cartwright's power loom and Watt's steam engine. Useful teaching notes.

Discovery – Penicillin (12 mins) 1964 Central Film Library
The story of penicillin, told using animation and live action, from Fleming's original discovery in 1928, to the research of Florey and Chain in the 1930s, and to work in Oxford in the 1950s. Examines the wartime increase in the production of the drug.

The Discovery of a New Pigment (40 mins) 1950 Originally made by ICI films (now withdrawn)
A superb story, tracing the development of one of the first of the post-war dyes, from a 'lucky' accident to technological and scientific breakthrough.
Available from: Geoff Cox, South London Science Centre, Wilson Road, London, SE5.

The Polyolefins (26 mins) 1964 Shell Film Library
Despite its title, this is a very simple film which is mostly concerned to show how the right plastic is chosen, or modified, for any one of several separate jobs.

Unit IV Evolution

SUMMARY

In discussing Darwin's ideas on evolution, it is important to bear in mind that most pupils, even those who have studied evolution to A-level in biology, tend to hold a Lamarckian interpretation of evolution, i.e., that organisms can gradually adapt to a change in the environment if they need to, and hence, evolve. The differences between Lamarckian and Darwinian theories need to be carefully pointed out.

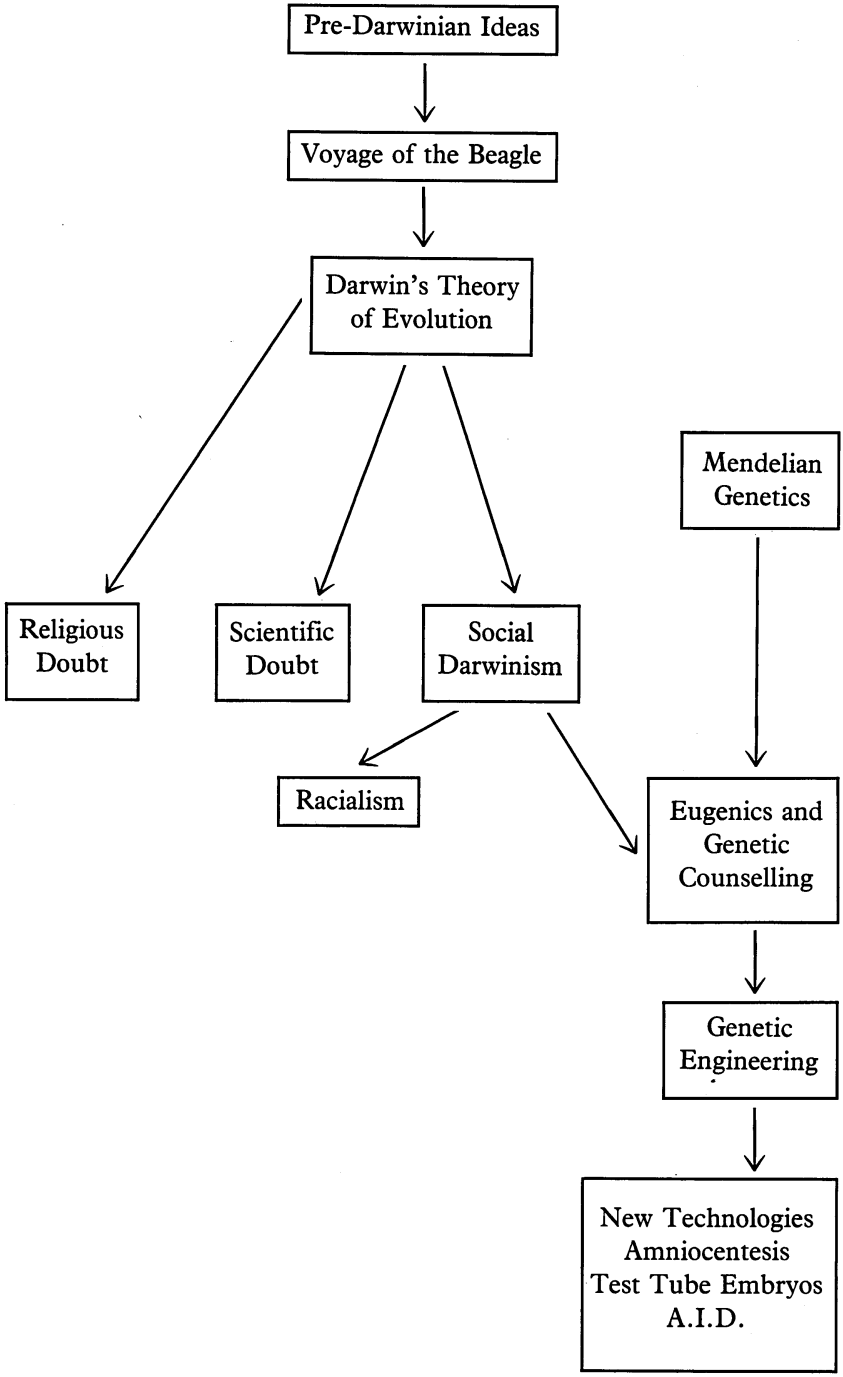
The first part of the unit concerns the voyage of the *Beagle* and the emergence of Darwin's theory. The human incidents on this voyage can be stressed to show how Darwin was affected by the plight of the South American Indians, Tasmanian Aborigines, etc. Social Darwinism and the early crude forms of Eugenics allow for plenty of indignation and offer a challenge to pupils to think out their attitude towards less fortunate people. The debate in the USA about teaching 'Evolution' and 'Creationism' is not stressed, since it is mentioned in Unit II, *How Can We Be Sure?*

The second part of the unit starts with some simple facts about genetics in order to make sense of moral, medical, and legal dilemmas connected with genetically handicapped babies. There is no shortage of newspaper articles about these. Genetic engineering (or manipulation) has been mentioned because of its important technological potential, but the technical details are not expected to be learnt by pupils.

EXPERIMENTAL WORK

Nuffield Biology (Revised)
Text 4 The Perpetuation of Life 1975
Useful as a resource for data as well as standard genetics experiments.

Nuffield Secondary Science
Theme 2 Continuity of Life 1971
Concentrates mainly on human inheritance and variation.


Pre-Darwinian Ideas
Voyage of the Beagle
Darwin's Theory of Evolution
Mendelian Genetics
Religious Doubt
Scientific Doubt
Social Darwinism
Racialism
Eugenics and Genetic Counselling
Genetic Engineering
New Technologies
Amniocentesis
Test Tube Embryos
A.I.D.

Books and articles

1 These two articles could be used as references by teachers who wish to investigate the status of Darwin's theory as a scientific theory:
Darwinism and Indoctrination
G. H. Harper, 1977. The School Science Review *59*, 207, pp. 258-268.
Alternatives to Evolutionism
G. H. Harper, 1979. The School Science Review *61*, 214, pp. 15-27.
2 There is as yet no published material on issues such as *punctuated equilibria* which is suitable for pupils, but there are occasional articles in the *New Scientist* which may be useful.
Evolution by Colin Patterson, 1978 (Routledge & Kegan Paul). An account of modern evolutionary theory which is designed for those with little technical knowledge of biology. A useful reference for teachers.

Visits

Origin of Species Exhibition Natural History Museum, Cromwell Road, London.
Downe House (Darwin's home), near Bromley, Kent. (Telephone Farnborough 59119 for details.)

Films (16 mm)

Evolution in Progress (16 mins) Silent or sound 1956 Scottish Film Library. On the mechanism of evolution and industrial melanism in the peppered moth.

Genetics – Mendel's Laws (15 mins) B/W 1964 Viewtech and many film libraries.
On Mendel's laws of inheritance.

Darwin and the Theory of Natural Selection (12 mins) 1967 Viewtech

Genetics and Society 1979 BBC Enterprises
1 *The Discoverers* (25 mins)
On genetic engineering.
2 *Genetics and Food Production* (25 mins)

Blueprints in the Bloodstream (50 mins) Horizon programme; BBC Enterprises.
About the possibility of tissue-typing at birth so that babies could be screened for a wide range of disabling and crippling diseases.

My Children, My Children BBC Enterprises

The Genetic Chance (55 mins)
Haemophilia is an hereditary disease which occurs only in men yet is carried only by the female. Amniocentesis now makes its possible to determine sex and so offer parents an abortion of a male foetus. But there is a 50-50 chance that the male child will be normal.

Television

Evolution (for A-level Biology) and booklet 1981 Granada TV
Comprises ten 20-minute programmes for sixth form students showing evidence of evolution, how natural selection works and how mutations arise.

The Clyne Affair (50 mins) 1981 Horizon programme, BBC (not yet in film library)
A programme about the ethics of genetic engineering. Dr. Clyne, an American doctor and medical researcher, attempted to help people suffering from inherited blood diseases by using genetic engineering. Since he had not been granted official consent, his research was considered unethical, and this led to his being discredited.

Filmstrips

1 *Evolution of Man*
2 *Cultural Evolution*
Available from: Educational Products Ltd, Bradford Road, East Ardesley, Wakefield, WF3 2JN.

Sources of information

Evidence against Evolution
Evolution Protest Movement 'Santhia', 110 Havant Road, Stoke, Hayling Island, Hants.

Schools Council General Studies Project: Genetics and Evolution Pack
A pack of booklets on human genetics, genetic engineering, human evolution, theories of evolution, etc. Material for the booklets is

culled from newspapers, items from books, etc., and is designed for sixth formers.

N.B. It may shortly go out of print, but it is a useful pack to look out for. Available at present from: Longman Group Ltd., Resources Unit, 33/35 Tanner Row, York, Y01 1JP.

Unit V The atomic bomb

SUMMARY

With the possibility of CND badges winking from all corners of the classroom, this unit starts coolly with some discoveries in pre-war physics, stressing the international aspect of the scientific endeavour.

