11.5 Drugs and infectious disease

Progress in the fight against infectious diseases by 1900

By 1900 the germs which caused the most common diseases had been discovered. Koch, Pasteur and others had developed a number of vaccines that could prevent people from catching these diseases. Governments were also introducing preventative measures against disease by enforcing councils to provide clean water and efficient sewage disposal. Doctors and scientists now needed to find effective cures for people with infectious disease.

There was some knowledge to build on. Drugs made from natural substances had been used for centuries in the treatment of illness. For example, opium was used as a pain-killer and colocynth as a purgative. These drugs, however, were unable to combat the bacteria which caused the disease. By about 1890, the work of Joseph Lister was accepted by most doctors. Lister showed that a chemical, carbolic acid, would kill germs outside the body – but it was too toxic to use internally. A chemical that could be used safely to kill bacteria inside a person was needed. In 1900 the conditions were ripe for a breakthrough in curative medicine to be made – but who was going to make it?

Paul Ehrlich

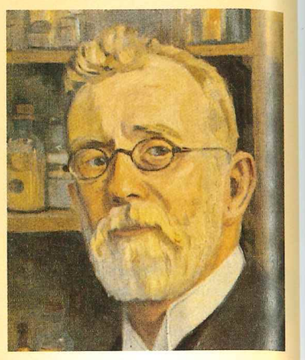
By the late-19th century, the German chemical industry was progressing rapidly, particularly in the manufacture of synthetic dyes. Koch was experienced in using synthetic textile dyes to stain microbes for examination under the microscope. This made the microbes stand out and easier to study.

Paul Ehrlich was a German doctor who joined Koch's research team in 1889. He began by working with Emil Behring on diptheria and became fascinated by the fact that the body produced **antibodies** to ward off specific germs inside a person without damaging the rest of the body. He referred to such antibodies as magic bullets because, like a bullet from a gun, they sought out their specific target. Antibodies, however, did not always kill off invasive bacteria. Ehrlich began to think that there must be a chemical dye that could be used internally to kill specific bacteria without harming the rest of the body – a synthetic magic bullet.

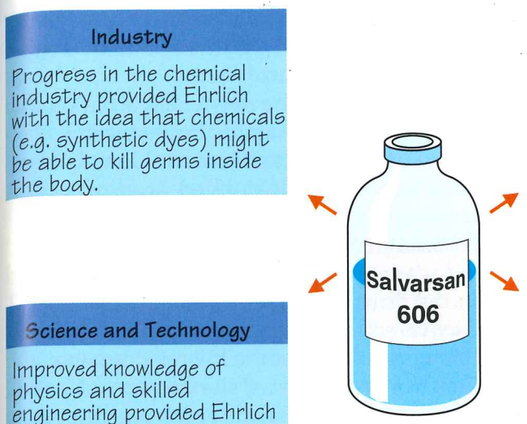
The search for a magic bullet

Ehrlich became director of his own research institute. His team concentrated on looking for chemical cures for disease. In 1899 Ehrlich, and his team of researchers, started to test different dyes to see if they would kill microbes. This involved a great deal of patience and perseverance. Numerous dyes were tried but they met with only limited success. Dyes were found that attacked malaria and sleeping sickness germs.

PAUL EHRLICH



Ehrlich was born in the town of Strehlen in Silesia, Germany, in 1854. He studied at the University of Leipzig, researching in chemistry and bacteriology. He worked first as a doctor but, in 1886, caught tuberculosis (TB). It took him three years to recover completely. In 1889, he joined Robert Koch's research team at the Institute for Infectious Diseases in Berlin. He helped Emil Behring to find an anti-toxin that cured diphtheria. From 1899, until his death in 1915, he was the Director of the Royal Institute of Experimental Therapy in Frankfurt. It was here that he carried out his research into chemotherapy (the treatment of disease by chemical drugs). In 1908 he shared the Nobel Prize for medicine with the Russian bacteriologist Elie Metchnikov.



Factors involved in the discovery of Salvarsan 606.

The syphilis microbe

In 1906 the microbe that caused syphilis was identified by Fritz Schaudinn and Paul Erich Hoffman. Syphilis was a sexually transmitted disease which killed thousands of people each year. In 1907 Ehrlich decided to test chemical compounds of various poisons, hoping that one might kill the syphilis germ. His team made up and tested over 600 **arsenic** compounds. All of them were said to be useless. The research seemed to be going down a blind alley.

In 1909 Sahachiro Hata, a Japanese bacteriologist, joined Ehrlich's team. Hata was asked to retest the compounds already discarded. He found that compound 606 did in fact kill the syphilis germ. Why had it previously been ruled out? Perhaps the assistant who had previously tested the compound lacked concentration or was not such a skilled researcher. Ehrlich called the new drug Salvarsan 606. He was concerned that doctors might give the wrong dose, or that the drug might be harmful in other ways. He insisted on repeated testing on many hundreds of animals that were deliberately infected with syphilis. He found that it always targeted the syphilis germ without harming the rest of the body. Salvarsan 606 was used for the first time on a human patient in 1911.

Opposition

The discovery of Salvarsan 606 was not welcomed by everyone. Some doctors were not keen to use the new drug; it was not very soluble and was difficult and painful to inject into veins. Some doctors believed that people would become promiscuous now that they knew that syphilis could be cured. Despite Ehrlich's rigorous testing there were many doctors who did not like the idea of giving their patients arsenic, in any form.

QUESTIONS

1 a What progress had been made in the fight against infectious diseases by 1900?

b What new breakthrough was needed?

2 a What factors enabled the discovery of Salvarsan 606 to be made?

b Was any one of these factors more important than the others? Explain your answer.

3 a What opposition was there to Salvarsan 606?

b Does your study of the history of medicine make you surprised that there was opposition to such an important breakthrough in the treatment of disease? Give reasons and examples in your answer.

Gerhard Domagk and sulphonamide drugs

Domagk worked for a large chemical firm in Elberfeld, Germany. Inspired by Ehrlich's work, he carried out a programme of systematic research looking for dyes that might destroy infecting microbes within the body. Domagk, like Ehrlich, was conscientious and determined.

His first success was the discovery of germanin, a drug which was effective against sleeping sickness. Then, in 1932, he discovered that a red dye, called prontosil, stopped the streptococcus microbe (which causes blood-poisoning) from multiplying in mice without harming the rest of the animal. He had no idea, however, whether this drug would work on humans. One day, in 1935, Domagk's daughter, Hildegarde, pricked herself with an infected needle and blood-poisoning set in. The girl was seriously ill and Domagk, with nothing to lose, gave her a huge dose of prontosil. Although her skin turned slightly red she made a rapid recovery.

Further research by a team of French scientists found that the compound in the dye which acted on the germs was sulphonamide, a chemical derived from coal tar. It was not long before other sulphonamide-derived drugs were developed that were capable of fighting diseases such as tonsillitis, puerperal fever and scarlet fever. In 1938, chemists working for the British firm, May and Baker, discovered a sulphonamide-derived drug that worked against the microbe causing pneumonia. They tried the drug on a Norfolk farm labourer, who had severe pneumonia, and it worked. They called the drug M&B 693, as it was the 693rd compound they tested before they met with success.

Sulphonamide drugs, however, had disadvantages. They sometimes caused damage to the kidneys and liver and were ineffective against the more virulent microbes. An even more powerful magic bullet was needed if infectious disease was to be conquered.

Source O

◀ A painting from the 1860s called *An Anxious Hour*. Before sulphonamide drugs, many children died of common illnesses such as 'flu.

The story of penicillin

Penicillin was the world's first **antibiotic** – that is the first drug derived from living organisms, such as fungi, which would kill or prevent bacteria from growing. Penicillin was effective against a variety of germs. Its development involved three brilliant individuals: Alexander Fleming, Howard Florey and Ernst Chain.

'Alexander Fleming: The man who didn't invent penicillin'

The name Alexander Fleming is one of the most famous in the history of medicine. If you ask people what he did they will probably tell you that he 'invented penicillin' or perhaps they will say that he was 'the first person to discover penicillin'. Unfortunately, neither of these is true. Penicillin is not something you invent, it is a natural substance. For example, when cheese or fruit goes bad, mould grows on it. This mould has a Latin name 'penicillium' and has become more commonly known as penicillin. In 1871 Joseph Lister, who discovered antiseptic surgery, began experimenting with penicillium when he noticed that it appeared to weaken the microbes he was studying at the time.

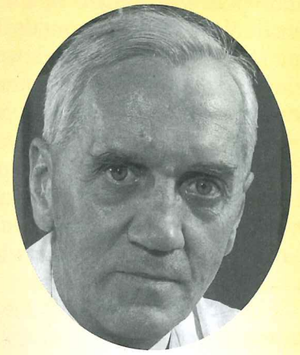
Source P

In 1881 a young nurse, working at King's College Hospital, was injured in a street accident. Her wound became infected. Several antiseptics were used, but unsuccessfully. Then a different treatment was used. It was so effective that she wrote down its name. It was 'penicillium'.

▲ Adapted from a book about Fleming published in 1985.

For reasons which we do not know, Lister did not continue his studies into penicillium and did not leave detailed notes on his work. Several other scientists also worked on using penicillium as a treatment, but were unable to find a way of making sufficient quantities to treat patients successfully. So there had been plenty of work done on penicillin before Fleming, but it was he who was to become famous. Why was this?

ALEXANDER FLEMING
Medical Researcher



Born: Lochfield Ayrshire 1881.

Career: joined military services but resigned in 1901 when left money in a relative's will. Studied at St Mary's Hospital London and qualified as doctor in 1906.

Offered a job as a research assistant by Sir Almroth Wright, head of the Inoculation Department at St. Mary's Hospital.

Worked in a military hospital in Boulogne, France during the First World War.

Returned to St Mary's Hospital after the war and continued work as a medical researcher.

Honours won: knighted in 1944 (became Sir Alexander Fleming).

Won Nobel Prize for Medicine in 1945 (along with Florey and Chain).

Died: 1955.

Fleming's discovery

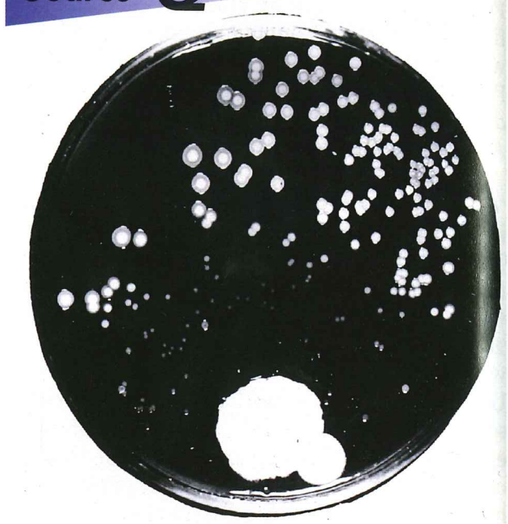
During his time working in a military hospital in Boulogne, Fleming had been appalled to see that antiseptics such as carbolic acid did not prevent infection in deep wounds. Later in his memoirs he wrote 'Surrounded by all those men suffering and dying, I was consumed by a desire to discover something which would kill the microbes'. After the war, Fleming returned to St Mary's determined to find a substance that could kill germs more effectively. In 1922 he discovered that a natural substance in tears, lysozyme, would kill some germs, but not those that caused disease and infection.

