HOW
DO THEY
KNOW THAT?

Foreword

But did it really happen? Anyone writing or filming history is, or should be, haunted by the question. Try to recite a conversation you had with friends even a few weeks ago and then hear their version; you'll probably be surprised by the difference. Stories are different depending on who tells them. They're 'improved' – added to, coloured, simplified – over time.

Though there are times when you might conclude that almost no facts are reliable, luckily there are plenty of ways to stack the odds in the direction of truth. Writing my history, I tried where possible to find first-hand accounts. Going back to ancient Egypt, where village gossip was written down on pieces of pottery, or to the martyrdom of early Christians, where one woman left her story, they do exist.

Then there's the other physical evidence. Stones don't lie. There's nothing like going to archaeological sites and seeing for yourself – from Peru to Israel, we went to the buildings, the graves, the siege ramps. History should never be done just in libraries. Science helps too, from new thermal imaging to the use of DNA tracing for our earliest stories.

Finally – there are historians you can trust! They are the people who review each other's work, learn from past mistakes and challenge lazy thinking. We are living through a golden age of great history writing. I hope what follows helps you to discover more about some of the remarkable skills that the true professionals rely on.

This booklet has been produced by Open University academics in support of the OU/BBC co-production, *Andrew Marr's History of the World*.

The academic study of the past embraces many subdisciplines. Some relate to specific methodologies – for example, maritime archaeology or military history – while others relate to particular periods and/or places – medieval history, for instance – and a few combine a specific methodology with particular areas of human activity – such as the history of science. The feature that unites all these areas of study is their concern with the materials of the past and what these can tell us.

When creationists challenge scientific theories of human evolution, they frequently confront a disconcerted professor with the question, *Were you there?* swiftly followed by, *In that case, how do you know that?* The reply is normally something along the lines of, *We don't need to have been there to know.* Although this may sound like a cryptic reference to 'the Force', it really refers to the body of evidence, methods and theories that archaeologists and historians draw upon when studying and interpreting the past.

One of the most important aspects of exploring the past is to learn how to read and explain its materials. We have to ensure that we understand them in their own terms; comprehend the context that gave rise to their origins; interpret the values embodied in them, which may be very different from ours; and be able to translate those findings into a coherent portrayal of processes and events. This applies to human evolution as much as late Victorian history.

However, it isn't always smooth sailing. The editor of the popular magazine *History Today*, Paul Lay, described history as "a discipline in opposition to certainties and easy answers". Historians' occasional lack of certainty in telling the stories of the past, along with their habit of disagreeing constantly with each other, can seem peculiar to people who enjoy learning about history from documentaries, visits to historic houses and sites, or reading popular history books. After all, the past has been and gone; nothing can change, so why are historians and archaeologists always changing their minds about it? In his *History: a Very Short Introduction*, John Arnold explained that "there is an essential difference between 'history' and 'the past'", defining 'history' as the product – what historians have written about events in the past. So, although the past may not be changing, the practice of history always is – how we find out about events of the past, with new or improved techniques to gather evidence, how we interpret and explain that evidence, and how we record our findings.

The study of the past generates constant debate, but this isn't necessarily a bad thing. History and archaeology are collaborative disciplines, in which researchers build upon the work of each other, learning from colleagues, and often stealing ideas and methodological procedures from other disciplines, in order to dig deeper into the past, unlock new insights into our origins and add new answers to the question, *how do they know that?*

Introduction

Content analysis

Chemistry, biology and geology have been a goldmine for archaeologists and historians. In our quest to better understand the development of humanity, we have borrowed and readapted many scientific methods that were originally developed in these fields. An example of this is molecular archaeology – the study of ancient molecules extracted from archaeological remains. It sounds like the stuff of science fiction, but molecular archaeology allows us, amongst other things, to identify the organic residues contained by an ancient vessel – that is, the food that someone was slurping out of their bowl hundreds or even thousands of years ago.

How? When exposed to high temperatures, pottery and other porous materials generate aluminosilicates (a type of mineral), which absorb and trap liquids. These liquid residues decompose with time, but they leave behind minuscule traces, each of which has an individual structure (a form of molecular signature).

When observed under an electron microscope, these traces allow us to guess the original content of the vessel. This, in turn, gives us a wealth of information about aspects of ancient life, such as agriculture, trade, ritual practice and the domestication of species. For example, thanks to molecular archaeology, we have established that the earliest known form of alcoholic beverage from anywhere in the world comes from China some 9,000 years ago (during the Neolithic), where pottery jars were shown to contain a mixed drink of rice, honey and grape/hawthorn tree fruit.

Palaeoenvironmental studies

Archaeologists also apply scientific methods to the study of ancient environments, not just artefacts. By exploring the ways in which landscapes and climates evolved, we develop better understandings of the ancient world, as well as the challenges and opportunities encountered by its inhabitants. Ice cores, for example, can provide us with a vertical time line of past climates dating back thousands of years.

The texture and chemical composition of snowfall is heavily affected by factors such as temperature, light, humidity and air pressure. In extremely cold places like Greenland or Antarctica, layer after layer of snowfall has been deposited and compacted for millennia without

melting. By drilling large ice cores out of glaciers and studying the different layers of snow, we can make a good guess as to what the climatic conditions were like thousands of years ago.

