CH. 12 – ADVANCES IN TECHNOLOGY

Ch. 12 – Advances in Technology

Learning Intentions

In this section, you should understand:

- The advances in military technology.
- The advances in space technology.
- The advances in information technology.
- How advances in military and information technology helped space technology.
- Case Study: The First Moon Landing, 1969.

ADVANCES IN MILITARY TECHNOLOGY

Advances in Military Technology

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Military Technology

In the second half of the twentieth century, America led most advances in military technology. Its involvement in a series of wars - hot and cold - its powerful economy, advanced research and technology, its superpower status and public opinion have all contributed to continuous advances in military technology:

- The **wars** provided the reason for developing weapons and the final testing of them.
- The **economy** provided the resources to fund the development of military technology.
- **Research and development** came up with new ideas and built them.
- **Superpower status** needed to be maintained.
- American **public opinion** supported the strengthening of the military.

KEY CONCEPT: TECHNOLOGICAL DEVELOPMENT

Technological Development is the application or use of scientific discoveries in industry.

Nuclear Weapons

The most spectacular and dangerous advances in military technology occurred in **nuclear weaponry**. Already during the Second World War, the US had developed the atomic bomb in the **Manhattan Project**. When they dropped the bombs on **Hiroshima** and **Nagasaki** in August 1945, the atomic age truly began.

These bombs were delivered on board **B-29 bombers**. In the post-war era, the US began to develop more powerful planes, particularly after the USSR exploded its own atomic bomb in 1949. Now the US needed a plane that could attack the USSR directly. This became the **B-52 Stratofortress**, which entered service in 1955. The B-52 was the backbone of Strategic Air Command for the next 35 years, with 650 in operation at its peak in 1963. It had a dual role both in delivering atomic bombs and in conventional bombing, as in Vietnam.

At the same time, President Truman gave the go-ahead for a crash programme to develop the **hydrogen bomb** (H-bomb), largely in response to the USSR's A-bomb and to counteract the possibility that the USSR would develop a hydrogen bomb itself. **Computer technology** played a key role in the development of nuclear bombs. The US tested its first H-bomb in the Pacific Ocean in 1952. The explosion sent a radioactive cloud 25 miles into the sky and developed a crater one mile wide.

Rockets

The development of **rockets** gave much greater precision to nuclear warfare. They were also much more difficult for the enemy forces to shoot down. US rocket development was boosted enormously when the best German staff working on rockets of the Second World War, and headed by **Werner von Braun**, surrendered to US troops. The US also captured some of the rockets (the V2s), which they tested in America between 1945 and 1951.

The US used their experience of these rockets to develop short- and medium-range missiles such as the **Snark** and **Corporal**. These were developed to supplement the long-range bomber, not replace it. By the 1960s, the US had replaced earlier rockets with the **Pershing**, which had a range of 400 miles (640 kilometres) and was based in Europe. They could all carry either nuclear or conventional warheads.

ICBM

The development of **intercontinental ballistic missiles** (ICBMs) began in the mid-1950s. President Eisenhower speeded up the arms race with his preference for nuclear missiles over conventional ones. He said nuclear weapons gave *'more bang for the buck'*. The development of the H-bomb, the improved rocket guidance systems and new rocket fuels made building the ICBMs possible. The launching of the **Russian *Sputnik*** into space made it necessary. Now Americans feared the Russians would attack from space.

The first ICBM rocket was the **Atlas**, launched in 1958, followed by **Titan** and later by the **Minuteman**, which could be fired from an underground silo. Further development of the Minuteman gave it a longer range (7,000 miles) and **multiple warheads** (MIRV).

At the same time, the navy developed the Polaris missile, which could be fired from nuclear-powered submarines. By the 1970s, these were being replaced by the **Poseidon**, with a longer range and carrying MIRV warheads.

Warning Systems

The similar development of Soviet planes and missiles made it necessary for the US to develop an **early warning system** to detect an attack and to initiate counter-attacks. The US worked with Canada to develop the **DEW** (**Distant Early Warning**) system - a series of radar stations stretched across northern Canada and Alaska. The US also developed **airborne search radars** such as AWACS (Airborne Warning and Control System), which are constantly in the air. In 1960, they launched the first **reconnaissance satellite**, SAMOS, which provided early warning.

In the 1980s, President Reagan announced his **Strategic Defence Initiative** (SDI) - popularly known as **Star Wars** - which would be able to defend US territory against Soviet attack by launching intercepting missiles from space. However, the huge costs involved in developing such a missile defence system ($1,000 billion) and the end of the Cold War meant that this was not developed by the end of the 1980s.

REVIEW QUESTIONS

1. What factors influenced in US military technology?
2. How was atomic bombs delivered?
3. How important was the B-52?
4. What was the significance of the H-Bomb?
5. Why were rockets developed?
6. What were ICBMs? How and why were ICBMs developed?
7. What warning systems were developed?

Conventional Technology

In spite of President Eisenhower's wish in the 1950s to cut back on spending on conventional weapons, these were not neglected either. In fact, the awesome power of nuclear bombs made their use unlikely and the US was involved in a number of conventional wars - the Korean War, 1950-3 and the Vietnam War in the 1960s, for example.

To cope with this kind of fighting, the US continued with the development of planes, a variety of missiles such as air-to-air or surface-to-air, tanks, reconnaissance aircraft, chemical and biological warfare, aircraft carriers and submarines. In spite of the huge advances in military technology, **tactics and strategy** remained much as they were, and these weapons were used in the same way as in the Second World War. As well as this, the **Vietnam War** showed that superior technology did not guarantee victory in fighting unconventional **guerrilla warfare**.

Air War

The development of the **jet engine** at the end of the Second World War increased the speed and range of aircraft. Fighter aircraft were equipped with missiles to attack enemy aircraft, but also other missiles to attack tanks, troops, fuel depots and airfields. These aircraft included the McDonnell F-4 (1958) and the Northrop F-5 (1959). By the late 1950s, supersonic air-to-air missiles such as the **Sidewinder**, **Phoenix** and **Falcon** were developed to cope with faster aircraft.

Bomber aircraft were also developed with greater range and accuracy, including the **B-29 Superfortress** (1943) and the **B-52 Stratofortress** (1955). They were used in the **Korean War** and in **Vietnam**, where they **carpet-bombed** areas of the Vietnamese jungle. But they had to wait for the development of computer-controlled, radar-guided bombs in the 1990s to increase their accuracy and effectiveness.

Reconnaissance aircraft were also developed, especially the supersonic U-2, which was involved in spying over the USSR and also over Cuba before and during the Cuban Missile Crisis. In more recent decades, **drones** or **pilotless aircraft** were developed for spying.

Helicopters

The **helicopter** was one of the most significant developments in military technology. After their use in the Second World War, helicopters came into their own in the **Korean War**. They were used for scouting and troop-carrying, as well as search and rescue. Their ability to evacuate casualties from particularly difficult countryside was given as a reason for the reduced death rate. In the Vietnam War, **helicopter gunships** became symbolic of the action there. They were fast, heavily armed and used in support of ground troops. However, they were also **noisy** and the Vietcong could hear them coming some distance away.