A chance discovery?

In 1928 Fleming was carrying out research into staphylococci (the germs which turn wounds septic). This involved growing the germs on **agar** in culture dishes. When Fleming came to clean a pile of discarded culture dishes, he noticed a mould spore had lodged itself on to one of them. It had grown to a size of about one centimetre across the dish. This was not an unusual thing to happen but Fleming was quick to notice that, around the mould, the germs had stopped growing. Another less astute person might have thrown away the dish and thought nothing more about it, but Fleming was curious. The mould was a member of the *penicilium notatum* family. It produced a bacteria killing juice which Fleming called penicillin.

He grew further quantities of the mould and found that it stopped other deadly germs growing, including anthrax and diphtheria bacilli. He injected it into animals without it harming them. However, if penicillin was to be of any practical use in treating humans, a way had to be found of turning the mould juice into a pure drug. Fleming and his colleagues were unable to do this. No one was prepared to give them the specialist help or money to carry out further experiments. Fleming wrote up his findings and published articles in the *British Journal of Experimental Pathology* in 1929 and 1931. He did nothing more about his discovery.

Source Q



▲ **The dish with the 'abnormal' culture that caught Fleming's attention. The mould can be seen at the bottom. At the top, germs can be seen growing in large numbers, but near the mould there is a clear area.**

Source R

Nothing is more certain than that when, in September 1928, I saw bacteria fading away from around the mould, I had no suspicion that I had got the clue to the most powerful substance yet used to defeat bacterial infection.

▲ **Part of a speech made by Fleming in 1943.**

QUESTIONS

1 'The work of Fleming in penicillin came about more because of luck than individual brilliance.' Explain how far you agree with this statement.

2 If Fleming's discovery of the value of penicillin was so important, why didn't he develop the drug further?

Howard Florey and Ernst Chain

In 1935 Howard Florey, an Australian doctor, became the head of the William Dunn School of Pathology at Oxford. He built up a team of brilliant biochemists to carry out medical research, including Ernst Chain, a scientist who was a refugee from Germany. Chain, who was Jewish, came to Britain to escape from Nazi persecution. In 1938 Florey's team decided to study germ-killing substances. Chain came across Fleming's articles on penicillin and they decided to see if they could produce pure penicillin from the mould juice. They succeeded in making small quantities of pure penicillin in powder form and decided to test it out on animals. On 25 May 1940 eight mice were injected with streptococci. Four were then given regular doses of penicillin and they survived. The other four mice all died within sixteen hours. Florey claimed that they had witnessed a miracle.

When you think that Florey was usually a very unexcitable man, you can understand how important he considered the experiment to be! You get a much better idea of how careful he was not to be carried away with optimism when you realise that a little later, when he had thought more about the experiment, he said 'But a man is three thousand times as big as a mouse'.

Source S

People sometimes think that we worked on penicillin because we were interested in helping suffering humanity. I don't think that it ever entered our minds about suffering humanity. This was an interesting scientific exercise.

▲ **A comment made by Howard Florey in an interview in 1957.**

QUESTIONS

1 Are you surprised by what Howard Florey says in Source S? Explain your answer.

2 Does what Florey said make you respect him less? Explain your answer.

Problems in the production of pure penicillin

Florey's team did not have the resources to manufacture the pure penicillin in large amounts. They grew the mould in milk bottles, bed pans and milk churns and turned it into pure penicillin using a a process of freeze-drying devised by Chain. In October 1940 they tried it out for the first time on a human – a policeman, Albert Alexander, who was suffering from blood-poisoning and close to death. He began to recover after receiving penicillin, only to die when supplies ran out.

War and the US chemical industry

The curative qualities of the drug were now beyond question. But mass producing the drug for commercial use still remained a problem. Only large chemical companies, with their resources could solve the problem, but it was unlikely they would be willing to get involved. By this time, Britain was deeply engaged in the Second World War against the might of Nazi Germany. The British chemical industry was too busy producing explosives to become involved in the manufacture of penicillin.

Florey realized that penicillin would be able to cure the deep infections caused by war wounds. He decided to visit the USA to try and persuade American chemical firms to invest in the mass production of penicillin. To begin with, he was unsuccessful. Then, in December 1941, the USA entered the war after the Japanese attacked Pearl Harbour. Soon, the US government had made grants available to firms wishing to buy expensive equipment to make penicillin. Mass production by British firms began in 1943. When the Allies launched the D-day invasion of Europe there was sufficient penicillin to treat all the wounded and thousands of lives were saved. In 1945 the Americans estimated that almost a sixth of all wounded men were saved. They were given penicillin to avoid death from infected wounds. After the war more efficient processes for the mass production of penicillin were invented. The cost of the drug was reduced and it became used across the world to treat a whole range of diseases.

Factors in the development of penicillin

When you answer questions in the exam on the development of penicillin, you may well be asked to consider how important certain *factors* were in helping make it successful.

Let us look at some of those factors and consider what you might say in the exam if you were asked 'how far' each of them played a part. (Don't forget that if you are asked how far one of the factors was important, you not only have to explain the importance of that factor, but how important the others were too.)

Chance (or luck)

This is the factor that is usually associated with Fleming's discovery. Certainly you can say that chance played a part because Fleming had not been looking for penicillin and had only found the mould by chance. But was it really chance? If Fleming had not been carrying out medical research, or if he had been a less observant person then he might not have noticed the mould. So you could say it was the result of individual ability, not chance.

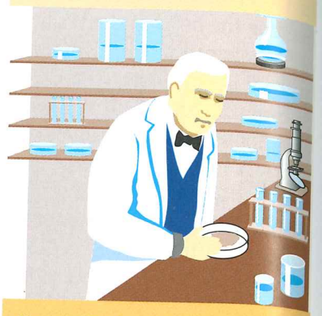
War and governments

War had a big part to play in the development of penicillin because the British and US governments put large sums of money into mass producing penicillin. Without this the drug would not have reached most of the people it saved. But Fleming didn't do his research because of war (although he was motivated by what he saw in the First World War) and Florey and Chain said they did their work because they enjoyed the science. So once again it's not so straightforward.

Individuals and teams

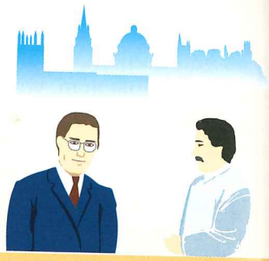
Obviously Fleming, Florey and Chain were very important in developing medicine and we have to accept that talented individuals were an important part of the story. But it is also true that the work of these individuals on its own would not have brought the benefits that came from the development of penicillin. If Florey and Chain had not become interested in Fleming's work, things might have happened much more slowly. If the world had not gone to war in 1939, then governments would not have poured money into mass producing penicillin. Just to confuse things even more, you might like to know that Chain said that even without Fleming, he and Florey would still have done their work. It would just have taken longer.

Stage 1 1928



Alexander Fleming discovered the penicillin mould. He was unable to produce pure penicillin from the mould. He published a report of his work but did no more.

Stage 2 1938–41



A team of researchers at Oxford University, led by Howard Florey and Ernst Chain, developed a method of making pure penicillin. They could not make large amounts however.

Stage 3 1941–4

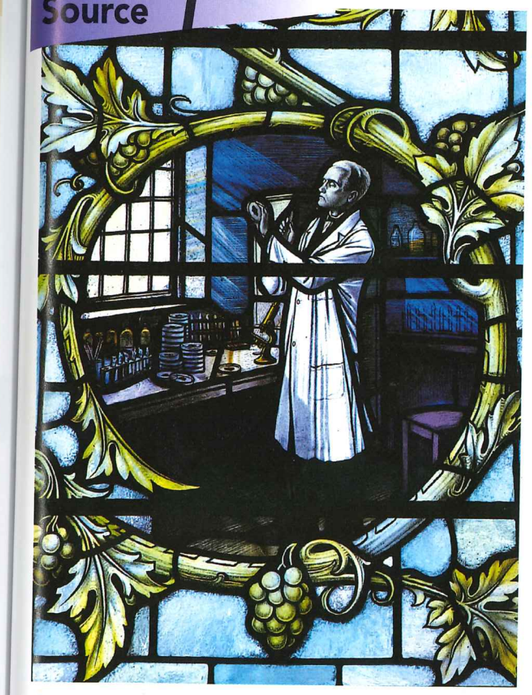
In 1941 the USA entered the Second World War. The US government funded research into methods of making large quantities of penicillin. By 1944 enough penicillin was available for Allied soldiers.

Stages in the penicillin story. ▶

The Fleming 'myth'

In August 1942 a friend of Alexander Fleming's lay dying in St Mary's Hospital. Fleming contacted Florey in Oxford and asked for some penicillin to treat his friend. Florey immediately obliged and the patient made a rapid recovery. The story appeared in *The Times* and, on 30 August 1942, Almroth Wright wrote a letter to the newspaper saying that Fleming was the person responsible for the drug. People began to believe that the development of penicillin was due entirely to Fleming. Even though Florey and Chain were awarded the Nobel Prize, along with Fleming in 1945, their part in this incredible medical breakthrough was played down.

Source T



▲ **This stained glass window, showing Alexander Fleming at work in his laboratory, was installed in St James' Church, Paddington, London. The church is very close to St Mary's Hospital, where Fleming had worked for 49 years.**

Source U

Sir In your article on penicillin yesterday you refrained from putting the laurel wreath for this discovery around anyone's brow. I would supplement your article by pointing out that it should be decreed to Professor Alexander Fleming of this laboratory. For he is the discoverer of penicillin and also the author of the original suggestion that this substance might ... have important applications in medicine.

▲ **Extract from the letter written to *The Times* by Sir Almroth Wright. It was published on 30 August 1942.**

Source V

There has been a lot of most undesirable publicity in the newspapers and press about penicillin. The whole subject is presented as having been foreseen and worked out by Fleming. This steady propaganda seems to have its effect even on scientific people, in that several have now said to us, 'But I thought you had done something on penicillin too'.

▲ **Extract from a letter written by Howard Florey to Sir Henry Dale in December 1942. Dale was the President of the Royal Society, a body concerned with the advancement of science and medicine.**

QUESTIONS

1 a What is the Fleming 'myth'?
  b How did it come into existence?
  c Who do you think deserves the credit for penicillin: Fleming or Florey and Chain? Give reasons for your answer.
2 Would penicillin have been discovered even if Fleming, Florey and Chain had not lived? Explain your answer.
3 If you knew that for many years before 1900 mould from fungus had been used by people in numerous parts of the world to treat wounds, would you say that the work of Fleming, Florey and Chain was not really a breakthrough in the history of medicine? Explain your answer.