Teaching the necessary scientific understanding of fission is not as difficult as explaining how the decision to drop the bomb was made. It is important that pupils appreciate the *scientific*, *human*, *political* and *military* implications in this decision because these are all involved in the present disarmament debate.

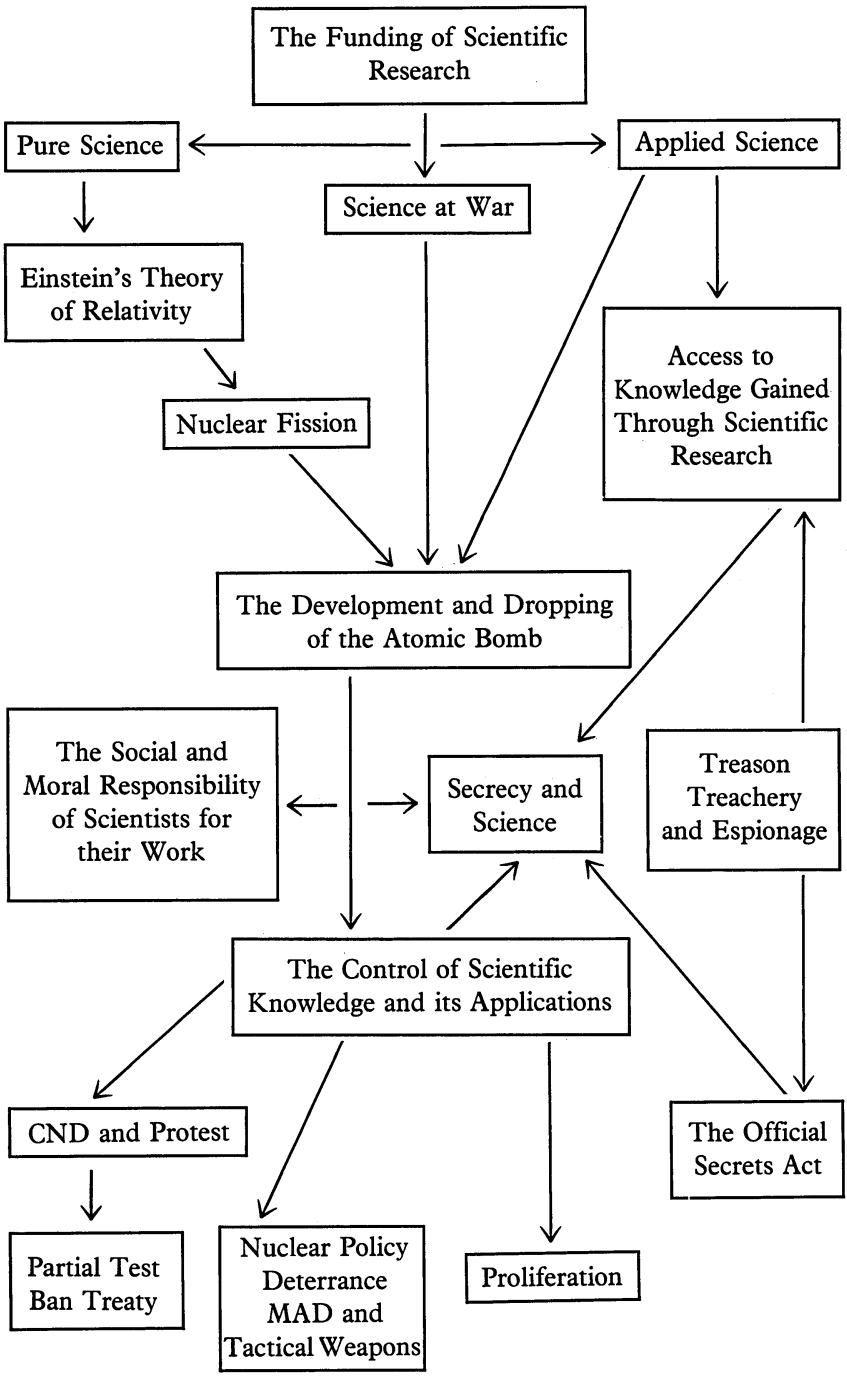
The stories of the 'Atom Traitors' and some information on the Official Secrets Act are given to provide substance for any discussion on the scientist's role and responsibility. Many points of view are possible and without either defending or attacking scientists, it should be possible for pupils to see a role and a responsibility for citizens in any political decision.

At the end of the unit there is a section on the strategy of Mutually Assured Destruction, on the Non-Proliferation Treaty and on limited tactical nuclear weapons. The subject has *not* been brought up to date because the situation is continually changing. (There is no specific mention of Cruise missiles, Trident or the Neutron bomb.) It would be very valuable for a class to pursue any of these topics, or to discuss the aims and activities of groups such as CND if they wish to. Pupils do need to have understood the concept of 'nuclear deterrent' in order to argue about it.

Some teachers might decide to include more details about the personalities involved in the bomb debate, e.g., Oppenheimer and Teller.

EXPERIMENTAL WORK

To put nuclear weapons and nuclear energy (Unit VI, *Energy*) into perspective, it is helpful if pupils have some understanding of


The Funding of Scientific Research
Pure Science
Applied Science
Science at War
Einstein's Theory of Relativity
Nuclear Fission
Access to Knowledge Gained Through Scientific Research
The Development and Dropping of the Atomic Bomb
The Social and Moral Responsibility of Scientists for their Work
Secrecy and Science
Treason Treachery and Espionage
The Control of Scientific Knowledge and its Applications
CND and Protest
The Official Secrets Act
Partial Test Ban Treaty
Nuclear Policy Deterrance MAD and Tactical Weapons
Proliferation

radiation. The variation in background rate around Britain and around the earth should be appreciated.

Simple demonstrations can be carried out by using a *geiger counter* to measure the radiation all around us, and to compare this with the radiation from granite or an old luminous watch face.

Safety Note Any teacher wishing to carry out practical work, *including* the two demonstrations described below, MUST first attend a radioactivity certification course.

1 *Demonstration of exponential decay* Nuffield Physics O-level Teacher's Guide 5. Experiment 89. (Revised Edition) 1980.
2 *Demonstration of penetrating powers of alpha, beta and gamma rays* Nuffield Physics A-level, Unit 5 on Atomic Structure 1971. Experiment 5.4.

EXTENSION WORK

Books

The Third World War John Hackett Sidgwick and Jackson
Protect and Survive Home Office HMSO
Protest and Survive E. P. Thompson Penguin Books
New Internationalist magazine, Issue 97.
Fiction:
On the Beach Nevil Shute William Heinemann Ltd and Pan Books
The Chrysalids John Wyndham Hutchinson and Penguin Books
Poetry and songs:
'Your attention, please' Peter Porter
'The Horses' Edwin Muir
'We're going to see the rabbit' Alan Brownjohn
'We've all got the bomb' Tom Lehrer

Discussion Topics

Chemical and Biological Warfare (CBW).
Nuclear disarmament – unilateral versus multilateral disarmament.
Simulation exercise to show how a Third World War could occur. This exercise could involve history staff.
The design and cost of the many commercially available nuclear fall-out shelters could be investigated – this project might be used to stimulate a discussion on civil defence.

Visits

The Imperial War Museum, London.

Films (16 mm)

Hiroshima, Nagasaki: August 1945 (15 mins) 1970 Concord Films
A harrowing documentary of the dropping of the atomic bombs on these two Japanese towns. It contains many disturbing scenes and should be previewed by teachers before being shown to pupils.

The War Game (50 mins) 1965 Concord Films
A controversial film by Peter Watkins in which an imaginary nuclear attack on Britain is treated in a documentary style. It is a very disturbing film and should be previewed by teachers before a decision is made to show it to pupils. The film was made for the BBC but it has never been transmitted.

Many other films on this topic are held by Concord Films Council Ltd.

Atomic Physics Part V (25 mins) 1956 Most Film Libraries
This is an old film, made soon after the last war. It has very good historical passages, including Einstein and others in person, and scenes at the United Nations when there was still hope that nuclear weapons might be outlawed by agreement.

Television Programmes

These programmes are not available through BBC Enterprises, but they are well worth looking out for in case they are repeated in the future.

Oppenheimer – an excellent series, especially programmes 5 and 6. BBC
QED – Guide to Armageddon BBC
The Bomb in Evidence ITV

AVA Resources

Tape-Slide Pack
Nuclear Weapons by Bob Fromer (£17.00)
Available from: Mary Glasgow Publications, 140 Kensington High Street, London, W8 4BN.
One side of the tape comprises quotations about this issue from a variety of sources, ranging from Pope John XXIII to U.S. Defence

Secretary, Caspar Weinberger (23 mins). The other side of the tape provides the commentary for the slides (26 minutes). This excellent programme takes an historical view, examining the history of the nuclear arms race, the effects of nuclear weapons and the prospects for civil defence.

Slides
The Threat of Nuclear War
This comprises 3 sets of about 30 slides, costing £9.50 per set, each with a very informative teacher's handbook. The first of these is probably the most valuable.

Set 1 *Nature and Effects*
Set 2 *Offence and Defence*
Set 3 *Nuclear Strategy*

Available from: Focal Point, 251 Capner Road, Portsmouth, Hampshire.

Sources of Information

Campaign for Nuclear Disarmament (CND) 11 Goodwin Street, London, N4.
Campaign Against the Arms Trade 5 Caledonian Road, London, N1.
Friends of the Earth (FOE) 9 Poland Street, London, W1.
Arms Control and Disarmament Research Unit Foreign and Commonwealth Office, Downing Street, London, SW1.
HMSO for leaflets on Civil Defence High Holborn, London, WC1.