To combat the power and speed of enemy aircraft, **surface-to-air missiles** were developed to replace conventional artillery. The US army and navy developed separate types the army developed the **Hercules**, which had a range up to 85 miles, while the navy developed the **Terrier** and the **Sea Sparrow**. But as well as these, the **Redeye**, a shoulder-mounted missile, was developed for ground troops. All these used various methods such as radar and heat seeking to guide their missile on to the target.

Aircraft Carriers

The growing significance of air war increased the importance of **aircraft carriers**. These gave mobility and rapid response to cater for small and larger-scale wars. The advent of jet aeroplanes after the Second World War meant that aircraft carriers had to be larger and stronger. It also led to the development of the **catapult** (a British device) to cater for larger and faster planes.

Carriers, such as the **Valley Forge**, played crucial roles in the Korean War. Fighter planes took off from carriers based in the Sea of Japan to bomb North Korean forces. Other carriers were used on blockade duty off the west coast of North Korea. Carriers also were vital in the **Vietnam War**. They were deployed in the South China Sea and supported combat operations over South Vietnam and bombing operations over North Vietnam. The fighter aircraft from aircraft carriers **Saratoga** or **Independence**, for example, supported troops on the ground, attacked enemy troops or bombed military targets near Hanoi.

The **Enterprise** (1961), a nuclear-powered aircraft carrier, was the most powerful of the new carriers, with great speed, manoeuvrability and endurance. It was equipped with a wide range of military technology to meet the needs of modern warfare - radar, missile guidance, guided missiles and sophisticated communications equipment. She also saw action during the **Vietnam War**.

Land War

Tank development proceeded similarly to the Second World War. The essential design of the tank remained the same, but there were significant improvements in engines, suspension and firepower. By the 1960s and 1970s the **M60** and **MBT-70** tanks had gun launchers to fire missiles as well as conventional shells.

To cope with the vast range and power of the new weaponry developed against them, the **soldiers** also had improved military technology. Apart from the Redeye missile, they were equipped with heavy machine guns, anti-tank grenade launchers, recoilless rifles with armour-piercing bullets and night-viewing glasses. Soldiers also had to be equipped to meet new threats from **chemical** and **biological** warfare.

REVIEW QUESTIONS

1. What was conventional military technology?
2. Why did the US need to develop such technology?
3. Was it always successful?
4. What developments took place in air warfare?
5. What role did aircraft carriers play?
6. How did tanks change? How did soldiers cope with tanks?

Permanent War Economy

The huge advances in US military technology from 1945 onwards cost a great deal of money. Indeed, so much money was spent on weapons and the military that some claimed America was a **permanent war economy**. On average, 10 per cent of national income was spent each year on such technology.

Most of the money was spent on a small number of companies - General Dynamics, Lockheed, IBM, Boeing and a few others. Their manufacturing plants were located largely in the states of the **Sun Belt** in the south and south-West of the US, from California to Florida.

This led to the development of what **President Eisenhower** called the **military- industrial complex** - the link between the Defense Department, industries, certain states and their political representatives. He warned about the danger of the military- industrial complex and its influence on government policy, in particular its interest in pushing for an aggressive foreign policy.

KEY CONCEPT: MILITARY- INDUSTRIAL COMPLEX

Military-Industrial Complex was the combination of the armed forces, the politicians who supported them and the industries who supplied them. They had a strong influence on government decisions.

REVIEW QUESTIONS

1. What was (i) the permanent war economy and (ii) the military-industrial complex?

ADVANCES IN SPACE TECHNOLOGY

Advances in Space Technology

Rockets and Soviet Competition

During the 1950s there were considerable developments in **rockets**. But these were mainly to power nuclear missiles. Then, in 1957, the Russians sent a modified rocket into space called ***Sputnik***. In contrast, the Americans' first attempt to send a rocket into space - the *Vanguard* - was destroyed by an explosion on its launch pad a few months after the Sputnik's success. According to the press, it was a case of *'Flopnik'* and *'Kaputnik'*.

This and later Russian **firsts**, such as **Yuri Gagarin** becoming the first man in space - shocked the Americans. They had believed that American technology was superior to the Russians' and the Russian successes were a severe blow to American **morale**. They also saw the Russian successes as a danger to national security, a very important consideration in the middle of the **Cold War**.

NASA (National Aeronautics and Space Administration) was set up in 1958 to catch up to, and beat, the Russian space technology. The Americans launched their first satellite, ***Explorer I***, also in the same year. In 1961, President Kennedy, inspired by Cold War competition and Yuri Gagarin's success, promised that the Americans would have a man on the moon *'before the decade is out'.* During the 1960s the Americans spent $25 billion to achieve that aim.

Mercury and Gemini Projects

This was done in stages. First the **Mercury Project** sent Americans into space. The first was **Alan Shepard** in 1961, a month after Gagarin. This flight lasted 15 minutes. Five more flights followed, including ***Freedom 7*** in February 1962, in which **John Glenn** orbited Earth three times.

In the **Gemini Project**, two-man flights were organised to test **rendezvous** and **docking techniques** - this included space walks. The US also used the **Surveyor** space flights to test soft landings on the moon, as well as photographing and testing the surface. Then a series of **Lunar Orbiter** craft photographed possible landing sites for manned flights to the moon. By now American technology had overtaken the Russians'.

Rockets and Space Technology

The developments in rocket technology helped space technology. Rockets developed as missiles were adapted to send satellites into space. **Atlas rockets** powered the Mercury Project to put Americans into space. **Titan rockets** powered the Gemini Project of two- man flights. **Saturn rockets** were specially designed for the Apollo Missions to land on the moon, orbit and return.

REVIEW QUESTIONS

1. How did rocket technology help the space programme?
2. How and why did the US and USSR complete in the space race?
3. What role did NASA play in the US space programme?

Man on the Moon

The next stage was the development of a **three-man spacecraft**. This was the **Apollo Mission**. In 1968, *Apollo 8* made a successful manned orbit of the moon, sending back television pictures for millions of viewers at Christmas. Later missions tested the operation of the lunar module. In July 1969, *Apollo 11*, with **Neil Armstrong**, **'Buzz' Aldrin** and **Michael Collins** on board, lifted off from Cape Kennedy, Florida for the moon. On 20 July 1969, Neil Armstrong stepped out of the lunar module, **Eagle**, to become the first man to set foot on the moon.

Later Apollo missions continued with further **landings** - in some of which the astronauts used a moon buggy to get around - and scientific investigations of the moon until 1972.

- ***Apollo 12***, later in 1969, collected soil samples from the moon, took photographs and set up scientific experiments.
- ***Apollo 13*** took off in 1970 but ran into difficulties when an oxygen tank burst. The astronauts had to cancel their planned landing on the moon. Instead they had to use the power of the lunar module to bring them back to Earth.
- ***Apollo 14*** (1971) carried out the mission intended for Apollo 13. They landed in a rugged part of the moon and set up scientific experiments and collected rock samples.

Man on the Moon

- **The crew of *Apollo 15*** (1971) spent almost three days on the moon. They used a **moon buggy** to travel away from their spacecraft. They collected some of the oldest samples of moon rock and set up further experiments. They also launched a **lunar mini-satellite** to send back data about the moon's environment. This was the first crew which did not have to be quarantined.
- ***Apollo 16*** (1972) and ***Apollo 17*** (also 1972) followed the same pattern as previous moon visits.
- ***Apollo 17*** was the last of the missions to the moon.