A similar principle applies to sedimentary deposits. The quantity and composition of silt that is carried by rivers and deposited into layers (called varves) on sea beds tells us about aspects such as rainfall, erosion, the fertility of the soil and even the types of plant that grew in any given region.

However, we don't always have to go as far as Antarctica or the bottom of the ocean in order to obtain evidence for past ecologies. Some of this information can be found much closer to us – in our gardens, parks and forests. Each year, trees grow a new ring inside their trunks. The growth pattern of these rings is affected by environmental factors such as humidity, temperature, CO_2 levels and the pH of the soil. This produces unique tree ring sequences, providing archaeologists with a wealth of data about past climatic conditions.

Thanks to these methods, we have been able to identify and study environmental processes from periods that have otherwise left very limited archaeological or historical evidence. For example, by the end of the last glacial period (a prolonged stage of extremely low temperatures from approximately 110,000 to 15,000 years ago) writing had not yet been invented and pottery use was very limited, which means that palaeoenvironmental data is especially useful.

Environmental scientists have also used similar methods to plot periods of more localised climate change. For instance, the period between around 1550 and 1860 on both sides of the North Atlantic has been dubbed the Little Ice Age, during which the Rotterdam canal and River Thames in London were frequently frozen solidly enough to support thousands of people and stalls at 'frost fairs'. Several studies in Europe and North America have analysed tree-rings to demonstrate limited growth in this period and verify the advance of glaciers south through the Alps and Rocky Mountains.

Thanks to research using sedimentary deposits from seas and rivers, along with radiocarbon analysis of dead plants beneath ice-sheets, we have been able to confirm that temperatures had, in fact, already begun to fall at the start of the 14th century. Several medieval chronicles tell of a series of unusually wet and prolonged winters in the 1310s, and the terrible famines that followed, demonstrating that scientific evidence can enhance or back up the written record.

Mummy tomography

3D computed tomography is now a common diagnostic tool in modern hospitals. An X-ray scanner is rotated around a patient and a three-dimensional image is gradually built up that can then be visualised on a computer screen. The technique enables doctors to see inside a patient's body, but it can also be used to investigate patients who are long dead.

Scientists in Lisbon have recently scanned the mummified body of an ancient Egyptian man and discovered bone lesions caused by prostate cancer.

In another investigation, scientists have scanned 52 mummies and found evidence for hardening of the arteries in 20 that were aged between 35 and 55 at the time of death. The technique enables a virtual autopsy to be carried out in such a way that it's no longer necessary to unwrap mummies. The technique can image objects wrapped in the mummies, as well as explore their bones and tissues.

Skeletal remains

Forensic analysis of human remains has become an invaluable tool to archaeologists and historians: it can provide a test of evidence in written historical accounts and add to our knowledge of even the most famous events, such as major battles.

In 1996, a mass grave was discovered near the site of the Wars of the Roses battle of Towton (1461), said to have been the bloodiest ever fought on British soil, in which around 28,000 men lost their lives. Forensic studies conducted on some of the 46 skeletons by osteoarchaeologists have revealed particularly ferocious injuries. Many had multiple head injuries – over 20 in some instances – with trauma impact indicating a range of different weapons used. There are blunt traumas from a weapon like a mace or ball-hammer, slashes from swords or daggers, and penetrating wounds from arrows or, in one case, a pole-axe – a contemporary weapon exactly matching the entry-point on one skull. Trauma evidence from the human remains supports the historical narrative around the battle that no

mercy was shown to already-fallen soldiers. Very few cavalrymen were deployed at Towton, so the position of many wounds found on the very top or back of the head suggests that victims were kneeling or lying on the ground, and may well have been attacked repeatedly and ferociously after they had been captured, or were already gravely injured.

More sophisticated chemical analysis of skeletal material, for example measuring the levels of stable isotopes in tooth enamel, can reveal the geographical origins of soldiers' remains, greatly adding to historians' knowledge of international conflicts, such as the Thirty Years War (1618-48), which was fought primarily across the German states but attracted combatants from as far afield as Sweden, Spain and the Ottoman Empire.

Dead Sea Scrolls

Scientific methods are not just for material remains. Textual information gets its fair share of high-tech methodology too.

In 1947, a goat-herd from Bethlehem discovered scrolls of parchment contained in jars in a cave near Khirbet Qumran on the West Bank of the Jordan. They caused a sensation because they contained 2,000 year old Hebrew versions of parts of the Bible that were hundreds of years older than the previous earliest known versions written in Greek.

Archaeological investigations subsequently found more caves containing hundreds of fragments of scrolls of biblical texts, apocryphal texts (not included in the

official Bible) and documents relating to the organisation of a Jewish sect.

The scrolls have been hugely controversial because of their disputed ownership, cultural and historical significance, secrecy and delays in publishing their contents, legal battles over their copyright and academic jealousies. They also have a great religious significance because the text differs in many ways from the standard, approved versions of the Bible used by Moslems, Jews and Christians. They also provide details about Jewish society at the time Christianity emerged.

