LIVES IN THE 19TH CENTURY

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September 29, 2021

INTRODUCTION[1]

Human history as cultural history

We need to reform our teaching of history so that the emphasis will be placed on the gradual growth of human culture and knowledge, a growth to which all nations and ethnic groups have contributed.

This book is part of a series on cultural history. Here is a list of the other books in the series that have, until now, been completed:

- Lives in Biology
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[1] This book makes some use of my previously-published book chapters, but much of the material is new.

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Chapter 1

CHARLES DARWIN'S LIFE AND WORK

1.1 Family background and early life

As a boy, Charles Darwin was passionately fond of hunting and collecting beetles, but he was a mediocre student. His father once said to him in exasperation: "You care for nothing but shooting, dogs and rat-catching; and you will be a disgrace to yourself, and to all your family!"

Darwin's father, a wealthy physician, sent him to Edinburgh University to study medicine; but Charles did not enjoy his studies there. "Dr. Duncan's lectures on Materia Medica at 8 o'clock on a winter's morning are something fearful to remember", he wrote later. "I also attended the operating theatre in the hospital at Edinburgh and saw two very bad operations, one on a child, but I rushed away before they were completed. Nor did I ever attend again, for hardly any inducement would have been strong enough to make me do so; this being long before the blessed days of chloroform. The two cases fairly haunted me for many a long year."

The time at Edinburgh was not entirely wasted, however, because several of Darwin's friends at the university were natural philosophers[1], and contact with them helped to develop his interest in natural history. One of the most important of these scientific friends was Dr. R.E. Grant, an expert on marine invertebrate zoology with whom Darwin often collected small sea slugs in the cold waters of the Firth near Edinburgh. On one of these expeditions, Grant suddenly began to praise the evolutionary views of Lamarck, while Darwin listened in silent astonishment. Charles Darwin had previously read his own grandfather's book *Zoonomia* and had greatly admired it; but after a few years he had read it again in a more critical spirit; and after the second reading he had decided that *Zoonomia* was too speculative and contained too few facts. Grant's praise of Lamarck may have helped Darwin to become, later in his life, an advocate of evolution in a different form.

[1] Today we would call them scientists.

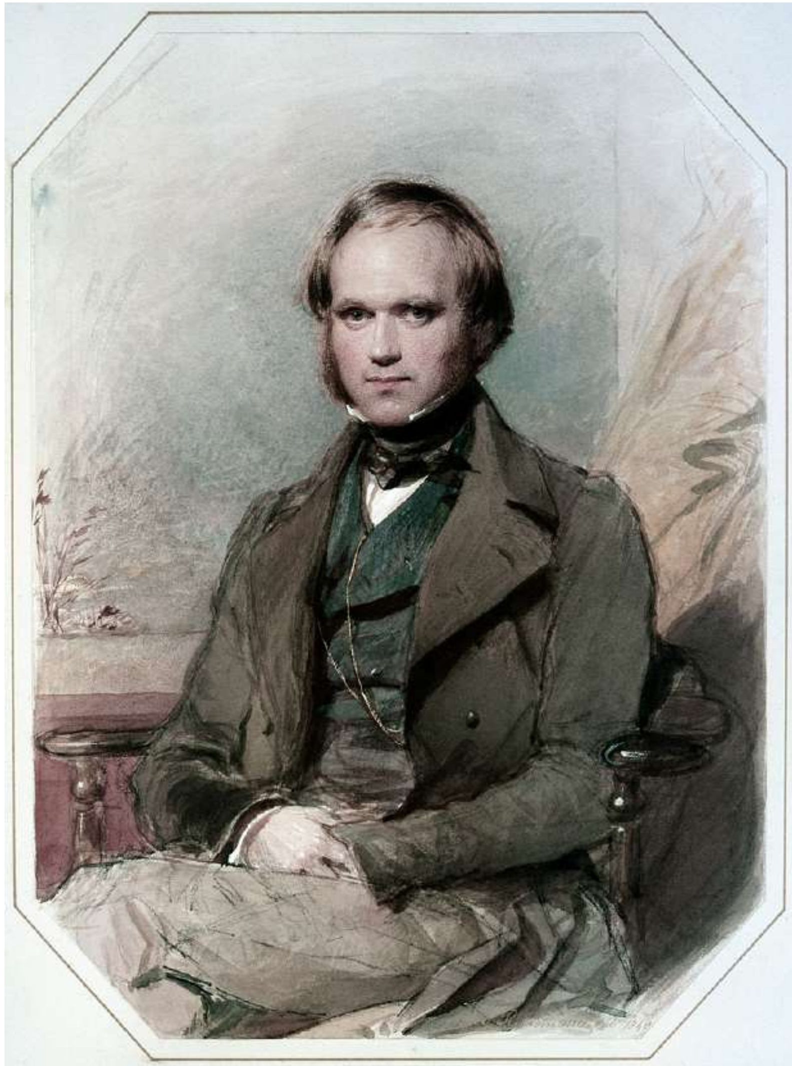

Figure 1.1: **Charles Darwin as a young man.**

Darwin's father finally gave up the idea of making him into a doctor, and sent him instead to Cambridge to study for the clergy. At Cambridge, Darwin made many friends because of his unfailing good nature, enthusiasm and kindness. A friend from university days remembers that "at breakfast, wine or supper parties he was ever one of the most cheerful, the most popular and the most welcome... He was the most genial, warmhearted, generous and affectionate of friends."

Darwin's best friend during his last two years at Cambridge was the Reverend John Stevens Henslow, Professor of Botany. Darwin was often invited to Henslow's family dinner; and on most days he accompanied the professor on long walks, so that he became known as "the man who walks with Henslow". This friendship did much to develop Darwin's taste for natural history. Henslow's knowledge of botany, zoology and geology was vast; and he transmitted much of it to his enthusiastic young student during their long walks through the beautiful countryside near to the university. At Cambridge Darwin collected beetles; and the hobby became almost a passion for him. "One day, on tearing off some old bark", he wrote later, "I saw two rare beetles, and seized one in each hand. Then I saw a third kind, which I could not bear to lose, so I popped the one held in my right hand into my mouth. Alas! It ejected some intensely acrid fluid which burnt my tongue, so that I was forced to spit the beetle out, which was lost, as was the third one."

During his last year at Cambridge, Darwin read Alexander von Humboldt's famous *Personal Narrative of Travels to the Equinoctial Regions of South America During the Years 1799-1804*, a book which awakened in him "a burning zeal to add even the most humble contribution to the noble structure of Natural Science". Darwin longed to visit the glorious tropical forests described so vividly by von Humboldt.

Henslow persuaded Darwin to begin to study geology; and during the spring of 1831, Darwin joined the Professor of Geology, Adam Sedgwick, on an expedition to study the ancient rock formations in Wales. This expedition made Darwin realize that "science consists in grouping facts in such a way that general laws or conclusions may be drawn from them." When Darwin returned from Wales, he found a letter from Professor George Peacock, forwarded by Henslow. "My dear Henslow", Peacock's letter read, "Captain Fitz-Roy is going out to survey the southern coast of Tierra del Fuego, and afterwards to visit many of the South Sea Islands, and to return by the Indian Archipelago... An offer has been made to me to recommend a proper person to go out as a naturalist with the expedition. He will be treated with every consideration. The Captain is a young man of very pleasant manners (a nephew of the Duke of Grafton), of great zeal in his profession and highly spoken of..."

In forwarding this letter to Darwin, Henslow added: "I have stated that I consider you to be the best qualified person I know of who is likely to undertake such a situation... The voyage is to last two years and if you take plenty of books with you, anything you please may be done... In short, I suppose that there never was a finer chance for a young man of zeal and spirit..."

Darwin was beside himself with joy at this chance to follow in the foot- steps of his hero, Alexander von Humboldt; but his plans were immediately squelched by the opposition of his father, who considered it "a wild scheme", unsuitable for a future clergyman. "If you can find any man of common sense who advises you to go", his father added, "I will give my consent." Crushed by his father's refusal, Charles Darwin visited his uncle's family. Darwin's favorite "Uncle Jos" was the son of the famous potter, Josiah Wedgewood, and the nearby Wedgewood estate at Maer was always a more relaxing place for him than his own home - a relief from the overpowering presence of his father. (His uncle's many attractive daughters may also have had something to do with Darwin's fondness for Maer.)

The Wedgewood family didn't seem to think that sailing on the *Beagle* as naturalist would be a "wild scheme", and Darwin's Uncle Jos offered to drive him over to see whether the verdict could be changed. "My father always maintained that my uncle was one of the most sensible men in the world", Darwin wrote later, "and he at once consented in the kindest manner." Darwin had been rather extravagant while at Cambridge, and to console his father he said: "I should be deuced clever to spend more than my allowance whilst on board the *Beagle*." His father answered with a smile: "But they tell me you are very clever."