11.6 Into the future?

Antibiotics

When the Second World War ended in 1945, the companies producing penicillin for the military were able to mass produce it for the public at large. The first **antibiotics** had been born.

Since 1945 drug companies have invested millions of pounds into research. They know that if they find drugs that are able to cure or prevent illness there are huge profits to be made. As a result of research hundreds of different types of antibiotics now exist. Although penicillin is still the most widely used, other antibiotics have proved more effective against certain diseases. For example streptomycin, discovered in 1944, is particularly effective in dealing with tuberculosis. Some people have proved to be allergic to penicillin and instead can now take other antibiotics, such as tetracycline or mitomycin.

Why has illness not been ended?

As drug companies have spent more and more on research, so increasingly effective drugs have been developed. We now have vaccines which can prevent most diseases and drugs which can control irregular heartbeat or even help the heart to pump blood through damaged arteries. But the story is not one of complete success. Sometimes our new 'wonder drugs' turn out to be less effective than we would like.

Thalidomide

In the early 1960s a new drug, **Thalidomide**, was introduced to help women who were suffering from morning sickness during pregnancy. The drug proved effective, but it had not been tested thoroughly enough. What the makers did not realise was that the drug actually caused harm to the foetus. As a result of the mothers taking thalidomide a number of children were born with severely deformed limbs. Later it was discovered that the effects of thalidomide could be passed on from generation to generation. The drug companies were forced to pay millions of pounds in compensation. Following this, in 1964 the British government set up the Committee on Safety of Drugs to screen all developed drugs.

Source W

£485,000 DAMAGES FOR 28 THALIDOMIDE CHILDREN

Agreed damages totalling £485,528 were awarded in the High Court yesterday to 28 deformed children who were affected by the drug thalidomide.

Seeking approval for the settlements, Mr Desmond Ackner, the children's lawyer, revealed that negotiations were taking place to provide for 300 other children thought to have been deformed by thalidomide.

Discussions were being held with the Distillers Company (Biochemicals) Ltd. to set up a trust. This would save the 'years of time' it would take to deal with all the children on an individual basis.

▲ **An article from the *Daily Telegraph*, July 1970.**

Superbugs

One of the most worrying developments in medicine since the introduction of antibiotics has been the demand from busy people to take antibiotics as an instant cure for their illnesses. This has resulted in the overuse of antibiotics with the result that certain bacteria are beginning to develop resistance to their effects. Consequently people have to be given stronger antibiotics when they are ill, and this means bacteria are beginning to develop immunity to these stronger antibiotics.

A member of the US Department of Health recently said:

'The concern is that we may run out of weapons to deal with severe infections. When used properly, antibiotics save lives. But when used incorrectly bacteria can form defences, mutate, and ultimately outwit the medicine and survive.'

Scientists have begun to call bacteria which are resistant to antibiotics 'superbugs'.

Source X

Like characters in a bad horror movie we had our backs turned when bacteria we thought we'd beaten, rose up with new powers and began to fight back. Within just a few years of the introduction of antibiotics, a troubling pattern emerged. Bacteria frequently treated with the same antibiotic would eventually develop resistance to the drug. Another antibiotic would have to be used until the bug learned to resist that drug too.

Hospitals are particularly fertile breeding grounds for these superbugs. It is estimated than more than two million Americans acquire infections in hospital each year and between 60,000 and 80,000 of them die as a result.

▲ **A recent report on the power of superbugs in the USA.**

AIDS

AIDS (Acquired Immune Deficiency Syndrome) is a new disease for which no cure has yet been found. It first came to the attention of US doctors in 1981 when they realised that young gay men were dying in large numbers from unrecognised conditions involving the breakdown of the body's immune system.

By 1983 the HIV virus had been discovered to be the cause. No one really knows where the disease has come from and various theories have been put forward. One suggestion is that it had previously been restricted to small areas of African rain forest, but increased communication led to it being spread across the world. Whatever the origin of the disease, it had, up to the end of 2001, killed almost 25 million people.

	Adults (millions)	Children under 15 (millions)
No. of people living with AIDS	37.2	2.7
AIDS deaths up to 2001	17.5	4.3
AIDS deaths in 2001	2.4	0.6
No. of children orphaned by AIDS		13.2 million

The proportion of adults living with AIDS in 2001	
Africa, south of the Sahara	8.4%
Caribbean	2.2%
North America	0.6%
South and South East Asia	0.6%
South America	0.5%
Western Europe	0.3%

Source Y

AIDS has driven a coach and horses through the idea that disease is being conquered. We quickly recognised it and put our best brains to work on it. We made it a household word. All in vain. It spread through Africa and the Americas, crossed the seas to Europe and Asia and is now the leading cause of death in young adults in many parts of the world.

▲ **Matt Ridley, in his book *Disease*, written in the USA in 1997.**

Tuberculosis

It isn't just new diseases which are causing problems. We thought we had conquered tuberculosis, but now it too is beginning to show signs of resistance to antibiotics. Between 1985 and 1991 tuberculosis increased by 12 per cent in the USA, 30 per cent in Europe and a massive 300 per cent in parts of Africa. The disease kills more than three million people each year, 95 per cent of them in the less economically-developed world.

Genetic engineering – hope for the future?

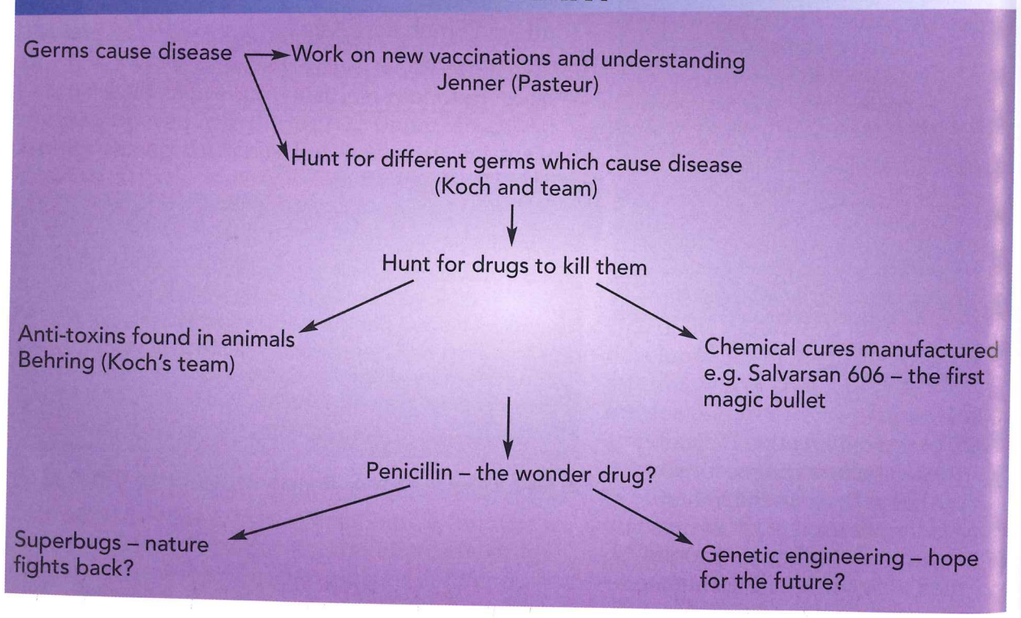
With technological advances, in particular more powerful microscopes, scientists have been able to study human cells and the genes and chromosomes within them. This has allowed them to develop means of 'genetic engineering' where the genetic material within a person is altered by destroying specific damaged or diseased cells. Such a practice is still in its early years, but has already proved valuable in the treatment of cancers, blood, liver and lung disorders. Some medical experts believe that the time will come when spare 'body parts' could be cloned to replace damaged or diseased organs. Perhaps in the future we will be able to transplant test-tube grown parts into our own bodies.

QUESTIONS

1 What lessons can we learn about medicine from:

- a the Thalidomide affair
- b superbugs
- c AIDS?

SUMMARY



11.7 Exercise

Source 1

▲ Pasteur and his team. Dr Emile Roux, his main assistant, is seated on his right. Albert Calmette who, together with Camille Guerin, discovered a vaccine against TB in 1906, is seated on the far right of Pasteur.

Source 2

Pasteur was a small man capable of inspiring devotion in others. He also had aggressive manners which could make people who were equally as clever both bitter and turn them into enemies. One of his strongest motivations was to show how much more clever he was by destroying their arguments entirely. **Nationalism** was a powerful force in his life. He wanted to work for the glory of France. He worshipped the French Emperor, Napoleon III. When France and Prussia (part of Germany) went to war in 1870, his hatred of the Germans was intense. Personal ambition was very important to him. He wanted to be famous.

▲ **This opinion of Pasteur was written by Robert Reid in *Microbes and Men*, 1974.**

Source 3

At the International Conference of Hygiene in Geneva, 1882, Koch left Pasteur in no doubt that he believed that Pasteur had contributed nothing new to science. Pasteur lost his temper and years of hatred came out. Yet Pasteur's work had been the great idea, Koch's scientific skill had made its application possible.

▲ **Robert Reid's analysis of the conflict between Pasteur and Koch in *Microbes and Men*, 1974.**

10.3 The development of the pharmaceutical industry, new treatments and new diseases

Research & Record

How far has medicine progressed in the last 100 years?

The Germ Theory led to new methods of treating disease which significantly increased life expectancy in Britain. However, the last 100 years has also seen new problems.

Use the information on these two pages to draw up two lists like this.

Areas where medicine has progressed	New threats or challenges that remain

Pharmaceutical companies have competed to make more effective drugs ...

During the twentieth century, British companies such as Beechams became worldwide businesses, manufacturing drugs. They:

- invested in research and development (including employing scientists) and did careful experiments to look for better remedies
- used industrial technology to make huge quantities of each remedy.

Drug manufacture became big business. Drug companies could make a lot of money, save many lives and reduce suffering if they discovered an effective drug.

Case study: aspirin

Aspirin comes from willow bark and has been used as a medicine for centuries, although no one knew why it worked.

Developments in science enabled scientists to identify the exact chemical in willow bark that was beneficial. It was then manufactured in huge quantities. In the 1970s, researchers found that aspirin also helped to thin the blood and could help to prevent blood clots from forming. More recent research has shown that low doses of aspirin can reduce the risk of heart attack.

... and the discovery of DNA has uncovered the genetic causes of disease ...

Following the discovery that germs cause disease, for nearly 100 years, all the scientific focus was on illness caused by bacteria.

However, many illnesses have genetic causes – they are inherited in the sufferer's genes. These include Alzheimer's disease, diabetes, Parkinson's disease and some forms of cancer.