Timeline on Advances in Space Technology	
-1948	US launched captured V2 rocket
-1957	USSR launched the first ICBM USSR launched Sputnik 1; Space Race began USSR launched Sputnik 2 with a dog, Laika, on board Failure of US Vanguard rocket launch
-1958	US launched Explorer 1 NASA established to organise US space programme First US ICBM launched, Atlas
-1960	Launch of first US weather satellite
-1961	USSR sent first man into space, Yuri Gagarin, in Vostok 1 and orbited Earth US sent first American, Alan Shepherd, into space in Freedom 7 in a sub-orbital flight President Kennedy's speech on sending an American to the moon and back 'before the decade is out'
-1962	John Glenn orbited Earth three times Telstar, US communications satellite, beams first live transatlantic telecast
-1962-63	Further Mercury missions
-1963	First woman in space, Valentina Tereshkova of the USSR
-1966-68	Star Trek series on television
-1966	First soft landing on the moon by USSR
-1967	The Outer Space Treaty
-1969	Apollo 11 mission on the first Moon landing
-1969-72	Further Apollo missions (12-17) to the moon; successful except for Apollo 13
-1971-86	USSR first space station programme
-1973	Skylab, first US space station
-1975	Viking missions to Mars
-1977	Voyager missions to other planets
-1981	First successful flight by space shuttle, Columbia
-1986	Explosion of space shuttle, Challenger, stopped use of space shuttles for 3 years

THE SPACE RACE AND THE COLD WAR

Cold War rivalry and suspicion, competition between Democrats and Republicans, public opinion and the strength of the US economy were **important factors** in influencing the Space Race.

In the mid-1950s, President **Eisenhower** had little interest in having a space race but he was forced to set up NASA due to Cold War rivalry and the work of Lyndon Johnson.

After the success of Sputnik 1 in October 1957, **Lyndon Johnson**, then Democratic Senate Majority Leader, set up hearings of the Senate Armed Services Committee on US unpreparedness for space. Johnson and his Democratic senators laid the blame for US failure on the Republican Eisenhower. Johnson argued that the country 'that would conquer outer space would dominate the world of the future'. The 'Free World Must Control Space, Johnson tells Senate Group', announced The Washington Post. Johnson said the control of space was the first aim of the Soviet Union's national policy. Johnson's campaign led to the founding of **NASA** (the National Aeronautics and Space Administration) in 1958 and to a huge increase in spending on the space programme.

The **Presidential election campaign in 1960** heightened Cold War tensions. Johnson warned that the Russians *'will be dropping bombs on us from space like kids dropping rocks onto cars from freeway overpasses'.* **John F. Kennedy** added to the fear by stating that the country that controlled space would control Earth, like in the past control of the seas gave control of the continents.

THE SPACE RACE AND THE COLD WAR

This was reinforced by the statements of **Khrushchev**, the Soviet Johnson got agreement with the Soviet Union on the Outer Space leader, who said that *'Russian space successes and American failures proved the superiority of Communism over capitalism, as well as the inevitability of Communism's world triumph through process of peaceful economic and technological competition.'* (quoted in the *New York Times*, July 1969)

However, when **Kennedy** became President, he had little interest in the space programme. He put **Johnson**, now the Vice President, in charge of it, and Johnson continued to work on developing the space programme. He used his influence, along with others, to ensure that the **Manned Spacecraft Centre** was based in **Houston**, Texas, his home state.

Soviet success in sending **Yuri Gagarin** into space in April 1961 (and the Bay of Pigs disaster soon after) forced Kennedy to change his mind on space quickly, with Johnson's support. He announced a huge increase in spending on the space budget and made his promise*, 'before the decade is out, of landing a man on the moon and safely returning him to earth'* (May 1961). US public opinion also supported this plan.

When Johnson became President, he continued his support for the space programme. During his Presidency the US made huge strides in preparing for landing men on the moon and returning them safely to earth. He renamed Cape Canaveral Space Centre the Kennedy Space Centre.

THE SPACE RACE AND THE COLD WAR

However, Johnson's **Great Society** and the **Vietnam War** forced him to reduce space rivalry, and cut spending.

By now also, public opinion saw 'reaching the moon before Russia does' as much less important than earlier in the decade. With each successful step in the Mercury, Gemini and Apollo programmes, the US caught up to and passed out the Soviet technological lead, so the people were **less afraid** of the Soviet threat from space.

Johnson got agreement with the Soviet Union on the Outer Space Treaty in 1967. This said that there would be no nuclear weapons in space, and neither country would claim ownership of the Moon, the regardless of which country got there first. Johnson provided enough resources for NASA to continue its moon planning but after that spending on space development decreased.

Space Stations and Space Shuttles

Much of the later advances in space technology were in **unmanned spacecraft**. This involved unmanned space flights to distant parts of the **solar system**, and also the development of **space stations** and the **space shuttle**.

A succession of space flights in the 1970s were sent to **Jupiter**, **Mars**, **Mercury** and **Venus**, followed by flights to Saturn in the 1980s. These flights were mostly scientific investigations of the surface and atmosphere of these planets, with the main aim being to try to find signs of life.

At the same time NASA was developing the **Skylab** programme to maintain a space station above the Earth. Skylab was designed as a laboratory to carry out experiments in space, to test the effects of long periods of weightlessness on crew members and to observe the sun. Skylab was launched in 1973 and eventually crashed to Earth in western Australia in 1979.

At the same time the US also developed the **space shuttle** - a reusable space vehicle which could cut the cost of space research and exploration and reduce the amount of space litter. The first successful flight was made in 1981 by the space shuttle ***Columbia*** with a crew of seven. But the explosion of ***Challenger*** in January 1986 and the deaths of its seven astronauts (including the first US civilian in space) raised doubts about the organisation of the space programme. A special commission on the disaster did not hold NASA responsible for design flaws in the shuttle, but it recommended that the agency be reorganised. By the end of the 1980s there was declining public interest and declining support from Congress for space flights. **Budget cutbacks** limited research and development. This led to fewer manned space flights.

Other Satellites

The advances in space technology led to other developments. In 1960, the US launched its first **weather satellite**, which gave much greater understanding of global weather patterns. This was followed in the mid-1960s by commercial **communications satellites**; the first was called **Early Bird**. These provided a faster, worldwide system of communications by television, radio and phone.

In military and security, the US competed with the Russians by putting **spies in the sky**. These were satellites which used high- definition cameras and infrared technology to survey each other's country in great detail. But President Reagan's plan for the **Strategic Defense Initiative** (SDI), or Star Wars as it was called, was too ambitious for its time. This would have developed a space technology to intercept incoming Soviet missiles by exploding them before they reached America.