1.2 Aboard the Beagle

Thus it happened that on December 27, 1831, Charles Darwin sailed from Devonport on *H.M.S. Beagle*, a small brig of the British navy. The *Beagle's* commander, Captain FitzRoy, was twenty-seven years old (four years older than Darwin), but he was already an excellent and experienced sailor. He had orders to survey the South American coast and to carry a chain of chronological measurements around the world. It was to be five years before the Beagle returned to England.

As the brig plowed through rough winter seas, Darwin lay in his ham- mock, miserably seasick and homesick, trying bravely to read a new book which Henslow had given to him as a sending-off present: Sir Charles Lyell's *Principles of Geology.* It was an exciting and revolutionary book - so revolutionary, in fact, that Henslow had found it necessary to warn Darwin not to believe Lyell's theories, but only to trust his observations. According to Lyell, "No causes have ever acted (in geology) but those which now are acting, and they have never acted with different degrees of energy from that which they now exert."[2]

Lyell's hypothesis was directly opposed to the Catastrophist school of geology, a school which included deeply religious men like Cuvier, Henslow and Sedgwick, as well as most other naturalists of the time. The Catastrophists admitted that geological evidence shows the earth to be much older than the six thousand years calculated on the basis of the Bible, but they explained this by saying that the Bible describes only the most recent era. Before this, according to the Catastrophists, life on earth had been created many times, and just as many times destroyed by cataclysms like Noah's flood.[3] In this way they explained the fossils embedded in ancient rocks: These they believed were the remains of antediluvian creatures destroyed by the wrath of God. The Swiss naturalist Charles Bonnet (1720-1793) even predicted a future catastrophe after which apes would become men and men would become angels. The Catastrophists believed that periodic cataclysms had created the earth's great mountain ranges, deserts and oceans.

Lyell's book contradicted this whole picture. He believed the earth to be immensely old, and asserted that over thousands of millions of years, the same slow changes which we can still see taking place have accumulated to produce the earth's great geological features. Over long ages, Lyell believed, gradual changes in the level of the land built up even the highest mountain ranges, while the slow action of rain and frost cut the peaks into valleys and planes.

By the time the *Beagle* reached the volcanic island of St. Jago, Darwin had become ardently converted to Lyell's "wonderfully superior method of treating geology"; and after

[2] This is the famous Principle of Uniformitarianism first formulated by Hutton and later developed in detail by Lyell.

[3] One group of Catastrophists, the Neptunists, believed that gigantic floods shaped the earth's features. A rival group, the Plutonists, attributed most geological features to volcanic action, rather than flood.

studying the structure of the island, he realized that he could understand it on the basis of Lyell's principles. The realization that he might perhaps write a book on the geology of the various countries visited by the *Beagle* made Darwin's spirits soar; and he was thrilled also by the sight of so many totally new species of birds, insects and flowers.

"It has been a glorious day", he wrote, "like giving a blind man eyes: He is overwhelmed by what he sees and cannot easily comprehend it." Later, when the *Beagle* reached Brazil, Darwin was greatly moved by the experience of standing for the first time among the cathedral-like arches of a tropical rain forest. "My mind has been, since leaving England, in a perfect hurricane of delight and astonishment", he wrote, "The glorious pleasure of walking amongst such flowers and such trees cannot be comprehended by those who have not experienced it... Here (the naturalist) suffers a pleasant nuisance of being fairly tied to the spot by some new and wondrous creature... twiners entwining twiners - tresses like hair - beautiful Lepidoptera - silence - hosanna... I am at present fitted for nothing but to read Humboldt: He is like another sun, illuminating all that I behold."

While Captain FitzRoy sailed the *Beagle* slowly southward towards Tierra del Fuego, Darwin followed the ship on horseback, studying the geology of the Argentine Pampas and collecting specimens to send back to Cambridge. Darwin's companions on these expeditions were gauchos, wild Argentine horsemen, expert at throwing the lazo and bolas while galloping at full speed. On one of his rides across the Pampas, Darwin came across the bones of an enormous animal, half buried in a bank of mud and ancient seashells. In a state of great excitement he dug in the surrounding area, and in a few days he succeeded in unearthing the remains of nine huge extinct animals. He was struck by the fact that the bones resembled those of various living South American animals, except for their colossal size. Among them was a guanaco (a wild llama) as big as a camel, a huge armadillo-like creature and a giant sloth-like animal, both as big as elephants. What was the relationship between these extinct animals and living South American species? This problem was to haunt Darwin for many years.

On its way to Tierra del Fuego, the *Beagle* stopped at the Falkland Islands, and Darwin was fascinated by the strange flightless "steamer" ducks found there. He noted that their wings were too small and weak to allow flight. The ducks seemed to paddle with their right and left wings alternately in swimming along the surface of the water; and in this way they were able to move very fast. Darwin reflected that in the South American region there were three species of birds which used their wings for purposes other than flight: the steamer ducks used their wings as paddles, penguins used them as fins, and ostriches used them as sails. Did the ancestors of these birds use their wings for flying? Had the function of the wings changed over a period of time?

On the Falkland Islands, Darwin also noticed that the wild horses had become much smaller than their ancestors, the European horses released there almost three centuries earlier. If the Falkland horses had become noticeably smaller during only a few centuries, then perhaps, over millions of years, the giant armadillo and sloth could have shrunk from the monstrous size of the bones discovered by Darwin to their present size. Perhaps also the wings of the steamer duck, the penguin and the ostrich had become smaller, so that the birds had lost the power of flight. Recalling Lyell's belief in the immense age of the earth,

Figure 1.2: **Plate showing Fuegans from the voyage of the Beagle. Wellcome Images,**

Darwin began to wonder whether small changes, continued over long periods of time, could ultimately produce large changes in living things as well as in geology.

The *Beagle* rounded Cape Horn, lashed by freezing waves so huge that it almost foundered. After the storm, when the brig was anchored safely in the channel of Tierra del Fuego, Darwin noticed how a Fuegian woman stood for hours and watched the ship, while sleet fell and melted on her naked breast, and on the new-born baby she was nursing. He was struck by the remarkable degree to which the Fuegians had adapted to their frigid environment, so that they were able to survive with almost no shelter, and with no clothes except a few stiff, untanned animal skins, which hardly covered them, in weather which would have killed ordinary people.

In 1835, as the *Beagle* made its way slowly northward, Darwin had many chances to explore the Chilean coast - a spectacularly beautiful country, shadowed by towering ranges of the Andes. On January 15, the watch on the *Beagle* noticed something resembling a large star, which gradually increased in size and brilliance. Looking through their telescope, the officers of the *Beagle* could see that the volcano of Osorno was erupting. Darwin was later surprised to learn that on the same night several other volcanos, spread along three thousand miles of coast, had simultaneously erupted.

On February 20, Darwin felt the shock of a severe earthquake, which totally destroyed the towns of Talcahuano and Concepcion. Near the Bay of Concepcion, he could see that the level of the land had been raised three feet by the earthquake; and on the nearby island of St. Maria, Captain FitzRoy found banks of decaying mussel-shells on rocks ten feet above the water line. After the earthquake, it was easy for Darwin to visualize the process by which, over millions of years, the Andes had been raised from the ocean. The sea shells which he found high in the mountains showed that even the highest peaks had once been under the Pacific. Later, high in the Andes, Darwin observed the opposing process - the process by which mountain ranges are torn down. Beside a rushing torrent

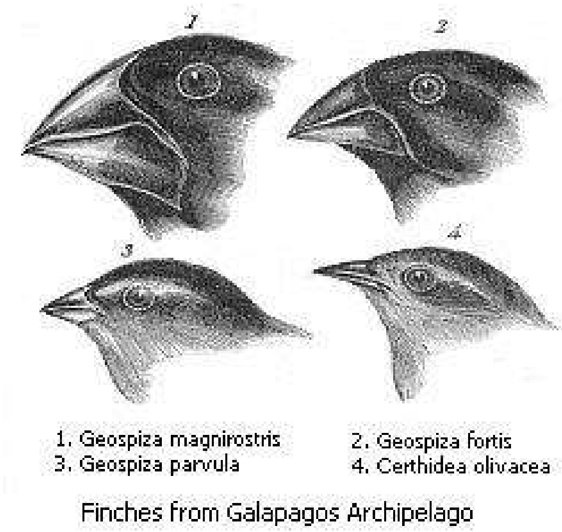

Figure 1.3: **Darwin's finches.**

he stood listening to the rattling noise of stones carried downward by the water. "The sound spoke eloquently to the geologist", he wrote, "The thousands and thousands of stones, which striking against each other made one dull uniform sound, were all hurrying in one direction. It was like thinking on time... As often as I have seen beds of mud, sand and shingles, accumulated to the thickness of many thousands of feet, I have felt inclined to exclaim that causes such as present rivers and present beaches could never have ground down and produced such masses. But on the other hand, while listening to the rattling noise of these torrents and calling to mind that whole races of animals have passed away from the face of the earth, and that during this whole period, night and day, these stones have gone rattling in their course, I have thought to myself, can any mountains, any continent, withstand such a waste?"

