Science In a Social CONtext

HEALTH, FOOD AND POPULATION

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John Holm

Health, Food and Population

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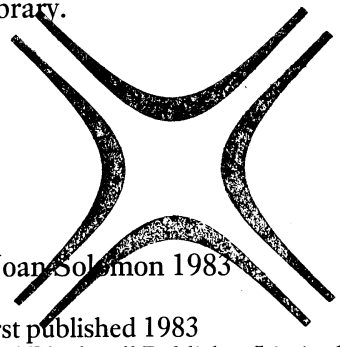

NATIONAL STEM CENTRE

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Introduction

The three topics in this book are grouped together because they depend closely upon one another. The general health of a community is influenced far more by its supply of food and drinking water than by modern treatment of disease, however new its technology or encouraging its success.

The first section takes a historical view of the eradication of diseases which were due to bad sanitation or lack of vaccination. In present-day Britain, public concern is focused upon growing use of medicines and the sometimes controversial methods by which we test them for complete safety, especially in cases like the contraceptive pill where they may be taken daily over the course of several years.

In the final section, we look at aspects of these topics in the societies of the Third World. Everyone becomes aware of occasional disasters and the outbreaks of famine; here we look at new strains of food plants, new sources of protein and the problems of food distribution. Some of what we learned about early preventive medicine in Britain can be applied, but the solutions that are adopted – local health workers or national family planning programmes – shed light on the different cultures and ways of living of these societies.

1 Public Health in Britain

PREVENTIVE MEDICINE

When in poor health we are eager to benefit from the results of scientific and medical research. However, in this section, we are concerned not so much with new cures and the advances being made in modern medicine as with the general health of whole communities. This depends upon the purity of their water, their housing conditions, the inspection of food supplies and public vaccination programmes. The subject is Public Health, and it relies upon general education and legal regulations just as much as on doctors and hospitals.

There are two ways of fighting illness: 'preventive medicine', finding ways in which disease may be stopped before people become ill; and 'therapeutic medicine' in which patients are treated by medicines or other means when they are ill. Public health is a branch of preventive medicine.

Read through the following list of diseases and say which can be treated by preventive medicine:

diabetes	heart disease	cholera	cancer
rickets	smallpox	tuberculosis	diptheria
tetanus	typhus	kidney failure	measles
mumps	malnutrition	pneumonia	rheumatism

SANITATION AND PURE WATER

Appalling sanitation, with open sewers in the road into which householders dumped their 'night-soil', was usual in Britain up to the middle of the nineteenth century. The Industrial Revolution with its great increase in urban population made this much worse, but it was not until 1842, when Edwin Chadwick published his *Report on the Sanitary Conditions of the Labouring Population*, that the connection between the filth of the poorer sections of the city and the continual outbreaks of epidemic disease became accepted. Even in Buckingham Palace conditions were little better, according to a contemporary report which the government dared not publish. Albert, the Prince Consort, died from typhoid as did thousands of Queen Victoria's poorer subjects. In his

historic report Chadwick set out three main conclusions, most of which later became implemented in the Public Health Act of 1848:

> Good health depends upon good sanitation.
> Sewage should be run off in enclosed pipes and sewers.
> Local authorities should be responsible for local sanitation.

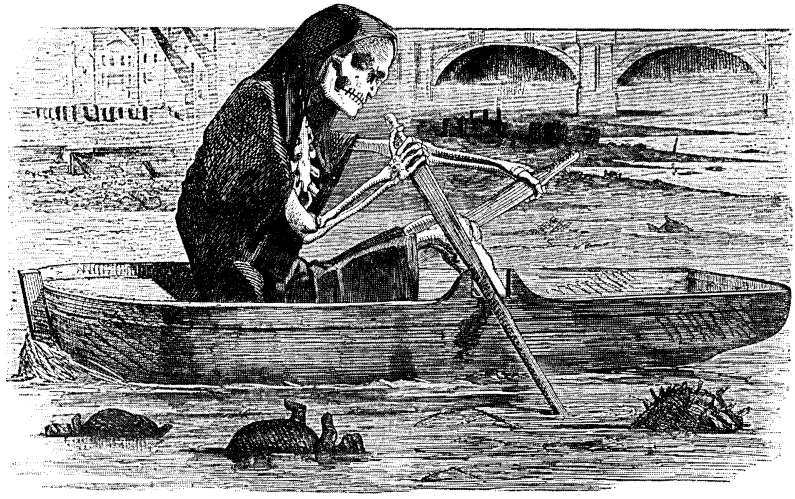
Drinking water which was contaminated with sewage used to be a regular source of disease. In 1848 there was an outbreak of cholera in the district round Golden Square in London. Dr. John Snow wrote:

> Within two hundred and fifty yards of the spot where Cambridge Street joins Broad Street, there were upwards of five hundred fatal attacks of cholera in ten days. As soon as I became acquainted with the situation . . . I suspected some contamination of the water of the much-frequented street-pump in Broad Street, near the end of Cambridge Street. . . . The result of the inquiry was that there had been no particular outbreak or increase of cholera, in this part of London, except among persons who were in the habit of drinking the water of the above-mentioned pump-well.

Dr. Snow obtained permission to remove the pump handle so that the well could not be used and the epidemic was halted almost immediately!

Since contemporary medical theory held that the source of infection lay in the 'miasma' or smell of refuse it took some years before individual experiments in public health, such as Snow's, convinced the authorities.

A drop of London water.



THE "SILENT HIGHWAY"-MAN.

Finally it was shown that both cholera and typhoid were transmitted by contaminated water and that typhus fever, another killer, was carried by the common body louse.

These contemporary cartoons from Punch illustrate the strength of public feeling over the state of the Thames in the year of 'The Great Stink' (1858). It was fed by open sewers and resembled one itself. Drinking water was pumped out of the river into the taps and standpipes of the city. Four years earlier 459 people had died from cholera in a single day – all had drunk water supplied by the Lambeth and Southwark Water Companies, straight out of the Thames!

In spite of improvements in sanitation and supply of piped drinking water, public health statistics continued to show little improvement.

	Deaths per 1,000 of population	Infant deaths per 1,000 births
1841–5	21.4	148
1851–5	22.7	156
1861–5	22.6	151
1976 (Britain)	12	16
1976 (Nigeria)	21	163

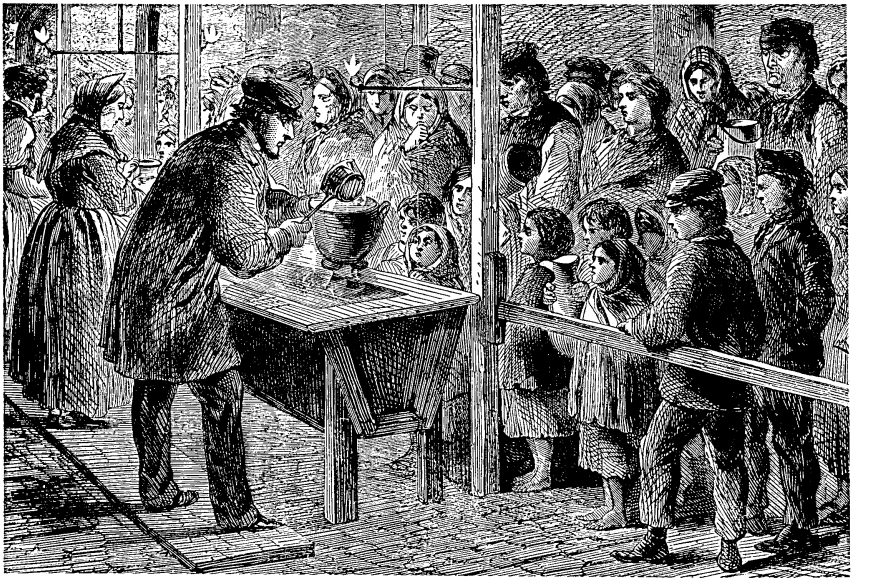
Suggest as many reasons as you can for the continuation of high infant mortality in the nineteenth century and in a Less Developed Country.

Where there is poverty, especially in towns, there will be a poor and unbalanced diet from which the more expensive components – meat, fish, fruit and dairy products – may be lacking. Even the cheap staple foods which contain mainly carbohydrates, such as bread, potatoes and porridge, may be in short supply for the very poor. Such chronic malnutrition cripples the health of individuals, lays them open to infection and lessens the chances of recovery. It took the medical examination of recruits during conscription for the First World War to prove that almost fifty per cent of the population, in some regions of Britain, were suffering serious effects from malnutrition. The most common of these diseases was rickets, a condition in which the bones of the legs become weak and permanently deformed from early childhood due to a lack of vitamin D.