Unit VI Energy

SUMMARY

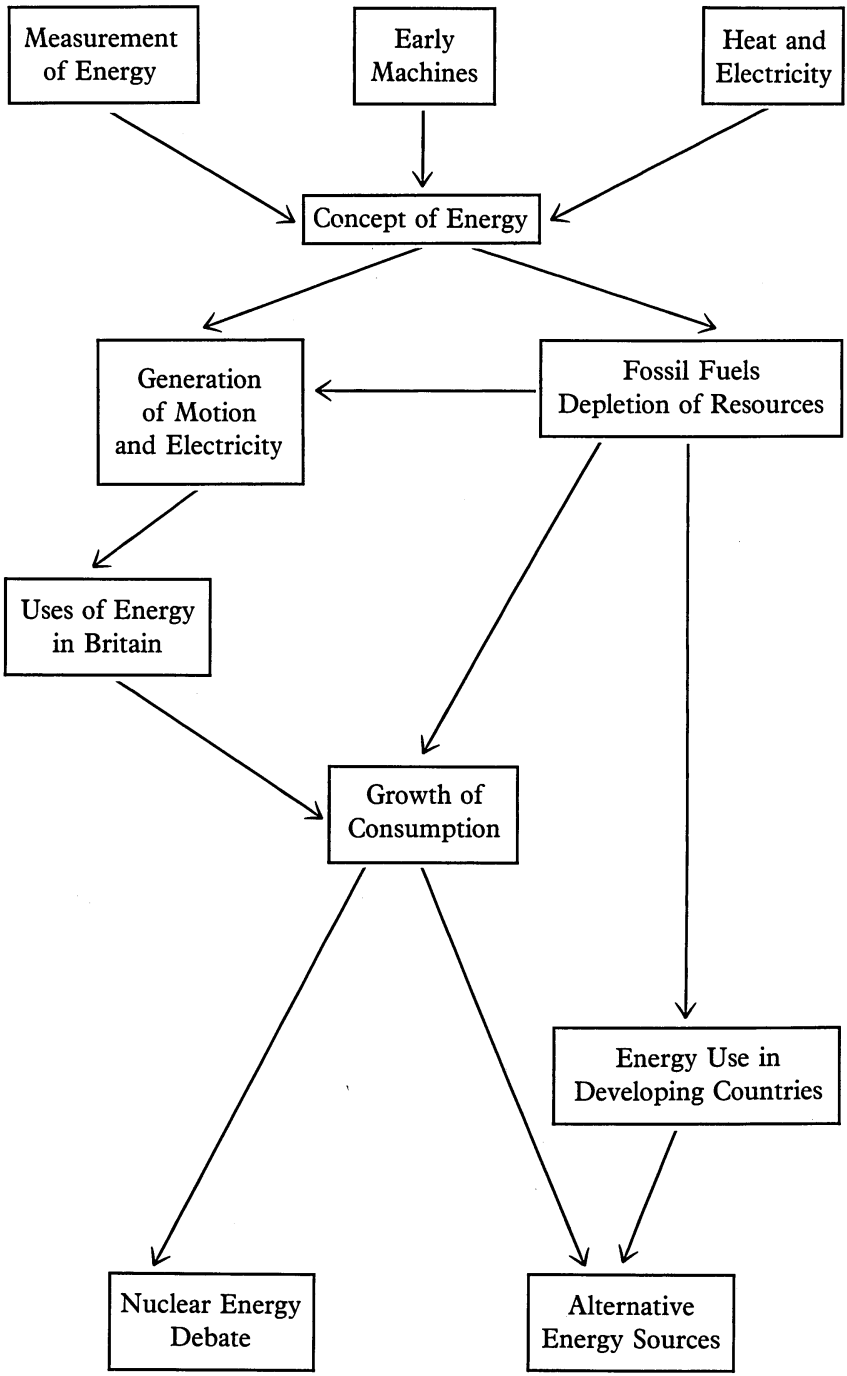
Behind the physical principles that we need to understand about energy and the new technologies that are being suggested in this unit, lie more personal issues involving our preferences and choices in the home, in the production of power, in transport and in employment. It is a good idea to use extracts from newspapers, the *New Scientist* and television programmes to demonstrate the research that is going on, the politics involved and the public concern which has been aroused, in order to liven the technical details with human interest. Most pupils will have some idea that energy is a measurable quantity which is available in different forms, cannot be created out of nothing, and is necessary for doing useful work. The early heat machines (Newcomen to Watt) show the same struggle to increase efficiency in the use of fuels which is still with us today, but it is necessary to emphasise the *inevitable* loss of heat whenever power (movement or electricity) is generated. Without some such idea about the degradation or 'running-down' of energy into low-level heat, we cannot make sense of *both* the conservation of energy *and* the ever-present energy crisis, nor the possibilities of combined heat-and-power production.

There is a section on the different fuels used for the generation of power, the structure and working of nuclear power stations, and material for a class debate for and against nuclear power.

Pupils need to be clear about the distinction between renewable and non-renewable sources before they go on to consider the problems of alternative energy. These vary from one country to another as do the energy needs of people. This leads into the last section where the energy problems of the Third World are discussed.

EXPERIMENTAL WORK

1 *Steam Engine* If your school or college possesses a model steam engine, it can be set working so that pupils can discuss where heat


Measurement of Energy
Early Machines
Heat and Electricity
Concept of Energy
Generation of Motion and Electricity
Fossil Fuels Depletion of Resources
Uses of Energy in Britain
Growth of Consumption
Energy Use in Developing Countries
Nuclear Energy Debate
Alternative Energy Sources

losses could be reduced (boiler and pipes), and where losses are inevitable (spent steam outlet).

2 *Thermocouple* This is another way to produce electric power from heat. Although it is not the method used commercially in Britain, it has the advantage of being easy to demonstrate and shows clearly the greater efficiency at higher temperatures (and hence the necessity for running nuclear reactors and steam turbines at 500°C or higher).

3 *Geiger Counter* This can be used to provide a simple demonstration of background radiation using a rock sample of granite, or pitchblende, or even a luminous watch face. (See also Experimental Work for Unit V, *The Atomic Bomb*.)

EXTENSION WORK

Visits

Visits can be arranged to some power stations and to coal mines, provided that adequate notice is given (at least 1 term).

Films (16mm)

Nine Centuries of Coal (32 mins) Revised in 1976, originally made in 1958 National Coal Board Film Library
Good on history, social conditions and mining accidents.

Time for Energy (33 mins) 1982 Shell Film Library
Discusses better ways of using fuel and mentions alternative energy sources.

Energy for All (25 mins) 1982 Viscom
A film with the emphasis on nuclear energy. Free loan.

Nuclear Power Reactors U.K. (22 mins) 1977 Central Film Library Made by U.K. Atomic Energy Authority
A review of the principles and practice of the generation of electricity by nuclear power in Britain. Describes various types of reactors. Free loan.

Energy in Perspective (21 mins) 1976 BP Film Library
Good on the various uses of fossil fuels and the alternatives, but rather dense. Probably best used to summarise the course.

The Steam Engine (15 mins) Most Film Libraries
From Newcomen to Watt.

Energy within Reason (26 mins) 1980 BP Film Library
About conserving resources and new methods in industry, transport and building.

Television Programmes

Nuclear Power (25 mins each) 1981-2 BBC Schools
Three programmes as part of General Studies:

1 *The Facts*
2 *The Risks*
3 *The Options*

First shown in 1981-82, but may be repeated in the future.

Whatever Happened to the Energy Crisis? Horizon programme, BBC
A useful programme on alternative energy sources, if a little long-winded. Worth watching out for in case it is repeated.

AVA Resources

Slides, Filmstrips
Alternative Sources 96 frame filmstrip and 12 pp booklet Bob Fromer £16.00 (Aimed at 12-16 year olds)
Available from: Mary Glasgow Publications, 140 Kensington High Street, London, W8 4BN.

Nuclear Energy Pack
Four sets of ten frame filmstrips with notes. The clear and colourful pictures explaining nuclear disintegration should prove helpful, but there is little or no mention of reactor hazards, wastes or proliferation. The set on the Uses of Radioisotopes is good, but the one on Detection of Radiation is too advanced and technical for any but an A-level physics group.
Cost: £15.00 the pack.
Available from: UKAEA, 11 Charles II Street, London, SW1Y 4QP.

Wallcharts
Nuclear Power
1 *Life with Nuclear Power* principles of generating electricity from uranium.
2 *Nuclear Power in Britain* shows different types of reactors and siting of the various power stations.
Available from: UKAEA, 11 Charles II Street, London, SW1 4QP.

Generating and Distribution of Electricity
1 *The Bartholomew Electricity Map of Britain*
2 *Electricity Distribution*
Available from: The Electricity Council, 30 Millbank, London, SW1P 4RD.

Sources of information

Energy Trends: a statistical bulletin (Free) Department of Energy
A useful booklet which gives information on the proportion of fuels that our society uses for different purposes.

Atom The free monthly bulletin of the UKAEA (Information Services), 11 Charles II Street, London, SW1 4QP.
It is an essential source of nuclear information and accident reports in the United Kingdom.

Nuclear Power Source Book which lists books, pamphlets, films, etc.
Available from: Birmingham Friends of the Earth, 54-57 Allison Street, Digbeth, Birmingham, 5.

The State of the World Atlas Michael Kidron (£5.95) 1981 Pluto Press
A4 collection of full page maps showing a range of facts about different countries in an unusual graphic form, e.g., shows population, infant mortality, GNP, sources of export income, nuclear power, etc.

Nuclear Energy Questions (£4.95) 1981
An excellent study pack presenting the principles and problems of nuclear energy production, including uranium mining.
Available from: Information Service on Energy (ISE), 2A Ainslie Place, Edinburgh, 3.