After charting the Chilian coast, the *Beagle* sailed westward into the Pacific; and on September 15, 1835, the brig arrived at the Galapagos Archipelago, a group of strange volcanic islands about 500 miles from the mainland. Most of the species of plants, birds and animals which Darwin found on these islands were aboriginal species, found nowhere else in the world; yet in studying them he was continually reminded of species which he had seen on the South American continent. For example, a group of aboriginal finches which Darwin found on the Galapagos Islands were related to South American finches. The Galapagos finches were later shown to belong to thirteen separate species, all closely similar to each other, but differing in their habits and in the structure of their beaks.[4]

The geology of the islands showed that they had been pushed up from the bed of the sea by volcanic action in fairly recent times. Originally each island must have been completely

[4] Darwin was not even aware at the time that they were finches. It was on his return to London that an ornithologist friend identified them, noted their close relationship to an Ecuadorian finch, and Darwin came to understand their significance.

bare of plants and animals. How had it been populated? The fact that the Galapagos species resembled those of the South American mainland made it seem probable to Darwin that the islands had become the home of chance wanderers from the continent. Seeds had perhaps drifted onto the shore and germinated, or perhaps they had been brought to the islands in the stomachs of birds. Land birds, like the Galapagos finches, could have been blown there by storms. Perhaps a flock of a single species of finch had arrived, storm-driven, on the black volcanic shores of the islands. Over the centuries, as the finches multiplied, their beaks could have become adapted to the various forms of food available. "The most curious fact", Darwin wrote later,"is the perfect gradation in the size of the beaks in the various species... Seeing this gradation and diversity in one small, intimately related group of birds, one might really fancy that from an original paucity of birds in this archipelago, one species had been taken and modified for different ends.. Here... we seem to be brought somewhat near to that great fact - that mystery of mysteries - the first appearance of new beings on this earth".

The idea of the gradual modification of species could also explain the fact, observed by Darwin, that the fossil animals of South America were more closely related to African and Eurasian animals than were the living South American species. In other words, the fossil animals of South America formed a link between the living South American species and the corresponding animals of Europe, Asia and Africa. The most likely explanation for this was that the animals had crossed to America on a land bridge which had since been lost, and that they had afterwards been modified.

The *Beagle* continued its voyage westward, and Darwin had a chance to study the plants and animals of the Pacific Islands. He noticed that there were no mammals on these islands, except bats and a few mammals brought by sailors. It seemed likely to Darwin that all the species of the Pacific Islands had reached them by crossing large stretches of water after the volcanic islands had risen from the ocean floor; and this accounted for the fact that so many classes were missing. The fact that each group of islands had its own particular species, found nowhere else in the world, seemed to Darwin to be strong evidence that the species had been modified after their arrival. The strange marsupials of the isolated Australian continent also made a deep impression on Darwin.

1.3 Work in London and Down

The *Beagle* was now on its way home, and Darwin impatiently counted the days and miles which separated him from his family and friends. To his sisters he wrote: "I feel inclined to write about nothing else but to tell you, over and over again, how I long to be quietly seated among you"; and in a letter to Henslow he exclaimed: "Oh the degree to which I long to be living quietly, without one single novel object near me! No one can imagine it until he has been whirled around the world, during five long years, in a Ten Gun Brig."

Professor Sedgwick had told Darwin's father that he believed that Charles would take his place among the leading scientific men of England. This encouraging news from home reached Darwin on Ascension Island. "After reading this letter", Darwin wrote, "I clambered over the mountains with a bounding step and made the rocks resound under my geological hammer."

On October 2,1836, the *Beagle* docked at Falmouth, and Darwin, "giddy with joy and confusion", took the first available coach to The Mount, his family's home in Shrewsbury. After a joyful reunion with his family, he visited the Wedgwood estate at Maer, where his Uncle Jos and his pretty cousins were equally impatient to see him. To Henslow he wrote: "I am in the clouds, and neither know what to do or where to go... My chief puzzle is about the geological specimens - who will have the charity to help me in describing their mineralogical nature?"

Soon Darwin found a collaborator and close friend in none other than Sir Charles Lyell, the great geologist whose book had so inspired him. One of Lyell's best characteristics was his warmth in encouraging promising young scientists. Darwin's theory of the formation of coral barrier reefs and atolls had supplanted Lyell's own theory, but far from being offended, Lyell welcomed Darwin's ideas with enthusiasm. According to Lyell's earlier theory, coral atolls are circular in shape because they are based on the circular rims of submerged volcanos. However, Darwin showed that any island gradually sinking beneath the surface of a tropical ocean can develop into an atoll. He showed that the reef-building organisms of the coral are poisoned by the stagnant water of the central lagoon, but they flourish on the perimeter, where new water is constantly brought in by the waves. Darwin was able to use the presence of coral atolls to map whole regions of the Pacific which are gradually sinking. He pointed out that in the subsiding regions there are no active volcanos, while in regions where the land is rising, there is much volcanic activity.

The years between 1836 and 1839 were busy ones for Darwin. He found lodgings in London, and he worked there with Lyell on his geological collection. During these years he edited a five-volume book on the zoological discoveries of the voyage; and in 1839 his *Journal of Researches into the Geology and Natural History of Various Countries Visited by the H.M.S. Beagle* was published. Originally Darwin's journal formed part of a multi-volume work edited by Captain FitzRoy, but the publisher, John Murray, recognized the unusual interest of Darwin's contribution, bought up the copyright, and republished the journal. It immediately became a best-seller, making Darwin famous. Under the shortened title, The *Voyage of the Beagle*, Darwin's journal has been reprinted more than a hundred times.

In 1839 Darwin married his pretty cousin, Emma Wedgwood, the youngest daughter of his much-admired Uncle Jos. She was a charming and light-hearted girl who has studied piano under Chopin. Emma and Charles Darwin were to have ten children together (of whom three were knighted for their contributions to science[5]) and thirty years later he wrote of her: "I can declare that in my whole life I have not heard her utter one word which had rather had been left unsaid."

Darwin was beginning to show signs of the ill health which was to remain with him for

[5] Among Darwin's grandchildren were Sir Charles Galton Darwin, a pioneer of relativistic quantum theory, and the artist and author, Gwen Raverat. One of his grand-nephews was the composer, Ralph Vaughn Williams.

the rest of his life, and to escape from the social life of the capital, he moved to the small country town of Down, about 16 miles south of London. Darwin's illness was probably due to a chronic infection - perhaps Chagas disease- , picked up in South America. For the remainder of his life, his strength was very limited, and his daily routine at Down followed an unvarying pattern which allowed him to work as much as possible within the limits imposed by his illness. The early mornings were devoted to writing (even Sunday mornings) while correspondence and experimental work were done in the afternoons and scientific reading in the evenings.

1.4 The Origin of Species

In 1837 Darwin had begun a notebook on Transmutation of Species. During the voyage of the *Beagle* he had been deeply impressed by the great fossil animals which he had discovered, so like existing South American species except for their gigantic size. Also, as the *Beagle* had sailed southward, he had noticed the way in which animals were replaced by closely allied species. On the Galapagos Islands, he had been struck by the South American character of the unique species found there, and by the way in which they differed slightly on each island.

It seemed to Darwin that these facts, as well as many other observations which he had made on the voyage, could only be explained by assuming that species gradually became modified. The subject haunted him, but he was unable to find the exact mechanism by which species changed. Therefore he resolved to follow the Baconian method, which his friend Sir Charles Lyell had used so successfully in geology. He hoped that by the wholesale collection of all facts related in any way to the variation of animals and plants under domestication and in nature, he might be able to throw some light on the subject. He soon saw that in agriculture, the key to success in breeding new varieties was selection; but how could selection be applied to organisms living in a state of nature?