IMPACT OF ADVANCES IN SPACE TECHNOLOGY ON US SOCIETY

- Developed **new technologies** which benefitted society
- Boost to **US economy**, jobs, sun belt, military-industrial complex
- Increased US **national debt** and **budget deficit**
- Resources taken from **other government programmes**
- **The Moon Landing – Victory** in the Space Race
- **Satellites** for weather forecasting, communications, spying, GPS for navigation; conduct of war; study Earth/ ozone layer/rainforests
- Public debate on **arguments for** and **against** space exploration
    - **For:** victory for capitalism over Communism; undermined Soviet Communism; boosted economy through increased government spending; more than 400,000 employed; boost for scientists; technological spin-offs bettered society
    - **Against:** Too expensive, took resources from other government programmes which could improve society health care, education, housing; done to boost politicians; space debris from older satellites.

ADVANCES IN INFORMATION TECHNOLOGY

Advances in Information Technology

Advances in Information Technology

Information technology (IT) is the equipment and methods used to handle information. The information is collected, processed and stored. As the twentieth century progressed, more and more information needed to be handled to organise a more complex society. The development of the computer was central to the new information age and the development of modern information technology.

The needs of the **American government** and **military** in the middle of the century were crucial to the development of the computer. Their need to handle vast amounts of data concerning atomic weapons gave a spurt to the development of the early computers. They linked with **business** (mostly IBM) and **universities** to design and build the first US computers.

First Computers

Computers developed rapidly during and after the Second World War. **Mark 1** was developed in 1943 through co-operation between Harvard University and IBM (International Business Machines). But this used **mechanical switches** to do its calculations. Much faster was **ENIAC**, which was the **first all-electronic computer**. It was developed for the army for calculations of thermonuclear fusion. Both machines were huge - ENIAC weighed 30 tonnes - and were very expensive. They needed a team of operators to work them.

One of those who contributed to the development of computers was **John von Neumann**, a Hungarian-born mathematician working in the US. He devised the logic which became the basis for the **mainframe computers**, particularly those built by IBM. His work led to the development of **EDVAC**, which influenced the building of IBM mainframe computers. They next developed **UNIVAC 1**, which became the first commercially available computer. It was used to count the US Census in 1951 and the presidential election results in 1952.

Invention of the Transistor

However, computers were still very large. This began to change after the invention of the **transistor** in 1947 by **William Shockley** at Bell Telephone Research Laboratories. It was mostly made of silicon and it replaced the electronic valves, produced no heat, eliminated miles of wiring, was very small and cheap to produce. In 1958, Seymour Cray designed the **first fully transistorised** computer.

IBM produced its own version a year later. The spread of this new form of information technology was gradual. Twenty computers were sold in 1954, but this rose to 1,000 in 1957 and 2,000 in 1960.

Further advances in integrated circuits in the early 1960s led to the development of the microchip. Now the entire workings of the computer could be put on a few **microchips**. Smaller, personal computers became possible with the development of **Intel's microprocessor** in 1971.

REVIEW QUESTIONS

1. What is information technology?
2. What led to the development of computers?
3. What were the main steps in the development of computers?
4. What was the importance of the invention of:
    a. The transistor
    b. The microchip?

Personal Computers

The first **personal computer** (**PC**) was produced in 1975, but its use was mainly confined to electronic engineers. Two years later, however, **Steve Jobs** and **Steve Wozniak** introduced the **Apple II**, which brought personal computers within the range of small business, families and schools. Shortly afterwards, **IBM** entered the personal computer market and the market expanded dramatically in the 1980s. The development of new operating systems, begun by Apple and later spreading to others, in particular **Bill Gates** of **Microsoft**, made computers much more user friendly. The number of computers rose quickly from less than 2 million to over 65 million in 1991.

Computer Industry

By 1958, the US produced about $1 billion worth of computer equipment. Ten years later, this had grown to almost $5 billion, and to $17 billion by 1978. This was all part of the move away from heavy manufacturing to the **high-technology industries**, which also included genetic engineering, lasers and fibre optics. In 1952, 50 per cent of workers were employed in manufacturing industry; by 1992 this had fallen to 20 per cent.

By 1990, the US had the **largest computer industry** in the world, employing 1 million people with a revenue of $100 billion. Companies such as Dell, Compaq, Apple and Microsoft dominated hardware and software production. It also had the greatest number of computers - 50 million - half of the world's computers, compared to Japan with 11 per cent and Europe with about 25 per cent.

However, the industry split between the high-cost **research and development** side and the **production** side. Research and development was largely confined to **core areas** in the US Silicon Valley in California, the Route 128 corridor around Boston and the Research Triangle in North Carolina. On the other hand, much of the routine production and assembly functions were transferred to **peripheral locations**, particularly in Asia. This is how **multinationals** in information technology have developed. In this way, they have increased the gap between the **haves** and the **have-nots** on a worldwide scale.

The Internet

In 1969, fear of a Cold War nuclear attack resulted in the beginning of the **internet**. This was the Defense Department's Advanced Research Project Agency (**ARPANET**) to allow military scientists to communicate over computers in the event of a nuclear explosion. It was expanded in 1986 to the National Science Foundation to include researchers at American universities. By the late 1980s, the **internet**, as it had become known, was widely used by businesses and individuals. But the huge expansion of the internet, or the World Wide Web as part of it, did not come until the early 1990s.

Impact of Information Technology

- By the late 1980s, computers had made a huge impact on **all aspects of American life**, from home to shopping and from work to entertainment.
- They played an important role in the **Moon Landing**.
- They caused a rapid **rise in productivity**. Indeed, they caused a debate about the danger of **technological unemployment**.
- Some point to the fact that the Fortune 500 companies in the US shed over **4 million jobs** in the 1980s. These used information technology to replace workers with machines. At the same time, these companies' sales and assets grew, and their **chief executives** increased their own income by six times. This increased the gap between the rich (haves) and poor (have-nots) within America during the 1980s.
- Others argue that the fears that computer technology would replace people are exaggerated. They say that while some industries have declined, others have replaced them.
- An **example** of how the computer and information technology industries have made many people extremely **wealthy** is **Bill Gates** of **Microsoft**. Gates dropped out of college, founded Microsoft and produced the MS-DOS and Windows operating systems for IBM computers. By the age of 32 in 1987, he was worth $1 billion.

Impact of Information Technology

- Information technology had a major influence in the **globalisation** of industry, finance and culture. Computers speeded up communications and the transfer of money and made it easier to transmit television channels worldwide.
- There was **a greater concentration of industry** because of the expense of the new technology, which only the largest corporations could afford.
- Computer technology gave rise to a debate about the **invasion of privacy** and **dangers to democracy** of storing information on people. The US government passed a law to protect the privacy of individuals.

KEY CONCEPT: GLOBALISATION

Globalisation is the spread of institutions, organisations and culture on a worldwide or global scale. It is usually associated with the spread of trade and industry by large companies or corporations to many different countries. Goods, services and culture gradually become the same in all parts of the world.

REVIEW QUESTIONS

1. How was the personal computer developed? How did the computer industry grow?
2. How did the computer industry divide? How and why was the internet developed?
3. How did developments in technology influence American life?

CASE STUDY THE MONTGOMERY BUS BOYCOTT, 1955-56

CASE STUDY the First Moon Landing, 1969

Introduction

The Russian space successes in the late 1950s and early 1960s surprised and shocked the US. The country was going through its greatest economic boom and its technology appeared to be well in advance of all other countries. Then the Russians proved otherwise.