Until the 1950s, these diseases were untreatable. This began to change in 1953, when **Francis Crick and James Watson** discovered the structure of human DNA and how it passes from parents to their children.

In the 1990s, the Human Genome Project, a worldwide project, began working out exactly how each part of human DNA affects the human body. This information has allowed scientists to find ways of treating specific genetic illnesses. For example, researchers have used computers to predict how cancer can evolve in individual patients. This should help doctors decide the most effective form of treatment for each individual patient and so boost their chances of survival.

... but, the fight against disease is not straightforward

Thalidomide

In the late 1950s, **thalidomide** was introduced as a 'safe' sleeping tablet. It was later given to women to reduce morning sickness during pregnancy. However, this drug had not been fully tested and led to children being born with severely deformed limbs.

Thalidomide was banned in 1961, but, by then, around 10,000 children worldwide had already been affected. Since then, research on thalidomide has continued and, in a different form, has been shown to help people with blood cancer and leprosy. The impact of thalidomide led to much more thorough testing of drugs before use.

Antibiotic resistance

Since the development of penicillin, new, stronger antibiotics have been produced. They have saved millions of lives (an estimated 200 million lives in 70 years).

However, within just a few decades of antibiotics being introduced, some bacteria began to develop immunity to the drugs. They have been labelled **'superbugs'**. MRSA is one example – it can resist science's efforts to kill it, either with antiseptics or antibiotics.

Overuse of antibiotics has made them less effective. This has become a major concern. In 2014, the World Health Organisation warned of a 'post-antibiotic era' in which common infections could once again kill because antibiotics simply no longer work.

New diseases – AIDS

New diseases have appeared. In 1982, doctors recognised a new illness, AIDS, which destroys the body's immunity to other diseases, leaving sufferers much more vulnerable to infections and other diseases, such as cancer.

AIDS is transmitted through sexual fluids and blood. More than 40 million people worldwide have died of AIDS-related illnesses. A cure or effective vaccine has yet to be found.

However, in the 1990s, treatments such as HAART (highly active anti-retroviral therapy) were introduced that helped to improve long-term survival rates.

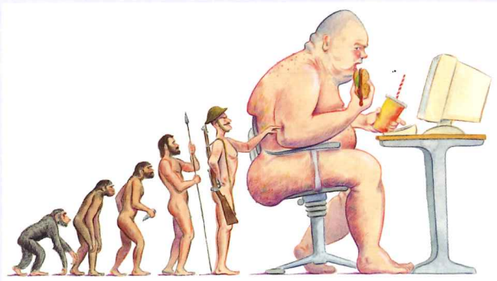
Alternative treatments

Drug treatments have been a big part of making us healthier, but there are some people who think that pharmaceutical companies are now part of the health problem – not the solution. Our response to any illness is 'must find the wonder drug', yet the solution to modern conditions can be found in other ways, called **alternative treatments**.

Lifestyle remedies

Doctors are now keenly aware that the biggest medical problems facing people in Britain are not infectious or genetic diseases, but the choices people make and the way they live their lives. For example:

- **Mental health problems** caused by not enough sleep and stressful working and home lives cause thousands of deaths each year.
- **Breathing difficulties caused** by polluted air put hundreds of thousands of people at risk each year.
- **Obesity** caused by people eating too much of the wrong kinds of food and exercising too little is now a leading cause of death, particularly among men.



▲ A cartoonist's comment on the effect of a modern lifestyle

Traditional remedies

- **Acupuncture** has been used in China for 4000 years. It involves inserting fine needles at pressure points on the body to release blocked energy. It is used both to treat disease and as a painkiller during surgery.
- Many health shops sell '**herbal remedies**' made from plants and animal substances which have been used in medicine for centuries.

Improvement 1: X-rays

X-rays had been discovered 20 years before the war.

In 1895 Wilhelm Röntgen, a German scientist, was experimenting with cathode rays which cause splashes of light in a glass tube. He had covered the tube with black paper but was amazed to find the rays were still lighting up the other side of the room. They were passing through the paper! He investigated further and found that they could also pass through wood, rubber and even human flesh, but not through bone or metal.

He called these mysterious rays X-rays since he did not know what they were. However, their importance was immediately obvious to Röntgen. He published his findings on 28 December 1895. The discovery caused great public excitement, and it had an immediate impact on medicine.

Within six months hospitals had installed X-ray machines. However, it was the First World War which really confirmed the importance of the X-ray in surgery. More machines were quickly manufactured to meet the new demands and they were soon installed in major hospitals all along the Western Front. X-rays immediately improved the success rate of surgeons in removing deeply lodged bullets and shrapnel which would otherwise have caused fatal infections.

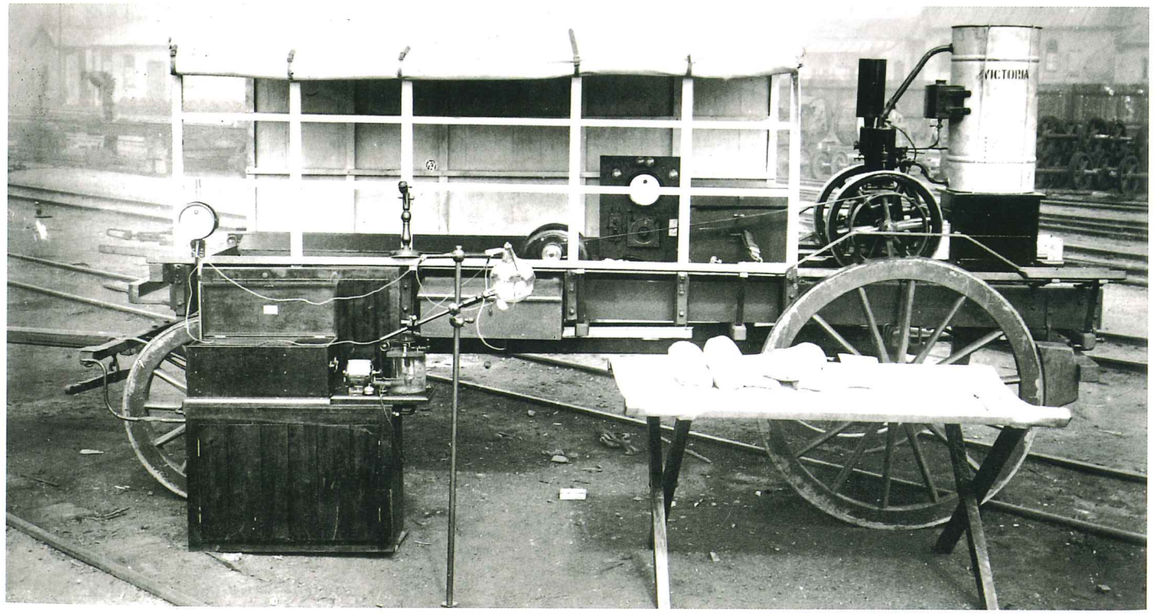
Improvement 2: Blood transfusion

Blood transfusion had been regularly tried in the 1800s but, mysteriously, it sometimes worked and sometimes failed. Then in 1901 scientists discovered that there were different blood groups. They realised that transfusion only worked if the donor's blood group matched the receiver's.

This discovery finally made transfusion practical. However, in the years before the war it was still performed with on-the-spot donors because doctors had no way of storing blood properly – it just coagulated (changed into clots or semisolid mass).

During the First World War vast amounts of blood were needed. This made the use of on-the-spot donors very difficult. Many soldiers bled to death in the trenches before blood could be got to them. The search began for a better method of storage and transfusion.

This led doctors to the discovery that the liquid part of the blood (the plasma) could be separated from the tiny particles in the blood (corpuscles). The cells could be bottled, packed in ice and stored where they were needed. The cells only had to be diluted with a warm saline solution and usable blood was ready. This discovery helped save many lives both in the trenches and on the operating table.



SOURCE 4 A portable X-ray machine – X-rays were a vital means of finding bullets and shell fragments in wounded soldiers

2. Did the First World War have a greater role in the development of X-rays or of blood transfusion? Explain your answer.

Improvement 3: Fighting infection

In Britain aseptic surgery was practised in all hospitals and success rates in operations were much higher than they had been 30 years earlier. However, on the battlefield and under the pressure of enormous numbers of operations it was often difficult to prevent the infection of wounds. This was made worse by the presence of bacteria which lodged in clothing. When soldiers were wounded, fragments of clothing would enter the wound and the bacteria would cause GAS GANGRENE.

SOURCE 5 In the insanitary conditions of the trenches even minor wounds could quickly become infected

SOURCE 6 A medical description of gas gangrene

"After forty-eight hours the edges of the wound begin to swell up and turn … making a gape. The cut surface takes on a curious half-jellied, half-mummified look; then the whole wound limb begins to swell up and distend in the most extraordinary fashion, turning as it does so, first an ashy white and then a greenish colour. This is because the tissues are being literally blown out with gas, and on pressing the fingers down on this balloon-like swelling, a distinct crackling or tiny bubbling sensation can be felt."

By trial and error on the massive number of casualties, surgeons arrived at the answer to this problem. They cut away infected tissue and soaked the wound with a saline solution. This was a practical advance made possible by experiment during wartime.

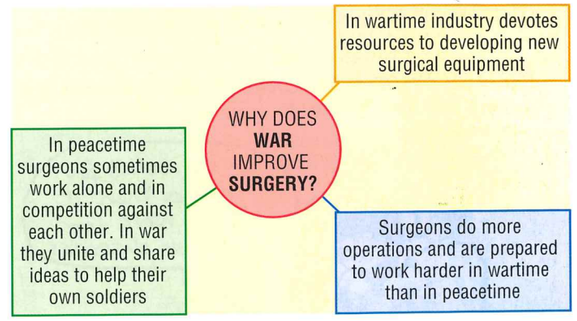
However, this was only a limited improvement and surgeons were all too well aware of their helplessness against serious infection.

Other improvements

Faced by hundreds of thousands of casualties surgeons learned fast. They:

- developed new techniques to repair broken bones
- improved methods of grafting skin which later formed the basis for plastic surgery
- improved surgery of the eye, ear, nose and throat
- successfully attempted brain surgery.

Many surgeons who learned these skills in battlefield hospitals set up as specialists back at home after the war. There were also similar developments in the other countries involved in the war.



SOURCE 7 Chart summarising the views of Heneage Ogilvey, a British surgeon, about the relationship between war and surgery

3. What evidence is there on pages 150–53 to support the views in Source 7?

TASK

'The First World War helped more than it hindered developments in medicine.'

Explain whether you agree with this statement. You can get a sheet from your teacher to help you.

Source J

▲ An antiseptic operation in Aberdeen in the 1880s. Lister's steam carbolic spray is being used.