Other Addresses for Information on Energy

Friends of the Earth (FOE), 9, Poland Street, London, W1.
Information Services Department, *British Nuclear Fuels Limited*, Risley, Warrington, WA3 6AS.
British Nuclear Forum, 1, St. Alban's Street, London, SW1Y 4SL.
Press and Publicity Office, *Central Electricity Generating Board*, Sudbury House, 15, Newgate Street, London, EC1A 7AU.
Institute of Petroleum, 61, New Cavendish Street, London, W1. (for oil statistics).

Unit VII Health, Food and Population

SUMMARY

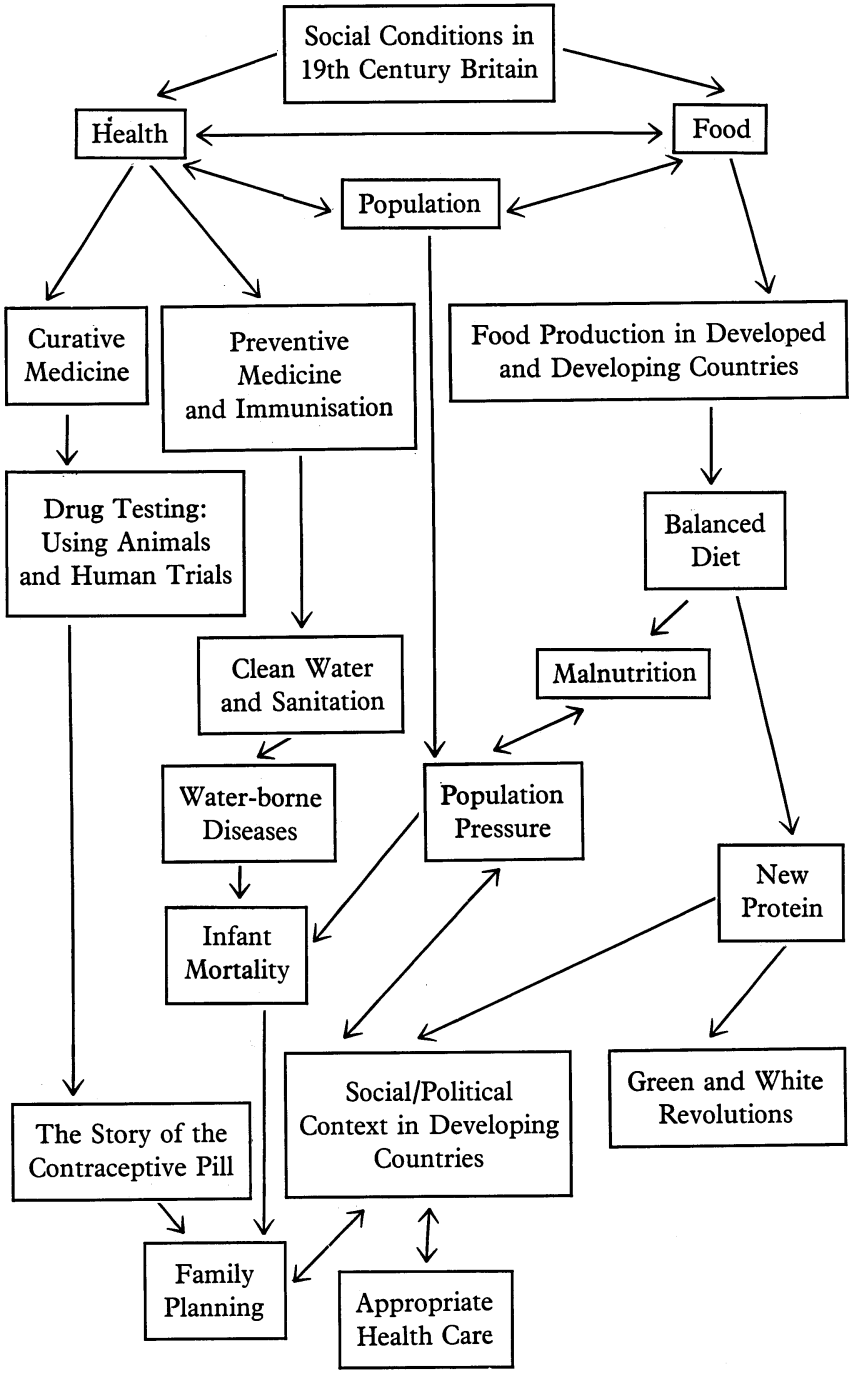
This unit begins with sanitation/clean water, food, infant mortality and immunisation in nineteenth-century Britain, and closes with a look at similar problems in the Third World today. In this way we hope to minimise the remote and condescending attitude that can be taken towards health in the Less Developed Countries. In between these sections are two very controversial topics in modern western society – the testing of drugs (including the use of animals and the thalidomide tragedy) and the contraceptive pill. Obviously many issues have been omitted, including new treatments, transplants, mental illness and the working of the National Health Service. This is a pity, because they are all very important, but the size of the unit made severe pruning essential; all of them could make valuable topics for pupils to investigate in their individual projects. The section on food in the LDCs would benefit from some practical sessions on tasting foods made from soya beans and other protein substitutes – this brings out obvious points about palatability and cultural food practices.

It is important to teach carefully about social issues in the various countries involved, e.g. the politics of food distribution, appropriate health care in rural communities and acceptable practices of contraception. Western science and technology does not transplant readily into other societies. Good examples of this are provided by the sections on the treatment of infantile diarrhoea (so often fatal) and regional attitudes towards family planning.

EXTENSION WORK

Films (16mm)

Down on the Factory Farm (55 mins) (*World About Us* series) 1979 BBC Enterprises
An investigation into the welfare of farm animals in Britain. Factory-farming is claimed by some people to be cruel, but the


Social Conditions in 19th Century Britain
Health
Food
Population
Curative Medicine
Preventive Medicine and Immunisation
Food Production in Developed and Developing Countries
Drug Testing: Using Animals and Human Trials
Balanced Diet
Clean Water and Sanitation
Malnutrition
Water-borne Diseases
Population Pressure
New Protein
Infant Mortality
Social/Political Context in Developing Countries
Green and White Revolutions
The Story of the Contraceptive Pill
Family Planning
Appropriate Health Care

farming community say the intensive methods are inevitable if we want cheap food.

Food for Thought (25 mins) Rank Film Library
Deals with the improvement in agricultural practices in Europe in recent years.

Food – or Famine (27 mins) 1962, re-edited 1974 Shell Films
Methods of improving food production are illustrated, using fertilisers, improved seeds, pesticides, modern machinery and improved animal stocks. No comment on ecological hazards or Third World alternatives.

The High Cost of Cheap Food (25 mins) 1975 (*Heritage* series) BBC Enterprises
The film looks at new techniques of industrialised farming, e.g., implications of the removal of hedgerows. It examines the fears that such methods will make irreversible changes to the countryside.

One Planet, Two Worlds 3 programmes (25 mins each) re-edited from the original film *Five Minutes to Midnight* BBC Enterprises

Part 1 Rural and Urban Poverty
Part 2 Malnutrition – the hidden killer.
Part 3 Rich and Poor – what can we do?

That Our Children May Not Die (50 mins) 1978 Ahrtag
An excellent and moving film on appropriate health care in Nigeria.

Licence to Kill (30 mins) 1976 Concord Films
Examines the massive £70 million promotion budget of the tobacco industry. Thames Television programme.

AVA Resources

Slides
Intermediate Technology 7 sets of 35 mm colour slides available separately or as a complete pack. Each set contains a detailed 13 page teacher's guide.

Set 1 Introduction to IT
Set 2 IT in Tanzania
Set 3 Agricultural implements
Set 4 Processing and storing crops
Set 5 Water catchment, irrigation
Set 6 Building
Set 7 Energy and Power

Available from: Centre for World Development Education, 128 Buckingham Palace Road, London, SW1W 9SH. Tel: 01-730 8332
Cost: Sets 1–2 cost £5.70 each (38 slides)
Sets 3–7 cost £3.00 each (20 slides)
Village Industries There are 5 sets (20 frames each) in this series: Earth and Clay, Wood and Basketry, Metal, Cloth, and Sugar and Coconuts. Each comes with teaching notes and ideas on how they may be used. The last two are particularly recommended.
Available from: Centre for World Development Education (address above)
Cost: £5.20 per set.

Games
The Farming Game This is a revised version of the Poverty Game. Participants play role of subsistence farmers in a savannah region of Africa. The class is divided into 'villages', each of which decides what crops to grow. Dice, chance and disease cards control the fate of these 'farmers'.
Available from: Centre for World Development Education (address above) cost £1.00 approx.

Posters
Choices in Development A set of 34 A3 black and white photographs taken in Tanzania and Kenya. Teacher's booklet explains how to use these photographs to stimulate discussion, linking areas such as health, population, food production and employment in developing countries.
Available from: Centre for World Development Education (address above).

Sources of Information

Centre for World Development Education (CWDE) 128 Buckingham Palace Road, London, SW1W 9SH. Tel: 01-730 8332
CWDE produce an excellent catalogue and the organisation serves as a distribution agency for development education materials. Also, they produce the following books and booklets: *The Development Puzzle, Priorities for Development, Population Today, Progress and Poverty*, all of which are highly recommended for use with this unit.
Oxfam (Youth and Education Department), 274 Banbury Road, Oxford, OX2 7DZ.

Overseas Development Administration (Information Department), Eland House, Stag Place, London, SW1E 5DH.
(The newspaper 'Overseas Development' can be ordered on a regular basis and is free).
Christian Aid P.O. Box No. 1, London, SW9 8BH.
(The booklets 'Food for All', '1. 'Nutrition, Diet and Disease' and '2 The Cases of Hunger and some Remedies' cost 20p each. 'Facts about Food' is free.)
Health Education Council 78 New Oxford Street, London, WC1A 1AH.
War on Want 367 Caledonian Road, London, N7 9BE.
New Internationalist (monthly magazine).