In October 1838, 15 months after beginning his systematic enquiry, Darwin happened to read Malthus' book on population.[6] After his many years as a naturalist, carefully observing animals and plants, Darwin was very familiar with the struggle for existence which goes on everywhere in nature; and it struck him immediately that under the harsh conditions of this struggle, favorable variations would tend to survive while unfavorable ones would perish. The result would be the formation of new species!

Darwin had at last got a theory on which to work, but he was so anxious to avoid prejudice that he did not write it down. He continued to collect facts, and it was not until 1842 that he allowed himself to write a 35-page sketch of his theory. In 1844 he enlarged this sketch to 230 pages, and showed it to his friend Sir Joseph Hooker, the Director of Kew Botanical Gardens. However, Darwin did not publish his 1844 sketch. Probably he foresaw the storm of bitter hostility which his heretical theory was to arouse. In England at that

[6] *An Essay on the Principle of Population, or, A View of its Past and Present Effects, with an Inquiry into our Prospects Respecting its Future Removal or Mitigation of the Evils which it Occasions*, 2nd edn, Johnson, London (1803)

time, Lamarckian ideas from France were regarded as both scientifically unrespectable and politically subversive. The hierarchal English establishment was being attacked by the Chartist movement, and troops had been called out to suppress large scale riots and to ward off revolution. Heretical ideas which might undermine society were regarded as extremely dangerous. Darwin himself was a respected member of the establishment, and he was married to a conservative and devout wife, whose feelings he wished to spare. So he kept his work on species private, confiding his ideas only to Hooker and Lyell.

Instead of publishing his views on evolution, Darwin began an enormous technical study of barnacles, which took him eight years to finish. Hooker had told him that no one had the right to write on the question of the origin of species without first having gone through the detailed work of studying a particular species. Also, barnacles were extremely interesting to Darwin: They are in fact more closely related to shrimps and crabs than to molluscs.

Finally, in 1854, Darwin cleared away the last of his barnacles and began to work in earnest on the transmutation of species through natural selection, arranging the mountainous piles of notes on the subject which he had accumulated over the years. By 1858 he had completed the first part of a monumental work on evolution. If he had continued writing on the same scale, he would ultimately have produced a gigantic, unreadable multivolume opus. Fortunately this was prevented: A young naturalist named Alfred Russell Wallace, while ill with a fever in Malaya, also read Malthus on Population; and in a fit of inspiration he arrived at a theory of evolution through natural selection which was identical with Darwin's! Wallace wrote out his ideas in a short paper with the title: *On the Tendency of Varieties to Depart Indefinitely from the Original Type*. He sent this paper to Darwin with the request that if Darwin thought the paper good, he should forward it to Lyell.

Lyell had for years been urging Darwin to publish his own work on natural selection, telling him that if he delayed, someone else would reach the same conclusions. Now Lyell's warning had come true with a vengeance, and Darwin's first impulse was to suppress all his own work in favor of Wallace. In a letter to Lyell, Darwin wrote: "I would far rather burn my whole book than that he or any other man should think that I had behaved in a paltry spirit." Darwin's two good friends, Lyell and Hooker, firmly prevented this however; and through their intervention a fair compromise was reached: Wallace's paper, together with an extract from Darwin's 1844 sketch on natural selection, were read jointly to the Linnean Society (which listened in stunned silence).

At the urging of Lyell and Hooker, Darwin now began an abstract of his enormous unfinished book. This abstract, entitled *On The Origin of Species by Means of Natural Selection, or The Preservation of Favoured Races in the Struggle for Life*, was published in 1859. It ranks with Newton's *Principia* as one of the two greatest scientific books ever written.

Darwin's *Origin of Species* can still be read with enjoyment and fascination by a modern reader. His style is vivid and easy to read, and almost all of his conclusions are still believed to be true. Darwin begins his great book with a history of evolutionary ideas. He starts with a quotation from Aristotle, who was groping towards the idea of natural selection: "Wheresoever, therefore... all the parts of one whole happened like as if they were made for something, these were preserved, having been appropriately constituted by an internal spontaneity; and wheresoever things were not thus constituted, they perished, and still perish." Darwin lists many others who contributed to evolutionary thought, including the Chevalier de Lamarck, Geoffroy Saint-Hillaire, Alfred Russell Wallace, and his own grandfather, Erasmus Darwin.

Next, Darwin reminds us of the way in which mankind has produced useful races of domestic animals and plants by selecting from each generation those individuals which show any slight favorable variation, and by using these as parents for the next generation. A closely similar process occurs in nature, Darwin tells us: Wild animals and plants exhibit slight variations, and in nature there is always a struggle for existence. This struggle follows from the fact that every living creature produces offspring at a rate which would soon entirely fill up the world if no check ever fell on the growth of population. We often have difficulty in seeing the exact nature of these checks, since living organisms are related to each other and to their environment in extremely complex ways, but the checks must always be present.

Accidental variations which increase an organism's chance of survival are more likely to be propagated to subsequent generations than are harmful variations. By this mechanism, which Darwin called "natural selection", changes in plants and animals occur in nature just as they do under the artificial selection exercised by breeders.

If we imagine a volcanic island, pushed up from the ocean floor and completely uninhabited, we can ask what will happen as plants and animals begin to arrive. Suppose, for example, that a single species of bird arrives on the island. The population will first increase until the environment cannot support larger numbers, and it will then remain constant at this level. Over a long period of time, however, variations may accidentally occur in the bird population which allow the variant individuals to make use of new types of food; and thus, through variation, the population may be further increased.

In this way, a single species "radiates" into a number of sub-species which fill every available ecological niche. The new species produced in this way will be similar to the original ancestor species, although they may be greatly modified in features which are related to their new diet and habits. Thus, for example, whales, otters and seals retain the general structure of land-going mammals, although they are greatly modified in features which are related to their aquatic way of life. This is the reason, according to Darwin, why vestigial organs are so useful in the classification of plant and animal species.

The classification of species is seen by Darwin as a genealogical classification. All living organisms are seen, in his theory, as branches of a single family tree. This is a truly remarkable assertion, since the common ancestors of all living things must have been extremely simple and primitive; and it follows that the marvelous structures of the higher animals and plants, whose complexity and elegance utterly surpasses the products of human intelligence, were all produced, over thousands of millions of years, by random variation and natural selection!

Each structure and attribute of a living creature can therefore be seen as having a long history; and a knowledge of the evolutionary history of the organs and attributes of living creatures can contribute much to our understanding of them. For instance, studies of the evolutionary history of the brain and of instincts can contribute greatly to our understanding of psychology, as Darwin pointed out.

Darwin then discusses the complex networks of relationships between living organisms[7]. For example, he discusses the way in which a certain kind of fly prevents horses, cattle and dogs from becoming feral (i.e. thriving as wild animals) in Paraguay. The fly lays its eggs in the navels of these animals when they are born. If the infestations are untreated, fewer of the newborns survive. In other parts of South America, to the north and south of Paraguay, the flies are less numerous, probably because of the presence of parasitic insects. Hence, Darwin concludes, if insect-eating birds were to decrease in Paraguay, the parasitic insects would increase, and this would lessen the number of navel-frequenting flies. Then cattle and horses would become feral, and this would alter the vegetation, which would affect the insects, and so on in ever-increasing circles of complexity.

Another interesting chain of ecological relationships involves clover, bumble-bees, mice, cats and cat-loving people: Red clover is much more common near to towns than elsewhere. Why should this be so? Darwin's explanation is that this type of clover can only be pollinated by bumble-bees. The underground nests of bumble-bees are often destroyed by mice; but near to towns mice are kept in check by cats. Hence, Darwin notes, the presence of cats in a district might determine, through the intervention first of mice and then of bees, the frequency of certain flowers in that district.

Among the many striking observations presented by Darwin to support his theory, are facts related to morphology and embryology. For example, Darwin includes a quotation from the naturalist, von Baer, who stated that he had in his possession two embryos preserved in alcohol, which he had forgotten to label. Von Baer was completely unable to tell by looking at them whether they were embryos of lizards, birds or mammals, since all these species are so similar at an early stage of development.

Darwin also quotes the following passage from G.H. Lewis: "The tadpole of the common Salamander has gills, and passes its existence in the water; but the Salamandra atra, which lives high up in the mountains, brings forth its young full-formed. This animal never lives in the water. Yet if we open a gravid female, we find tadpoles inside her with exquisitely feathered gills; and when placed in water, they swim about like the tadpoles of the common Salamander or water-newt. Obviously this aquatic organization has no reference to the future life of the animal, nor has it any adaptation to its embryonic condition; it has solely reference to ancestral adaptations; it repeats a phase in the development of its progenitors."