As soon as they were found, the ink began to fade, and the fragile fragments are incredibly difficult to handle and read. Now a project in the Israel Museum, Jerusalem, is digitising the scrolls using a 1,200 megapixel camera (compare that with yours!) and enhancing the images. Infra-red and multi-spectral scanning has made parts of the text readable for the first time. Five scrolls can now be seen in amazing detail on the internet, and read in translation at the same time. This means that anyone can now read the <u>oldest surviving text from the Bible.</u>

Techniques

In literate cultures, written records and sources provide the bulk of the evidence used by historians to piece together their narratives of the past. At first glance, it might be tempting to think that written sources present fewer challenges and are easier to interpret than archaeological findings, but no historical evidence appears in a neat package. As part of their training, professional historians need to acquire a range of skills, dependent on their subject area, to understand and interpret documents. Records need to be read, and even 20th-century historians cannot guarantee always to have printed or typewritten sources. If you've ever tried reading your GP's handwriting, you can probably guess how tricky manuscript sources of the past can be!

In past centuries, even written English had scripts and letter forms so different from what we use today that historians need to learn palaeography (the deciphering of historical manuscripts and writing systems), in order to decipher texts. Most historians also need to learn the languages in which their documents are written, including dialects like Low German or Provençal, or tongues long passed into history, such as classical Latin, Koine (New Testament) Greek, or Hittite.

Translation

With dead languages, the challenge is not just in deciphering manuscripts or learning a language, but also reconstructing the language from scratch. This is easier said than done. Despite centuries of research, archaeologists and historians are still faced with plenty of undeciphered scripts.

The process of reconstructing a dead language is very methodical. It usually involves the following:

Mapping all known characters – charting a sort of A-Z of the old script

Searching for patterns – studying the order and variations of these characters in known texts

Deciding what these characters stand for – for example, syllables, sounds or words

Contextualising and classifying the language – for example, guessing its linguistic family and using known parallels to tentatively infer meaning from sections of the texts

Once a word or phrase is translated, the pieces of the puzzle start falling into place. However, in some cases, all this work bears little fruit, so progress stalls until we strike lucky. A famous example of this is the discovery of the Rosetta Stone, which helped translate Egyptian hieroglyphs.

The Rosetta Stone contains the same text in three versions – Classical Greek, hieroglyphs and Demotic (a late form of Egyptian writing). This made it relatively easy to compare all three versions and use the known languages to finally crack Ancient Egyptian.

Reconstructing a dead language is not too dissimilar from the code breaking traditionally done in espionage. In fact, during World War I and World War II, many eminent palaeolinguists were approached by intelligence officers and discreetly recruited as agents, putting their academic skills to His Majesty's service.
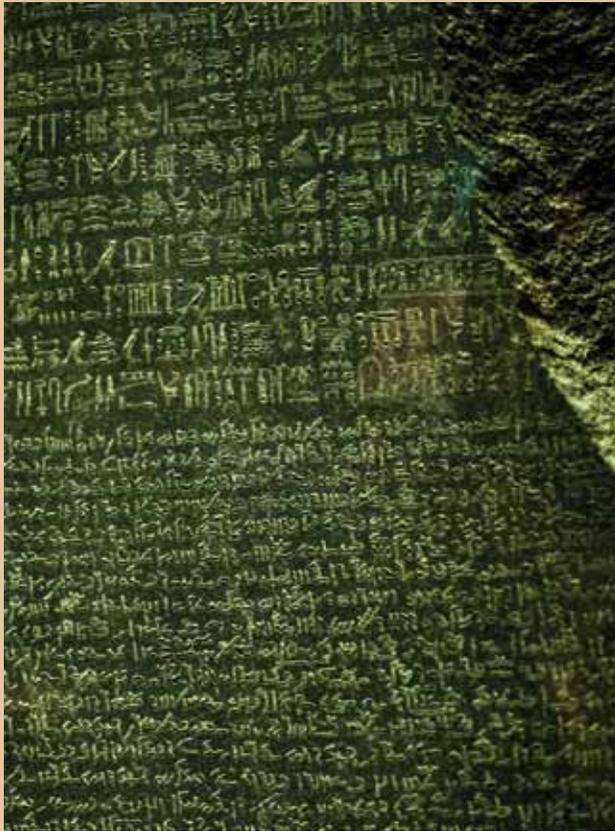
Translation helps people to understand each other when they speak different languages. But in history, translation can also provide new evidence and overturn stereotypes.

What do you know about Robin Hood? That he was a good man who stole from the rich to give to the poor and defended England against bad King John? Think again. Translation of a Medieval Latin document kept at Eton School puts a new spin on Robin Hood.

Dr Julian Luxford has translated a comment scrawled in the margin of an early 15th-century manuscript.

Circa hec tempora vulgus opinatur quendam exlegatum dictum Robyn hode cum suis complicibus assiduis latrocinijs apud shirwode & alibi regios fideles Anglie infestasse.

Translation: "Around this time, according to popular opinion, a certain outlaw named Robin Hood, with his accomplices, infested Sherwood and other law-abiding areas of England with continuous robberies."

Not all 'green tights' and 'swooning Maid Marion' after all. But there's more: *"Circa hec tempora"* means "around this time", and yet it's written on the chronicle by the years 1294-9 (the reign of Edward I), 100 years later than the traditional date of Robin Hood. It's also the earliest Latin associating Robin with Sherwood (*shirwode*).