> See the boys go down the street
> Advertise extract of meat;
> One is knock-kneed, two are bow,
> O-X-O . . . OXO!
>
> *Children's rhyme (1935)*

The worst-afflicted children had to wear leg irons, which were common up to the 1930s.

Nineteenth century care for the poor: a night shelter.



A soup kitchen.

During the Second World War food was rationed but the government was determined that the health of children should not suffer. Free school milk for all and subsidised school meals proved so successful that, despite food shortages, children enjoyed better health and grew stronger than the previous generation.

In recent years British doctors have begun to find cases of rickets among children once again. This may be partly due to the stopping of free school milk, and partly to the eating habits of the immigrant populations who are used to sunnier climates in which the body can manufacture its own vitamin D. Education forms an essential part of any system of public health.

Britain's system of Public Health now includes the inspection of all public premises in which food is prepared.

What is the function of vitamin D?
What are the natural sources of vitamin D?
To what cheap foods is it now added?

The basic idea of vaccination is to use the body's own mechanism to fight the disease. The first to be tackled in this way was smallpox which disfigured its victims with pox scars and killed many of them. It was well known that those who were lucky enough to recover, then had protection against any further attacks; they had developed antibodies which made them immune to the smallpox virus.

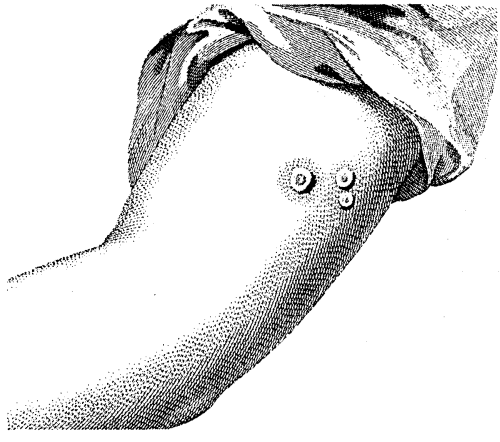
In 1721 Lady Mary Montagu brought back the idea of immunisation from Turkey where, she reported, wealthy people had themselves deliberately infected with the disease in order to obtain protection. Back in England she had tests carried out on seven condemned criminals from Newgate Prison. As it was their only escape from certain death on the gallows, they agreed to submit to the uncertain risk of inoculation with pus from a 'mild' case of smallpox. Although all seven survived and won their freedom they, and others after them, spread the disease to other less fortunate people and by 1840 inoculation of this kind was made illegal.

A contemporary cartoon showing the supposed ghastly effects of the innoculation cowpox.

Doctor Edward Jenner invented the process of vaccination against smallpox some years later. He observed that milkmaids who milked the cows by hand often caught a mild form of a disease called cowpox but rarely got smallpox. The girls themselves thought that their protection was due to having had cowpox. Jenner formed the theory that the body's reaction to cowpox, its antibodies, worked against smallpox, but he kept the idea to himself until 1794 when there was a particularly severe outbreak of the disease. One in five of all the deaths reported in that year were due to smallpox. So Jenner decided to act upon his theory: 'I selected a healthy boy, about eight years old, for the purpose of inoculation for the Cow Pox. The matter was taken from a sore on the hand of a dairymaid who was infected by her master's cows'. The boy had a slight fever, and six weeks later Jenner deliberately infected him with deadly smallpox pus in several places on both arms. The boy remained healthy. If Jenner's experiment had not been successful, what would public opinion have said? Smallpox has now been eradicated throughout the world as a result of vaccination.

Work on other vaccines followed slowly; often there were long years of research before a successful method was found. Sometimes an animal was infected and its antibodies were extracted for use on humans; other vaccines, like that for polio, had to be made from killed virus since the living organism was too dangerous to use in any form. Much of the dramatic decrease in childhood illness and death during this century is due to the free public vaccination programme.

How many diseases have you been vaccinated against?



Dairymaid's arm infected with cowpox.

2 Making Medicines Safe

WHY THEY NEED TESTING

Patients who receive medicines from their doctors are usually ill, in pain or discomfort. The more dangerous their disease the more unpleasant the drug that they will be prepared to take in the hope of a cure. Medicines may have distressing side-effects like the 'vaccination fever' that some babies experience. Nowadays, however, medicines are more widely used, sometimes for conditions that cannot be considered as diseases at all, such as sleeplessness, obesity and bereavement. Treatment may continue for a long time, and in some cases side-effects may be more unpleasant than the condition being treated.

Do you consider that it is a part of a doctor's job to treat his patients for anxieties and worries of an emotional and social nature?

Scientists are far from a total understanding of the body's chemistry. Enormous strides are being made but it is still comparatively rare for a doctor to be able to treat a disease simply by prescribing a substance identical or similar to the missing chemical which causes the illness. Diabetes, treated with insulin, and thyroid deficiency are two outstandingly successful cases of this kind. Even when an identical substance is administered, its timing and regulation are bound to be relatively crude compared with the delicate control system of the human body. More often the direct biochemical cause of the illness, if there is one, remains unknown and doctors can only seek for drugs that will deal with the symptoms or attack the harmful organisms. Such medicines will be foreign to the body's own biochemistry and in need of careful testing.

We use many new materials in our food as preservatives or condiments, on our hair and skin as cosmetics and perfumes, and in our homes as cleaners and paints. Such substances must be carefully tested before use in case they produce dangerous or unexpected effects. For agriculture and horticulture we have developed sprays to kill pests and increase food production. Some of these chemicals may eventually become ingested into our bodies through unforeseen links in a food chain.

During the 1960s farmers regularly fed antibiotics to their livestock. Why was this?

Why has this practice now been stopped?

EARLY MAN-MADE MEDICINES

The first man-made drugs were the anaesthetics ether and chloroform which were synthesised in the 1840s and began to change surgery from butchery to the delicate craft it has become today. Both anaesthetics needed careful administration and the right dosage could only be discovered by trial and error. In 1877 the first committee on drug safety was formed to investigate some unexpected deaths due to the use of chloroform during operations.

In the same period the first specialised pharmaceutical firms were being set up. A movement in America coined the term 'ethical medicine' for preparations made according to a known and published formula. This distinguished them from the secret and often scandalous patent medicines used to produce 'miracle cures'.

Progress in developing a new medicine was often slow. The famous discovery of Salvarsan in 1910 for the treatment of syphilis was a case in point. Paul Ehrlich had investigated over 600 related compounds before he hit upon Salvarsan; but this was only the beginning. Large-scale manufacture of the product while maintaining its laboratory purity proved difficult. Ehrlich rejected batch after batch and involved his firm in many years of costly development before the medicine was ready for the market. Even then it produced some unpleasant and dangerous side-effects, as well as being expensive. Years later, in the 1950s, when the Salk vaccine against polio was produced in highly sophisticated American laboratories, one single batch of impure vaccine caused more than eighteen deaths and a great public outcry.

While the development of new medicines remained so slow there was no pressing need for an official watchdog on safety. In 1918 there was a minor scandal about the number of soldiers who had died from an acute form of jaundice brought on by the treatment of syphilis by a compound of arsenic. A special investigating commission was set up to look into it. During the 1930s and 1940s a whole new range of

medicines was developed of which insulin, sulphanilamides and penicillin are the best known.

When the National Health Service was set up after the Second World War, the first permanent commission was organised to report on the host of new medicines which became available each year. It had no power to order further tests or to withdraw any medicine from the market but its approval was held in high regard as a public safeguard, until the case of the drug thalidomide.

THE SCANDAL OF THALIDOMIDE

This tragic story began in Germany in 1957 when a medicine which had been widely tested on rodents, cats, rabbits and human subjects was launched on the market as a powerful tranquiliser. Compared with barbiturates it seemed a great advance. (There are still hundreds of deaths per year caused by barbiturates – suicides and cases of terminal addiction.) Thalidomide, it was said, did not produce harmful effects, even when given in many times the necessary dosage. The Distillers Company of Britain became interested in it during 1956, acquired the rights from the German firm and did few tests of their own. Two years later it had won the commission's approval and was put on the market for use on a doctor's prescription. In Germany it could be bought over the counter.

During 1960 the first doubts about the drug began to be expressed. In Germany and Britain doctors found that it could be dangerous if finely powdered, causing damage to the nerve endings. Such criticism made the American Food and Drug Administration order more stringent tests, but the Distillers Company continued to advertise and supply thalidomide. It was not until November 1961, when a conference in Germany heard evidence of its deforming effect upon the unborn child, that the horrific news hit the world's headlines and thalidomide was withdrawn. By this time about ten thousand deformed babies had been born, mostly in Germany, of whom about two thousand survived.