Source K

Despite the [support] of statistical evidence, Lister's method met with interference and even violent opposition … Fully twenty years of patient trial, improvement, demonstration and education were needed before British surgeons were won over to the idea, and not before many senior members of the profession had been replaced by a younger generation.

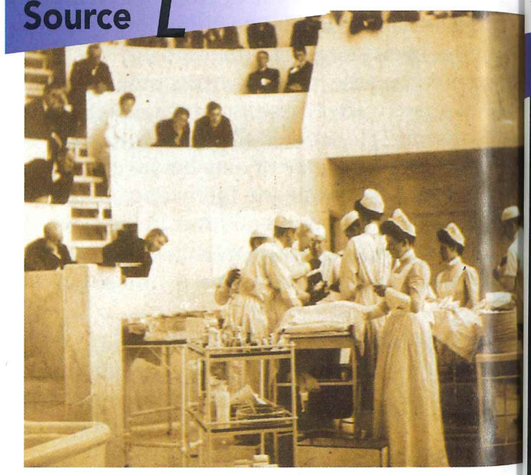
▲ Leo M. Zimmermann and Ilza Veith, *Great Ideas in the History of Surgery*, 1961.

From antiseptic to aseptic surgery

Antiseptic surgery had its drawbacks, not least being the discomfort felt by surgeons and nurses whose skin was burnt by the carbolic acid and lungs irritated by the spray. Rather than trying to fight germs, surgeons in Germany developed techniques for keeping them away. This is known as **asepsis** and aseptic surgery quickly became the normal procedure in the operating theatre. The idea of scrupulous cleanliness originated with Professor Neuber and was developed by Ernst Bergmann. Surgeons' hands, clothes and instruments were all sterilized. A chamber was used to pass superheated steam over the instruments, thus killing the germs without the need for disinfecting chemicals.

The 'father' of American surgery, William S. Halsted, introduced a further innovation. In 1889 his nurse, Caroline Hampton, complained that antiseptic chemicals were harming her hands. Halsted asked the Goodyear Rubber Company to make some gloves. He had a particular interest as he was to marry Nurse Hampton in 1890. Halsted realized that the gloves were protecting the patient as well as the nurse. He followed this by introducing caps, masks and gowns for surgery. Halsted also investigated cocaine as an anaesthetic but became a drug addict, taking both cocaine and morphine.

Source L



▲ Halsted in the operating theatre at the Johns Hopkins Medical School, Baltimore, USA. He operated and taught his students at the same time.

Today instruments are pre-packed in sterile containers. The air is sterilized before it enters the operating theatre. Some operations, especially on babies or for joint replacement, take place in sterile 'tents' to ensure that there is no risk of infection.

12.3 Rapid progress in surgery

Plastic surgery

Grafting skin to repair damaged features was practised in ancient India and during the Renaissance but infection was a major problem. The development of new weapons in the 20th century meant that the number and type of facial and skin wounds increased. In Britain, Harold Gillies set up a unit to treat horrific wounds inflicted during the First World War. He was the first plastic surgeon to consider the patient's appearance. Gillies' assistant was a New Zealander, Archibald McIndoe. In the Second World War, McIndoe set up a unit at East Grinstead in Sussex where he treated over 4000 patients, mostly airmen, whose faces and hands were disfigured by blazing petrol. His patients, known as 'guinea pigs', were helped by developments in drugs like sulphonamides and penicillin that helped prevent infection. Plastic surgery has become a vital branch of surgery, bringing better quality of life to people whose lives would otherwise be shattered by injury or birth defects.

Source M

▲ A modern plastic surgery operation. The patient is undergoing reconstruction of one of her breasts following treatment for breast cancer.

ARCHIBALD MCINDOE
'The face-builder'

Born: Dunedin, New Zealand 1900.

Career: Studied medicine at Otago, the Mayo Clinic and St Bartholomew's Hospital in London. After the First World War he worked with the British surgeon, Harold Gillies in treating patients who had suffered disfigurement as a result of wounds received in the war.

During the Second World War, McIndoe ran a special plastic surgery unit at East Grinstead in England. He specialised in plastic surgery on the faces and limbs of airmen who had suffered burns when their planes had been shot down. A good example of this can be seen in a recent obituary of an ex-RAF pilot published in June 2002. The obituary describes how 'the pilot's fuel tank caught fire, spilling fuel over the cockpit and the pilot himself. He was taken to East Grinstead, where the pioneering surgeon Sir Archibald McIndoe, rebuilt his hands and carried out skin grafts.

Honours won: knighted in 1947 (became Sir Archibald McIndoe).

Died 1960. As a symbol of gratitude his ashes were buried in the RAF church in London.

High technology surgery

Surgeons could often benefit from the rapid development of science and technology in the late 19th and 20th centuries. The increasing use of electricity meant that many machines could be developed to assist surgery. Plastics and steel enabled artificial joints to be made for replacement surgery.

- In 1895 Wilhelm Röntgen, professor of physics at the University of Würzburg, discovered X-rays. These enabled surgeons to look at the inside of a patient without making any incision.
- Marie and Pierre Curie discovered a new element, radium, in 1898. This eventually led to improved treatment for cancer.
- In 1903 the first electrocardiograph was developed by Willem Einthoven. Eventually it enabled surgeons to monitor the heartbeat effectively.
- The first artificial kidney machine was developed in 1943 by the Dutch surgeon, Willem Kolff.
- The first successful operation with a heart-lung machine, which enabled the heart to be stopped long enough for an operation to be carried out, took place in 1953.
- Efficient microscopes for surgeons to use when operating were developed in the 1960s. Along with fine **sutures** and needles, they made it possible for doctors to join microscopic nerves and blood vessels and even to reattach severed limbs. One strange result of the development of microsurgery was the reintroduction of leeches in the 1980s because they are efficient in keeping blood flowing in an affected limb.
- The development of **fibre optics** has meant that it is now possible to examine the inside of a patient's body and to operate without having to make a large wound.
- Miniature cameras called endoscopes have been developed which can be inserted into the body through the mouth or the bowels, via the rectum. As surgeons can see 'from the inside', they do not need to make large incisions.
- This 'keyhole surgery' means that patients can have a local, rather than a general anaesthetic. Their body suffers less shock and recovery is much quicker.

Heart surgery

Before the Second World War, surgery on the heart was dangerous and rarely carried out. When surgeons opened the chest, the patient's lungs collapsed and when the heart was touched, it stopped. It was thought that nothing could be done about this.

The Second World War provided the stimulus for further research as some soldiers had bullets and fragments of shrapnel lodged in their hearts. A US army surgeon, Dwight Harken, had the courage to try to save them. He cut into the beating heart and used his finger to remove the fragments. The problem for the patients who needed open heart surgery to correct defects was that the blood supply needed to be cut off when the heart was opened. After four minutes, this would cause brain damage. A Canadian surgeon, Bill Biggelow, came up with the idea of lowering the patient's body temperature to gain more time. Nevertheless the problem remained.

▼ **A surgeon using an endoscope to look inside the patient. It is inserted through a small incision near the patient's navel.**

Source N

Source O

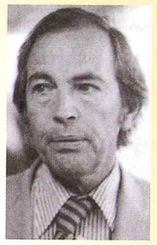
▲ **Surgeons attaching a patient to a heart-lung machine during heart valve surgery. This machine takes over the circulation of the patient's blood and provides oxygen for the blood. Before the invention of this machine, surgeons could not operate on the heart for more than a few minutes.**

At the University of Minnesota, Norman Shumway led a team specializing in pioneering heart surgery but there was sometimes a 50 per cent death rate. In 1960 the Methodist Hospital in Houston, Texas, became the centre for heart surgery under Michael de Blakey. He worked at immense speed and used knitted Dacron, an artificial fibre, to replace diseased arteries. The problem of transplanting a replacement heart remained. Tissue rejection made it seem impossible. However, research continued despite the shortage of human hearts. In 1967 Norman Shumway announced that he was ready to try a human heart transplant. In New York, Dr Adrian Kantrowitz prepared to operate on a baby on 3 December. That same morning he heard that Christiaan Barnard had performed the world's first human heart transplant.

Christiaan Barnard

Surgeons in the USA were disappointed, as they felt that they had done all the experimental work and Barnard had used their ideas. He denied this. Shumway and Kantrowitz carried out their operations but their patients soon died. Barnard did another transplant and his patient lived over a year-and-a-half. In Texas, Michael de Blakey and Denton Cooley also tried human transplants. Cooley was able to complete a transplant operation in twenty minutes. No one, however, could overcome the problems caused by the patient's immune system. The drugs the patients needed to get the body to accept the donor heart, left them open to infection. They always died within a relatively short time.

CHRISTIAAN BARNARD
Pioneering surgeon



Born: Beaufort West, South Africa 1923.

Career: Walked five miles each day to study at Cape Town University and qualified as a family doctor. In the late 1950s he went to the USA to study heart treatment at the University of Minnesota.

In 1967 he transplanted the heart of a female road accident victim into 59 year-old Louis Washkansky. Although Washkansky died 18 days later, Barnard had shown that the operation was possible. He became world-famous and was invited to meet the Pope in Rome and the US President Johnson in Washington. He was surprised by the publicity. As he said 'I didn't even inform the hospital superintendent what we were doing'.

Died: 2001.

Enormous public expectation had been shattered. The failure rate was too high. Barnard tried to keep transplants going but did not succeed. Some saw him as the villain. Heart transplant operations ceased. Some doctors turned to experimenting with artificial hearts and, in 1982, Barney Clarke was given a plastic heart in Salt Lake City, USA. He died three weeks later.

The solution arrived by chance. In 1974 a researcher in Norway looking for new drug substances in soil samples came across the drug cyclosporin. It was found it controlled tissue rejection but did not eliminate all resistance to disease. Cyclosporin had a more dramatic effect on heart transplant surgery than the skills of Barnard and Cooley combined because it meant that transplants were possible again. By 1987, 90 per cent of patients lived more than two years. Heart transplants are now routine. Surgery, drugs, patient care and the control of rejection all interlink to give success.

Source P

Tiny tubes, wires, balloons, coils, glue, plastic particles – these sound like pieces of a child's construction kit, not the tools of a rapidly growing branch of medicine. But the chances are that soon your doctor will be threading a few of those tools into your blood vessels or possibly going right through the skin into one of your organs. The doctor will be using the tools to treat you, not just to look to see what's there. And the treatment will be done with the constant guidance of powerful imaging machines, like ultra scanners, X-ray and computerised tomography.

▲ **A US doctor writing on how high-tech surgery will soon be so straightforward that doctors will be able to use it, as well as surgeons in hospitals.**

Source Q

One hundred and fifty years ago, patients would only lie on the operating table in desperation when they were tortured by agony from their gangrenous leg or stones in the bladder. Now with modern anaesthesia, with antiseptics, with blood transfusion, with antibiotics – the modern miracles of surgery – nothing can escape. Everything, from the brain to bunions, is available for the surgeon's healing knife.