Written evidence

Zimmermann Telegram

The intention in Berlin in 1917 would have been that neither contemporaries nor future historians should ever have chanced across the secret message. Germany's State-Secretary for Foreign Affairs telegraphed his German Ambassador in Mexico (von Eckhardt), via Germany's Ambassador in Washington (von Bernstorff), suggesting to the Mexican Government that it should collude with Germany against the United States.

It was long believed that the telegram was decrypted with the help of German code books that had been obtained by the British, although it would appear as if this was only partially true – guesswork and actually trying to 'solve' the code was as much behind the successful decoding of the text.

Germany's transatlantic cables had been cut by the British at the beginning of the war, and this meant it relied on wireless communication for messages between Germany and the outside world. Such messages were usually sent in enciphered code.

In ciphers, letters or groups of letters were represented by other letters or groups according to a systematic method, whereas codes were an arbitrary substitution of characters that were listed in a code book or, as was the case with the Zimmermann Telegram, a substitution of letters with numerals. Usually, such coded telegrams were then also put into cipher for added security. This did not happen with Zimmermann's telegram, making it easier for the British code-breakers to break the code, although unravelling all of the text took many weeks.

The problem Whitehall faced was how to pass on what they had intercepted to Washington without revealing that they had broken the German code. They could perhaps wait to see if the unleashing of unrestricted submarine warfare, announced for two weeks later, would have the desired effect of bringing the US finally into the war on the Allied side. In the end, they presented the telegram to President Woodrow Wilson on 24 February, and on 1 March it was made public in the US press, without revealing the source of the decoded text. On 6 April 1917, the United States formally declared war on Germany and its allies.

Whether the telegram really was the trigger for America's entry into the war is impossible to say. Arguably the US was bound to enter the war in any case, now that Germany was resolved to conduct unrestricted submarine warfare. However, it has been argued that this message helped draw the US into the war, and it certainly set public opinion against Germany. If that was so, its deciphering certainly changed both the course of the war and of the 20th century.

Medieval coroners' records

If private or secret documents can reveal information of vital political importance, public sources (documents intended to be read by substantial numbers of people) can give historians valuable insights into domestic life.

It may seem like a truism, but historians can only use sources that still exist. England was perhaps the most bureaucratised kingdom in Europe during the Middle Ages, with royal clerks producing thousands of papers

each year and, compared with many states on the Continent, has escaped comparatively lightly from the destructive impact on its records of warfare, revolution and other damage. Yet, administrative historians estimate that little more than one per cent of official documents produced between the Norman Conquest

and the 14th century have survived. Thus, historians have to glean as much as possible from what remains, and commonly use documents for purposes other than those for which they were originally intended.

'Reading against the grain' in this way can often provide what has been called 'unwitting testimony' by historians or, in other words, information that the document's author has unintentionally provided about values, attitudes or broader picture of their society or themselves. In this way, historians can gain insights into subjects for which we have few other sources, such as the domestic lives of ordinary people. Inquests of medieval coroners' courts, for instance produced to record unlawful or accidental deaths, actually reveal a good deal about the lives of the victims and their families.

Historians have calculated that, in English peasant communities, 47 per cent of all fatal accidents suffered by babies occurred over just four months of the year, from May to August, when all able-bodied adults were needed to work the fields, and babies taken to work with their parents might be endangered – laid in cribs on the ground or baskets in trees, out of the way of heavy equipment, but where disaster might occur.

Records show children were closely involved with parental work and space, and had a gendered pattern from a young age. Girls suffered fatal accidents while mimicking their mother's routine – scalded or burned in the kitchen, drawing water from wells, or injured by barnyard animals. Boys more often died away from home, in accidents on the road or with their father in the workshop, forge, farm or forest.

Geographical Information Systems

Our archive of material from which we can learn about the past doesn't solely consist of text. As we moved into the 20th century, we also started learning about the past through other means such as film footage, sound archives and photographs.

One example is the millions of aerial photographs taken of the Western Front in the 1914-1918 war. The trenches were constantly photographed; around half a million of these pictures have survived, and they provide a unique insight into how the war was fought.

To study these photographs on a large scale needs electronic help, and so historians and archaeologists have learned how to use Geographical Information System (GIS) software to hold maps and other spatial information on computers. In this case, GIS systems allow the aerial photographs to all be digitised and combined. Belgian archaeologist Birger Stichelbaut has used 7,000 of these aerial photographs to create a visible archive of the Belgian end of the Western Front over the whole course of the First World War.

The database means that the history of particular installations can be tracked from when they were built to when they were abandoned. The trenches and other installations that were in fact built didn't match the plans for them; the men on the Western Front were ignoring the rulebooks in order to cope with their new situation.