To counter the Soviet success, the US set up **NASA** (National Aeronautics and Space Administration) in 1958 to take charge of US space exploration. Now the space race became fully part of Cold War rivalry. It forced **President Kennedy** to commit the US to landing a man on the Moon before the end of the 1960s. (Source 1)

SOURCE 1 MAN ON THE MOON

'...if we are to win the battle that is now going on around the world between freedom and tyranny, the dramatic achievements in space which occurred in recent weeks should have made clear to us all, as did the Sputnik in 1957, the impact of this adventure on the minds of men everywhere, who are attempting to make a determination of which road they should take.. I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to earth.'

President Kennedy's Special Message to Congress, 25 May 1961

QUESTIONS

1. According to W.T. Cosgrave, what advantages did de Valera have as a negotiator?
2. What did Cosgrave mean by the words 'keeping their ablest player in reserve'?
3. How did de Valera regard his own role as 'symbol of the Republic'?
4. In his view, what was a 'shirking of duty'?

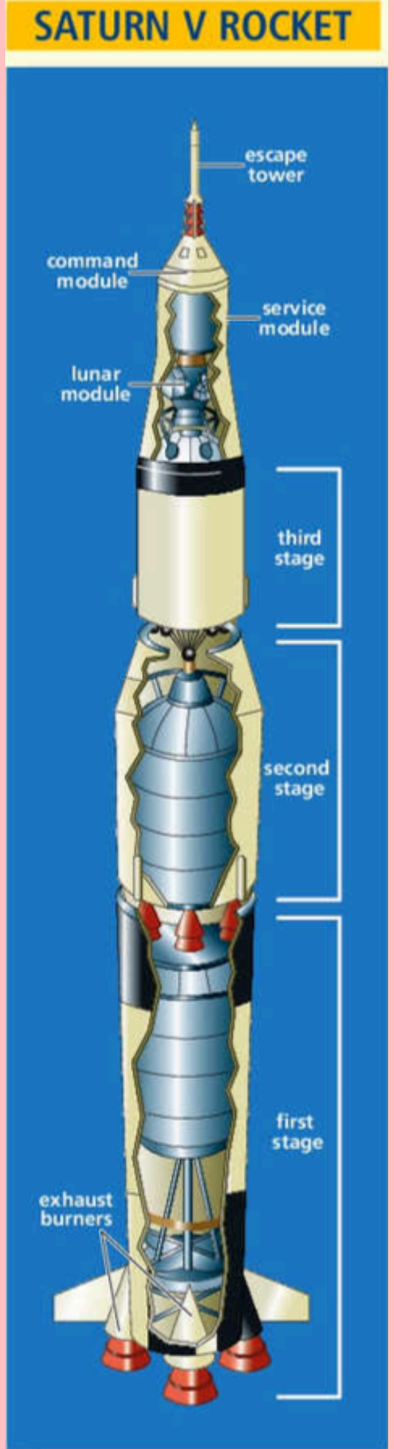
The Apollo Programme

The Apollo Program was developed to land the first man on the Moon. The first six Apollo missions were unmanned. They were used to test the giant **Saturn** rocket. But soon after, it hit disaster. In 1967, three astronauts in ***Apollo 7*** died when a fire broke out in the spacecraft on the launch pad. The next three missions successfully tested various aspects of the Moon journey:

- ***Apollo 8*** undertook an important mission in December 1968 by orbiting around the Moon and returning.
- ***Apollo 9*** practised docking the command ship and the lunar module in Earth's orbit.
- ***Apollo 10*** went to the Moon to test the lunar module further by flying to within 15 kilometres of the Moon's surface before rejoining the command module.

NASA AND THE MILITARY-INDUSTRIAL COMPLEX THE TOP 5 INDIVIDUAL CONTRACTS AWARDED BY 1968

1. To develop, and test the Apollo command and service modules (North American Rockwell Corp.)
2. To develop the Apollo lunar module (Grumman Aircraft Engineering Corp.)
3. To design, develop and fabricate one stage of the Saturn V vehicle and provide launch support services (Boeing Co. Aerospace Division)
4. To design, develop and fabricate a second stage of the Saturn V vehicle and provide launch support services (North American Rockwell Corp.)
5. To design, develop and fabricate another stage of the Saturn V vehicles and provide launch support services (McDonnell Douglas Corp.)



The Role of Technology in the Apollo Programme

In the Apollo programme, NASA had to overcome many technological problems to get men on the Moon and back. NASA worked with many different **private companies** to develop these technologies.

The **Saturn V rocket** was developed in the US mostly by German engineers led by **Werner Von Braun**. It needed enormous power to lift-off, and it had three stages to carry its payload into orbit.

But there were **many other technologies** needed to solve other problems.

- They developed **special photography** to select a suitable landing site, similar to CAT and MRI scanning used in hospitals today.
- They developed **freeze-dried food** to feed astronauts on an extended voyage to the Moon.
- **Cool suits** were used to keep astronauts at a comfortable temperature while they were on the Moon.
- They also developed **boots** for better shock absorption and stability on the Moon's surface.
- **Cordless power tools** were developed to help gather Moon rock.
- They also developed a **heart conditioner** to maintain the heart on long space voyages, **insulation barriers** of aluminium foil to protect instruments and astronauts from radiation and **water purification technology** to maintain a fresh water supply.

Without these advances in technology, the US would not have been able to put men on the Moon and return them safely.

'Apollo really did drive our industry. We were asking people to do things that were probably 10 or 20 years faster than they otherwise would have done. And they knew it. They stepped up to it and succeeded. Today's cell phones, wireless equipment, iPads and so on are a result of the fact that the country did this hi-tech thing and created this large portfolio of available technologies.'

(The Guardian, 16 December 2012)

Apollo 11

Apollo 11 was destined to make the first Moon landing. It was powered by the most powerful Saturn rocket yet, 111 metres tall. It had three **modules** (parts) to it:

- The **command module** (called **Columbia**) to carry the astronauts to the Moon and back.
- The **service module** which held the rockets and fuel needed for the Moon journey.
- The **lunar module** (**Eagle**) to land on the Moon. It had four landing legs, each with a large footpad to prevent it from sinking into the lunar soil.

At the top was the **launch escape tower** to allow the astronauts to escape from the command module if there were problems on the launch pad.

The Astronauts

The three astronauts were selected some years before:

- **Neil Armstrong**, the commander, was a pilot in the Korean War and later a test pilot. He flew in ***Gemini 8*** in 1966.
- **Edwin 'Buzz' Aldrin** was also a pilot in Korea. He flew in ***Gemini 12*** when he also walked in space. He was pilot of the lunar module.
- **Michael Collins**, also a pilot, flew in ***Gemini 10***. He was the pilot of the command module.

The astronauts went through intensive training. They practised in simulators, similar to the Apollo spacecraft. They also experienced **weightlessness** in underwater tanks and in special aeroplane flights. Armstrong practised flying the **Lunar Module**, on one occasion narrowly escaping death when he ejected out of the module as it burst into flames.