What had gone wrong? It had seemed that this new tranquilliser was particularly useful in treating the depressions and nausea that often produce misery during the early stages of pregnancy. For this purpose it had never been tested on pregnant animals or human beings. In the assessment that followed the tragedy it became clear that there was no

effective procedure for collecting evidence on such devastating side-effects. A new central clearing-house was required.

In 1963 the Committee on Safety of Drugs (later Medicines) began its work, and a few years later a law was passed making its approval compulsory for all new drugs. It does not prescribe the tests or carry them out (in Sweden and Canada where similar state bodies carried out the tests, thalidomide had still been passed as safe for general use). It examines the records of tests carried out by the drug firms and operates an energetic follow-up service to track down new and unexpected reactions by urging general practitioners to make frequent reports.

METHODS OF TESTING

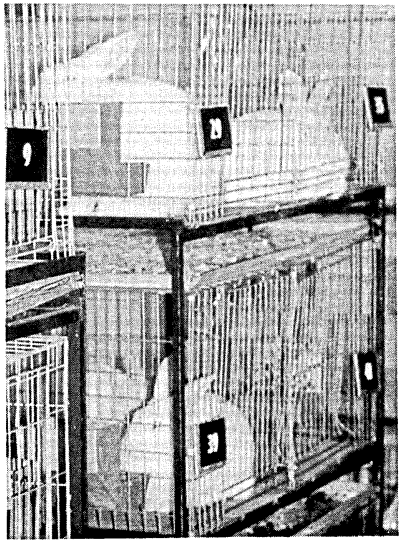
Before a new medicine is licensed for use on general prescription, it must be well tested. This will almost inevitably involve experiments in which animals will die and humans will be at risk. Consider the following fairly typical stages in the development of a drug to treat some specific complaint:

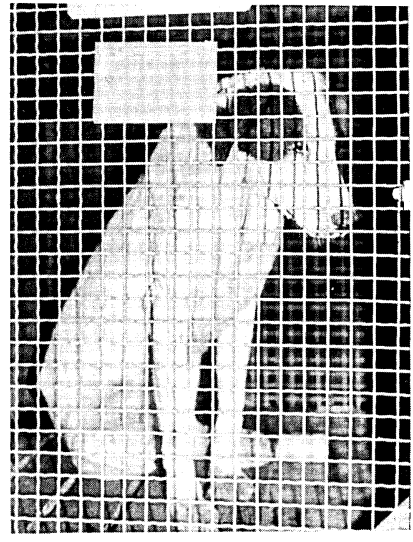
1 *Medical research* In order to establish the cause of a disease, animal experiments are often considered necessary. This may involve dissection and careful examination of infected organs.
2 *Laboratory analysis* Any new substance suggested for treatment of the disease will be chemically analysed and may be tested in the laboratory on human cell cultures.
3 *Animal trials* Because a whole body is so much more complicated than a tissue culture the drug must be tested on living animals. The World Health Organisation recommends the use of at least three different animal species, (for example mice, rats, and either rabbits or dogs). In every case the treated animals will be compared with a control batch of untreated ones to find out if the drug has unpleasant effects. The law requires that all new medicines, cosmetics and pesticides be put through the Lethal Dose 50 test. For this a number of animals have the substance administered to them in increasing amounts until fifty per cent of the sample die.

Do you think that the testing of common household products, which children might easily swallow, justifies this?

Is it necessary to know the exact LD50?

In 1976 about 5½ million licensed animal experiments were carried out. About one-third of these were for cancer research, diagnosis such as Rhesus blood tests, and the testing of medical products. The use to which the other two thirds were put is less well documented. Most were probably used for biological research and the testing of commercial products. Licensed animal experiments are subject to laboratory inspection to ensure that the animals are adequately housed and treated with as much care as possible.





Left *Caged rabbits to be used in animal experiments at a Medical School.*
Right *A dog which is to be used for research.*

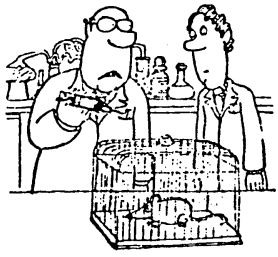
Britain, but not the other countries in the EEC, has a legal requirement that experiments on animals should be carried out under anaesthetic and should cause as little suffering as possible. This is the 'pain clause' for which groups of animal lovers have been campaigning for some time.

Many people are deeply concerned about animal experiments and the posters of anti-vivisection organisations show hideous sights. Others are worried that the image of scientists suffers as a result of public distress over animal tests.

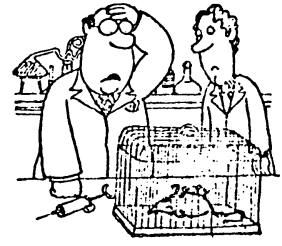
4 *Clinical Tests* Animal reactions are not an invariable guide to human reactions. There are differences even between the reactions of different animal species to the same drug. Penicillin, for example, is deadly to guinea-pigs. Had the test been done before this 'miracle

drug' was submitted for approval it might have been withheld from general prescription until many more preventable human deaths had occurred. The first human patients who take part in clinical trials must be at some risk.

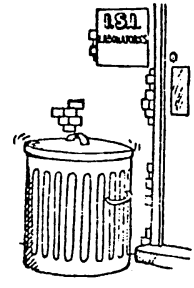
Should all such patients be volunteers who understand the risks?
Would you allow careful, monitored trials to be carried out on prisoners or on mental defectives?

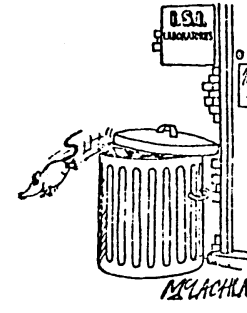


'Well, Trenshaw, this is the last chance for our super-intelligence drug XLR6. I've just given the rat the injection.'



'Yet another one dead! That's it, I guess . . . it doesn't work. Take it away.'





5 *Large-scale trials* For drugs like the contraceptive pill, tranquillisers and sleeping pills, which many people are likely to take regularly over long periods, a different kind of test will be required. The dosage will need to be corrected by giving it to a large number of people (individuals may vary) for many years. In the recent (unsuccessful) appeal to licence a contraceptive inoculation, the drug-makers claimed that trials had already been carried out over a period of 15 years and had involved 'six million patient-years'. This firm carried out trials in countries with less rigorous medical regulations.

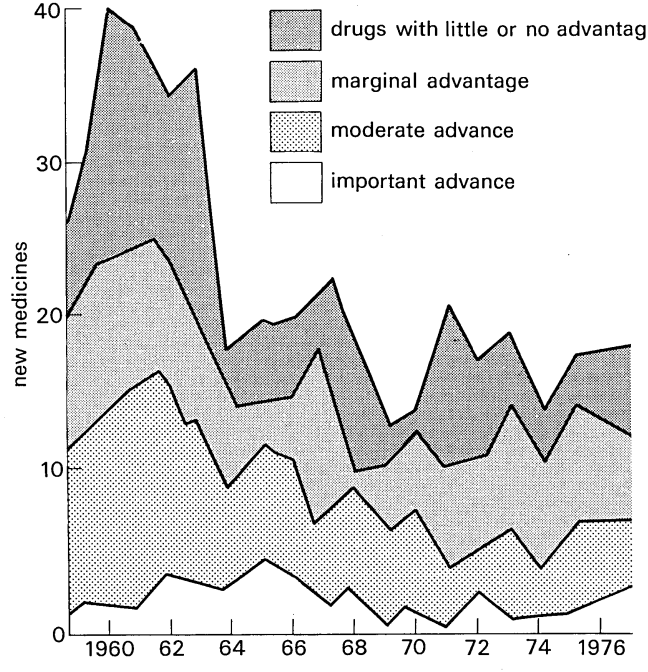
Four typical positions taken in the debate on drug-testing are:

'Medical research and the testing of drugs is of the greatest importance.' We cannot afford to relax our present safeguards and they should be strengthened – think of the thalidomide tragedy.

'Animals have as much right to enjoy a healthy painfree life as we do.' Most animal experiments cause pain, mutilation and death for the testing of non-essential commercial substances.

'It is not death, but the onset of significant damage that scientists should be looking for.' Instead of the LD50 test an alternative must be found in which the first signs of harm are detected in test-animals, as they are in humans.

'Drug-testing has become unnecessarily elaborate and expensive.' No safety procedures can eliminate all risk, and the present laws discourage drug firms from developing new and valuable medicines.