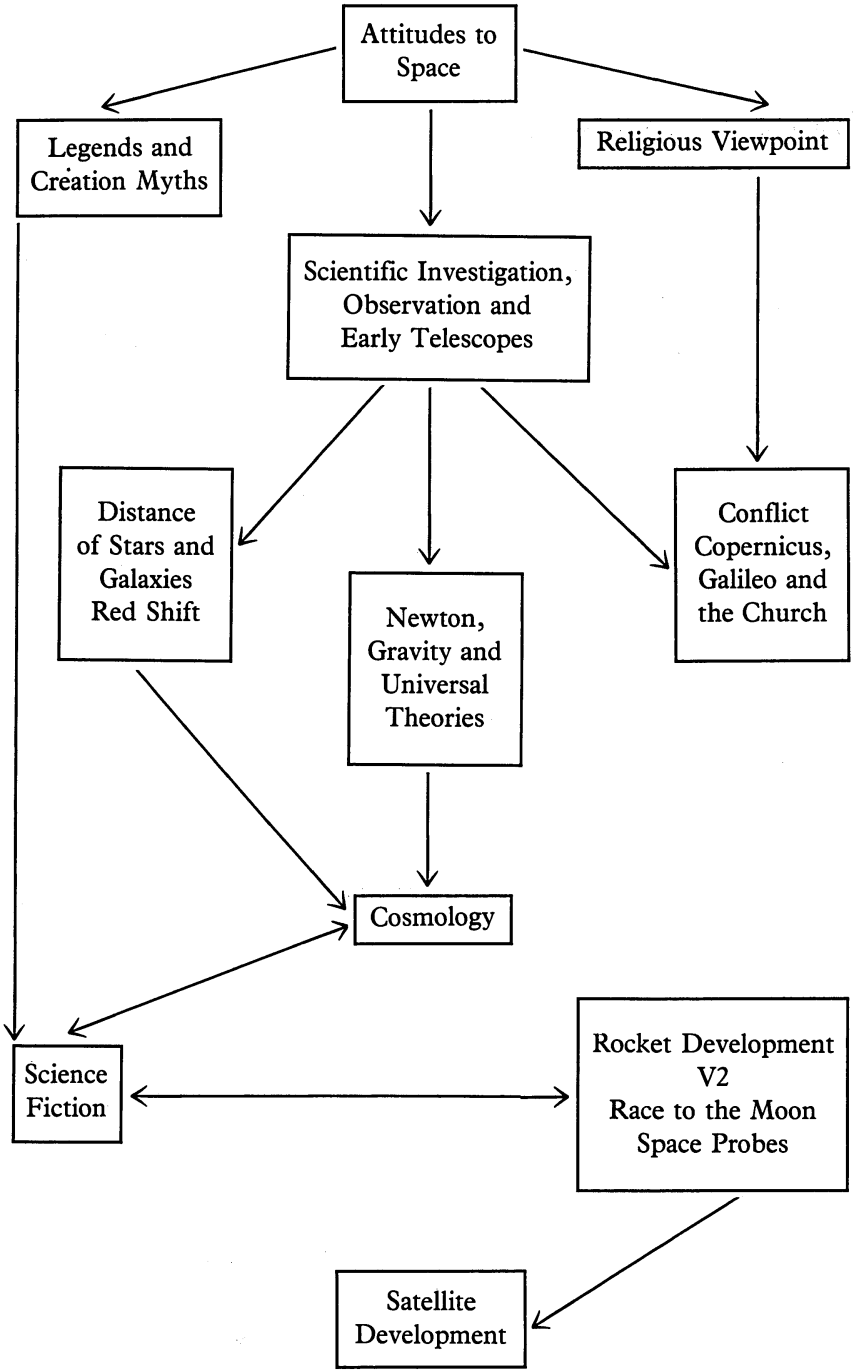
Unit VIII Space, Cosmology and Fantasy

SUMMARY

This unit appeals strongly to some pupils, for whom astronomy and spaceflight with its associated technology are of consuming interest. Teachers have to be careful not to teach exclusively in such a light; thinking about space should be related to society in a way which shows the interaction between them.

Different societies have produced quite different theories about the universe: creation myths, the medieval religious standpoint, and the modern scientific view. The conflict between Galileo and the church needs to be taught carefully, trying not to 'take sides' so as to show the totally different points of view involved. Some teachers recommend reading part of Brecht's play *Galileo* at this point, but this is quite demanding. Unit II, *How Can We Be Sure?* should be useful here for underlining the difference between the certainty of belief and the uncertain theory-laden nature of observation. (Note that Galileo was actually wrong in his observations of the 'seas' on the moon and of the 'atmosphere' around it. Clearly he wanted it to be like the earth.) The great step forward of assuming that the same laws of science hold on the earth and everywhere else was made by Newton. The next section on the galaxies and the Big Bang takes us away from society, its beliefs and technology.

However, the last part of the unit puts this right by including rockets, science fiction, and the political decisions involved in the race to put a man on the moon. It is probably a good idea to make a water rocket with the class in order to teach the reaction principle. (The recipe for this can be found in Nuffield Secondary Science; it only needs a detergent bottle and a bicycle valve; it performs well – out of doors!). Two very important points which should be brought out clearly in this part are the connections between war, technology and space (rockets, and miniaturisation of electronic components), and also the changing emphasis in science fiction as an expression of society's optimism or pessimism about the future. It is a good idea for pupils to read some short stories from Asimov or other sources which can act as a class comprehension exercise. 'The Winnowing' from


Attitudes to Space
Legends and Creation Myths
Religious Viewpoint
Scientific Investigation, Observation and Early Telescopes
Distance of Stars and Galaxies Red Shift
Conflict Copernicus, Galileo and the Church
Newton, Gravity and Universal Theories
Cosmology
Science Fiction
Rocket Development V2 Race to the Moon Space Probes
Satellite Development

Bicentennial Man (Asimov) is on the right kind of theme and encouragingly short! Television programmes can also be very useful for the less able. It is essential to recommend SF books to all pupils, either at the beginning of this unit or even earlier.

EXPERIMENTAL WORK

Experiments using water rockets

Nuffield Secondary Science 8 The Earth and its place in the Universe, 1971 Section 8.11. How do we get away from Earth? Subsection v. Making and testing water rockets: these water rockets are easy to make and provide a very dramatic demonstration – they can only be launched outside.

EXTENSION WORK

Discussion and further reading

History of Science Fiction.
How SF themes are influenced by changes in society.
Major authors and themes in SF.

Visits

Planetaria See under Unit I, *Ways of Living* for details about planetaria.

Films (16 mm)

Galileo – the Challenge of Reason (26 mins) 1972 Rank Film Library
Acted scenes of the life of Galileo which may help to make the conflict more real to pupils.

Apollo II – One Giant Leap for Mankind (28 mins) 1969 Central Film Library
This film was made by the United States National Aeronautical and Space Administration and so has an American flavour. It begins with the story of rockets and ends with Neil Armstrong's first steps on the moon.

There are four other films recording the flights of the other Apollo missions.

The Earth's Movements (11 mins) 1967 Viewtech (formerly Gateway Media)
An elementary film illustrating simple ideas on the changing positions of stars and seasons.

A Space Flight Around the Earth (12 mins) 1970 Viewtech
A film about John Glenn's historic flight in space. Contains some good shots of the earth from space, although the commentary is out of date.

AVA Resources

Tape/Filmstrip
The Story of Space Flight No. 5 *Exploring the Moon* approx. 13 mins) 1972 Viewtech
This particular tape/strip is probably one of the best in this series. Made for American junior high school pupils, but a good filmstrip made interesting by the historic sound recordings of the first astronauts on the moon.

Philip Harris Slide Sets on the Flight to the Moon and the First Landing 6 sets of slides (approx. 9 slides per set) plus teaching notes.
These sets of slides were compiled from the official NASA photographs and contain many of the well-known, but hard to locate, views.
Available from: Philip Harris Ltd., Lynn Lane, Shenstone, Staffs, WS14 0EE. Tel: 0543-480077.

Wallcharts
Space Charts: 1 Space Shuttle; 2 Jupiter; 3 Saturn.
Available from: Spacecharts, Newton Tony, Salisbury, Wilts, SP4 0HF.
Cost: £1.75 each + postage.

Sources of Information

The Planetarium, Armagh, Northern Ireland.
It is a good idea to write to this planetarium and ask to be put on their mailing list. They supply good information on space and list relatively cheap resource materials.

Appendix I

Science and Society

SYLLABUS
(for both A/O level and CSE examinations)

A This syllabus is intended to introduce candidates to the background and social impact of science. It is designed with expectation that:

(i) the subject material will be covered in a *one year course* of study,

(ii) the candidates will be of *sixth form* age, or more mature, so that they can better relate to the social problems to be examined,

(iii) the study of this syllabus will not be dependent upon, or exclusive of, any other subject or course of study.

Each unit of the course contains some historical background material showing the interaction of science and society in earlier times, prior to discussion of the modern issues. Care must be taken to keep the content as up to date as possible and candidates should be enouraged to make intelligent use of the media for this purpose. It is intended that everyone who has studied a General Science course for at least the first three years of secondary school will have sufficient background to benefit from the course.

Aims of the Syllabus

1 *To introduce candidates to the essential nature of science as a process.*

2 *To encourage the pupils to express concern about current issues.* It is expected that candidates will have to make informed value judgments and express individual points of view.

3 *To exhibit science as a endeavour of and for society*, both because it is a source of technology for attacking contemporary problems and because its system of thinking is rooted in the attitudes of its own society.

4 *To unite the various interests and specialised study areas of the sixth formers* so that their different disciplines can be brought to bear on the subject, including the vital 'human' qualities of compassion and responsibility.