Darwin points out that, "...As the embryo often shows us more or less plainly the structure of the less modified and ancient progenitor of the group, we can see why ancient and extinct forms so often resemble in their adult state the embryos of existing species."

Darwin sets forth another line of argument in support of evolution based on "serial homologies", - cases where symmetrically repeated parts of an ancient progenitor have been modified for special purposes in their descendants. For example, the bones which fit together to form the brain case in reptiles, birds and mammals can be seen in fossil sequences to be modified vertebrae of an ancient progenitor. After discussing many examples, Darwin exclaims, "How inexplicable are these cases of serial homologies on the

[7] Here we can see Darwin as the founder of the modern discipline of ecology.

ordinary view of creation! Why should the brain be enclosed in a box composed of such numerous and extraordinarily-shaped pieces of bone?... Why should similar bones have been created to form the wing and leg of a bat, used as they are for totally different purposes, namely walking and flying? Why should one crustacean, which has an extremely complex mouth, formed of many parts, consequently have fewer legs; or conversely, those with many legs have simpler mouths? Why should the sepals, petals, stamens and pistils in each flower,though fitted for such distinct purposes, be all constructed on the same pattern?... On the theory of natural selection we can, to a certain extent, answer these questions.... An indefinite repetition of the same part is the common characteristic of all low or little-specialized forms... We have already seen that parts many times repeated are eminently liable to vary... Consequently such parts, being already present in considerable numbers, and being highly variable, would naturally afford materials for adaption to the most different purposes."

No abstract of Darwin's book can do justice to it. One must read it in the original. He brings forward an overwhelming body of evidence to support his theory of evolution through natural selection; and he closes with the following words:

"It is interesting to contemplate a tangled bank, clothed with many plants of many different kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us... There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning, endless forms most beautiful and wonderful have been and are being evolved."

1.5 The Descent of Man

Darwin's *Origin of Species*, published in 1859, was both an immediate success and an immediate scandal. Darwin had sent an advance copy of his book to The Times to be reviewed; and because of the illness of the usual reviewer, T.H. Huxley (1825-1895) was asked to comment on the book. Huxley, who was one of the most brilliant zoologists of the period, immediately recognized the validity and importance of Darwin's work and exclaimed: "How exceedingly stupid not to have thought of that!" He wrote a long and favorable review for The Times, and partly as a result of this review, the first edition of *The Origin of Species* (1200 copies) was sold out on the day of publication. A second edition, published six weeks later, also sold out quickly; and new editions, reprintings and translations have been published ever since in a steady stream.

Darwin had avoided emphasizing the emotionally-charged subject of man's ancestry, but he did not think that it would be honest to conceal his belief that the human race belongs to the same great family which includes all other living organisms on earth. As a compromise, he predicted in a single sentence that through studies of evolution "light would