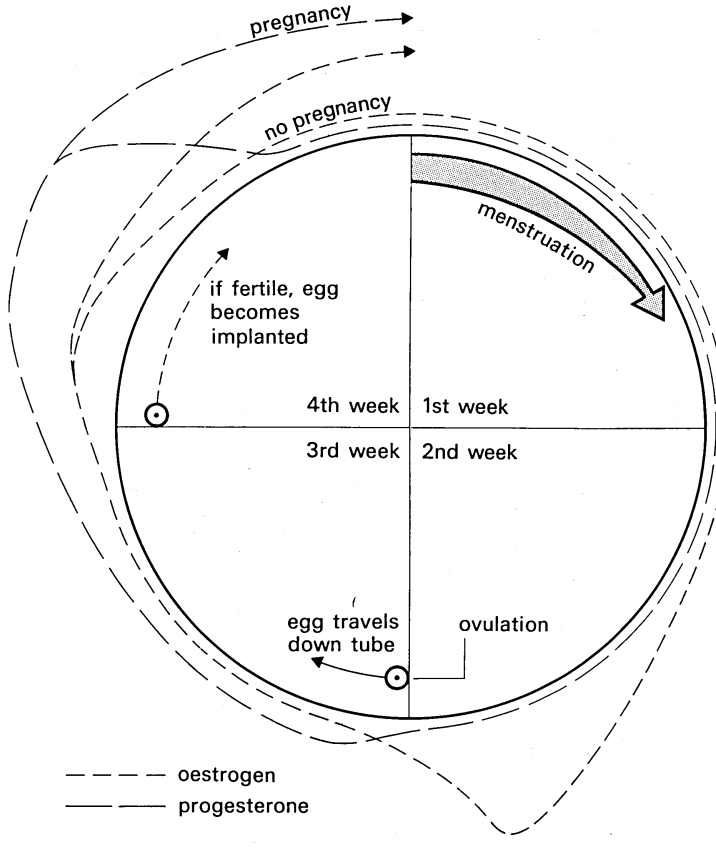


New medicines in Britain.

In the years 1964 and 1972 new acts were passed requiring more safety tests on new drugs. What class of medicine was most affected by the new regulations?

The oral contraceptive is the drug most widely used by those not suffering from illness.

By the early 1940s two hormones had been isolated in minute quantities from gallons of human and animal urine. One of them, oestrogen, had already been used clinically to help with painful periods, and progesterone had been injected during pregnancy to prevent miscarriages. Further progress in 'hormone therapy' was prevented by its enormous expense.



The egg cycle: animal experiments confirmed that both oestrogen and progesterone prevented ovulation.

Russell Marker, professor of Organic Chemistry at the State College of Pennsylvania, had managed to synthesise small quantities of progesterone from a steroid (a complicated organic compound built up from carbon rings) which he had isolated from sarsaparilla, which is extracted from the root of a Central American plant. Marker then set about examining other plants in the hope of finding one which would yield more of this substance. Roots and leaves arrived at his laboratory and eventually Marker discovered that the wild black Mexican yam was the best source of progesterone. All he needed now was the backing of a pharmaceutical firm.

Finding money in wartime America for setting up a drug-firm in politically unstable Mexico proved difficult. Marker's reaction was to leave his college in mid-term, fly to Mexico and hire mules for a long journey into the interior. A few months later he walked into a small chemical firm in Mexico City and unwrapped two large jars of pure synthetic progesterone worth nearly £50,000. Within the year a new firm, Syntex, had been founded; a few months later, in 1945, Marker walked out on the whole enterprise as abruptly as he had begun it.

During the next ten years chemists at Syntex managed to synthesise other hormones, both male and female, from the same plant steroid. Then, because progesterone had to be injected in large and uncomfortable doses in order to be effective, they set about constructing a new formula which could be taken by mouth as a liquid or a powder. Two different teams of chemists, one working at Syntex and another at G. D. Searle in America, arrived at almost identical solutions to the problem within a few months. In 1957 the new drugs were licensed for medical use by the Food and Drug Administration, the American counterpart to the British Committee for Safety of Medicines.

CONTRACEPTION AND TRIALS

The interest in oestrogen and progesterone now moved away from the treatment of women's problems to their use as contraceptives. At first, research concentrated on tests with animals. Progesterone was given by injection and by mouth to rabbits and rats; it did seem to prevent ovulation successfully but its effects on humans and the dosage required could only be guessed. Carrying out the next stage would be

difficult since the use of the drug as a contraceptive was still experimental and not covered by medical licence.

Some small-scale trials were carried out in America, at a clinic for childless women, with a few student volunteers, and with patients in a mental institution whose relatives had given permission on their behalf. No harm came to these subjects, but since the drug was given to them for a few months only, and many were unmarried, such tests were not enough. Doctors needed to know the right mixtures of oestrogen and progesterone which could be taken, year in year out, by healthy or undernourished women, without having any serious side-effects.

The large-scale trials took place in Puerto Rico, a Carribean island which was small and overcrowded; it was underdeveloped and had no laws against contraception even though it had a considerable Catholic population. The women were largely uneducated but many were eager to regulate the size of their families. All those selected had at least two children, the purpose and use of the pill was explained to them, they had agreed to take part and underwent a careful medical examination.

When the programme began in 1956 the risks involved were almost totally unknown. No one had yet taken the pill for more than four or five months and some had suffered from headaches, nausea and irregular bleeding. The best dosage had yet to be worked out and there was no evidence as to whether pregnancy could always be begun again after the pill was stopped. The government health department of Puerto Rico had not been informed and the local Catholic priests tried to dissuade their congregations from taking part. It was a large-scale gamble using an ignorant population of a different race for the benefit of American medicine, a drug company, and the women of the world; thankfully it was a success. The effect of contraception of women prematurely aged by excessive childbearing was often dramatic:

> 'To see these women after they'd been on for a year . . . You know, to get them through one year, without having a baby. And the fact that they themselves realized they'd gone this whole year and they weren't pregnant, and here they were, hale and hearty. But the exciting thing was that, for instance, some lost their babies in a flood, and they decided they wanted another baby and they just stopped the pills. And then we started seeing the babies that were arriving and they'd be fine. I can remember the first time we worked out statistics and found out that we got fifty-fifty propor-

tion of boys and girls. Because there was this terror – are you going to get all girls or all boys, you know, what's going to happen?'

Research worker in Puerto Rico

The outstanding result of the trials was the low failure-rate when compared with the other contraceptive methods which had been used at various clinics on the same island.

Contraceptive method	*Failure rate per 100 woman-years*
vaginal suppositories	42.3
dutch cap	33.6
condom	28.3
pill	1.7

Success meant more than a reduction in the growth-rate of an impoverished and crowded island population and the release from fear of pregnancy for overburdened women. The maternal mortality in Puerto Rico was high, about two out of every thousand, so lives were being saved by the pill.

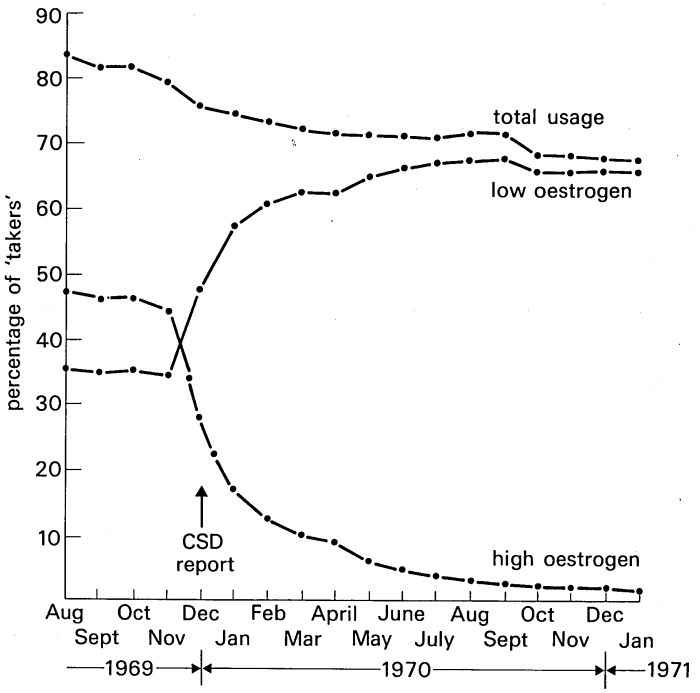
In 1960 the pill was licensed for use as a contraceptive in America, and within three years it was accepted by the Committee on Safety of Medicines in Britain.