5 *To develop the pupils' sense of belonging to a wider adult community.* The course assumes that the students may be involved in the contemporary problems which are studied.
6 *To stimulate an interest in current scientific developments.*

B Subject Matter of the Syllabus

Unit I *The interaction of man and nature*
Primitive ideas about nature illustrated by early astronomy, magic or astrology related to the needs and beliefs of the community.

The differences between these and modern man's attitude towards nature.

Man's effect upon the environment. Candidates should have knowledge about at least two major areas of concern and the outline of steps which are being taken, or have been taken, to cope with them, e.g., water pollution, air pollution, rubbish disposal, effects of road traffic, urban living conditions.

Balance in the natural environment. Candidates should understand the meaning of 'ecological balance' and be able to give at least one example of the effect of its disturbance, e.g., pesticides, eutrophication, deforestation, sewage disposal into rivers.

Resources: depletion of natural reserves of valuable ores, the problems of recycling. Urban living, employment and new technologies.

Unit II *Logic and certainty as applied to Science*
Deductive thinking. Candidates should be able to make a *valid* deduction from a universal premiss and a particular statement. Such systems to be contrasted with the scientific search for an explanatory theory. Differences between rules for classification, generalisations, and experiments or observations.

Scientific explanations. Candidates will be expected to appreciate the inherent lack of certainty, the imaginative, mechanistic and predictive nature of scientific theories.

The growth of scientific theories by a study of at least one example (e.g., the nature of light and explanation of the rainbow, continental drift and plate-tectonics), and one example of a change of theory.

The nature of experiment: how theory affects observation and interpretation.

Citizen participation in democratic decision-making. Elections, MPs, local government. Public inquiries and pressure groups.

Unit III *Technology, Invention and Industry*
Candidates should be able to demonstrate an understanding of the meaning of the following terms, and the relationship between them by an outline study of at least two important industrial discoveries and developments: *individual invention, patents, scientific knowledge, technological research, developmental or production research*. Examples might include some of the following: flying machines, wireless telegraphy, electric batteries, electric motor, cracking petroleum, penicillin.

Research and development in industry. Candidates should be aware of the vast proportion of first time patents awarded to scientists working inside industry and of the relative expense of the different stages in developing a new invention to a commercial product.

A more detailed case-study of *either* the Plastics Industry *or* the Microelectronics Industry. This should include a historical survey, the commercial need, the effects of new scientific advances, the industrial firms which encouraged research, new processes, applications and wider social effects.

Unit IV *Evolution and genetics of the human population*
Darwin's observations during the voyage of the *Beagle* related to earlier ideas on evolution (e.g., catastrophes, acquisition of characteristics from the environment and original creation). Darwin's theory of evolution: life-forms not static, gradual change, competition for survival forming the basis of natural selection. Reactions to Darwin's theory. Religious opposition to the ideas of the Descent of Man, Social Darwinism and the attitudes of Herbert Spencer and the Eugenics movement. Candidates will be expected to be able to argue how far the concept of 'competition' can be applied to a social system.

Genetics: simple gene-pair inheritance. Dominant and recessive characteristics related to the experiments of Mendel. Genes, chromosomes crossing, and shuffling of genes, inheritance.

Genetic defects in the population. Common genetic defects in the new-born, genetic counselling for prospective parents. Amniocentesis. The concept of the gene-pool and continuing evolution and mutation. New methods for combating infertility: AID, in vitro fertilisation. Genetic manipulation.

Unit V *The atomic bomb, the effect of war on science*

A short history of the discovery of nuclear fission; the constituents of the nucleus, Cockcroft and Walton's splitting of the atom, bombardment of uranium and the nature of fission.

The international pre-war context. International scientific journals, examples to show openness in research. Refugee scientists and Hitler's capture of the Czech uranium mines. Einstein's letter to Roosevelt.

The Manhattan Project. The discovery of plutonium, the separation of U-235 from U-238, the human context of Los Alamos, the nature of the two bombs, the testing of the bomb, decision to drop the bomb.

Secrecy and treachery. The case of the 'atom spies'; internationalism in science contrasted with military secrecy during the Cold War; Government research establishments, the Official Secrets Act, personal responsibility.

The hydrogen bomb tests, atmospheric pollution, CND and the Aldermaston marches; the Partial Test Ban Treaty; the policy of MAD, problems of disarmament and proliferation. The meaning of strategic and tactical weapons.

Unit VI *Energy*

Historical study of the concept of energy. Perpetual motion, the pendulum, early heat engines. Statement of conservation of energy.

The efficiency of conversion of energy, e.g., steam engine, turbine, thermocouple, internal combustion engine. Energy flow in a power station.

The fossil fuels. Coal, gas, oil; probable lasting times.

Nuclear power. Outline of conventional nuclear power station, reprocessing of spent fuel elements, radioactive wastes, plutonium production, fast breeder reactors, hazards and benefits.

Our present use of energy and fuels for different purposes. Effects of fuel shortage on ways of living, e.g., district heating, building design, transport and industry.

Alternative energy. Renewable resources, some ideas on the feasibility and environmental impact of bio-mass, solar, wind, tidal, wave, and geothermal power. Energy appropriate for the Third World.

Unit VII *Health, Food and Population*

The development of public health in Britain during the nineteenth and twentieth centuries, including sanitation, safe water, nutrition and vaccination.

Testing of medicines. The Committee on Safety of Medicines. Medical research, animal tests, clinical trials and the reporting of side-effects (illustrated by the development of the oral contraceptive).

Nutrition in the Less Developed Countries. The Green Revolution and its effects. The problem of protein deficiency and methods of combating it through education and new food technologies.

Health and population in the Less Developed Countries. Appropriate health technologies, medical auxiliaries, infant welfare, socially acceptable contraceptives. Candidates should be able to appreciate the significance of population profiles, *population density* and *population pressure* in the light of local conditions.

Unit VIII *Cosmology, space and science fiction*

Ancient myths of creation related to the way society lived. Ptolemaic model. The Copernican Revolution. Galileo's telescopic discoveries. Conflict with the Church.

Some idea of the growth of theories about the evolution of the universe: the measurement of stellar distances, the discovery of galaxies, expansion and Big Bang theory.

Space flight. Early rockets including the reaction principle. Landing on the moon. Space probes to the planets. Uses of satellites.

Science Fiction. It is expected that candidates will have read at least one such novel and be able to comment in some detail both on the validity of its scientific content and also upon the social impact of the science to which they relate. No particular books will be set; television serials or films will be acceptable alternatives.

Appendix IIa

Sample Questions

From 1982 A/O Level Examination – Joint Matriculation Board (JMB)

A1 WAYS OF LIVING

(a) Forests have been cut down and destroyed since the beginnings of agriculture.

  (i) In what ways is our attitude to changing the environment different to that of people who lived 500 years ago?

  (ii) Why are some scientists worried by the destruction of tropical rain forests in Brazil?

  (iii) Why do you think that the countries concerned are not preventing the destruction of their forests, to any great extent?

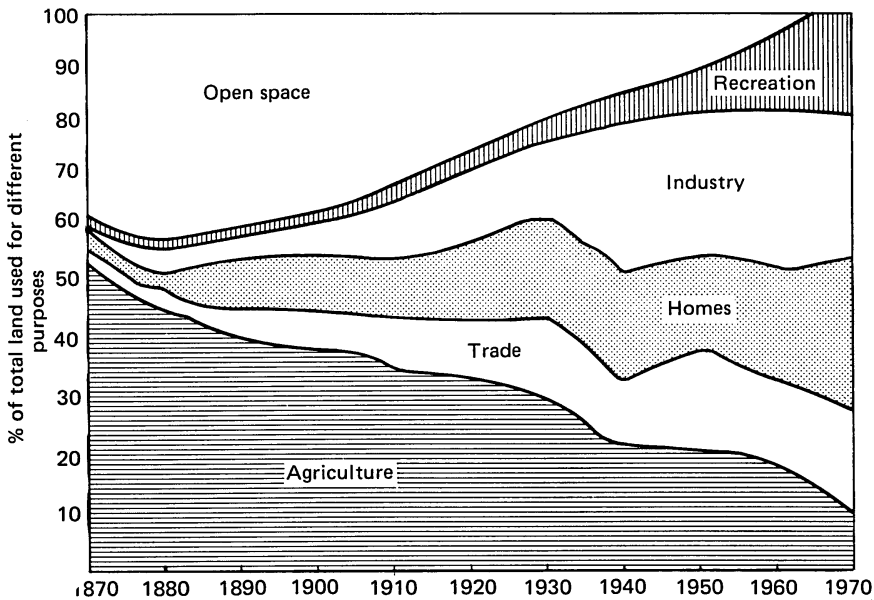
(b) Name one natural ecosystem (other than a tropical rain forest). By the use of a diagram or flow-chart, show how the balance between its main parts is maintained.

(c) Study the chart on following page, which shows the change in the use of land in a certain locality, and then answer the following questions:

  (i) What percentage of the land was built-up in (a) 1900, (b) 1970?

  (ii) In what ways related to information on this graph may children's leisure activities have changed between these two years?

  (iii) Do you think that the trends shown in the chart might have had an unfortunate effect upon the quality of our lives in any way? Be precise and give reasons.



A2 HOW CAN WE BE SURE?

(a) Read the following two statements carefully and then decide which one of them is a scientific theory, giving as many reasons as you can for your answer.

(i) All rocks which have been laid down in layers of small particles are sedimentary.

(ii) All the great continental plates of the world are slowly moving.

(b) In the eighteenth century it was widely believed that an iron bar expanded when it was heated because the heat was a kind of fluid which flowed into the bar, pushing its atoms apart.

In the next century, it was suggested that when a bar is hot, its atoms are vibrating with more amplitude and so take up more room.

