CHAPTER 1

Introduction

Transitions and Impacts

What innovations marked major transitions in the long trajectory of human history? What impacts did these bring about?

In this book, I present five key developments in human history which resulted in dramatic, widespread and long-term changes to the way we live. I describe what we know (from archaeology and history) of the origins and early development of each innovation and suggest what were their multiple and diverse effects.

While there have been other discoveries, inventions and changes which altered a single aspect of human life, the topics chosen for this book facilitated many transitions in society. Indeed, innovations whose origins lie in the deep past may continue to affect daily life in modern times. The subjects featured here are the taming of fire, the domestication of the horse (and development of the wheeled vehicle), the invention of writing, the technology and use of the printing press and the revolution in wireless communication.

Each of these developments brought major benefits to those who possessed the new skills, in contrast to those who lacked them. The story of an innovation is also the story of its spread, across time and space. A new capability can establish a new level of control over the environment, as did the ability to create fire. It can change hunters' relationship with their prey, move people at speed or enhance an army's power in battle, as did horse riding. It can transport goods in bulk and allow trade over new distances, as did the horse when combined with the wheeled vehicle. New means of communication gave power to those who mastered those skills, a feature of the beginnings of writing and the development of the printing press and printed book in Europe. Innovations can integrate widely separated groups of people, a function of the written word and the printed word and especially the era of the wireless revolution.

I suggest the topics selected for discussion in this book are distinct from many of the numerous important innovations which mark human history (and prehistory) because of the range and scale of the impacts they made. There are many kinds of innovation – technological, economic, political and ideological – and the final chapter in this book comments on some of these.

There were certainly significant ancillary impacts, for example, from the discoveries in the prehistoric world that effective composite tools could be made from small-scale stone artefacts, or that wild cattle could be domesticated for milk as well as for their meat and hides or that copper and tin could be combined to make bronze for tools and weapons. Even in the deep past, a combination of chance, creativity, experimentation and experience can be credited with the beginnings of a major technological or economic transformation in human culture.

We have become used to the concept of an invention or a discovery in modern times. An innovation such as penicillin or the flying machine can be adopted quickly and widely because of its power and value. The introduction of a new, basic foodstuff can have broad implications, including new settlement patterns and new trading networks. We have come to see that the 'agricultural revolutions' of the Old World and New World were slower and more complex than once assumed. Animals which were hunted prey were gradually domesticated. Control of crops brought about closer settled life, although agriculture could also lead to negative impacts on diet and to the rise of communicable diseases. The long and successful continuity of Indigenous societies in Australia affirms the flexibility and adaptability of foraging economies until the arrival of external agriculturalists was to undermine their long-lasting life patterns. The contact of New World with Old World meant the introduction of new foodstuffs in both directions.

Political change, power shifts, invasions and conquests are conventional markers in historical narratives. Many of these events served as the agents for wider changes in economic life and material culture. The Spanish destruction of Inca power in South America is an obvious example. We might cite the impacts of the Macedonian defeat of the Persian Achaemenid Empire in 334–330 BC, the unification of the Chinese state in 221 BC, or the fall of Constantinople to the Ottoman Turks in 1453. But many other changes of rule were merely changes of ruler. Even the rapid conquest of Byzantine and Sasanian territories by Muslim armies from Arabia in the 7th century AD had little immediate impact on either economy or material culture.

Development and changes in ideologies impact more than just ideas; they stimulate political movements and population movements and create links between people which influence their material culture. So we should not underplay the power of religious or other idea systems, but their spread may well be related to other innovations, a topic mentioned in Chapter 5 on the printing revolution.

One feature of our perception of innovation is that the rate of change is increasing ever more rapidly. Is this because, in a world connected by instant communication and worldwide media, something new can spread so quickly, or is it the information about something new that is the fast traveller? How influenced are we by the sense that the present era is the inevitable climax of human history with the speed of new achievements unmatched in the past? This topic, too, is explored in the final chapter of this book. The present text was begun while the world was facing the COVID pandemic which, we were assured, was changing the world permanently. Debates about the impacts of human activity on climate change have gone further in marking our era as one of global environmental transition, not just adjustments in human society. The impact of environmental factors on the history of humankind and our earlier hominin relatives may be broader than any innovation brought about by human agency.