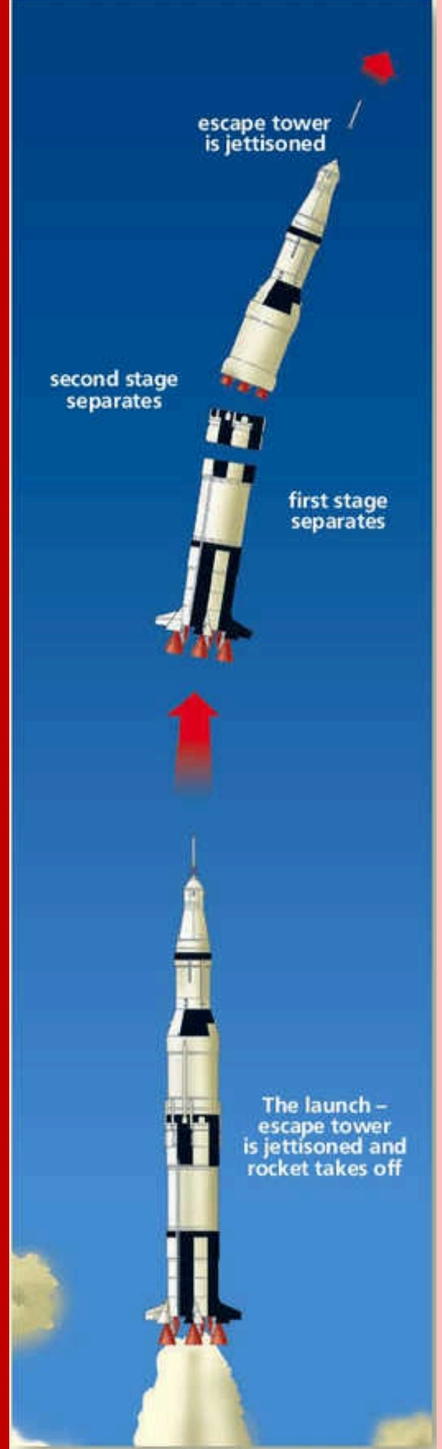
THE ASTRONAUTS

***'Neil Armstrong**: Devoted to duty, he has little time for anything but his job and sets himself apart from people except for his family and close friends. He has been described as a modern day soldier of fortune because he likes to be where the excitement is, whether as a test pilot of the X-15 rocket plane or flying 78 combat missions during the Korean War.*

***Edwin 'Buzz' Aldrin**: The young man seemed to know everything in his chosen profession. West Point honours graduate, Distinguished Flying Cross with Oak Leaf cluster, 56 combat missions in Korea with two MiGs shot down and one damaged, but, at the age of 33, his blond hair already thinning, he was back in school ... Writing the dissertation [study, thesis] that won him a Doctor of Science degree in Astronautics, he dedicated it to "the men in the astronaut programme".*

***Michael Collins**: How will he feel about acclaim after the flight? "I've really enjoyed the programme immensely. This job is the most fascinating in the world. On the other hand, I say in all candour [truth] that I appreciate remaining anonymous, and I'll do the best I can to keep that going. I like to live a normal private life."*

The Irish Times, 16 July 1969



The Launch

On 16 July 1969, the three astronauts ate a large breakfast of steak, eggs, toast and orange juice in the Kennedy Space Center in Florida. They then dressed in bulky **spacesuits** and went aboard the command module, ***Columbia***, two hours before take- off. Aldrin sat in the centre, with Armstrong on his left and Collins on his right. Thousands of spectators watched the launch some distance from Apollo, while millions more watched on television.

SOURCE 2 - LARGEST TURNOUT IN HISTORY

'An estimated 750,000 to one million persons witnessed the launching [at Cape Kennedy)]... The turnout was the largest in history to witness a space launch.. Traffic was tied up even further with about 160 members of the Poor People's Campaign, with four mules, who marched about one mile along the highway to emphasise the plight of the nation's hungry.'

New York Times News Service, The Irish Times, 17 July 1969

QUESTIONS

1. According to W.T. Cosgrave, what advantages did de Valera have as a negotiator?
2. What did Cosgrave mean by the words 'keeping their ablest player in reserve'?
3. How did de Valera regard his own role as 'symbol of the Republic'?
4. In his view, what was a 'shirking of duty'?

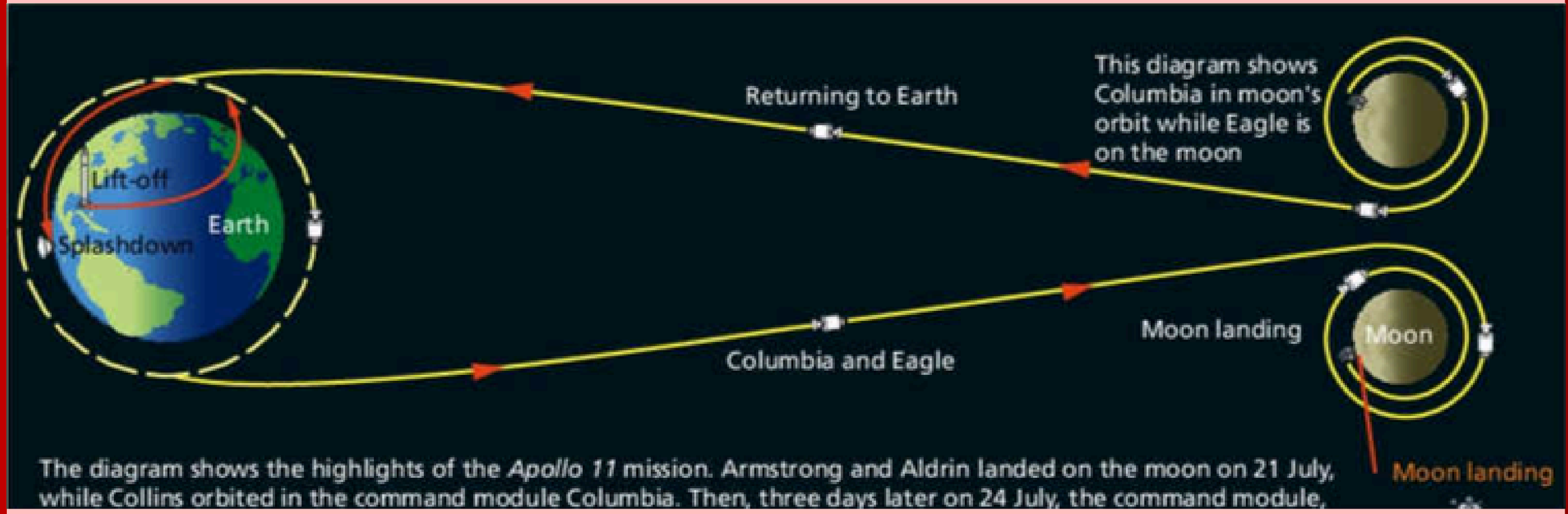
The Journey

At 9.32 a.m. Apollo was cleared for take-off. Saturn 5 had **three rocket stages** - each one was jettisoned (dropped off) when its fuel was used up (See Source 8 and The Launch). It was loaded with 2,000 tonnes of fuel which it burned at a rate of 15 tonnes a second:

- At 3 minutes, the **launch escape tower** was jettisoned; now the astronauts could see out from the command module.
- At 9 minutes the second-stage rocket was jettisoned.
- At 11 minutes Apollo and its three astronauts reached Earth's orbit. It was ready for its journey to the moon.