RISK AND REACTION

In Britain and the USA the new contraceptive pills gained popularity within a short time. By 1969 about 5 million women in America and 1½ million women in Britain were regular users. However, during the first five years of pill-taking, a grave suspicion began to form. As early as 1961 and 1962 the odd case turned up of a young woman dying of thrombosis (a blood clot in the heart or brain) after starting the pill. Doctors hastened to reassure the public. The number of cases was so small that it was hard to get reliable statistical evidence, but by 1968 there were clear signs of public concern. Coroners at inquests drew attention to the use of the pill and newspapers underlined the problem with headlines such as 'Pill caused Woman's Death'. Pill manufacturers in America hired a public relations firm to soothe public anxiety but the medical profession in Britain, still smarting from the horror of the thalidomide disaster, was quick to set up a working party to report on the risks of blood-clotting.

During 1968 and 1969 a series of research papers on the statistics of hospital patients with blood-clotting diseases showed that there was at least twice as great a risk for pill users as for non-users. In December 1969 the Committee for Safety of Medicines published their findings and recommended a pill with a much lower component of oestrogen. The reaction was immediate as women besieged their doctors' waiting-rooms to have their prescriptions checked or changed.

This report and its implementation may have saved some twenty lives per year since 1970.



The effect of the Committee for Safety of Medicine's report on the type of pill to be used.

Public consciousness of health hazards has come a long way since the days when Dr. Snow had to remove the handle from the pump in order to prevent disease.

An action group of British women has recently forced the drug companies to include a leaflet giving a detailed health warning with every packet of pills sold. It is now an open risk that adults are free to take if they so wish, after adequate warning.

3 Living in the Third World

AGRICULTURE AND THE SUPPLY OF FOOD

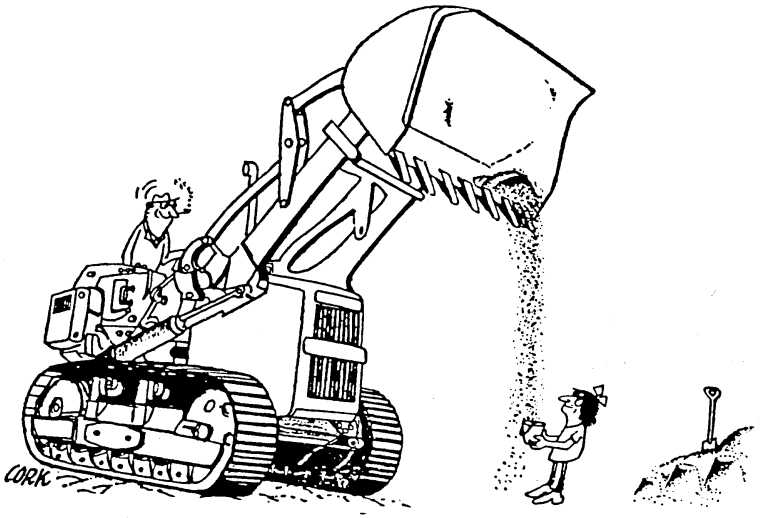
It is estimated that about two-thirds of the world's population live in continual poverty, and that almost one billion of these suffer daily hunger at some seasons of the year. Most of them live in the forty countries on the United Nations' official list of 'Less Developed Countries' (LDC). This list contains such contrasting parts of the world as Basutoland, Western Samoa and Afghanistan, each with its own traditions, climate and health problems. What they have in common is little industry, a low gross national product per head of population and widespread subsistence farming.

Agriculture in the developed countries is organised like an industry. Money can be borrowed for investment in machinery, seed, fertiliser and cattle fodder. The produce is sold on a stable market, often at prices subsidised by the government, and the cash return provides income for the farmer, his staff and family, as well as money for working the farm and interest on bank loans. In large parts of the Third World the situation is different. Farming there is a struggle to grow enough to feed the farmer and his family. There is little surplus for sale even in a good year, and a bad year can bring hunger or death.

Where the soil and climate are suitable for settled agriculture, as opposed to nomadic grazing, the usual crops grown are grains such as rice, wheat, millet and maize, or root crops such as yams and cassava. These form the staple carbohydrate food in the diet. Growing grass or grain to feed cattle for their meat or milk is extravagant of land resources:

1 acre of grain crops = food for about 800 man/days
1 acre of beef grazing = food for about 80 man/days

Differences in wealth and farming practice produce a surplus of grain in the west and curious patterns of world trade. America and the EEC subsidise their farmers and export some grain as 'food aid' to the LDCs, whose agriculture is little improved as a result. In the USA, where only 2% of the population works on the land, prices are guaranteed by the government and much of the surplus is fed to animals.



Some African countries export groundnuts to western nations for cattle fodder in order to gain foreign exchange. Their poorer inhabitants go hungry.

Fair distribution of food, on a national or international scale, is hard to achieve. It depends upon politics, transport and many other factors. Even in Britain, despite the social services and good transport, there are those that live near the hungerline.

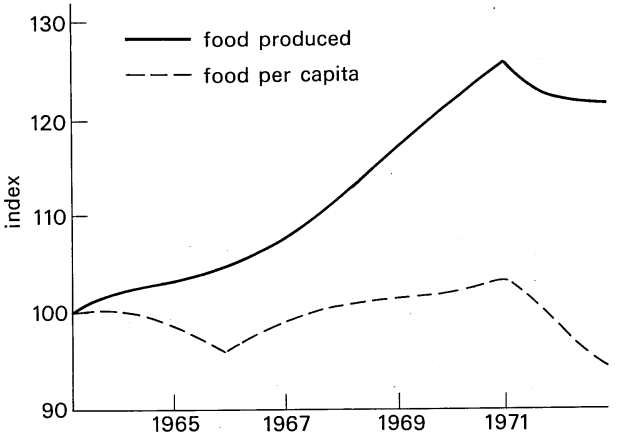
THE GREEN REVOLUTION

In 1950 a group of American scientists working in Mexico at the International Maize and Wheat Improvement Centre succeeded in producing new strains of these crops which were suitable for tropical conditions. The grains, including a new rice developed in 1962, brought about a change in the world's food supplies which has come to be known as the 'Green Revolution'. The new plants have two important features:

They are dwarf varieties The short, stout stalks of the new hybrids can support a heavy load of grain.

They have a shorter cropping time Where the traditional rice plant took about 170 days from sowing to harvest the new varieties take 120 days or less. In favourable climates it is possible to produce two or even three crops per year.

Two wheat varieties grow side by side in a field at a research institute near New Delhi. The plants on the left have 'lodged'. Having been heavily fertilised they have grown too tall, and the stalks have bent over so that some ears of grain will break off and others may be damaged. The plants on the right have not lodged as they are newly developed varieties that have three genes for dwarfism. Resistance to lodging is critical because it makes possible the heavy fertilisation that results in higher yields per acre.



Land in Asia planted with high yield wheat and rice

Year	Acres
1965	200
1966	41,000
1967	4,047,000
1968	16,660,000
1969	31,319,000
1970	43,914,000
1971	50,549,000

Food production in developing countries.

The impact of the Green Revolution: Although the yield of wheat and rice greatly increased, the amount of food per person stayed almost constant due to the increase in population.

The Green Revolution has been a great success in some countries. The Philippines, for example, have now become self-sufficient in rice for the first time in over a century. However, technological developments rarely produce unmixed blessings. They alter ways of living and produce unexpected results:

Growing crops depends upon adequate supplies of water and fertiliser. Where these are missing, as in the drier parts of Turkey, Pakistan and Africa, new strains of plant have little impact.

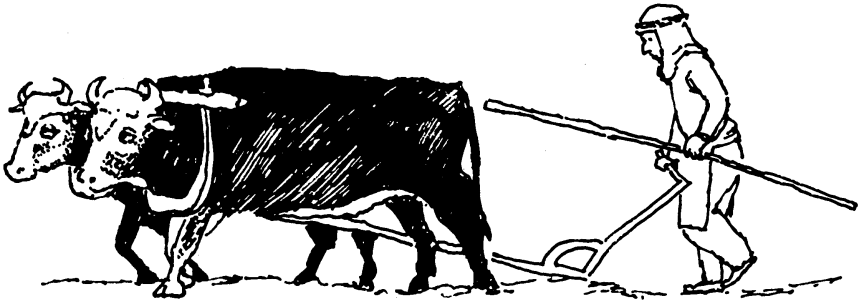
Reliance on a single crop or variety is unwise. Should it prove vulnerable to a disease a disaster might occur, like the Irish Potato Famine in 1840. This reduced the population, through starvation and mass emigration, to half its previous level. Other strains of plant must continue to be grown.

Small farmers cannot easily afford the outlay to buy the new seed and the necessary fertiliser. Many borrowed money at a high rate of interest and when the price of grain fell were forced to sell their land to pay off the loan. In general it is the richer farmers who have done best out of the Green Revolution.