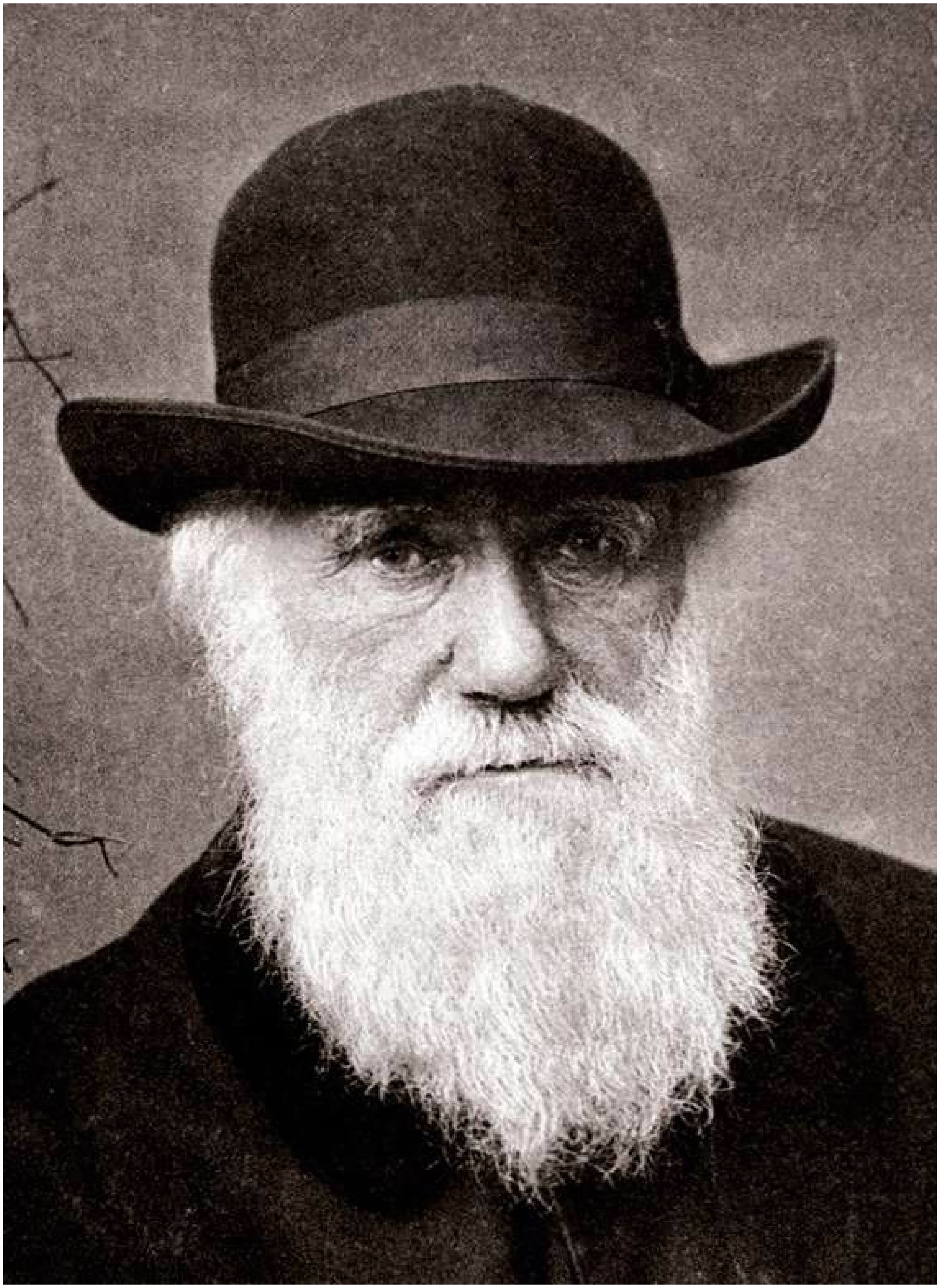

Figure 1.4: **Charles Darwin in 1880. The photograph is by Elliott and Fry.**

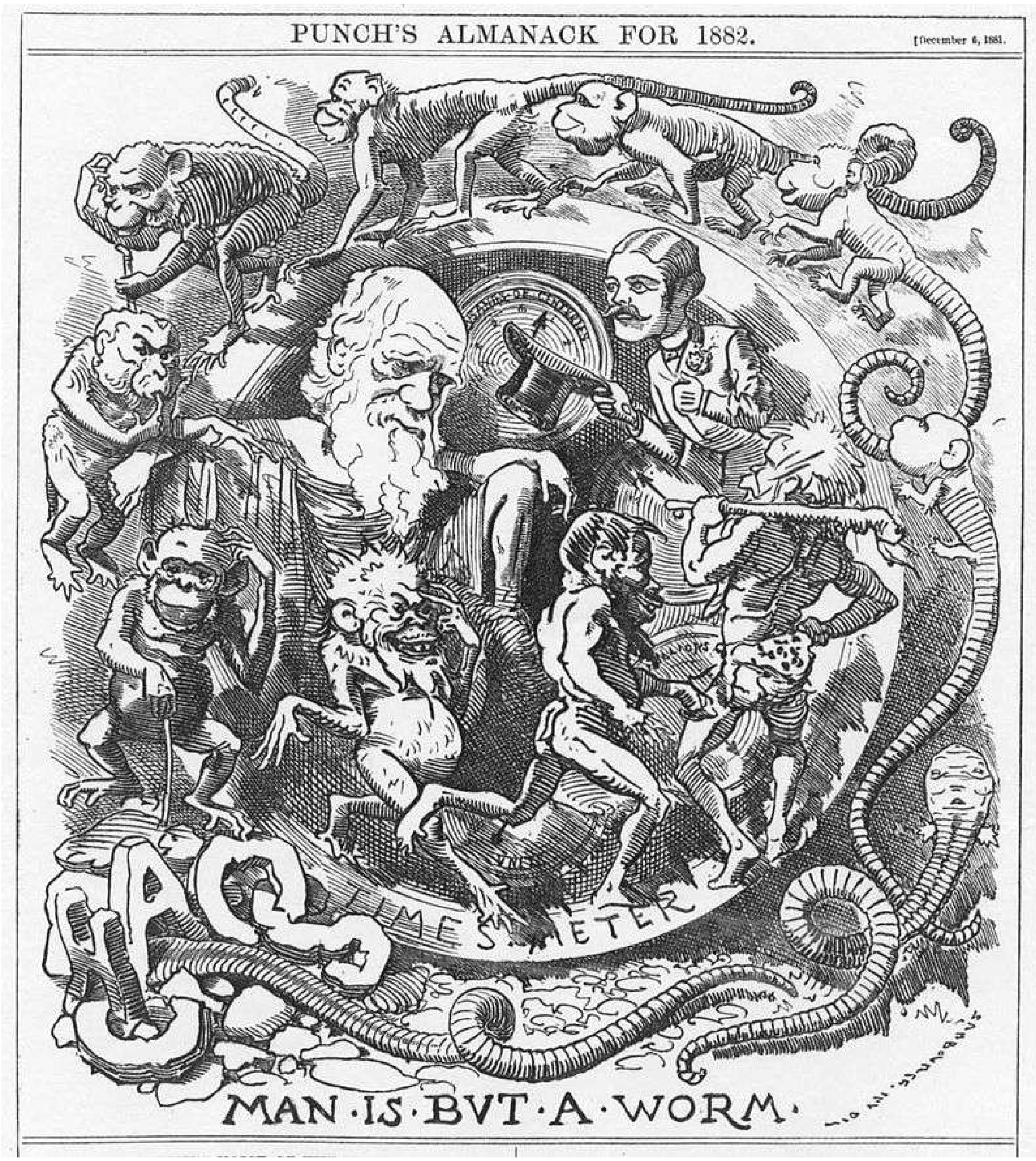

Figure 1.5: **"Man is is But a Worm", a cartoon, published in Punch in 1882. Public domain, The cartoon was undoubtedly inspired by the fact that Darwin had written a book about earthworms.**

be thrown on the origin of man and his history". This single sentence, and the obvious implications of Darwin's book, were enough to create a storm of furious opposition. One newspaper commented that "society must fall to pieces if Darwinism be true."

The storm of scandalized opposition was still growing in June 1860, when three anti-Darwinian papers were scheduled for reading at an open meeting of the British Association for the Advancement of Science at Oxford. The meeting hall was packed with 700 people as Samuel Wilberforce, Bishop of Oxford, took the floor to "smash Darwin". Darwin himself was too ill (or too diffident) to be present, but T.H. Huxley had been persuaded to attend the meeting to defend Darwin's ideas. After savagely attacking Darwin for half an hour, the bishop turned to Huxley and asked sneeringly, "Is it through your grandfather or your grandmother that you claim to be descended from an ape?"

Huxley, who was 35 at the time and at the height of his powers, rose to answer the bishop. He first gave scientific answers, point by point, to the objections which had been made to the theory of evolution. Finally, regarding the bishop's question about his ancestry, Huxley said: "If I had to choose between a poor ape for an ancestor and a man, highly endowed by nature and of great influence, who used those gifts to introduce ridicule into a scientific discussion and to discredit humble seekers after truth, I would affirm my preference for the ape." Huxley later recalled: "My retort caused inextinguishable laughter among the people."

Pandemonium broke out in the hall. Lady Brewster fainted, and Admiral FitzRoy, the former captain of the *Beagle*, rose to his feet, lifting a Bible in his hand, exclaiming that the Scriptures are the only reliable authority. Had he known Darwin's true nature, FitzRoy said, he would never have allowed him to sail on board the *Beagle*. As *Macmillan's Magazine* reported later, "Looks of bitter hatred were directed to those who were on Darwin's side." However, later that evening, in the discussions of the events of the day which took place in the Oxford colleges, Darwin's ideas were given a surprisingly fair hearing.

The debate at Oxford marked the turning-point in the battle over evolution. After that, Huxley and Hooker defended Darwin's theories with increasing success in England, while in Germany most of the prominent biologists, led by Professor Ernst Haeckel, were soon on Darwin's side. In America the theory of evolution was quickly accepted by almost all of the younger scientists, despite the opposition of the aging "creationist" Louis Agassiz. However, opposition from religious fundamentalists continued in most parts of America, and in Tennessee a school teacher named John T. Scopes was brought to trial for teaching the theory of evolution. He was prosecuted by the orator and three-time presidential candidate William Jennings Bryan, and defended by the brilliant Chicago lawyer Clarence Darrow. In this famous "Monkey Trial", Scopes was let off with a small fine, but the anti-evolution laws remained in force. It was only in 1968 that the State Legislature of Tennessee repealed its laws against the teaching of evolution[8].

[8] In 1999, the Kansas State School Board removed biological evolution from the curriculum followed by students within the state. Furthermore, cosmology was also removed from the curriculum because it presents evidence that the earth is extremely old, thus supporting evolution. Fortunately, the 1999 decision has now been reversed.

In 1863 Huxley, who was not afraid of controversy, published a book entitled *Evidences of Man's Place in Nature*, and this was followed in 1871 by Darwin's book *The Descent of Man*. Huxley and Darwin brought forward a great deal of evidence to show that human beings are probably descended from an early ape-like primate which is now extinct. Darwin believed that the early stages of human evolution took place in Africa[9]. In order to show that men and apes represent closely-related branches of the same family tree, Darwin and Huxley stressed the many points of similarity - resemblances in structure, reproduction, development, psychology and behavior, as well as susceptibility to the same parasites and diseases.

1.6 The Expression of Emotions in Man and Animals; ethology

In The Origin of Species, Charles Darwin devoted a chapter to the evolution of instincts, and he later published a separate book on *The Expression of Emotion in Man and Animals*. Because of these pioneering studies, Darwin is considered to be the founder of the science of ethology - the study of inherited behavior patterns.

Behind Darwin's work in ethology is the observation that instinctive behavior patterns are just as reliably inherited as morphological characteristics. Darwin was also impressed by the fact that within a given species, behavior patterns have some degree of uniformity, and the fact that the different species within a family are related by similarities of instinctive behavior, just as they are related by similarities of bodily form. For example, certain elements of cat-like behavior can be found among all members of the cat family; and certain elements of dog-like or wolf-like behavior can be found among all members of the dog family. On the other hand, there are small variations in instinct among the members of a given species. For example, not all domestic dogs behave in the same way.

"Let us look at the familiar case of breeds of dogs", Darwin wrote in *The Origin of Species*, "It cannot be doubted that young pointers will sometimes point and even back other dogs the very first time they are taken out; retrieving is certainly in some degree inherited by retrievers; and a tendency to run round, instead of at, a flock of sheep by shepherd dogs. I cannot see that these actions, performed without experience by the young, and in nearly the same manner by each individual, and without the end being known - for the young pointer can no more know that he points to aid his master than the white butterfly knows why she lays her eggs on the leaf of the cabbage - I cannot see that these actions differ essentially from true instincts..."

"How strongly these domestic instincts habits and dispositions are inherited, and how curiously they become mingled, is well shown when different breeds of dogs are crossed. Thus it is known that a cross with a bulldog has affected for many generations the courage and obstinacy of greyhounds; and a cross with a greyhound has given to a whole family of

[9] This guess has been confirmed by the recent discoveries of Broom, Dart and the Leakey family, among many others.

shepherd dogs a tendency to hunt hares..."

Darwin believed that in nature, desirable variations of instinct are propagated by natural selection, just as in the domestication of animals, favorable variations of instinct are selected and propagated by kennelmen and stock breeders. In this way, according to Darwin, complex and highly developed instincts, such as the comb-making instinct of honey-bees, have evolved by natural selection from simpler instincts, such as the instinct by which bumble bees use their old cocoons to hold honey and sometimes add a short wax tube.

The study of inherited behavior patterns in animals was continued in the 20th century by such researchers as Nikolaas Tinbergen, Konrad Lorenz and Karl von Frisch, three scientists who shared the first Nobel Prize ever awarded in the field of ethology. Among the achievements for which Tinbergen is famous are his classic studies of instinct in herring gulls. He noticed that the newly-hatched chick of a herring gull pecks at the beak of its parent, and this signal causes the parent gull to regurgitate food into the gaping beak of the chick. Tinbergen wondered what signal causes the chick to initiate this response by pecking at the beak of the parent gull. Therefore he constructed a series of models of the parent in which certain features of the adult gull were realistically represented while other features were crudely represented or left out entirely. He found by trial and error that the essential signal to which the chick responds is the red spot on the tip of its parent's beak. Models which lacked the red spot produced almost no response from the young chick, although in other respects they were realistic models; and the red spot on an otherwise crude model would make the chick peck with great regularity.