(i) Which theory best explains why striking the bar repeatedly with a hammer makes it hot? Give reasons.

(ii) X-ray photographs of a hot bar show the atoms looking rather blurred. Which theory would have predicted this?

(c) When there has been a leak of radioactive material from a nuclear plant, some experts have stated that it is quite harmless, while others have protested about its possible dangers.

(i) How do you think such disagreements arise?

(ii) Explain your own reaction to the above problem.

A3 TECHNOLOGY, INVENTION AND INDUSTRY

(a) Tests made recently by a medical research team suggest that one of the B vitamins could prevent some tragic congenital deformaties such as spina bifida. It was known that women giving birth to such children often had low blood concentrations of this vitamin, and also that drugs which counteract its effect could produce these defects if given to a pregnant woman. The team reported that out of a group of 44 mothers (at risk because they had already given birth to a defective child) who took vitamin B tablets, none had defective babies, as compared with 6 born to a group of 67 mothers who had not taken the tablets.

(i) Use this extract to illustrate the difference between scientific *research* and technological *development.*

(ii) What further research would you expect?

(b) Explain briefly how the *patent laws* are designed to protect:

(i) the interests of the inventor,

(ii) the interests of the public.

(c) Use your knowledge of *either* the Plastics Industry *or* the Microelectronics Industry to illustrate the following points with actual examples.

(i) Chance findings which are not scientifically understood can start a new technology.

(ii) Scientific discoveries then accelerate the development of the new technology.
(iii) Once successful, a new technology may find unexpected uses which change some aspect of our lives.

A4 EVOLUTION

(a) What is the meaning of the word 'evolution' when it is used in a biological context?

(b) Charles Darwin proposed a mechanism which could explain how evolution might have occurred.
(i) Briefly explain Darwin's mechanism for evolution.
(ii) How did the mechanism proposed by Lamarck some years earlier differ from Darwin's mechanism?

(c) Give *two* reasons why some Christians found Darwin's theory repugnant.

(d) Explain the meaning of the following terms: gene; mutation; recessive; genetic counselling.

(e) (i) What was 'Social Darwinism'?
(ii) How far do you agree or disagree with the ideas expressed in Social Darwinism?

A5 ENERGY

(a) What is meant by a 'non-renewable' energy resource? Give *four* examples of such a resource.
For what purpose was such a resource first used to do useful mechanical work?

(b) Modern steam turbines work at temperatures as high as 600°C and have an efficiency of about 40%.
(i) Explain what this sentence means and why such high temperatures are used.
(ii) Outline *one* use which has been found to take advantage of this inevitable lack of efficiency.

(c) The risks involved in the production of 1 G Watt year of electric energy have been estimated at the following numbers of *deaths per year.*

Source of Power	To miners and workers		To General Public	
	Accidents	Disease	Accidents	Disease
Coal	3	3	—.	10
Oil	1.5	—.	—.	10
Hydro-Electric	3	—.	1.5	—.
Nuclear	1	0.5	—.	0.3
Gas	0.2	—.	—.	—.

(i) Explain the large numbers of deaths per year through disease caused to the general public from the use of coal or oil to generate power.

(ii) Britain produces about 23 G Watts year of electric power, of which about 70% is generated from coal. Estimate the number of deaths per year from this cause.

(iii) What research or legislation would you like to see undertaken to reduce any of these fatal risks?

A6 THE ATOMIC BOMB – SCIENCE AND WAR

(a) 'Somebody opened the door and shouted, "Hiroshima has been destroyed!"; about a hundred thousand people were thought to have been killed. I still remember the feeling of unease, indeed nausea, when I saw how many of my friends were rushing to the telephone to book tables at the 'La Fonda' hotel in Santa Fe, in order to celebrate.'

Otto Frisch

(i) Use this quotation to state the two different reactions of nuclear scientists to the bombing of Hiroshima.

(ii) Try to explain how both kinds of feelings arose.

(b) (i) What type of atomic bomb was used on Hiroshima?

(ii) Outline the principles upon which this bomb works, and include brief references to *neutrons, chain reaction* and $E = mc^2$.

(c) It is often said that scientists have been irresponsible about the development and use of nuclear weapons. Give one

(c) example which supports this statement and one which contradicts it.

(d) (i) What is the Partial Test Ban Treaty?
(ii) Do you think any other international action on nuclear weapons can, or should, be taken?

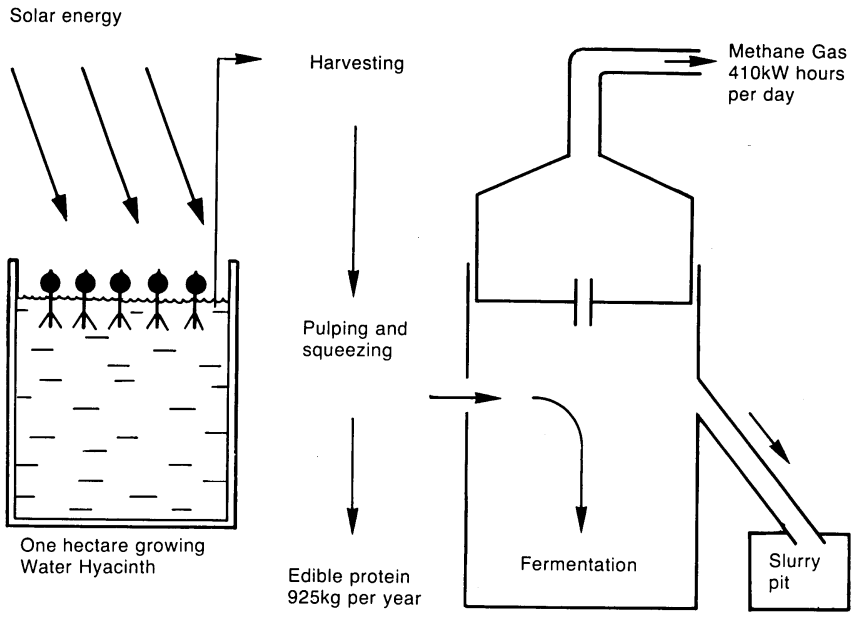
A7 HEALTH, FOOD, POPULATION

(a) In nineteenth-century England the death rate was high. The same is true in many of the Less Developed Countries today. Name *three* factors which you believe contribute to this high death rate.

(b) For each of these factors, briefly explain the role of science in dealing with them.

(c) Name *three* major stages in the testing of a new drug. What moral/ethical problems do you see that might be associated with each of these stages?

(d) The Indian Water Hyacinth is one of the world's fastest-growing weeds. It chokes waterways wherever the local temperature is suitable (latitudes between 32°N and 32°S). The diagram below outlines one suggested way of using it.
(i) How do rural Indian communities usually obtain their fuel and fertiliser? What difference would this suggested scheme make?
(ii) One acre growing rice in the same climate might yield 56 kg of protein in each of two harvests per year. Make calculations to compare this with the mass of protein produced by the above scheme. Does this prove that it would be better for local nutrition to cultivate this weed than to grow rice? Give two reasons for your answer.
(iii) Compare the daily output of energy by this process with what you might use in your home.



(1 hectare is approximately 2½ acres)

A8 COSMOLOGY, SPACE AND SCIENCE FICTION

(a) 'Study of the heavens has always involved the hopes and religious beliefs of society every bit as much as its scientific knowledge.'

Use your knowledge of *either* primitive cosmology *or* the conflict between Galileo and the Church to provide examples to support this statement.

(b) Explain briefly the meaning of the following terms: universal gravity, light-year, red-shift.

(c) Use the theme of any science fiction book you have read to show how the author explored some real world problem in an unfamiliar setting.

B9 Comprehension passage on nitrogen fixation by bacteria and the implications of introducing these bacteria into cereal crop plants as well as *Leguminosae* plants.

B10 Comprehension passage on the development of superplastic titanium and its potential uses in the aircraft industry.

Appendix IIb

Sample Questions

From *CSE Mode 3 Science and Society 1982 London Regional Examining Board (LREB)*

UNIT I WAYS OF LIVING

1 Why was a calendar, of some sort, so important to primitive agricultural people?

2 Explain clearly two differences between 'magical' thinking about nature, and modern 'scientific' thinking about it.

3 Swallows migrate each year in Autumn. Thinking as a scientist, write down TWO possible explanations for this that you might like to investigate.
Now invent ONE non-scientific reason.

4 Picture A – Deciduous woodland.
Picture B – Cattle grazing in a field.
(a) Picture A shows a balanced ecosystem which has developed over many years. List FOUR factors which make for a balanced ecosystem.
(b) Picture B shows an ecosystem which is NOT balanced. Give TWO ways in which this ecosystem is not balanced.
(c) Name TWO things which farmers must do so that they can continue to grow crops every year.

5 Write down TWO ways in which Industry has had a harmful effect on our ecosystem. In each case explain what has been done to control these harmful effects.

UNIT II HOW CAN WE BE SURE?

1 Science sometimes uses *classification* statements such as: 'All vertebrates have backbones'. Show how this could be used to classify a newly discovered animal.

2 Many scientific theories are about something which you cannot observe directly. Give ONE example of such a theory.

3 (a) Describe any experiment you have done which was explained by a theory you were taught.
(b) Now explain the result of the experiment using the scientific theory that you learnt.
(c) Did you think the experiment was convincing? (Give your reason.)

4 When scientific theories are used to explain social problems, the experts sometimes disagree with each other. Read the following passage carefully and then answer the questions on it.

'If children breathe in a lot of lead fumes, such as those from a car exhaust, it can do harm to their mental development. A group of children who lived near a junction of several motorways were tested and shown to have slightly less than average intelligence. Some experts said that this was due to lead fumes from the cars. Others said that the concentration of lead in the air could not have been high enough to be harmful. They thought that the houses near this motorway junction were so cheap and unpleasant that only less intelligent and unsuccessful people would be found living there.'