Landless peasants can get employment on bigger farms if there is a greater need for labour to plough, weed, fertilise and harvest the increased yield. There is evidence that this has happened in the Punjab region of India; rural employment has increased. However, the alternative of increased mechanisation and a subsequent rise in unemployment has occurred in other districts. In densely populated countries like India this could be a tragic consequence.

INTERMEDIATE TECHNOLOGY ON THE LAND

In the simplest technology tools such as the spade and the hoe cost little to buy and nothing to operate, but the work is hard and slow and productivity is therefore limited. This problem cannot be solved by advanced technology by introducing tractors and other sophisticated machines because, apart from the expense of fuel, there is a lack of spare parts and expertise to use and maintain them. They need intermediate technology, tools which can be made locally. A wooden plough might appear primitive to a European but to a Jordanian farmer it increases considerably the amount of work he is able to do in a day, even if it is not as efficient as more advanced equipment.



The buffalo has made a great change in the lives of thousands of poor villagers in the Gujarat, in north-west India. The Adivasis, tribal people who live in the forest areas, were offered a government subsidy for half the cost of a pair of buffaloes. The other half could be borrowed from banks, but poor people were faced with the difficulty of repayment. Some were assisted by relief organisations to obtain these animals to help them in their work by relieving them of the time-consuming chore of working all their land by hand, making possible the preparation of improved seed-beds and earlier sowing.

President Nyerere of Tanzania summarised the need for an intermediate technology for the farmer:

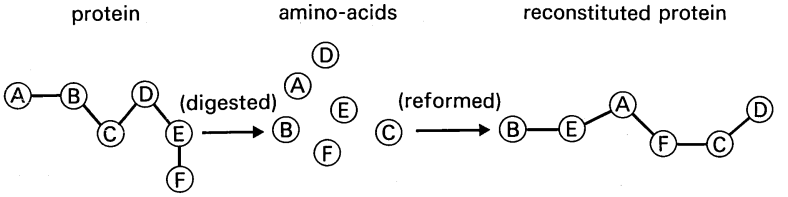
> 'I've been telling my own people, "We've got to change, we must mechanise, we must have better tools. But what are better tools? Not the combine harvester. If I were given enough combine harvesters for every family in Tanzania, what would I do with them? No mechanics, no spare parts . . ." I shudder at the thought. It would be a very serious problem – unless, of course, I sell them for hard cash. But we still have to give the people better tools, tools they can handle, and can pay for . . . We are using hoes. If two million farmers in Tanzania could jump from the hoe to the oxen plough, it would be a revolution. It would double our living standard, triple our product! This is the kind of thing China is doing. An ancient people, dealing with the difficulties of feeding seven hundred million people. The stage of their development is relevant to us. I wish I could state this as true observed fact and nothing more. But when I say "From China we can learn", they say we are going Red.'

Quantity of food is not always sufficient to prevent malnutrition. The food must provide a diet containing the vitamins and minerals on which health is based. The most serious common deficiency disease in the less developed countries is caused by lack of protein. The symptoms are wasted arms and legs, sores, swollen belly and listlessness, and are familiar through photographs on the posters of famine-relief organisations. In Ghana the disease is called Kwashiorkor, which means 'The sickness the older baby gets when the new baby comes'; the new baby takes the mother's breast milk and the older brother or sister is weaned on starchy foods which are deficient in protein.

	KJ	g	g	g	mg	mg	micrograms			
10g	Energy	Protein	Fat	C/Hyd	Calcium	Iron	A	B	C	D
Bread	101	1.0	0.3	4.7	2.8	0.3		24		
Potato	32	0.2		1.8	0.8	0.07		11	2000	
Rice	150	0.6	0.1	8.7	0.4	0.04		8		
Groundnuts	245	2.8	4.9	0.8	6.1	0.2		23		
Soya Flour	181	4.0	2.4	1.3	21	0.7		74		
Beef	131	1.5	2.8		1.0	0.4		7		
Chicken	60	2.1	0.7		1.1	0.15		4		
Fish	30	1.6			2.5	0.1		6		
Herring	80	1.6	1.4		10	0.15	4.5	3		2.2
Milk	27	0.3	0.4	0.5	12	0.01	4.4	4	130	0.005
Dried Milk	206	2.7	2.8	3.8	81	0.07	24.6	31	1100	0.03
Cheese	173	2.5	3.5		81	0.06	42	4		0.04
Eggs	66	1.2	1.2		5.6	0.25	30	10		0.15
Spinach	9	0.3		0.3	7.0	0.3	100	12	6000	
Oranges	15	0.08		0.8	4.1	0.03	.8	10	5000	

A chart showing the nutritional value of some common foods.

Proteins are complicated molecules consisting of long chains of amino-acids. Plants build them from nitrates and carbohydrates but animals cannot do so. They depend on digesting proteins and breaking them down into their component amino-acids, which are transported round the body and assembled into the required form of protein within the cells. A balanced diet contains proteins which will contribute all the amino-acids that the human body needs. Rice and wheat are comparatively rich in protein if they are not wastefully milled and refined. Beans are a rich source of most of the necessary proteins, but the root crops



Proteins are digested and broken down into their component amino acids which are assembled into the required form of protein within the cells.

cassava and yams are almost pure carbohydrate with little or no protein. Maize, the staple food of Zaire, Peru, Kenya, Tanzania, Central America and Uganda, is low in two of the key amino-acids that the human body requires. Feeding with maize meal often leads to kwashiorkor. Methods of dealing with this health problem vary from education to new kinds of plant technology.

NEW SOURCES OF PROTEIN

Soybeans When the oil has been extracted from soybeans (or groundnuts or cotton seed) the residue can be made into a meal having as much as forty per cent protein. This requires sufficient funds to set up local extraction plants, and a change in eating habits.

In the Far East soybeans are popular and bean-curd is used in a number of different ways. In African countries an intensive education campaign may be needed to teach women how to cook and use the whole bean or the flour, if it is available.

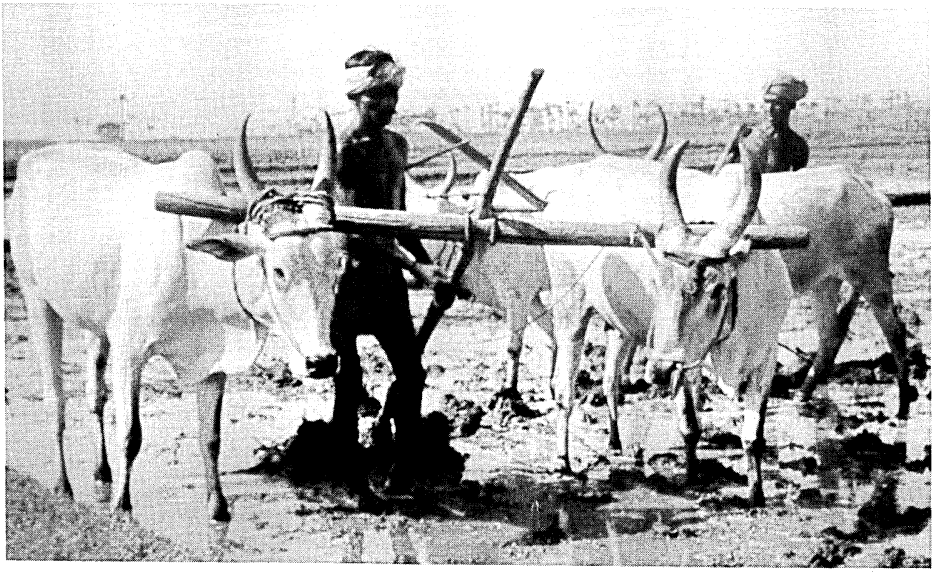
Cook soybeans, soyflour, bean-curd and 'Protoveg'. Taste them. What are the advantages of each? (Consider the cost, cooking time, digestibility as well as flavour.)

What proportion of the protein in school meals is now reconstituted soybean?

Leaf-protein Research work in Nigeria has shown that the protein in leaves can be extracted by squeezing out the juice in simple presses. The fibrous residue can be used as cattle fodder and the protein is concentrated. Leaves can yield almost three times as much protein per acre as soybeans. Village co-operation and some capital is necessary for the extraction. The taste of leaf-protein is not generally liked.

What incentives and action could the local government take to promote leaf-protein?

The White Revolution India has concentrated recently on encouraging the production of milk and milk products. Oxen and water buffalo are widely used on the land. The government has helped by providing milk collection centres within bicycle distance of many of the crowded small farms in the fertile regions of India.



Buffaloes in India.

Why was government action necessary?

Why is milk-based protein not available in large parts of Africa?

What milk product is most commonly used in Indian cooking?