This graph shows the pattern of a cross-section of the German side of the front. There are successive
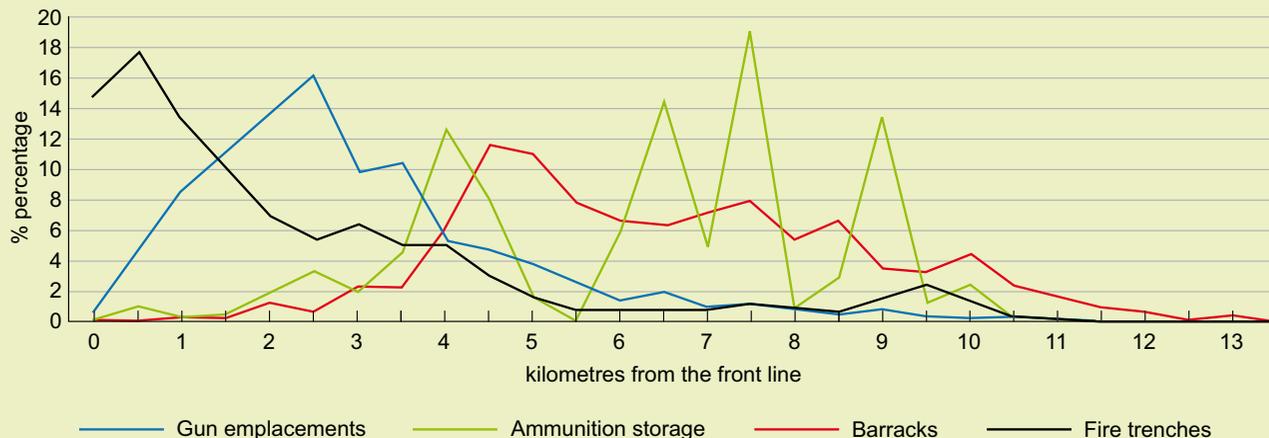
layers of trenches, with artillery (the most powerful factor in trench warfare) behind the front line, and barracks and ammunition dumps further back. The line was thin: 12km behind it, there are nearly no military installations.

Satellite images

With the internet age, options have become even more exciting. The availability of free, high resolution satellite images means that the idea of exploring landscapes through aerial photographs has gone on steroids.

Archaeological surveys usually involve convincing a generous mentor to part with a significant sum of money, getting oneself on a plane and spending several dreary days walking up and down a field whilst staring at the ground and marking the position of every single find. (Dehydration, frostbite and gangs of looters are optional extras.)

On the other hand, with tools like Google Earth, Microsoft's Virtual Earth and NASA's Visible Earth, all that's required is a computer, a trained eye and some patience. With a couple of clicks you can be surveying the Libyan desert in search of Roman camps. Open a new tab and you're exploring Nazca lines in Peru. The sky, literally, is the limit.

Sometimes, archaeological features are directly visible in the image, for example the converging footpaths shown in this image. Other times there are indirect tell-tale signs, like the patterns left on a field by crops growing at different rates or areas of snow melting at different speeds, which can indicate the position of physical structures lying beneath the surface of the earth.

Researchers in the University of Western Australia made the headlines in 2011 for discovering almost 2,000 archaeological features in Saudi Arabia without leaving the comfort of their Aussie couches. Even more surprisingly, a group of palaeoanthropologists from Witwatersrand University has successfully rigged Google Earth to automatically predict the location of certain types of archaeological site. They started by exploring approximately 130 known caves and 20 fossil deposits in search of tell-tale features. They then programmed Google Earth to automatically identify similar features, which led to the discovery of 500 previously unrecorded sites.

However, the technology has its limitations. As keen archaeologists, it can be easy to let one's optimism and imagination run wild. The only way to tell for sure whether that tantalising squiggle on the monitor is an undiscovered Iron Age hill fort or a shabby sheep pen is to put one's wellies on and inspect it in person.
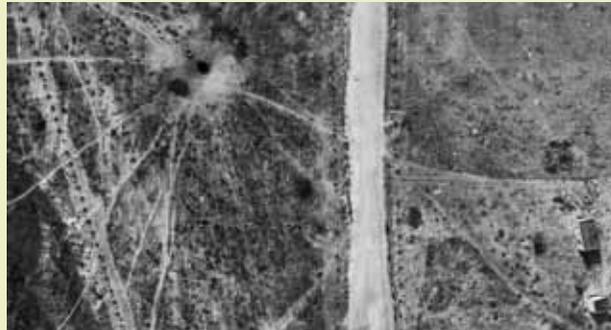
Written sources have often dominated historians' exploration of past societies, but 'visual sources' or material culture – the artworks, objects and artefacts that we can see and (if we are very lucky) sometimes touch – very often can complement or confirm our knowledge and, sometimes, tell us something quite different about the past that we would not otherwise realise.

Almost anything produced by a past society or culture can provide insights into that society, and historians investigate a broad range of source materials during the course of their research. Everyday objects and personal possessions, machinery and technology, buildings of all kinds, along with artworks and pictures – from classical sculpture to Renaissance fresco painting to early-modern woodcuts, 19th-century political cartoons to modern film, posters and photographs – can all be used as historical evidence.

In an era where digital-manipulation tools have become ubiquitous both in the media and in home computing, we are used to the idea that the camera can lie. However, we aren't always as questioning of historical photographs that, although not easily doctored post production, might in some way be staged or posed to present a not wholly true picture of events. Similarly, for audiences in the early years of photography, the technology would have been uniquely persuasive and hard to see as anything other than a literal snapshot of an historical moment – a fact that could be exploited by 19th-century war reporters, propagandists or campaigners.