It is a commonplace, then, to note that there may be other side effects and impacts from any single development, invention, innovation or introduction, whether in technology, economic resources, ideology, political power or geographic settlement. But certain innovations, such as those discussed in this book, are transformative in the sense that their numerous and diverse impacts may cut across technology, economy, politics, ideology and geography. However, in presenting suggestions about their impacts, one must also be cautious in defining cause and effect. Correlation is very different from causation; it may be clear when a new development leads directly to another social change, while in other cases both may derive from the same source or have quite independent origins. Care in interpretation is always needed.

As these chapters show, there are stages in innovation. There may be marked steps: the use of wildfire available after lightning strikes was very different from the ability to create fire at will. The domestication of the horse and the development of the wheeled vehicle were separate processes, with greater and further impacts when the two were brought together. Writing was invented independently in different areas of the world and initially served different functions. Even printing had separate and probably

unrelated origins in East Asia and Western Europe, although its spread in Europe was remarkably rapid as its commercial value matched market demands in linked regions. The wireless revolution took place in an increasingly unified world, where it enabled scientific communication to become ever faster and easier, but still the stages of development were distinct. We may have an image of the genius inventor, but as has often been stated, an invention is adopted and spreads only when it meets a contemporary or emerging need. Many 'discoveries' have had false starts, in a context not yet suited to their adoption, and our own experience reminds us of many apparently valuable innovations which prove to have no staying power as the world moves on or reasserts its traditions.

The spread of a new development may also be restricted, not only by geography, but also when a group may not wish to share it with another rival community. In competition for economic resources, and in the conflicts and wars that may result from that, the strength gained from an innovation (whether economic or material) can be so important as to make it essential to contain and restrict the knowledge for as long as possible. If knowledge is strength, maintaining the ignorance of others is also a strength. Fire could allow early *Homo sapiens* to dominate new territory in Europe and Asia through winters; cavalry could give a definitive military advantage over infantry; the written word gave power to the literate; and the printed text challenged those whose authority lay in just the spoken word. Wireless transmission of information is so powerful that it challenges authorities who may wish to control access in peace or war.

There is, inevitably, a personal and subjective choice in the topics I have selected for the present book. Each brought about transitions in human society, with impacts which foreshadowed longer-term development. Their individual importance is clear if we track back through time, imagining the past world without such additions to the armoury of human skills.

A modern world without wireless communication, or the technologies enabled by controlling radio waves, would deprive us of personal, social, work, economic and administrative activities. These appear daily essentials for the individual, the family, wider society, commerce, administration and the state. Yet until the 19th century (and in many world contexts well into the 20th century), all communication was limited by the proximity of humans to each other.

Before Europe's printing revolution of the 15th century, words were written individually one at a time in a single manuscript document. This meant limited access and allowed control of that access by the institutions of church and state. The remarkable speed with which the printing industry

developed in the states of Europe showed the appeal of putting multiple and identical copies of a work, short or long, into the hands of readers throughout the continent. If printing was a handmaiden of the move from the medieval to the modern world, how different would have been historical change without that innovation in that place and at that time?

The invention of writing – symbols that represent sounds, rather than depicting objects, to those trained to read them – was equally revolutionary in its impacts, even though some of these impacts appeared after several centuries rather than in the initial phase. If we consider radio communication an essential marker of the post-industrial world and printing an equivalent for the post-medieval world, writing was a core feature of the post-agriculturalist world, the first urban socially stratified civilisations of the Middle East five millennia ago. Without writing, we can say that ownership and trade, commercial agreements and laws, political propaganda and submissions to the gods, religious teachings and poetic compositions were all limited to oral presentation and human memory.

Wireless communication, printing and writing are part of a sequence that begins with language itself: the relations between intelligibility and accessibility.[1] Language enables communication within a group but marks that group off from others. Writing divides society into the literate and non-literate. Printing widened access to the written world but favoured the growing literate classes, while wireless technology has dramatically broadened and changed (and in many ways democratised) the nature and control of communication.

The wheeled vehicle was known before the first civilisations and is still the basis of land transport of humans and goods. The horse was domesticated elsewhere to be ridden for hunting and herding. A tamed horse meant that human movement was no longer limited to human pace or water transport. When horses were combined with wheels on chariots, carts and wagons, transport itself was transformed. In time, horse-drawn vehicles and the individual on a horse were the basis of daily life, interaction and the economy in numerous societies. Horses have ceased to have such prominence today, but literature and historical records before the 20th century remind us of the dependence of so many Old World communities on our most important domestic animal, as well as the impact on its introduction into the New World.