Cows convert grass into meat more efficiently than into milk. Why does India not try to solve her protein problem in this way?

New varieties of maize Since 1965 it has been possible to grow new varieties of maize with a better protein content. These have not proved popular due to an unattractive taste and difficulties in milling. Research goes on to find a more acceptable corn with a protein content as well-balanced as that of milk.

WATERBORNE DISEASES

Many of the worst diseases of the developing world are associated with infected water supplies just as they were in nineteenth-century Britain.

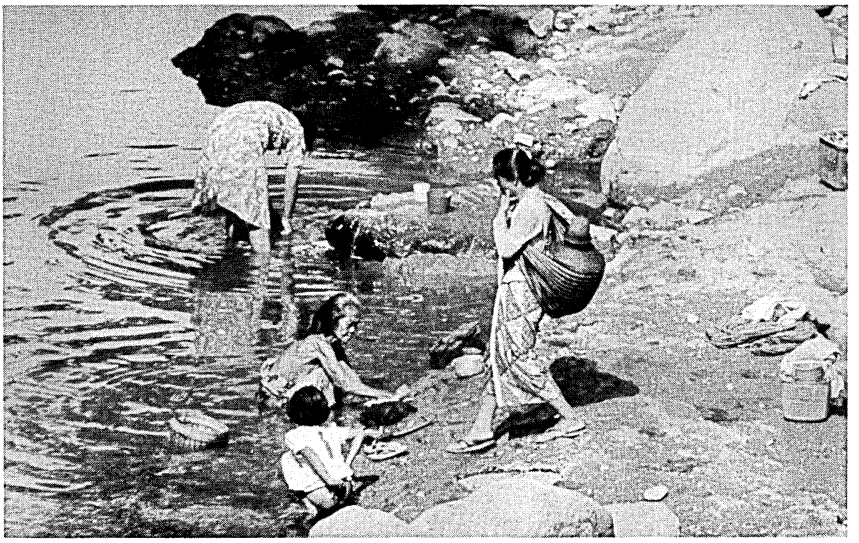
Malaria An estimated 400 million people (excluding the Chinese) still live in regions where malaria is a major health hazard.

Bilharzia This affects more than 200 million people in Asia, Africa and Latin America. Larvae penetrate the skin and breed in the bladder and liver.

Cholera and dysentery Many different organisms cause these diseases but all are carried by polluted water.

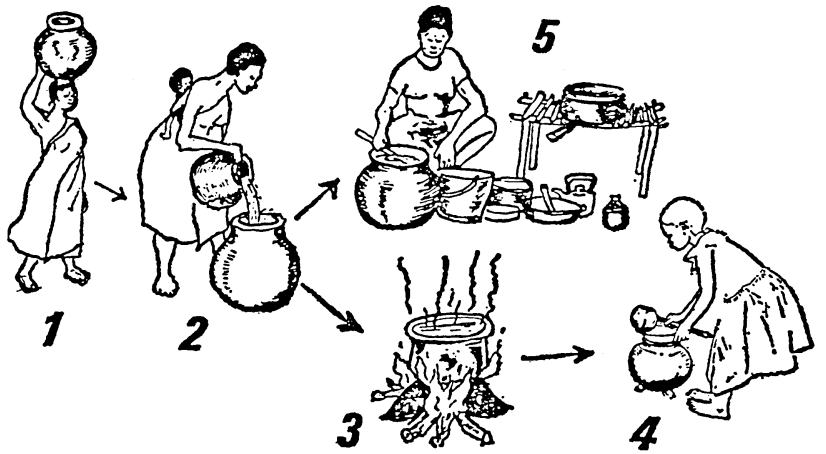
Sleeping sickness and river-blindness Carried by insects which breed in wetland and river areas.

Tuberculosis and measles More than three-quarters of the world's cases of these diseases occur in the LDCs, often in the insanitary dwellings of new shanty towns. Although not waterborne these two diseases could also be largely eradicated by better living conditions and public vaccination.



One source of water may be used for washing, drinking and carrying away sewage.

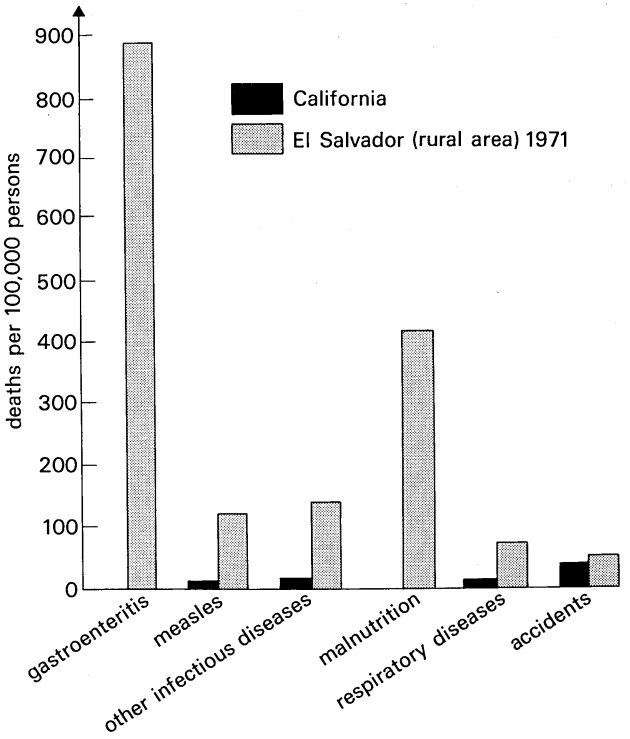
The World Health Organisation has made the supply of clean water a priority in many of their recent projects. One method is to dig wells to reach below the stagnant surface water. This requires expensive and elaborate pumps and regular maintenance. If there is no possibility of an alternative supply of water the best approach may be through community education.



Health Education in Tanzania:
1 Take water that comes from a good source. 2 Pour the water into a second jar. Let it settle. 3 Boil some of the water for drinking. 4 The boiled water should be kept in a good place and should be conserved. 5 The remaining water can be used for washing utensils.

Where preventive medicine fails, the next step must be to apply curative measures appropriate to the living conditions of the people. Cholera and dysentry kill by dehydration. Severe diarrhoea causes food to pass so rapidly down the intestinal tract that no liquid can be absorbed into the body. In the west this condition is treated by hospitalising the patient and introducing a slow saline (salt solution) drip into a vein in the arm, but treatment of this sort may be unavailable in less developed countries. In some cases, over fifty per cent of a country's children die before they are five, and gastroenteritis (diarrhoea) is the frequent cause of death.

A simple way to treat affected children is to dose them with frequent drinks of water containing a pinch of salt and a spoonful of sugar. The salt helps the body to absorb the liquid which gives nourishment from the sugar (glucose would be even better). Most homes have these simple ingredients; all that is needed is a vigorous health education programme.



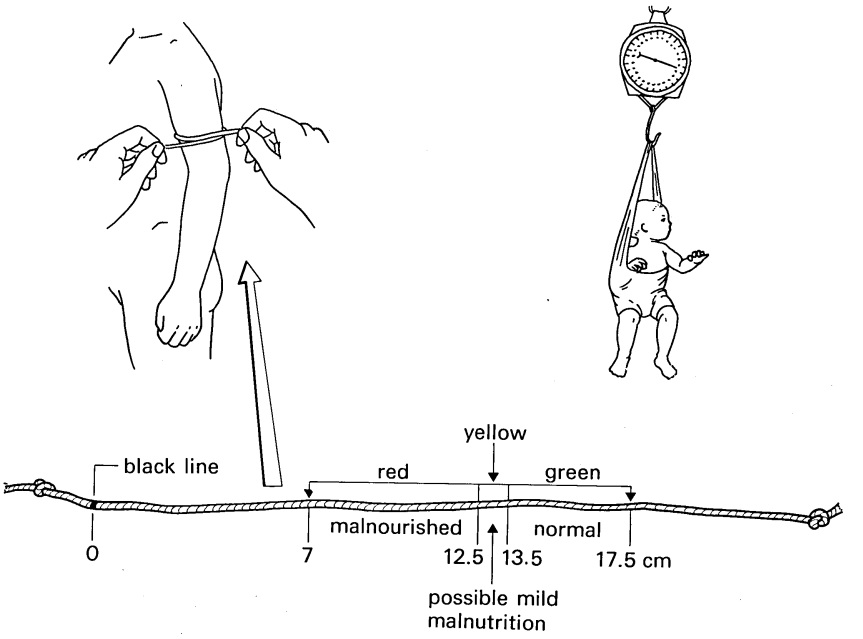
Mortality in children aged 2 to 4: a comparison between El Salvador and California.