At this point, **Collins** separated the command module from the third-stage rocket, then reconnected with the lunar module before heading for the moon. On the **journey**, the astronauts checked the lunar module, participated in live television broadcasts and rested in sleeping bags. They did not have to wear their spacesuits except at certain stages of the voyage, such as the launch and re-entry. Their food included bacon strips, peaches, chicken, salmon and beef stew and they had drinks of coffee and orange juice. The food was **freeze-dried** and sealed in small plastic bags and sometimes had to have water added. On 19 July, they reached the Moon.

The Journey



The diagram shows the highlights of the *Apollo 11* mission. Armstrong and Aldrin landed on the moon on 21 July, while Collins orbited in the command module Columbia. Then, three days later on 24 July, the command module,

THE ROLE OF COMPUTERS IN THE MOON LANDING

The Saturn rocket had its own computer to guide it into Earth orbit; NASA's computers on the ground helped with navigation corrections. The **command module** (CM) and the **lunar module** (LM) each had their own computer; the CM computer navigated between the Earth and the moon, while the LM controlled the landing, ascent and rendezvous again with the command module. Other **ground computers**, which cost $3.5 million each and were as large as cars, monitored the astronauts' health and maintained communication between Earth and the lunar module.

Moon Landing

The next day, 20 July, Armstrong and Aldrin went into the lunar module, ***Eagle***. They separated from Collins in the command module and landed in the **Sea of Tranquillity**. On the final descent, Armstrong noted that the automatic landing system was taking Eagle towards a crater with large boulders. He coolly took over manual control and continued over the crater, landing in a flat plain beyond. Eagle had only about 30 seconds' worth of fuel left at touchdown. Then he reported back to Earth, *'Contact light on. Engine off. The Eagle has landed.'*
When Armstrong came out of the module and stepped on the Moon, he said, *"That's one small step for man, one giant leap for mankind.'* Aldrin followed later and they planted an **American flag**, stiffened with wire. (See Source 3)
The **spacesuit** for walking on the Moon was similar to the suit for the launch, except that it had an extra layer for added protection. They also had special underwear cooled by plastic tubing filled with water. Their backpack, or **Portable Life Support System** (PLSS), supplied cooling water for the underwear and oxygen to breathe. Their helmets had a plastic shell, and two visors for added. protection.
They spent 21.5 hours on the surface conducting **scientific experiments** and **collecting rock samples**. They were able to walk quite easily on the moon without having to take the kangaroo-like steps they thought they would have to. They also placed a **metal plaque** on the moon, commemorating the landing: *'Here men from the planet Earth first set foot upon the Moon, July 1969 AD. We came in peace for all mankind.'* (Source 4)

SOURCE 3 - ONE SMALL STEP FOR MAN

'Mr. Armstrong, many would agree that you gave the most eloquent and enduring speech when you stepped onto the Moon, and I think if you could share with us how and when did you compose the "one small step"? And could you settle it for once and for all, was there an "a" before the word "man"?"

ARMSTRONG: *'I didn't think about that until after landing, but after landing I... actually having been somewhat surprised at the fact that we were able to make a successful touchdown, I realised I actually was going to have to say something. But it .. there wasn't anything very complicated: when you just think about stepping off, why, it seemed to follow.'*

"The "a" was intended. I thought I said it. I can't hear it when I listen on the radio reception here on Earth, so I'll be happy if you just put it in parenthesis [word in brackets].'

Apollo 11 thirtieth anniversary press conference in Cape Kennedy Space Centre, 1999

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SOURCE 4 ROCK SAMPLES AND SCIENTIFIC EXPERIMENTS

'The temporary inhabitants of Tranquillity Base collected enough pieces of the Moon early yesterday to keep scientists happy for months. They also established a remote geophysical observation station that should benefit science. The two scientific instruments left on the Moon were a laser mirror and a seismometer. The laser reflector will help scientists to reduce the error in Earth-Moon distances to about six inches. The seismometer is designed to see if the Moon has tremors. [and to measure] meteor impacts.'

The Irish Times, 22 July 1969

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Apollo 11 Moon Landing Timeline

16 July - *Apollo 11* launched from Kennedy Space Centre, Florida

19 July - *Apollo 11* entered lunar orbit

20 July - Lunar module, Eagle, landed on the Moon Armstrong and Aldrin walked on the Moon. Command module, Columbia, piloted by Michael Collins, orbited the Moon

21 July - Lunar module lifted off from the Moon Lunar module and command module docked Lunar Module jettisoned Command module began return to Earth

24 July - *Apollo 11* splashed down in the Pacific

The Return

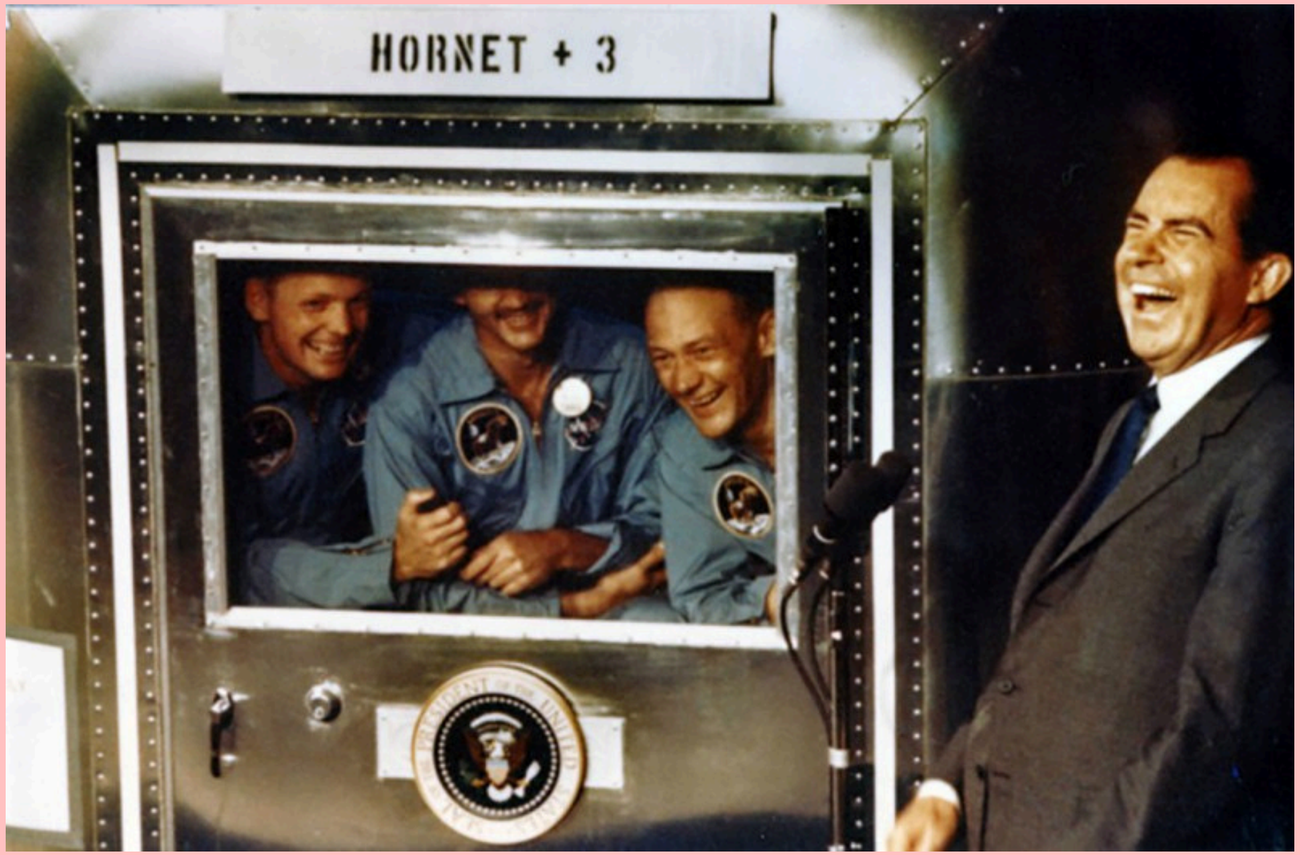
When Eagle took off from the Moon, the descent stage of the module was left behind. The lunar module then docked with Columbia. After Armstrong and Aldrin returned to the command module, Eagle was detached and left to float in the Moon's orbit.