Historical buildings like domestic dwellings, fortifications and churches can add to our understanding of a locality in past times and also, through their architectural features and decoration, communicate a good deal about the consumer culture, daily needs, lives and beliefs of the people who built or occupied them. For example, the commissioning of chantry chapels by wealthy individuals in late medieval Europe are evidence of the importance in lay Christians' lives of prayers being said *post mortem* for their soul, whilst the heraldic decoration, choice of patron saints and other religious ornament demonstrate family pride, the importance of chivalry and personal piety. The destruction of the majority of parish church decoration and the rearrangement of the interior space, in Tudor England, also reminds historians that buildings are often renovated or rebuilt, and that we need to be careful when drawing conclusions from what is currently standing.

The Mary Rose

Mary Rose was the flagship of Henry VIII's navy, and sank with the loss of around 400 men during the Battle of the Solent on 19 July 1545.

The raising of the ship, on 11 October 1982, was watched worldwide by millions of people on television and, thanks to the 30 years of painstaking exploration of the *Mary Rose* and her surviving contents since, historians' picture of naval warfare and the lives of sailors onboard has been enhanced.

The seabed silt had preserved hundreds of yew longbows and thousands of arrows, revolutionising the knowledge of military historians on the size, draw and range of the weapons, and proving that longbows and hand-to-hand fighting retained their importance on a ship equipped with the most up-to-date cannons.

Many of the artefacts found on the ship were personal possessions of the crew, from pewter bowls to dice, and gambling tokens to leather footwear. For instance, one shoe has a little slit on the upper, as though the owner had a bunion on his toe that he was trying to ease. All of the *Mary Rose* finds give us a tantalising glimpse into life in Tudor England.

Antikythera Mechanism

In 1901, near the island of Antikythera (between the island of Crete and the Greek mainland), divers found 82 fragments of a bronze clockwork machine in a shipwreck dating from between 100 and 150 BCE.

High resolution X-ray scanning of the 30 corroded gear wheels and dials enabled researchers to see inside, revealing the most complex piece of machinery that is known to have survived from the ancient world.

Counting the number of teeth in the gear wheels and reading Greek inscriptions that labelled parts with numbers, symbols and names of the months and planets has shown how it worked. On one side, the dials form a calendar showing the positions of the Sun, Moon and the planets. On the other, the dials enable the prediction of solar and lunar eclipses.

Greek astronomers had discovered by observation that the Earth, Moon and Sun rotate in such a way that every
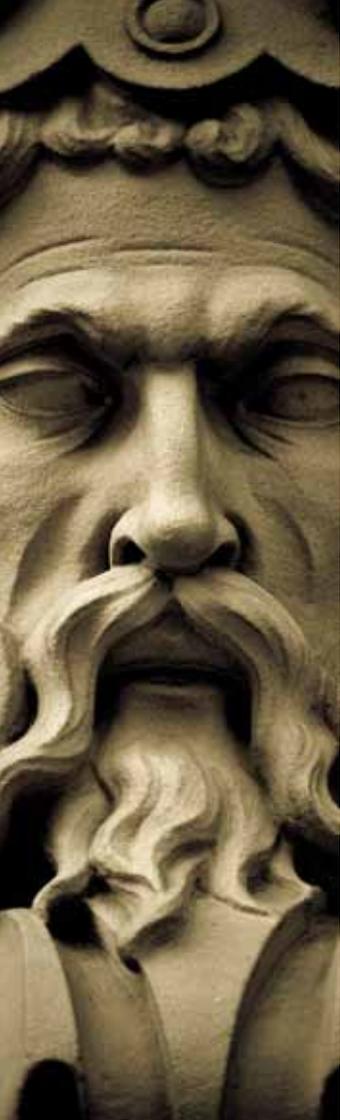
18 years 11 days they align to form an eclipse, with the Moon directly between the Earth and the Sun blocking out its light.

The mechanism is a model of the universe as the Greeks understood it, and could be used to foresee the future position of the planets.

Russian posters

You've already learned about the challenges of finding evidence about the distant past. Even as we near the information-rich present day, the historian still faces considerable obstacles. In a liberal society, governments or private individuals may still withhold, doctor or destroy important documents. These problems intensify in a one-party state like the Soviet Union where opposition was ruthlessly suppressed.

The Soviet regime controlled the written word through censorship and persecution. It also sought to shape its own history through the manipulation of visual images. Under Stalin, his defeated Bolshevik adversaries were systematically removed from group photographs.

The regime also made extensive use of propaganda posters. The example here celebrates the alliance of the urban industrial worker and the peasant: the 'hammer and sickle'. The support of the peasants was indeed crucial to the success of the Bolshevik seizure of power, but the subsequent happy union of worker and peasant depicted in the posters was an ideological fiction.

During the Civil War that followed the Revolution, the peasants' produce was requisitioned and many were

forced to fight for the Red Army. Although concessions were made during the 1920s to their desire for land and private trading, they were subjected, by Stalin, to a ruthlessly executed policy of the collectivisation of agriculture, during which millions perished.

Pottery

Few objects have been as useful to archaeologists as the unassuming pot. In the public imagination, archaeological research is often associated with sparkling treasures and towering monuments. In fact, a lot of what we know about the past is derived from more prosaic materials – boxes full of pottery sherds.