Tinbergen called this type of signal a "sign stimulus". He found by further studies that he could produce an even more frantic response from the young chick by replacing the red spot by several concentric black circles on a white background, a sign stimulus which he called "super-normal"

In his 1978 book on *Animal Behavior*, Tinbergen pointed out that the features of baby animals, with their large foreheads, round cheeks, and round eyes, all have a characteristic "baby" look. This, Tinbergen wrote, is a sign stimulus which draws a protective response from adults; and he calls attention to the exaggerated "baby" look of some of Walt Disney's animals as an example of a super-normal sign stimulus. Another example of a super-normal sign stimulus, Tinbergen wrote, is the red lipstick and dark eye makeup sometimes used by women.

In the case of a newly-hatched herring gull chick pecking at the red spot on the beak of its parent, the program in the chick's brain must be entirely genetically determined, without any environmental component at all. Learning cannot play a part in this behavioral pattern, since the pattern is present in the young chick from the very moment when it breaks out of the egg. On the other hand (Tinbergen pointed out) many behavioral patterns in animals and in man have both an hereditary component and an environmental component. Learning is often very important, but learning seems to be built on a foundation of genetic predisposition.

To illustrate this point, Tinbergen called attention to the case of sheep-dogs, whose remote ancestors were wolves. These dogs, Tinbergen tells us, can easily be trained to drive a flock of sheep towards the shepherd. However, it is difficult to train them to drive the sheep away from their master. Tinbergen explained this by saying that the sheep-dogs regard the shepherd as their "pack leader"; and since driving the prey towards the pack leader is part of the hunting instinct of wolves, it is easy to teach the dogs this maneuver. However, driving the prey away from the pack leader would not make sense for wolves hunting in a pack; it is not part of the instinctive makeup of wolves, nor is it a natural pattern of behavior for their remote descendants, the sheep-dogs.

Tinbergen also tells us that a Welsh shepherd who wishes to discipline his dog often bites it in the ear; and this is an extremely effective method of enforcing discipline with dogs. To explain the effectiveness of the ear bite, Tinbergen reminds his readers that the leader of a pack of wolves disciplines his subordinates by biting their ears.

As a further example of the fact that learning is usually built on a foundation of genetic predisposition, Tinbergen mentions the ease with which human babies learn languages. The language learned is determined by the baby's environment; but astonishing ease with which a human baby learns to speak and understand implies a large degree of genetic predisposition.

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Chapter 2

PASTEUR

2.1 Semmelweis

In 1800, when vaccination began to be used against smallpox, no one understood why it worked. No one, in fact, understood what caused infectious diseases. It had been more than a century since Anton van Leeuwenhoek had studied bacteria with his home-made microscopes and described them in long letters to the Royal Society. However, the great Swedish naturalist, Carolus Linnaeus, left microscopic organisms out of his classification of all living things on the grounds that they were too insignificant and chaotic to be mentioned.

Etiology, Concept and Prophylaxis of Childbed Fever

Puerperal fever, or "childbed fever", was common in mid-19th-century hospitals and often fatal. The Hungarian physician Ignaz Semmelweis, working in the maternity division of the Vienna General Hospital began to require that the doctors working under him should wash their hands in chlorinated lime solution between visits to patients. He found that this practice reduced mortality from childbed fever to less than 1%. In 1861, he published a book describing his results entitled *Etiology, Concept and Prophylaxis of Childbed Fever*. However, despite this and other publications, his results were not only rejected by the medical establishment of the time, but Semmelweis was also vilified, ridiculed and treacherously assigned to an insane asylum, where he was beaten to death by guard. He was before his time. His discoveries came before the germ theory of disease. Today, Semmelweis is recognized as a great pioneer of antiseptic practice in medicine.

Figure 2.1: **Dr. Ignaz Semmelweis, (1818-1865). He discovered that if physicians at the Vienna General Hospital's Obstetrical Clinic washed their hands in chlorinated lime solution between visits to patients, the mortality was drastically reduced. Tragically, since this discovery was made prior to the germ theory of disease, it was rejected by the medical establishment of his time. Semmelweis was sent to an insane asylum, where he died after being beaten by guards.**

Figure 2.2: **Semmelweis statue at the University of Tehran.**

Figure 2.3: **2008 Austrian commemorative coin picturing Semmelweis.**

2.2 Pasteur: artist or chemist?

This was the situation when Louis Pasteur was born in 1822, in the Jura region of France, near the Swiss border. His father was a tanner in the small town of Arbois. Pasteur's parents were not at all rich, but they were very sincere and idealistic, and they hoped that their son would one day become a teacher.

As a boy, Louis Pasteur was considered to be a rather slow student, but he was artistically gifted. Between the ages of 13 and 19, he made many realistic and forceful portraits of the people of his town. His ambition was to become a professor of the fine arts; and with this idea he studied to qualify for the entrance examination of the famous École Normale of Paris, supporting himself with a part-time teaching job, and sometimes enduring semi-starvation when the money sent by his father ran out.

The earnest, industrious and artistically gifted boy would certainly have succeeded in becoming an excellent professor of the fine arts if he had not suddenly changed his mind and started on another path. This new path was destined to win Louis Pasteur a place among the greatest benefactors of humanity.

The change came when Pasteur attended some lectures by the famous chemist Jean Baptiste Dumas. Professor Dumas was not only a distinguished researcher; he was also a spellbinding speaker, whose lectures were always attended by six or seven hundred excited students. "I have to go early to get a place", Pasteur wrote to his parents, "just as in the theatre". Inspired by these lectures, Pasteur decided to become a chemist. He put away his brushes, and never painted again.

While he was still a student, Pasteur attracted the attention of Antoine Jerome Balard, the discoverer of the element bromine. Instead of being sent to teach at a high-school in the provinces after his graduation, Pasteur became an assistant in the laboratory of Balard, where he had a chance to work on a doctor's degree, and where he could talk with the best chemists in Paris. Almost every Thursday, he was invited to the home of Professor Dumas, where the conversation was always about science.

Pasteur's first important discovery came when he was 25. He had been studying the tartarates - a group of salts derived from tartaric acid. There was a mystery connected with these salts because, when polarized light was passed through them, they rotated the direction of polarization. On the other hand, paratartaric acid (now called racemic acid), did not exhibit this effect at all, nor did its salts. This was a mystery, because there seemed to be no chemical difference between tartaric acid and racemic acid.

Studying tiny crystals of paratartaric acid under his microscope, Pasteur noticed that there were two kinds, which seemed to be mirror images of one another. His vivid imagination leaped to the conclusion that the two types of crystals were composed of different forms of tartaric acid, the molecules of one form being mirror images of the other. Therefore the crystals too were mirror images, since, as Pasteur guessed, the shapes of the crystals resulted from the shapes of the molecules.

By painstakingly separating the tiny right-handed crystals from the left-handed ones, Pasteur obtained a pure solution of right-handed molecules, and this solution rotated polarized light. The left-handed crystals, when dissolved, produced the opposite rotation!

Pasteur ran from the laboratory, embraced the first person that he met in the hall, and exclaimed: "I have just made a great discovery! I am so happy that I am shaking all over, and I am unable to set my eyes again to the polarimeter."

Jean Baptiste Biot, the founder of the field of polarimetry, was sceptical when he heard of Pasteur's results; and he asked the young man to repeat the experiments so that he could see the results with his own eyes. Under Biot's careful supervision, Pasteur separated the two types of crystals of racemic acid, and put a solution of the left-handed crystals into the polarimeter.

"At the first sight of the color tints presented by the two halves of the field", Pasteur wrote, "and without having to make a reading, Biot recognized that there was a strong rotation to the left. Then the illustrious old man, who was visibly moved, seized me by the hand and said: 'My dear son, all my life I have loved science so deeply that this stirs my heart!'"

As he continued his work with right- and left-handed molecules, Pasteur felt that he was coming close to an understanding of the mysteries of life itself, since, as Biot had shown, the molecules which rotate polarized light are almost exclusively molecules produced by living organisms. He soon discovered that he could make an optically active solution of tartaric acid in another way: When he let the mould *penicillium glaucum* grow in a solution of racemic acid, the left-handed form disappeared, and only the right-handed form remained. In this way, Pasteur became interested in the metabolism of microscopic organisms.