▲ **A comment made by Professor Harold Ellis of Westminster Hospital to a group of medical students in the BBC television programme, *The Courage to Fail*, in 1987.**

Source R

Administrators decided we were spending too much. They had the enormous stupidity to suggest that, if we kept patients out, we could work within budget. I said, 'No problem. We've got a shot gun. I'll load it. You fire it, because that's what you're planning. Now, out.'

▲ **Denis Melrose, a leading British heart surgeon, describing a difficulty he faced in the 1960s.**

The impact of high-tech surgery

The work of Christiaan Barnard and other 'pioneering surgeons' has been important in expanding the boundaries of surgery. We can now carry out operations which would only have been dreamt of 30 years ago. Transplants are now common and it is only a shortage of donors which stops them being carried out even more frequently. Some medical scientists dream of the day when we will be able to **clone** human organs ready to carry out a transplant if necessary.

Improved technology has meant that the use of lasers has become an accepted part of treatment. Lasers are used in minor operations, such as correcting eye faults, or in life-saving situations where cancers can be controlled through laser treatment. Our skill and technology has even increased to the point where we can detect problems with unborn babies and carry out corrective surgery even before the child has been born.

The wide range of surgery now available has had a major effect on the finances of hospitals and the NHS is facing great difficulties funding all the operations which could be carried out. A heart transplant is a wonderful thing for the recipient, but is so expensive that it might take funds away from other, seemingly less-important areas, such as hip replacements for the elderly. Many hospitals are forced to juggle their budgets to keep their operating theatres working. A tragic consequence of this is that surgeons sometimes have to 'prioritise' operations. There have been cases where treatment for 'self-imposed illness', perhaps as a result of smoking, has been put lower down the list of priorities than other treatment. Both surgeons and patients find this a very difficult situation to cope with (see also page 137).

SUMMARY

- The combination of anaesthetics and antiseptics, developed by Joseph Lister, meant that surgery became much safer after 1870.
- Aseptic surgery, when no germs are ever allowed to be present, soon replaced antiseptic surgery.
- The discovery of the different blood groups allowed safe transfusions thus reducing the risks from blood loss in surgery.
- Surgeons began to specialize as surgery became safer. Plastic, brain and heart surgery were developed by pioneering individuals.
- Developments in science and technology contributed to new techniques in medicine.
- The wars fought in the 20th century speeded up developments in surgery.

QUESTIONS

1 Study Source I (page 107), Source J (page 108) and Source O (page 112). What changes in surgery do they show?

2 a How important have individuals been in the development of surgery since 1870?
  b How has science and technology helped surgery develop since 1870?
  c What other factors have played a part in the development of surgery since 1870?

3 Some books claim that Christiaan Barnard made the most important breakthrough in the history of heart surgery. On the evidence in this chapter, do you agree?

4 Read Sources Q and R. In what way does Source R suggest that things are not as rosy as suggested in Source Q?

5 'It can't be right that some patients are deliberately refused treatment.' Explain whether you agree with this statement.

12.4 Nursing after 1850

In 1850, nursing was looked upon as a lowly occupation. Nurses were generally portrayed as uneducated and slovenly and they had a reputation for heavy drinking. This image, however, was not totally fair. The conditions under which they worked were often appalling and there was no proper training available. At Kaiserwerth in Germany, however, the local pastor, Theodor Fliedner, set up a small hospital and training school in 1853. He insisted that his nurses be of 'good character'. Elizabeth Fry, famous for her attempts to reform prison conditions in London's Newgate gaol, visited Kaiserwerth in 1840. She was so impressed that on her return to England she founded Britain's first nursing school, the Institute of Nursing Sisters. During the second half of the 19th century nursing underwent a revolution and developed into a respected profession. How did this change come about?

Source S

▲ **This illustration shows how nurses were often portrayed in the 19th century – old and unattractive and possibly drunk.**

The Crimean War (1854–6): a tale of two women

Florence Nightingale (1820–1910) came from a wealthy middle-class family. In 1844 she told her parents that she wanted to enter nursing. Her parents naturally had a low opinion of nurses and it took Florence seven years of determined effort to persuade them to agree. She then visited Kaiserwerth, travelling on to Paris to study nursing. In 1853 she became the Superintendent at the Institution for the Care of Sick Gentlewomen in Harley Street, London which she ran very efficiently. By now she was fully committed to a career involving the training of nurses.

In March 1854 Britain, along with France and Turkey, went to war against Russia. The war was fought in the Crimea, a peninsula on the Black Sea, three thousand miles from Britain. A scandal broke when the public read the reports of William Russell, the war correspondent of *The Times* newspaper. He told of chaotic conditions in the Barrack Hospital in Scutari near Constantinople. Wounded British troops were being kept in overcrowded and filthy conditions. There were no nursing staff, no bandages and men were dying in agony.

Nightingale's work at Scutari

The Secretary of War, Sidney Herbert, who was a friend of the Nightingale family, wrote to ask Florence if she would 'go and superintend the whole thing'. She agreed to Herbert's request and, in the autumn of 1854, departed for Scutari in Turkey with a team of 38 nurses whom she had personally selected. When they arrived in Scutari, they were not warmly welcomed by the army doctors who felt that female nurses were 'unfavourable to military discipline and to the recovery of the patients'. Despite this undercurrent of hostility, Nightingale made sure that the wards were clean, the patients well fed, the sanitation and water supply improved and that supplies were plentiful. By early 1856 the death rate in the hospital had fallen from 42 per cent to 2 per cent.

Source T

She was a woman of iron will and imposed her ideas of nursing and medical care on those in authority and on her nurses. She had friends in the high place of the Cabinet. Through an endless stream of letters … she determined to improve nursing education and care … It can only be said that she succeeded mightily, in that every nurse, every patient, every hospital design, the organization of medical and nursing services everywhere, owe something to her … spirit.

▲ **Philip Rhodes, *An Outline History of Medicine*, 1985.**

Source P

FATHER THAMES INTRODUCING HIS OFFSPRING TO THE FAIR CITY OF LONDON.

(A Design for a Fresco in the New Houses of Parliament.)

▲ **A *Punch* cartoon of 1858, showing Father Thames introducing his children (diptheria, scrofula and cholera) to London.**

Source Q

In hot, dry weather the Thames becomes like a huge lake. The water level falls so that little of the river reaches the sea. Instead it receives the filth of more than 2 million inhabitants which collects there until there is enough rain to swell the water. In times of cholera the evacuations of patients join the impurities in the river.

▲ **A description of the River Thames, from the 1850s.**

QUESTIONS

1 'Source P shows that many people must have agreed with Snow about the cause of cholera.' Explain whether you agree with this statement.

2 Why do you think the Board of Health (Source O) incorrectly explained that hot weather seemed to lead to increases in cholera?

Between 1886 and 1903 Charles Booth, a shipowner and social investigator, carried out a survey into living conditions in the East End of London. He published his findings in *Life and Labour of the People* in London. Booth concluded that about one-third of the people lived on incomes lower than 21s (£1.05) per week. In his opinion this was below the poverty line. They lived in sub-standard housing and had a poor diet. If they fell ill they could not afford to pay a doctor. In 1899 Seebohm Rowntree, a member of the chocolate manufacturing family, conducted his own inquiry in York. And his findings were very similar. Booth said that poverty was caused by sickness, old age, low wages and lack of employment – not laziness and drunkenness as many believed. There were no old age pensions. Old people who could not support themselves had only the workhouse to turn to. Many skilled workers could afford to pay into Friendly Societies and insure themselves against unemployment and illness. Unskilled workers, however, could not afford the subscriptions.

Time for action

In 1902 the nation was shocked to find that 40 per cent of those that had volunteered to fight in the **Boer War** were suffering from malnutrition and diseases such as rickets, caused by poor diet. It was clear ill-health was linked to poverty and that government action was needed to raise living standards. Some Liberal MPs were concerned that people would vote for the newly formed Labour Party if they did not help the poor.

The Liberals went on to pass a wide range of reforms (see diagram). Churchill said, 'Our cause is the cause of the left out millions. We are all agreed that the state must concern itself with the care of the sick, the aged and, above all, children.'

Source R

▲ **Slum housing in the east end of London in 1912.**

Date	Legislation
1906	**Provision of school meals** – local authorities given the power to provide free school meals.
1907	**School medical inspections.**
1909	**Old Age Pension Act** – people over 70 to receive 5s [25p] per week state pension as long as their income from other sources was not more than 12s [60p] per week.
1909	**Labour Exchanges** set up to help unemployed find work.
1911	**National Insurance Act** – two parts: Part I: Workers in manual trades earning less than £160 per year to pay 4d [2p] per week. The employer added 3d [1½p] and the government 2d [1p]. Workers entitled to 10s [50p] per week if they were off work sick, for upto 26 weeks. Free medical treatment available from a panel doctor. Part II: Workers, earning less than £160 per year in certain trades, together with the government and employers paid in 2½d [1p] per week. Workers could claim 7s [35p] unemployment pay for up to 15 weeks.

▲ **Social reforms of the Liberal government 1906–14.**

How did people react to the reforms?

For the first time the state had made a co-ordinated attack on poverty. Much of the legislation, however, was not very far-reaching and Lloyd George admitted that they had only just made a start. Nevertheless there was fierce resistance to some of the measures.

To pay for old age pensions, Lloyd George introduced the People's Budget, that aimed to tax the rich to provide for the poor. The House of Lords, largely made up of wealthy landowners, refused to pass the budget. This issue forced two general elections in 1910. The Liberals were narrowly returned. The budget was then allowed through but, in 1911, the power of the House of Lords to throw out finance bills was abolished by the Parliament Act. The Labour Party said that pensions should have been payable at 65, whereas many Conservatives were of the opinion that pensions 'would profoundly weaken the moral fibre of the nation, (report in *The Times*, 17 December 1909). People who qualified for a pension, however, were thankful to 'Lord' George.

The National Insurance Act was also widely condemned. Friendly societies and private insurance companies said that they would lose business. To overcome this, Lloyd George agreed to drop proposals for pensions to be paid to orphans and widows. He also allowed the Act to be administered by private insurance companies acting as 'approved societies' on behalf of the government. The Labour Party said that workers should not have to pay any money at all into the scheme, arguing that benefits should be paid entirely from taxes. Many doctors opposed the Act. They now had to register with a panel (a local list) and would receive 6 shillings (30p) for each patient under their care. Doctors argued that this meant a loss of independence and would cause medical standards to drop. In the face of such opposition, Lloyd George had to be strong and prepared to negotiate.

Government and social welfare 1919–39

After the First World War (1914–18) Lloyd George, by now the Prime Minister, promised to make Britain 'a country fit for heroes to live in'.