There are two main reasons for this: pots are extremely common in most ancient cultures – they were the equivalent of our soft drink cans and cardboard boxes, and they have excellent preservation rates – when pottery is fired, the molecular structure of clay is altered, resulting in a material that is as resistant as stone.

The shape and fabric of pots gives us invaluable insights into the past activities of people (for example, were they cooking meat, storing grain, drinking wine or brewing beer?) and by extension, their subsistence strategies and economic activities. For example, were they pastoralists, farmers, hunter gatherers, or a combination of these?

The presence of foreign pottery in a site can be useful evidence for trade activities. Their shapes and decorations show how some cultures imitated and reinterpreted the images and pottery styles of their neighbours, illustrating some of the effects of inter-cultural contact. In addition, pottery styles are one of the most efficient ways of dating an archaeological context. Think of it as a fashion trend – bell-bottom trousers and long beards screams 1970s, and nothing says 1980s like a bouffant mullet and a black leather jacket. Well, the same principle applies to pottery – Romans liked their pottery black between the 3rd and 1st centuries BCE, but, by the time Julius Caesar was around (in the early stages of the Imperial period), a new style known as samian ware (characterised by a red glossy slip) became the latest craze.

What is data mining?

Thanks to advances in computing, studying written evidence is not just about sitting down and reading texts. Today it's possible to apply a broad range of analytical techniques to historical sources. By tweaking database software and search engine algorithms, we can explore minute details in individual texts or analyse millions of books in seconds.

This process, called data mining, uses computers to tease out relations and visualise patterns in massive data sets, such as digitised newspaper archives and museum collections, saving us years of painstaking work.

The PELAGIOS project

The PELAGIOS project is a good example of what can be achieved with data mining. PELAGIOS, which stands for 'Pelagios: Enable Linked Ancient Geodata In Open Systems', is a tool that uses the infrastructure of the internet to bring together data from international archives and museums, exploring associations between people, places and objects. Think of it as a world wide web of antiquity.

Say we come across a reference to a man called Glaucus in an Ancient Roman text and we are interested in learning more about who he was. A couple of years ago we would have had to scour libraries up and down the country and phone up colleagues all over the world in the hope of striking lucky. Today, with a PELAGIOS search, a museum in Cologne instantly tells us where Glaucus was born 2,000 years ago, a library in London

gives us his known friends and family, and an archive in Paris lists the places that he visited in North Africa.

With tools like PELAGIOS, textual and spatial data can be combined and visualised in new ways. We are not just plotting dots in a map – we are representing webs of associations between interlinked entities. This means that, as well as saving us time and making all sorts of new research projects possible, data mining tools are redefining the ways in which we conceive the past. Archaeologists and historians are increasingly highlighting the connections that linked up the ancient world, developing a more rounded picture of how real people lived and interacted with each other thousands of years ago.

18th century newspapers

Data mining doesn't always require sophisticated international projects; the humble word search has played an important role in our understanding of the past. For example, we know that Edward Jenner helped to pioneer vaccination, but when did his contemporaries realise that he'd found the answer? How can historians find out what people knew 250 years ago?

In the 20th century, some old newspapers had indexes – but if historians wanted to find out about somebody or something that wasn't famous enough to catch the indexer's eye at the time, they were stuck. The only alternative to using indexes was to search laboriously through old copies, which could take months. Cheap data storage, web bandwidth and workable optical character recognition have changed all that – electronic images of many old newspapers are now available through university, national and local authority libraries. We can read them like we used to, but we can also search them instantly for names and words. This gives us a whole new way of finding out about history, so we can track the way that Edward Jenner's introduction of vaccination spread in Britain and beyond.

Charles Burney (1757-1817), a book collector, brought together thousands of newspapers from the 17th and 18th centuries, which are now digitised and available to search online through the British Library. We can use this collection to search for traces of Edward Jenner – this gives us a picture of what the public at large would have known about him.

1796 – Jenner is an expert witness at a murder trial in Gloucestershire: he suspects foul play, but the jury acquits Mrs Reed of murdering her husband by poison.
1798 – the first widespread reports of Jenner's pioneering work appear in the national press, with the publication of his book on vaccination.
1802 – Jenner is presented to the King: a sign that his views on the benefits of vaccination have been accepted by the British establishment.

This kind of research isn't just a new way of finding out Jenner's story – it's a very important aspect of the story itself. Jenner wasn't the first to vaccinate for smallpox, but he was the first to publicise what he had done. Once his discovery – that vaccines derived from cowpox were far safer than risking exposure to smallpox – became widely accepted, the way was laid open to the eradication of this scourge of humanity.

The Cow Pock — or — the Wonderful Effects of the New Inoculation!

The study of the past is not always squeaky clean. Historians should maintain a healthy scepticism about their sources' reliability, as written or printed documents don't always tell the truth, and closer scrutiny might reveal that all might not have been as it seems.

People in the past may have written deliberately to mislead, or may sincerely believe something that we now know not to have been true. For example, in the Wars of Religion that raged across Europe in the 17th century, both Catholics and Protestants produced lurid tales of atrocities that may have had some root in truth, were exaggerated or enlarged upon, or completely false in other instances, but certainly fuelled hatred and mistrust between communities for many generations to come.