The command module returned to Earth, protected by its **heat shield** as it came through the Earth's atmosphere. Parachutes then slowed down the entry speed. The command module splashed down in the **Pacific Ocean**, one thousand miles south-west of Hawaii, on 24 July, one mile from the target area. The capsule landed upside down in the sea, but it was soon righted. The astronauts were taken on board the **USS *Hornet*** and placed into quarantine for 21 days in case they brought back any dangerous germs. Their mission had lasted eight days. The quarantine chamber was taken to Houston Space Centre, Texas. (Source 5)

SOURCE 5

'It has only been eight days - just a long week - and this is the greatest week in the history of the world since creation. Because as a result of what happened in this week the world is bigger infinitely."

President Nixon speaking to the astronauts in their mobile quarantine laboratory on board USS Hornet, The Irish Times, 25 July 1969



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SOURCE 6 - COMING HOME

'What they have done is to push outward not only into space, but into untapped reserves of hope. A generation or so from now their contribution will move into a more settled perspective. By then, there may be interplanetary space stations and hotels on Mars. But the men on the Moon began it all."

Editorial, The Irish Times, 22 July 1969

SOURCE 7-CROSSING NATIONAL BOUNDARIES FOR MAGNIFICENT ACHIEVEMENT

'Apollo 11 will always be remembered as a magnificent achievement in the history of applied science and technology in the United States, and we Americans are justifiably proud of it. reality, however, the team that brought Apollo 11 to fruition cuts across national boundaries. The mission itself had its beginning not on 16 July 1969, but several centuries ago. The sense of history involved in this realisation of man's ancient dream of voyaging to the Moon is easily overlooked and we tend to consider this feat as the product of twentieth-century science and technology [quoting Frank Borman, previous astronaut] "Yet when we say this was an American achievement, we really have to go back to Newton and paraphrase him... How can anyone think of [the Apollo mission] without thinking of Galileo or Copernicus or Kepler or Jules Verne or Oberth or Tsiolkovski or Goddard or Kennedy or Grissom or White or Chafee or Komarov." We truly stood on the shoulders of giants.'

Dr Werner Von Braun, The Irish Times, 17 July 1969

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SOURCE 8-'AMERICAN KNOW-HOW'

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SOURCE 9 - IT'S OFFICIAL: US DID LAND ON MOON

'The US Moon landings, as any good conspiracy theorist knows, were staged on a movie set by Americans eager to outstrip the Russians in the space race. You can tell because the flag they plant there ripples in a gust of wind, because the film-makers forgot to include stars in the night sky and because Neil Armstrong and 'Buzz' Aldrin have never spoken about their lunar adventures.

But in a move the doubters will surely dismiss as just another plank in the conspiracy, NASA has finally been goaded into responding. The space agency is to launch a publication setting out the evidence that the 1969 Apollo landing really did take place, NASA's former chief historian told The Guardian yesterday, in response to a flood of questions from school students and their teachers.

The missing stars are easily dealt with: the photographs in question also show Earth, a huge patch of brightness hard to combine on the same exposure with dimmer flickering lights. Awkwardly for those who see evidence of deception, Armstrong and Aldrin have both spoken of the mission.

The rippling flag is explained as follows: the astronauts had to twist the flagpole to insert it into the Moon's surface, and doing so caused it to ripple. In the absence of any atmosphere, the rippling continued long after they had moved away.'

Oliver Burkeman in New York, The Guardian, 6 November 2002

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Media Coverage

The Moon landing was covered live by television. 600 million people worldwide (or a fifth of the world's population) watched it. There were also 3,500 press passes issued to watch Apollo 11's lift- off. It was headline news in all major newspapers around the world the next day. It was a **huge technological** and **publicity success** for the US.

Conclusion

The **significance** of the Moon landing, 1969:

- It fulfilled the **commitment** of the US, through its President, John F. Kennedy, to land a man on the Moon before the end of the 1960s.
- The Apollo mission was part of a **huge project** which involved over 400,000 people in assembly plants and control rooms.
- The US now led the **space race** against the Russians; it was portrayed as a victory for the democratic, capitalist system in the West: a US victory in the Cold War.
- The Soviet Union launched an unmanned spacecraft, Luna 15, shortly before the Apollo launch. It was aimed to reduce the publicity of Apollo 11, but it crash-landed on the Moon. After this, the Soviet Union concentrated more on developing **space stations**, where it had a clear lead over the US. However, these were not as spectacular as the first Moon landing.
- **Budget cuts** in the 1970s meant that since 1972, no one has gone to the Moon.

Conclusion

- The three astronauts were affected in different ways by the landing:
  - **Armstrong** was a quiet personality so he rarely talked publicly about the Moon landing afterwards. He became a professor and chairman of a computer company.
  - **Aldrin**, who had a brilliant mind, had a nervous breakdown and became an alcoholic. But he recovered and became a professor.
  - **Collins** published an account of the space voyage. He was a business executive.
- The cost of **the space programme** caused public debate. Some argued that the vast amount of money involved in putting the first men on the Moon could have been spent on **America's social and economic problems**, which were very evident in the 1960s (Source 8). Others argued that the technology developed for the Moon landing benefitted people in many ways.
- The **rocks** which they brought back, and others from later voyages, provided new information about the structure and formation of the Moon.

WEB RESOURCES

- July 20, 1969: One Giant Leap For Mankind, https://www.nasa.gov/mission_pages/apollo/apollo11.html
- Space Exploration, http://science.nationalgeographic.com/science/space/space-exploration/
- Space Race, https://airandspace.si.edu/exhibitions/space-race/online/index.html1
- Strange Facts You Didn't Know About the First Moon Landing, http://www.armaghplanet.com/blog/11-strange-facts-you-didnt-know-about-the-first-moon-landing.html
- Search YouTube for 'Apollo 11', 'Moon landing', 'Space Race'