In 1919 the Ministry of Health was set up to administer all matters to do with health. This, in itself, was an important step forward as previously health came under the jurisdiction of seven different government departments. During the war, house building had been neglected so, in 1919, the new Minister for Health, Christopher Addison, passed the Housing and Town Planning Act. Under this Act the government gave local authorities a grant to help them build council houses. In 1920 the Unemployment Insurance Act extended insurance cover to all workers (except farm labourers and domestic servants) who earned less than £250 per year.

Source S

▲ **Lloyd George had to overcome fierce opposition in steering the National Insurance Bill through Parliament. Do you think the cartoonist was a Lloyd George supporter?**

QUESTIONS

1 Why was the Central Board of Health abolished in 1854?

2 Study the diagram on page 128. Which factor was the most important in bringing greater government involvement in public health?

3 Why did the Liberals pass a wide range of social reforms?

4 Summarize the main Acts passed by the Liberals under these headings:

- Acts dealing with children
- Acts dealing with the unemployed
- Acts dealing with health and sickness
- Acts dealing with the elderly.

5 The Liberal reforms helped many people. Why was there opposition to them at the time?

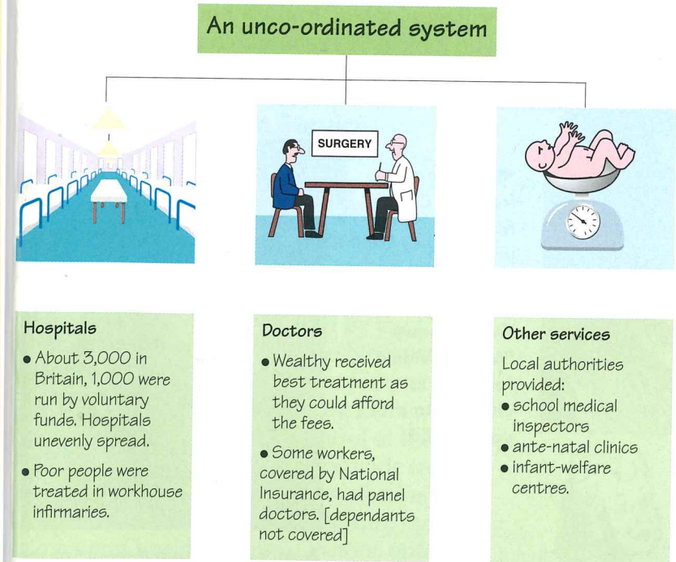
Rising unemployment

By 1922 the economy was in trouble. There was a slump in trade and rising unemployment. The government was forced to reduce its spending on housing, education and welfare provision. Other ways had to be found of funding reforms. Neville Chamberlain, Minister of Health from 1924–9, therefore encouraged the private sector to build more houses. The Pensions Act of 1925 was also Chamberlain's work. Pensions, funded by contributions from the state, employer and worker, were introduced at the age of 65. During the 1930s there was a world depression with mass unemployment. Dealing with the unemployed was more urgent than introducing welfare measures. The government was short of money and, therefore, reluctant to finance social reforms.

Despite this some progress in social provision was made between 1919 and 1939 (see Source U). The main problem was that the welfare services were an administrative muddle. Some services were provided by the government and some by private organizations. Health care, in particular, was a 'chaotic mixture' (see diagram). Opinion was growing that the health care system needed to be reformed. The Socialist Medical Association and the trade unions said that health services should be organized by the state. Others, however, still believed that voluntary organizations and self-help had a part to play. Many thought that social welfare should be provided only for the poor. It was argued that people who had the money should pay for their own medical treatment and schooling. The Second World War (1939–45) was to change many people's attitudes to welfare provision.

Source T

▲ **This *Punch* cartoon from October 1937 portrays Neville Chamberlain as anxious to lead the way to health reforms. Chamberlain was Chancellor of the Exchequer from 1931–7. The reality was that the government was mainly concerned with the problem of unemployment caused by the Depression.**



▲ **Health care in 1939.**

Source U

[In 1939] Britain was one of the most advanced of all countries in social provision. The majority of manual workers [but not their wives and children] were covered by social insurance schemes... The social services were complex and growing. State elementary schools and municipal hospitals were familiar landmarks. Ante-natal clinics and infant welfare centres were multiplying, and three million children received free milk in school.

▲ **Paul Addison, *A New Jerusalem*, 1994.**

13.4 The birth of the Welfare State 1945–51

Slow change

During the early years of the 20th century, the Liberals had brought in a series of reforms to improve the living and working conditions of the people of Britain. During the 1920s and 1930s there had been further help for those in need through improvements in housing, unemployment benefit and pensions (see page 133).

But these were only the first steps on the road towards the establishment of the government's acceptance of its responsibility to provide help for all those in need. During the 1930s the British economy experienced great difficulties as the impact of the Wall Street Crash was felt across the world. There was no money to spend on extending government welfare services. Instead the government was struggling to raise the money to finance its existing commitments.

The war years

In 1939 the Second World War broke out in Europe. The measures that the government took to help win the war proved very important in helping to bring about increases in social support in Britain.

- During the war there were shortages of food and the government was determined that children should be fed properly. So it ordered local education authorities to extend their provision of free school meals. Free school milk was also provided.
- Britain suffered heavy bombing during the war, particularly during the blitz of 1940–1. To cope with the casualties the government set up the Emergency Medical Service. Hospitals were put under the Ministry of Health and free treatment was provided. This arrangement proved to be very successful and people accepted that the government should be more involved in running the 'health service'.
- A most influential result of the war upon the increase of welfare provision was the programme of evacuation. Children from the inner cities were evacuated to rural areas in order to escape the air raids. The people with whom they stayed were often shocked at the filthy, deprived and badly clothed children who arrived in the towns and villages looking for new homes. Lord Chandos, who took in 31 evacuees, complained that these children regarded 'the floors and carpets as suitable places on which to relieve themselves'.

Source V

A cartoon from the *Daily Mirror* published during the Second World War. It shows 'War' providing food and vitamins to a young child.

Source W

They were filthy; we have never seen so many children with lice and nits and lacking any knowledge of clean and hygienic habits. It seemed as if they hadn't bathed for months. Some children had dirty, septic sores all over their bodies. Many of the children were bedwetters and were not in the habit of doing anything else.

An extract from a report of the Women's Institute in 1940.

The Beveridge Report

In 1941 the government asked Sir William Beveridge, a well-known economist, to suggest ways in which the government could help the sick, the unemployed, low-paid workers and retired people. In 1942 the Beveridge Report was published. He recommended that the government should provide a welfare state 'taking charge of social security from the cradle to the grave'. In other words, it was the duty of the government to look after all members of society, not just the poor. He argued that all cities had a right to be free from the five 'giants' which could ruin peoples' lives. These were:

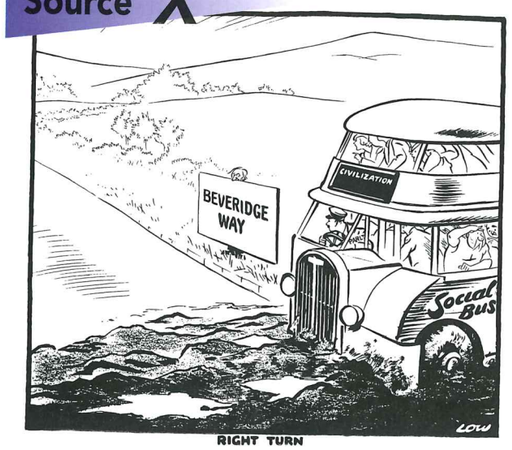
- want (need)
- disease
- ignorance
- squalor
- idleness.

The Beveridge Report became a best seller with over 100,000 copies sold in the first month. Members of all political parties welcomed the report, but the Prime Minister, Winston Churchill, feared that the country might not be able to afford to introduce all the measures suggested in the report. In a cabinet meeting in 1943 he asked whether 'we are committing our 45 million people to burdens beyond their capacity to bear'.

The National Health Service

In July 1945 the Labour Party came to power, and it fell to them to introduce a Beveridge-style welfare state. **Family Allowances** and compulsory **National Insurance** for everyone were introduced in 1948. The central hub of Labour's reform programme was the National Health Service, masterminded by the Minister of Health, Aneurin Bevan. The NHS was to provide free medical treatment for everyone. It came into operation on 5 July 1948. Hospitals came under the control of the state and local authorities were to provide free services including ambulances, vaccination programmes, environmental health, maternity clinics and health visitors. Doctors, opticians and dentists provided a free service.

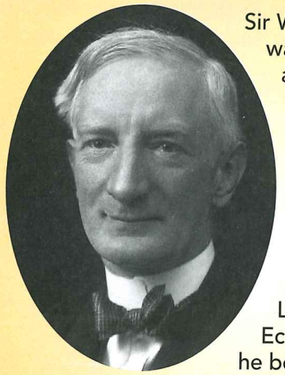
Source X



RIGHT TURN

A cartoon published in the *Evening Standard*, December 1949. It is called 'Right Turn'.

SIR WILLIAM BEVERIDGE



Sir William Beveridge was born in 1879 and was educated at Oxford University. He was knighted in 1919 after the First World War and in the same year became Director of the London School of Economics. In 1937 he became Master of University College, Oxford. In 1942 he produced the famous Beveridge Report and two years later entered Parliament as a Liberal MP. In 1946 he was created the 1st Baron Beveridge of Tuggal in recognition of his part in helping to bring about the Welfare State.

Reactions to the NHS

The NHS was received with great enthusiasm by most people. Immediately people took advantage of the free medical service. But there were also many people who were opposed to the new system. In early 1948 the British Medical Association, which represented the medical profession, carried out a survey to see what doctors thought. The results were as follows:

In favour of the NHS	4734
Opposed to the NHS	40,814

Doctors feared that the new system would give the government too much control. They would now be employed by the government and might be told where they had to practice. They could no longer charge for their services, and would be on a fixed salary. This might lead to a reduction in their income.

The Minister of Health responsible for introducing the NHS, Aneurin Bevan, was not a man to back down in the face of opposition. He had many angry discussions with the leader of the British Medical Association, Charles Hill, before agreement was reached. In the end Bevan won the doctors over by stating that they would receive a fee for each patient they registered and that they would still be able to treat private fee-paying patients if they wished. By June 1948, 92 per cent of doctors and the vast majority of hospitals had agreed to work under the NHS.

Source Y

She went and got tested for new glasses, then she went to the chiropodist, she had her feet done. Then she went back to the doctor's because she'd been having trouble with her ears and the doctor said he would fix her up with a hearing aid.

▲ **How one old lady reacted to the NHS, quoted by Paul Addison, in *Now the War is Over*, 1985.**

When the NHS started, oh it was fantastic. My mother and dad had been having problems with their teeth for ages, and I think they were first at the dentist, as soon as he opened. And instead of having just a few teeth out they had the complete set out. And free dentures. Thought it was wonderful.