Scrap of paper

Documents can become part of a propaganda war, and although this provides historians with many opportunities, there are also potential pitfalls. The famous 'Scrap of Paper', of 4 August 1914, is an account by former British Ambassador to Berlin, Sir Edward Goschen, about his last meeting with German Chancellor Theobald von Bethmann Hollweg on the day Britain declared war on Germany. The document is famous because it described the German Chancellor dismissively referring to the treaty, which guaranteed Belgian neutrality (about to be violated by German

soldiers), as a mere 'scrap of paper', and much was made of this callous remark in subsequent British anti-German propaganda.

Closer inspection of this source has, however, revealed that we do not know in what language the conversation took place, despite the fact that so much was made of the Chancellor's alleged callous words. Did he say the words 'scrap of paper' in English? Did he use a German term which was much more neutral? What's more, the date on the document is incorrect: it should be 4 August (the day of the Belgium invasion and declaration of war), not the 6th, when Goschen and the embassy staff left Berlin in the morning. Goschen's account of the meeting was received in London on the 19th, so the document may in fact not have been drafted until just before.

Given how much importance was attached to this document subsequently, particularly in terms of blaming Germany for the outbreak of war, any doubts on the reliability of Goschen's account of the meeting are crucial for historians. If it was not written up until two weeks after the event, Goschen's memory might not have been accurate, and the outbreak of war subsequent to the meeting may well have coloured his perception. Clearly,

THE SCRAP OF PAPER

Prussia's Perfidy—Britain's Bond.

The Treaty of 1839 (which the German Chancellor tore up, remarking that it was only "a scrap of paper") said :

"BELGIUM ... SHALL FORM AN INDEPENDENT AND PERPETUALLY NEUTRAL STATE. IT SHALL BE BOUND TO OBSERVE SUCH NEUTRALITY TOWARDS ALL OTHER STATES."

These are the facts and Signatures of the Six Nations who guaranteed Belgian Independence and Neutrality

GREAT BRITAIN	- Palmerston
BELGIUM	- Sylvain Van De Weyer
AUSTRIA	- Senfft
FRANCE	- H. Sebastiani
GERMANY	- Bulow
RUSSIA	- Pozzo Di Borgo

Germany has trampled on the Treaty she signed.

CAN BRITONS STAND BY WHILE GERMANY CRUSHES AN INNOCENT PEOPLE?

ENLIST TO-DAY

the fact that Bethmann Hollweg may never have used the words "scrap of paper" is crucial too, both for his personal reputation and, by implication, that of Germany's, given how much mileage British propaganda was to get out of it.

Piltdown Man

As well as being cautious with historical evidence, we also need to be wary of other historians, as scholars have been known to adjust their research results to better coincide with their own preconceptions or others' expectations. In some cases, unscrupulous researchers have gone as far as to consciously forge their data. Some do it to support a political agenda at any cost, some seek fame and glory, and some have asked the wrong questions from their evidence so, after years of frustration trying to square the circle, resort to fabricating the results that they were unable to produce legitimately.

The discovery of the Piltdown Man is an infamous example of forged data. By the early 20th century, anthropologists had spent decades searching for the elusive missing link (an evolutionary connection between humans and other ancient primates). Today we know that there is no such thing as a single missing link, but rather multiple gradual transformations leading to our present form.
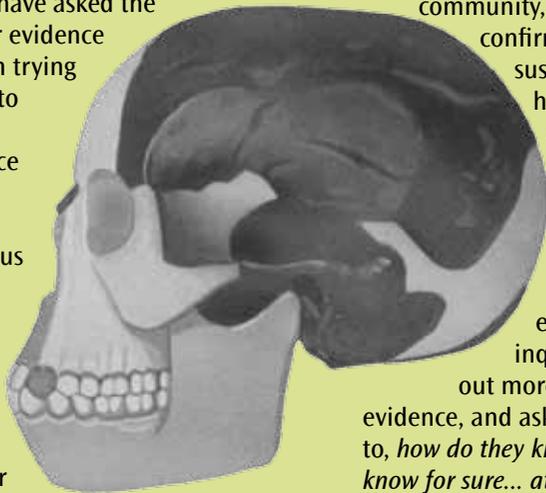
Frustrated with the lack of progress in their investigations, a group of researchers decided to take matters into their own hands. In 1912, Charles Dawson announced the discovery of a hominid skull in the Piltdown gravel pit, which displayed an extraordinary combination of human and primate features.

The find became known as the Piltdown Man and was touted by the media as the earliest Englishman. Initial reports suggested that he would have been sporty and brainy – a worthy rival indeed for the recently discovered German Neanderthals and French Cro-Magnons.

Although scepticism was soon rife in the academic community, it wasn't until 1953 that an analysis confirmed what many had increasingly suspected. The Piltdown Man was a hoax – his cranium belonged to a modern human and the jawbone came from an orang-utan.

Whether sources are written, visual, scientific data or archaeological records, historians always need to be careful, however tempting it can be to accept evidence on face value. Historians are inquisitive and will normally try to find out more, comparing their sources against other evidence, and asking more questions. Even so, the answer to, *how do they know that?* sometimes remains, *they don't know for sure... at least, not yet!*

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