The transformative power of fire is so dramatic that its impacts can be described as biological as much as historical. Fire changed where we could live and how we converted potential foods into energy and would form the focus of community lives. Its impacts went much further. We take for

granted the ability to create, control and transport fire as part of the deep time of humanity, but that knowledge is only clearly associated with our own species of anatomically modern humans; our earlier ancestors may have gained chance benefits from capturing wildfire from vegetation lit by lightning strike.

Human society is bounded by time and space. Sociological theory has explored understandings and transitions in time/space, and the processes of restructuring and arguably compressing time/space in the modern era.[2] Historians mostly set their narratives in such a framework, while archaeological interpretations are typically framed within (and often defined by) chronological and geographical constrictions and questions of continuity and change. A feature of the subjects discussed in this book is their ability to expand or alter human relations with space and also time.

Radio communication cut across the limitation of face-to-face exchanges and the time delays in passing messages between groups. It developed so that information such as breaking news of a cyclone or the start (or end) of a conflict could spread rapidly and worldwide. Printing conveyed a single identical message in a book distributed across numerous state borders and available then to read and reread (or reprint) for decades and centuries. A written message could be sent across great distances without changing contents or relying on a courier's memory. A stone inscription could outlive the ruler who commissioned it; some forms of written words survived for millennia to the present day. The horse and the wheeled vehicle transformed the space accessible to a human group and reduced the time to travel between locations. The light from tamed fire could extend the day beyond sunlit hours, and its heat could maintain settlement areas through a season of winter cold. But in any historical development, 'human progress' is limited to, but importantly by, those with access.

In this book, I am concerned with the kind of impacts these innovations made early in their presence in human history. Of the topics selected, some impacts of their introduction may come more obviously to mind. Fire lit our nights, made us warm and cooked our food. Horses gave us speed and transport. Writing allowed the development of records and literature. Printing spread knowledge and debate, not least in the Protestant revolution. Wireless technology gave us the radios that link us to the wider world and has now given us the smartphone. But I argue that a single innovation could transform multiple aspects of our ancestors' lives and set new agendas for their future. There may be distinct stages in the early development and adoption of the innovations, each with their own impacts. Uses and further impacts continued to develop through time, with many adaptations,

modifications and extensions, but this book is not a world history. The long sequence of roles and applications for each of these innovations can require, and indeed has generated, lengthy and detailed accounts. The emphasis here is on transition in human society, not the long subsequent experience.

The descriptions and discussions in this book draw their information both from historical studies and from archaeology, with questions inspired by other fields of knowledge. The narrative accounts have different characteristics the further back in time we look. The history of wireless technology and radio-wave applications is well enough established, although national pride puts different emphases to the fore in telling the story of remarkable discoveries, innovations and applications. The history of the 15th-century introduction of movable type and the printing press in Europe is also well enough established, with some disagreement on details relating to the life and specific authority of Johann Gutenberg himself. Scholars now recognise the earlier development of printing in East Asia, even if there is no evidence that the idea of printing spread from there to Europe.

The first writing is found in the earliest urban civilisations of the Middle East: Egypt, southern Mesopotamia (Iraq) and south-western Iran, with subsequent independent invention in China and Mesoamerica. Our knowledge of early writing in Egypt, in particular, is limited because of the friability and fragility of papyrus and linen as writing materials, in contrast to the fired clay tablets of western Asia. New archaeological finds of early writing may alter our interpretations. Meanwhile, questions remain about the timing and mutual influence of the idea of writing between these different contemporary emerging states in the Middle East. Note that the term 'Near East' is commonly used in the literature of archaeology and history to refer to the areas dominated by ancient civilisations in what today we call the Middle East; so both terms may be found in the text of this book and in sources cited.

The nature of the early societies we describe as civilisations is complex. They developed population concentrations in cities, the technique of writing, monumental architecture, centralised temple cults, state authorities and administrations, and social classes distinguished by wealth, role and power. The association of these features is open to differing interpretations on the nature and interrelationship of these different facets of the earliest civilisations, debates which go beyond the scope of this book.