▲ **A woman describing her reaction to the NHS.**

QUESTIONS

1 Look at the cartoon. Do you think the cartoonist approved or disapproved of the NHS? Explain your answer.

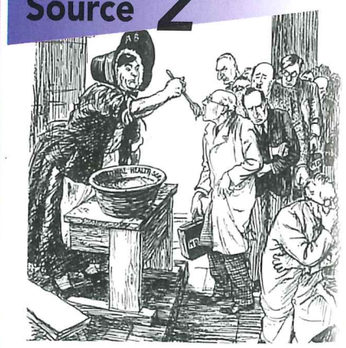
ANUERIN BEVAN

Anuerin Bevan was born in 1897 in Tredegar in Wales. He worked in the coal mines before becoming the Labour MP for Ebbw Vale in 1929. He became Minister of Health in 1945 and was responsible for introducing the National Health Service. He was a determined man who believed passionately in the Welfare State. In a speech to the House of Commons in 1946 he said:

Medical treatment should be made available to rich and poor alike in accordance with medical need and no other criteria. Worry about money in a time of sickness is a serious hindrance to recovery, apart from its unnecessary cruelty. The essence of a satisfactory health service is that the rich and poor are treated alike. Poverty is not a disability and wealth is not an advantage.

In 1951 the government increased taxes to pay for the NHS and the Korean War. One of its measures was to introduce charges for prescriptions given by doctors and dentists. Bevan was so angry that he resigned from the government.

Source Z



▲ **A cartoon from 1948 showing Aneurin Bevan dishing out 'NHS medicine' to the doctors.**

Problems faced by the NHS

When the NHS was set up, it aimed to provide the best possible care for everyone. This was to be paid for out of peoples' taxes and National Insurance contributions. However, two significant factors have made it increasingly difficult to provide the NHS with all the funds it needs:

- Firstly, the death rate has declined and people are living longer. So there are more people to treat.
- Secondly new cures have been found and new illnesses have developed. Some of these are very costly – for instance, transplant operations and many of the new drugs produced for illnesses such as AIDS which had not been heard of in 1948.

These two factors have led to an enormous increase in government spending on the NHS.

Spending on the NHS 1950–2000

	UK £ billion
1950	9.5
1960	11.5
1970	17.0
1980	26.0
1990	34.5
2000	50.0 (estimate)
2002	65.4 (estimate)

There has been heated debate about how to pay for the increased spending on the NHS. One way has been to increase prescription charges. Another has been to encourage people to take out private medical insurance to take the pressure off the NHS. Both of these measures have been controversial. Opponents of prescription charges say that such charges are contrary to the idea of a free NHS. Some people also argue that extending private medicine would lead to a two-tier system whereby the wealthy would receive better treatment.

A shortage of money has led to doctors and hospitals having to make some very difficult choices. Sometimes treatment is refused because of lack of money or sometimes because a patient's illness is 'self-inflicted' (for example, an illness caused by smoking). Sometimes patients have to wait so long for important operations that they die before the operation can be carried out.

The Labour government elected in 1997 took measures to try to improve the NHS. Some patients found themselves transferred to other countries, such as France, to have operations, rather than suffer a long wait in Britain. In March 2002 the Chancellor of the Exchequer, Gordon Brown, introduced a budget which increased National Insurance contributions. He said that he wanted to use the income to increase spending on the NHS by 7.4 per cent a year, so as to reach £105.6 billion in 2007–8.

Vaccination programmes

After 1948 the drive to improve the population's personal health was stepped up. Vaccination programmes, funded by the state, were put in place for all children. In 1954 Jonas Salk produced an effective vaccine against polio, a terrifying disease which, at its worst, could cause paralysis; it struck particularly at young people. In 1960 Albert Sabin produced an improved vaccine which could be taken orally on a sugar lump.

In 1948 the World Health Organization (WHO), an agency of the United Nations, was set up. One of its aims is to encourage vaccination programmes on a global scale. Advances have been made and today eight out of every ten children have been vaccinated against the major killer diseases.

In recent times, however, there have been doubts amongst some doctors about the safety of certain vaccines. In Britain it has been common practice to give young children a 'three-in-one' vaccination against mumps, measles and rubella. Some people argue that this has caused autism in a small number of children and so the numbers of children being vaccinated have dropped. Other doctors argue that this will lead to an increase in the individual diseases, often with tragic consequences.

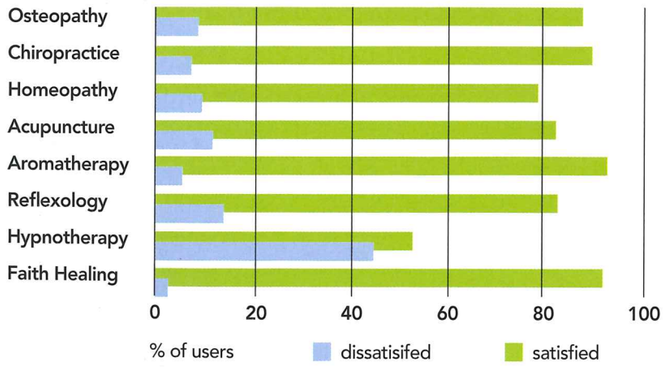
Alternative medicine

Developments in drugs have meant that we can often provide a pill or potion which will bring about a rapid cure to an illness or disease. Although this seems successful, in recent times some people have begun to question the wisdom of such an approach. They argue that continually bombarding the body with strong drugs cannot be beneficial in the long term. As our bodies develop immunity to drugs, so we have to find even stronger ones to cure the problem. Strong drugs can have very unpleasant side effects or led to addiction. Critics talk of a 'valium society' where problems with life-style are solved by regularly taking anti-depressants.

In the 21st century there is an increasing interest in maintaining both physical and mental health. This has led many people to consider whether a better approach to medicine is to look at the general health of the patient as a whole, not just individual symptoms. Consequently a number of different approaches to medicine have become increasingly popular. Since they are alternatives to modern 'scientific' medicine, they have generally been labelled 'alternative medicine'.

- One of the fastest growing 'alternative approaches' is the ancient practice of **herbal medicine**. Instead of taking drugs, people look to natural cures from herbs.
- **Hypnotherapy** is also increasing in popularity and is related to **psychotherapy** in that they both try to treat problems of the mind rather than the body. Spiritual or faith healing, which often involves 'the laying on of hands' is also sometimes used. Sceptics dismiss this approach as unscientific or even 'bogus', yet in a recent survey 90 per cent of people using faith healing were satisfied with its effects.
- **Acupuncture** was first developed in China 4000 years ago and involves inserting needles into pressure points in the body. These needles release blocked energy. Acupuncture has proved effective for migraines and as an anaesthetic during surgery.
- **Homeopathy** is based on the theory that 'like cures like'. A diluted substance similar to the original illness is taken and this provokes the body into providing its own natural cure.

These are just some of the many types of alternative medical approaches available. You may want to find out more about other practices, such as chiropractic, osteopathy, reflexology and aromatherapy.



▲ **The results of a recent survey by the consumer magazine, *Which?* It shows that people who had tried alternative treatments mainly regarded them as successful.**

QUESTIONS

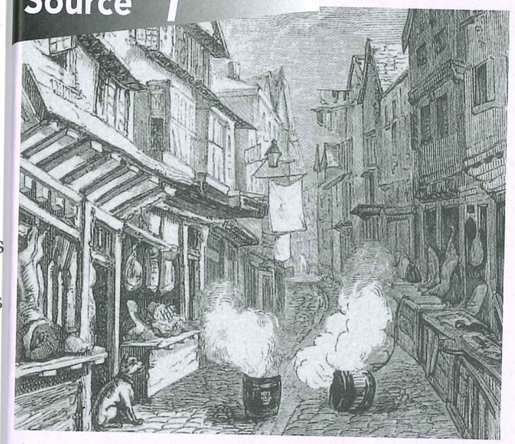
1 What part did the following factors play in the introduction of a welfare state after 1945?
- the work of the Liberal government, 1906–14
- changing social attitudes
- the 1942 Beveridge Report
- Labour's election victory in 1945?

2 Explain the reactions of ordinary people to the setting up of the NHS.

3 'Doctors opposed the introduction of the NHS because they were selfish.' Explain whether you agree with this statement.

13.5 Exercise

Source 1



▲ **Barrels of tar being burned in the streets of Exeter as a remedy for cholera, during the epidemic of 1831–2.**

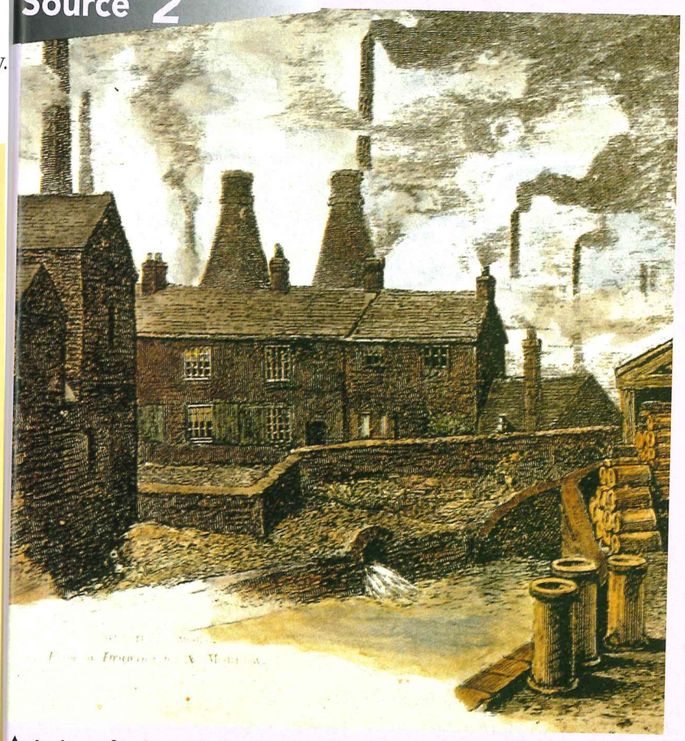
1 Burning barrels of tar will not stop diseases like cholera from spreading. Why, then, did many town councils order this to be done during the cholera epidemic of 1831–2?

2 Why were there four outbreaks of cholera between 1831 and 1866?

3 The first Act of Parliament to tackle the problems of public health effectively was the Public Health Act of 1875 (Source 3). Why was this Act so long delayed?

4 Which of the events shown in Source 3 did the most to bring about a Welfare State in Britain? Explain your answer.

Source 2



▲ **A view of industrial Sheffield in the mid-19th century.**

Source 3

Some events which improved health and welfare in Britain

1875 Second Public Health Act passed. Local councils were made to provide fresh water and sanitation.

1909 The first old age pensions were paid.

1942 The Beveridge Report said that the government should look after its citizens from 'the cradle to the grave'.

1948 The National Health Service came into being – free medical care for everyone.

▲ **From a modern history book.**