(a) What TWO points did the experts agree about?
(b) What TWO points did the experts disagree about?
(c) What do you think would be another good test to do?
(d) Lead is added to petrol to improve the performance of cars. Without it the price of petrol would be a few pence per gallon more than it is now. What is your opinion about adding lead to petrol?

UNIT III TECHNOLOGY, INVENTION AND INDUSTRY

1 Explain the meaning of each of the following terms:
(a) Market Need
Example:
(b) Technological Research
Example:
(c) Patents

2 These two graphs show the development and cost of medical

treatment with penicillin in America during the first ten years after its discovery

Graph I: *Number of treatments (in thousands) using penicillin between 1942–1952*

Graph II: *Cost of each complete treatment (in Dollars) between 1942–1952*

(a) What do the graphs show about the number and cost of penicillin treatments in America during 1944?
(b) How had the situation changed by 1950?
(c) Calculate the total amount of dollars spent on penicillin in 1944 and in 1950 (Show your working.)

3 Write a short account of some new development in EITHER the Plastics Industry OR the Microelectronics Industry. Explain how it may affect or change our way of living.

UNIT IV EVOLUTION AND HUMAN GENETICS

1 In order to explain how different species had evolved, Charles Darwin assumed that only the *fittest would survive*. Take any animal or plant species and show how this explanation might account for its special characteristics.

2 Some 'Social Darwinists' (although *not* Darwin himself) have argued that it would be a good thing for the human race, if people were left alone to struggle against poverty and disease, so that only the fittest would survive.

(a) What kinds of people would have been most likely to survive?
(b) What sort of Health Service would these Social Darwinist have wanted?
(c) What schools would they have set up?
(d) Does this argument agree with your own attitude towards society? Give your reasons.

3 Explain the terms 'dominant gene' and 'recessive gene' and give ONE example of each.

4 Intelligence tests were given to different kinds of twins. The *difference* between the scores of the twin children are recorded below.

Identical twins brought up together	Non-identical twins brought up together	Identical twins brought up apart (by foster parents)
3.1	8.5	6.0

(a) Which kind of twins seemed to have the most similar test results?
(b) Which kind of twins seemed to be most different?
(c) What other test result would be interesting to know? What result would you expect?
(d) Not many pairs of twins were tested, but if these figures are reliable, what do they show about ability to do these intelligence tests?

UNIT V SCIENCE AND WAR

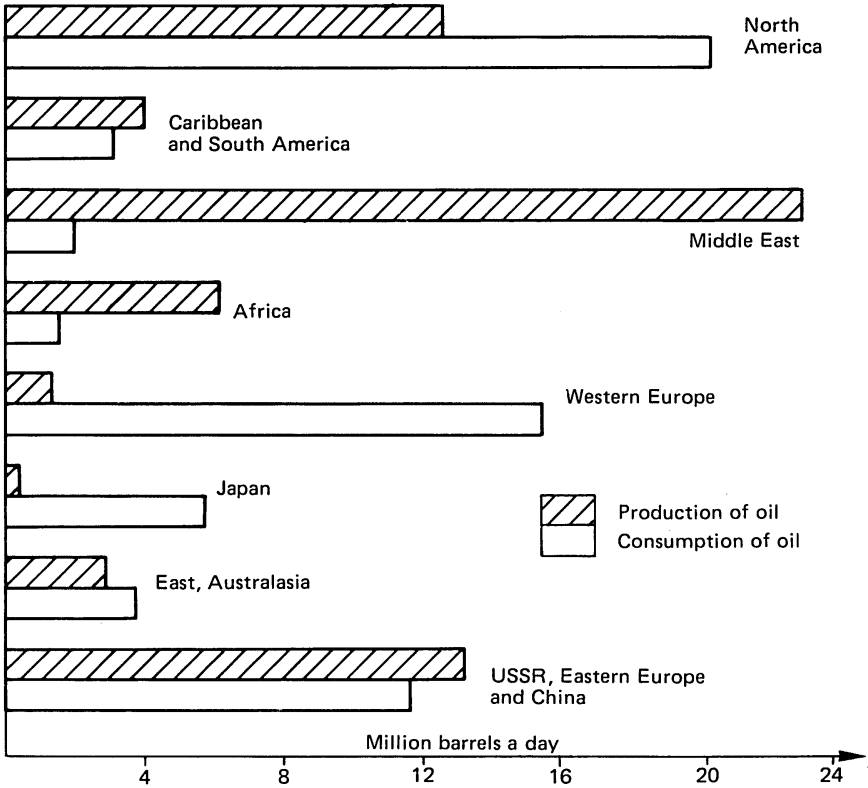
1 (a) On what city was the first atomic bomb dropped?
(b) What THREE groups of people were involved in the decision to drop this bomb?
(c) In your opinion was it right or wrong to drop this bomb? Give your reasons.

2 Explain the meaning of the following words:
(a) Fission
(b) Uranium 235
(c) Chain reaction

3 Before the Second World War science was an international activity.
(a) Give TWO examples of the way in which it was international.
(b) Nowadays about 25 per cent of all our scientists work in military research stations and have to sign the Official Secrets Act. State as clearly as you can the contents of the two main sections of this Act.

4 (a) What do the letters C.N.D. stand for?
(b) Draw the symbol which C.N.D. uses.
(c) What was the purpose of the Aldermaston Marches?

1 Look at the graph of oil supply and demand (1976).



(a) Which part of the world produces the most oil per day?
(b) Name the TWO parts of the world which have to import most oil.
(c) If you were in charge of the government of a country which imported large amounts of oil, write down two things you would do that would cut down your country's demand for oil.

2 Name TWO fossil fuels.

3 (a) Write down the name of one alternative source of energy.
(b) List ONE advantage and ONE disadvantage of this source of energy.
(i) Advantage
(ii) Disadvantage

4 (a) Where is the only fast-breeder nuclear power station in Britain?

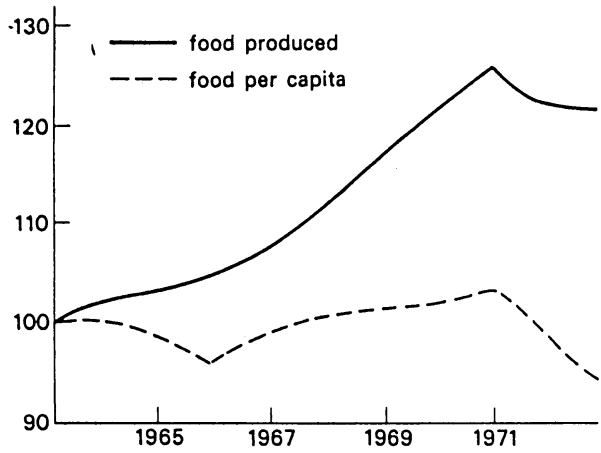
(b) There is much argument over nuclear power in Britain. Write down TWO reasons why many people are 'for' nuclear power and TWO reasons why many people are 'against' it.

5 There has been much talk for some time of the 'Energy Crisis'. Describe in your own words what you think the Energy Crisis is and how it might affect our lives.

UNIT VII HEALTH, FOOD AND POPULATION

1 (a) Name THREE important services provided by the Public Health Service.

2 Two graphs below show the *total food* produced in the Less Developed Countries and the food per head in the same countries. (The food production in 1963 is taken as 100 for comparison with other years.)



(a) Why did the food production increase so sharply between 1965 and 1971? (Give as much detail as you can).

(b) Suggest a reason why the 'per head' curve hardly rose at all during these years.
(c) Suggest a reason why both curves dipped sharply in 1971–1972.

3 (a) What is meant by 'family planning'?
(b) In spite of government-backed family planning programmes, the population is still rising in many of the Less Developed Countries. Give THREE reasons why people in these countries might have large families.

4 Write about any TWO of the following:
(i) 'Appropriate' health care in the Less Developed Countries.
(ii) How vaccination was discovered and how it works.
(iii) The use of animals for testing medicines.
(iv) Deficiency diseases.

Appendix III

Film Libraries

Ahrtag, 85 Marylebone High Street, London W1. Tel: 01-486 4175.
BBC Enterprises, Woodston House, Oundle Road, Peterborough, PE2 9PZ. Tel: 0733 52257/8.
BP Film Library, 15 Beaconsfield Road, London, NW10 2LE. Tel: 01-451 1129.
Central Film Library, Chalfont Grove, Gerrards Cross, Bucks., SL9 8TN. Tel: 02407 4111
Concord Films Council, 201 Felixstowe Road, Ipswich, Suffolk. Tel: 0473 76012
Encyclopaedia Britannica Films, National Audio-Visual Aids Library, Paxton Place, Gipsy Road, London, SE27. Tel: 01-670 4247
Guild, Sound and Vision, Woodston House, Oundle Road, Peterborough, PE2 0PZ. Tel: 0733 63122
ILEA Film Library, Centre for Learning Resources, 275 Kennington Lane, Lond, SE11 5QZ. Tel: 01-735 7660, ext. 249
National Coal Board Film Library, Hobart House, Grosvenor Place, London, SW1X 7AE. Tel: 01-235 2020
Rank Film Library, P.O. Box 20, Great West Road, Brentford, Middlesex. Tel: 01-560 0762
Scottish Central Film Library 14 Victoria Crescent Road, Glasgow G12 9JN. Tel: 041-334 9314
Shell Film Library, 25 The Burroughs, Hendon, London, NW4 4AT. Tel: 01-202 7803
Viewtech (formerly *Gateway*), 122 Goldcrest Road, Chipping Sodbury, Bristol, BS17 6XN. Tel: 0272 773422
Viscom Ltd., Audio Visual Library, Park Hall Road Trading Estate, London, SE21. Tel: 01-761 3035.

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