MEDICAL AUXILIARIES

Treatments for most common illnesses in the less developed countries are simple but there is a serious shortage of medical workers to apply them. Instead of training doctors in the western way and building large hospitals, some countries are recruiting local people to train as medical auxiliaries. Their course may last no longer than a few months, after which they return to their villages to spread new ideas on health care. They will know how to recognise malnutrition, using basic kits such as scales and a measuring cord (illustrated), as well as gastroenteritis, malaria and other common diseases. Only serious cases are transported to distant hospitals for expert attention. The cost of training a doctor in the western way is at least £40,000; to train a medical auxiliary in Africa costs between £500 and £1,500.

The figures below give the population per trained doctor in the late 1960s (it is much the same today):

	urban	*rural*
UK	860	
USA	650	
India	500	40,000
Indonesia	2,800	6,000,000
Kenya	1,500	45,000
Nigeria	2,050	59,000
Thailand	3,000	120,000



Aids to detecting malnutrition.

The ways in which medical auxiliaries help villagers are different to those used by our doctors. They may teach mothers how to cook beans or treat drinking water. Sometimes they are instructed to spread health information by acting out simple stories to show the results of disease and the traditional 'witch doctor' remedies. Their great advantage is that they know the local culture and any common superstitions.

In China, where mass health care and preventive medicine is taken

most seriously, the 'barefoot doctor' project was launched in 1965 at the time of the Cultural Revolution. The recruit is trained in traditional and western medicine over three years during the slack agricultural periods. After returning to the community his or her duties include the organisation of health education, sanitation, vaccination and treatment of simple ailments, and family planning.

There are technical problems. Transport and equipment are in short supply, and the distribution of vaccines, which must be kept at temperatures below 8°C, presents a difficulty. This kind of health service is often called 'appropriate health care': solutions to problems need to be appropriate to local ways of living.

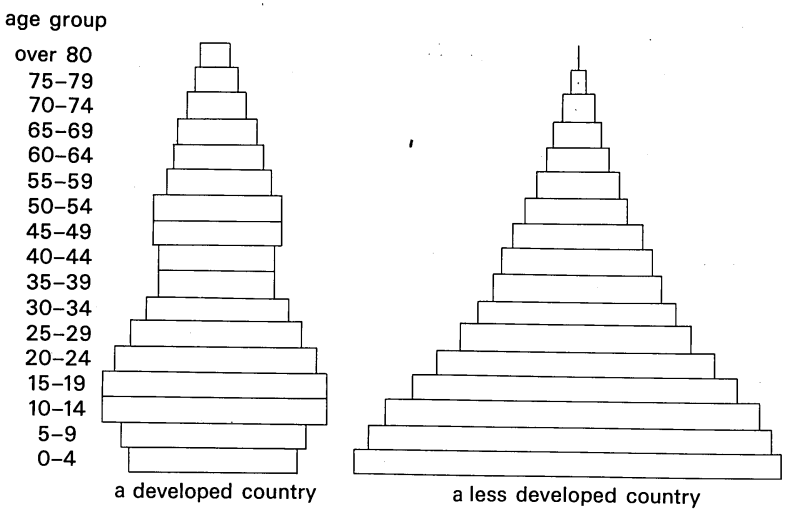
POPULATION EXPLOSION

The world population is expanding at a rate which has caused it to double every twenty-five to thirty years. This has almost obliterated the effect of the Green Revolution by continually increasing the number of mouths to be fed.

In a LDC there is often a low population density in terms of numbers per acre of land but a pressure of population which is much higher than in the developed countries since there is no way of providing adequate food, education or job prospects for the children being born. Even in countries like Libya and Zaire, with rich mineral resources, the wealth does not reach the vast majority of the people. These resources are exported to the rich western nations.

A high rate of infant mortality held the population almost steady in Britain during the nineteenth century and it has a similar effect in the poorest LDCs. When new health technology reaches these areas there is a dramatic increase of life expectancy (it has shot up by fifteen to twenty years in some countries since the Second World War). Their populations then begin to grow and change as ours did at the turn of the present century.

You can see from the charts opposite that even if better medical care is accompanied by a vigorous campaign of family planning, the population of an LDC must continue to expand for at least 30 years.



Population structure.

What do these profiles show about infant mortality? About total population? About the proportion of senior citizens?

FAMILY PLANNING AND BIRTH CONTROL

Our attitudes towards birth control will not necessarily be the same as those in the LDCs. Even in Britain this subject has been open for discussion only during the last fifty years. In the last century neither the Church of England nor the Roman Catholic Church were in favour of contraception; anyone found guilty of selling contraceptives or giving information about birth control risked a prison sentence. Religious beliefs are not the only factors against programmes for planning family size in some of the LDCs. Consider the following points:

In some countries with high growth rates such as Brazil (2.8%), Algeria (3.2%) and Madagascar (2.9%) the governments have refused to back family planning programmes because an expanding population is thought to be desirable, producing more manpower and stimulating the economy.

Medically supervised birth control is too expensive for the LDCs which can afford to spend only about 50p per head per year on total health care.

Families may need children for labour on the farm, or in the case of urban families, for working (or begging) to provide income for the family.

Sons are often essential to carry out important religious ceremonies for their parents and care for them in their old age. There may be no old-age pension.

The expectation of a high level of infant mortality leads to a general tendency towards large families to allow for inevitable loss. (Six is the most favoured number in India and Indonesia.)

There are strong arguments in favour of family planning:

Governments in about two-thirds of the LDCs support an official programme for family planning. They see in this the only possible method of decreasing unemployment, raising standards of health and education, preserving the fertility of the land, and stimulating savings.

In India and China strong positive incentives have been used, either bribes (100 rupees for a vasectomy) or social approval (vows on this subject are included in the Chinese marriage ceremony).

Confidence in the survival of children, the visible chances of good education and a better job are positive influences in the towns where contraceptives, clinics, schools and alternative employments are available.

Culturally acceptable methods of birth control are important. In Ireland, for example, families are limited by late marriage and almost a third of the men do not marry at all. In Japan abortion and condoms are the most acceptable methods; women are not encouraged to use any form of contraceptive. In Sweden and Eastern Europe, male vasectomy is illegal but female contraceptives are encouraged. In India the situation is almost reversed. In parts of Africa and Indonesia folk remedies producing abortion are an accepted part of the culture.

Applying Western style family planning in another country needs very great care. In 1966 there was a vigorous reaction in Brazil against the American backed programme of birth control. They interpreted this as neo-colonial interference in their internal affairs and publically protested that the USA was trying 'to keep Brazil from growing'. Although predominantly Roman Catholic, Brazil manages a quiet unofficial campaign by means of cartoon characters.

These cartoon characters are part of the birth control campaign in Brazil.

In communist China all kinds of contraceptives, including abortion, are administered by the barefoot doctors. The slogan used is 'Late, long, few' – marry late, leave spaces of three years between births and have fewer children. Two is considered the 'correct' number with an exception being made for couples having either two girls or one child with a serious defect. As a result of this campaign the growth rate in several provinces of China is already down to one per cent or less. It is currently about one-half per cent in Britain.

Discuss whether a scheme like the Chinese one would work in this country.

What are our main inducements to reduce the sizes of families?

How could you answer those who argue that sending aid and famine relief to the LDC only increases their population problem?

Suggested Reading

Suffer the Children P. Knightley *et al.* (Andre Deutsch)

An authoritative book on the Thalidomide disaster. For the library.

The Drug-Makers W. Breckon (Eyre Methuen)

An interesting history of the development of medicines and of the authorities responsible for testing them. For the library.

The History of Public Health A. Swinson (Wheaton Essex)

A short, straightforward history, written for 15 years upwards, with illustrations.

Microbes and Men R. Reid (BBC)

Highly recommended for the library. A historical survey of microbiology in a social context and well illustrated. 14 years upwards.

The Pill on Trial P. Vaughan (Penguin)

An interesting paperback, now difficult to get hold of. Complete history of the contraceptive pill and trials.

The Man-Made Future C. Waddington (Croom-Helm)

Recommended for the school library. Has a section on food production in the Third World. 15 years upwards.

Technology for Development Centre for World Development Education

This book is invaluable for giving the real flavour of Third World problems. You would need to write off for it.

More information can be obtained by writing to such organisations as Oxfam, the International Federation for Planned Parenthood, and the Alternative Health Technology Action Group, all of whom have their own periodicals.

Science In a Social CONtext is a series of eight books based on the project SISCON-in-Schools. The books provide a new course in science and society for general studies at sixth-form level. The course has been specially designed to make scientific problems accessible to the non-scientist, as well as to explain the social aspects of science to the scientist.

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The eight titles are as follows:

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