In discussing the origins of wheeled vehicles and the domestication of the horse, we are reliant on archaeological work. Information in some areas is rich, such as evidence from wagons buried with humans; elsewhere,

individual pieces of evidence of wheels can suggest an early date. The beginning of horse domestication is much more controversial, with well-argued and sometime passionate claims interpreting indirect evidence as proofs of human taming and control of horses. The picture has been enhanced by DNA studies, and new data and arguments are constantly emerging. The account in this book seeks to lay out some of the issues and suggests probabilities, but the detailed references in the notes are necessary to gain a fuller picture of the issue.

Similarly, there are diverse views in discussions on the origins of fire and the debate on when our human ancestors gained the ability to manufacture and control fire as and when required. Identifying evidence of fire within excavated sites occupied by prehistoric groups is relatively well established (despite some notable misinterpretations and some ambitious claims). But fire may occasionally have had an accidental presence in the site: it may have been brought in following a natural fire from a lightning strike, or it may be fire created artificially by friction or a stone strike-a-light. Here again, the discussion is amplified by the notes, which indicate some of the sources of debate.

Readers approaching these chapters on early innovations from the standpoint of archaeology may engage with such detailed accounts of current evidence and debates. Those with more historical interests may choose to focus on the accounts of their impacts and skim over the background chronological discussions on the taming of the horse and of fire, thinking perhaps that the more we find, or think we have found, the less we are sure we know.

This book has, I hope, avoided the simplistic view that human history is a one-directional (if interrupted) journey of progress with the present as its glorious pinnacle. As I have mentioned, the impacts of change can include positive benefits but may have other side effects; one person's gain may be another's deficit. Our society is not unique in seeing itself as the highest achievers in history, but the bias of 'presentism' can distort our perceptions of the past. I discuss this topic more fully in the final chapter of the book.

A linear narrative of history in the literature of today's wealthier nations often still places European (or European-American) civilisation at the core of the story of human achievement, stretching that Eurocentrism back in time. The studies in this book may help to inhibit such an approach. The taming of fire seems most probably to have emerged in Africa with our own species. Horses were first domesticated on the steppes of Central Asia. Writing was an invention of the Middle East, as well as China and Mesoamerica. Printing was first developed in China, Korea and Japan

before it emerged in Western Europe. The control of radio waves was an innovation shared between the Americas, Western and Eastern Europe.

Each of the following chapters uses the same basic structure. I have outlined what we know, from archaeology and history, of the first stages of the development and adoption of the innovations discussed. I then suggest with examples their range of impacts. My acknowledgement of the many contributors to our knowledge and understanding is clear from the notes. Sources cited are necessarily fuller when addressing themes where the history is still less definitely established. Selected major works for each chapter are listed for further reading. The final chapter of the book addresses some broader issues of what we mean by innovation and progress and how much our perspectives are biased by our focus on the recent and our sense of the importance of our own species.

CHAPTER 2

Taming Fire

> *Man in the rudest state in which he now exists is the most dominant animal that has ever appeared on this earth . . . He has discovered the art of making fire, by which hard and stringy roots can be rendered digestible, and poisonous roots or herbs innocuous. This discovery of fire, probably the greatest ever made by man, excepting language, dates from before the dawn of history. These several inventions, by which man in the rudest state has become so pre-eminent, are the direct results of the development of his powers of observation, memory, curiosity, imagination, and reason.*
>
> Charles Darwin, *The Descent of Man*, 1871

The Discovery of Fire

The taming of fire created dramatic and long-lasting transformations in human communities, with immense and varied impacts on personal, social and economic life. We take for granted warmth, light and cooking in the daily lives of societies we know from history or study in the archaeology of our own species. But the lifestyle of such communities required the ability to create fire whenever needed, maintain it, control its spread, move it within or even beyond the domestic setting.

Before the control of fire, our ancestors' days would have been shorter, their winters colder, their food raw and dangers many. Once humans had acquired the ability to create fire at will, control and transport it, their world changed. Fire transformed dark into light and cold into warmth and provided a focus for the camps of hunter-gatherer groups. It allowed game drives and management of landscapes to encourage browsing animals. Having cooked food as a regular part of the diet expanded available foodstuffs, removed toxins, required less energy to chew and digest and