Pasteur's work on crystallography and optical activity had made him famous among chemists, and he was appointed Professor of Chemistry at the University of Strasbourg. He soon fell in love with and married the daughter of the Rector of the university, Marie Laurent. This marriage was very fortunate for Pasteur. In the words of Pasteur's assistant, Emil Roux, "Madame Pasteur loved her husband to the extent of understanding his studies... She was more than an incomparable companion for her husband: She was his best collaborator". She helped him in every way that she could - protecting him from everyday worries, taking dictation, copying his scientific papers in her beautiful handwriting, discussing his experiments and asking intelligent questions which helped him to clarify his thoughts.

2.3 Saving the French wine industry

After a few years at Strasbourg, Pasteur was appointed Dean of the Faculty of Sciences at the University of Lille. In appointing him, the French government explained to Pasteur that they expected him to place the Faculty of Sciences of the university at the service of the industry and agriculture of the district.

Pasteur took this commission seriously, and he soon put his studies of microorganisms to good use in the service of a local industry which produced alcohol from beet juice. He was able to show that whenever the vats of juice contained bacteria, they spoiled; and he showed the local manufacturers how eliminate harmful bacteria from their vats. As a result of this work, the industry was saved.

PASTEUR en 1857

Figure 2.4: **Louis Pasteur in his laboratory, as painted by A. Edelfeldt.**

His work on fermentation put Pasteur into conflict with the opinions of the most famous chemists of his time. He believed that it was the action of the living yeast cells which turned sugar into alcohol, since he had observed that the yeasts were alive and that the amount of alcohol produced was directly proportional to the number of yeasts present. On the other hand, the Swedish chemist, Jöns Jakob Berzelius (1779-1848), had considered fermentation to be an example of catalysis, while Justus von Liebig (1805-1875) thought that the yeasts were decaying during fermentation, and that the breakdown of the yeast cells somehow assisted the conversion of sugar to alcohol. (Both Pasteur and Berzelius were right! Although the fermentation observed by Pasteur was an example of the action of living yeasts, it is possible to extract an enzyme from the yeasts which can convert sugar to alcohol without the presence of living cells.)

Pasteur studied other fermentation processes, such as the conversion of sugar into lactic acid by the bacilli which are found in sour milk, and the fermentation which produces butyric acid in rancid butter. He discovered that each species of microorganism produces its own specific type of fermentation; and he learned to grow pure cultures of each species.

At the suggestion of Napoleon III, Pasteur turned his attention to the French wine industry, which was in serious difficulties. He began to look for ways to get rid of the harmful bacteria which were causing spoilage of the wine. After trying antiseptics, and finding them unsatisfactory, Pasteur finally found a method for killing the bacteria, without affecting the taste of the wine, by heating it for several minutes to a temperature between 50 and 60 degrees centigrade. This process ("Pasteurization") came to be applied, not only to wine, but also to milk, cheese, butter, beer and many other kinds of food.

Pasteur developed special machines for heat-treating large volumes of liquids. He patented these, to keep anyone else from patenting them, but he made all his patents available to the general public, and refused to make any money from his invention of the Pasteurization process. He followed the same procedure in patenting an improved process for making vinegar, but refusing to accept money for it.

Pasteur was now famous, not only in the world of chemists and biologists, but also in the larger world. He was elected to membership by the French Academy of Sciences, and he was awarded a prize by the Academy for his research refuting the doctrine of spontaneous generation.

2.4 The germ theory of disease

In 1873, Louis Pasteur was elected to membership by the French Academy of Medicine. Many conservative physicians felt that he had no right to be there, since he was really a chemist, and had no medical "union card". However, some of the younger doctors recognized Pasteur as the leader of the most important revolution in medical history; and a young physician, Emil Roux, became one of Pasteur's devoted assistants.

When he entered the Academy of Medicine, Pasteur found himself in the middle of a heated debate over the germ theory of disease. According to Pasteur, every contagious disease is caused by a specific type of microorganism. To each specific disease there corresponds a specific germ.

Pasteur was not alone in advocating the germ theory, nor was he the first person to propose it. For example, Varro (117 B.C. - 26 B.C.), believed that diseases are caused by tiny animals, too small to be seen, which are carried by the air, and which enter the body through the mouth and nose.

In 1840, Jacob Henle, a distinguished Bavarian anatomist, had pointed out in an especially clear way what one has to do in order to prove that a particular kind of germ causes a particular disease: The microorganism must be found consistently in the diseased tissue; it must be isolated from the tissue and cultured; and it must then be able to induce the disease consistently. Finally, the newly-diseased animal or human must yield microorganisms of the same type as those found originally.

Henle's student, Robert Koch (1843-1910), brilliantly carried out his teacher's suggestion. In 1872, Koch used Henle's method to prove that anthrax is due to rodlike bacilli

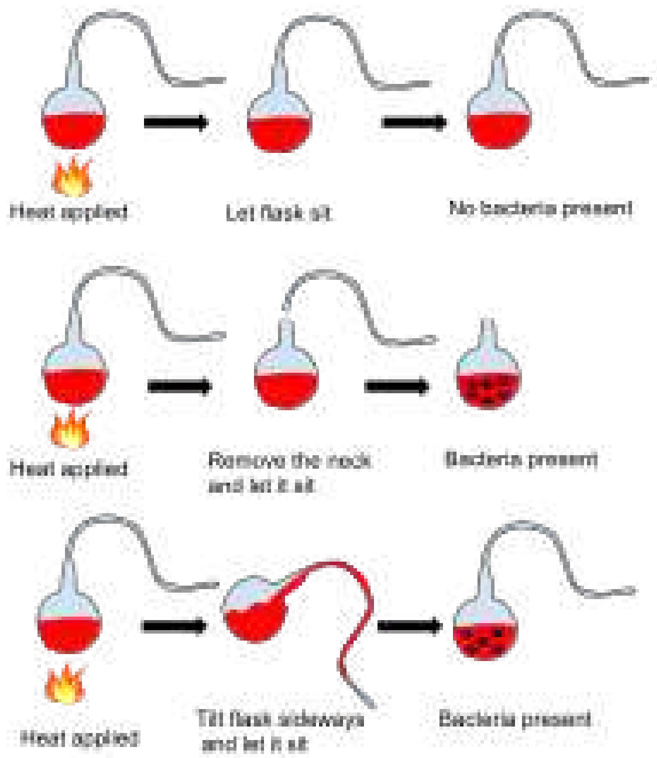

Figure 2.5: **One of Louis Pasteur's experiment illustrates the fact that the spoilage of liquid is caused by particles in the air rather than the air itself. These experiments were important evidence supporting the germ theory of disease..**

in the blood of the infected animal. Koch's pioneering contributions to microbiology and medicine were almost as great as those of Pasteur. Besides being the first person to prove beyond doubt that a specific disease was caused by a specific microorganism, Koch introduced a number of brilliant technical improvements which paved the way for rapid progress in bacteriology and medicine.

Instead of using liquids as culture media,Koch and his assistant, Petri, pioneered the use of solid media. Koch developed a type of gel made from agar-agar (a substance derived from seaweed). On the surface of this gel, bacteria grew in tiny spots. Since the bacteria could not move about on the solid surface, each spot represented a pure colony of a single species, derived from a single parent. Koch also pioneered techniques for staining bacteria, and he introduced the use of photography in bacteriology. He was later to isolate the bacillus which causes tuberculosis, and also the germ which causes cholera.

When Koch's work was attacked in the French Academy of Medicine, Pasteur rushed to his defense. In order to demonstrate that it was living bacilli in the blood of a sheep with anthrax which transmitted the disease, and not something else in the blood, Pasteur took a drop of infected blood and added it to a large flask full of culture medium. He let this stand until the bacteria had multiplied; and then he took a tiny drop from the flask and transferred it to a second flask of nutrient broth. He did this a hundred times, so that there was no possibility that anything whatever remained from the original drop of sheep's blood. Nevertheless, a tiny amount of liquid from the hundredth flask was just as lethal as fresh blood drawn from a sheep with anthrax.

Figure 2.6: **Robert Koch (1843-1910) was one of the important founders of modern bacteriology. He received the Nobel Prize for Physiology or Medicine in 1905.**

2.5 Vaccines

Pasteur read and reread the papers of Jenner on immunization against smallpox. He searched continually for something analogous to smallpox vaccination which could be applied to other diseases. Finally, the answer came by chance.

Pasteur and his assistants had been studying chicken cholera, an invariably fatal disease of chickens. Roux and Chamberland were carrying out a series of experiments where they made a fresh culture of chicken cholera bacteria every day. When they injected a bit of liquid from any of these cultures into a chicken, the chicken always died.

It was summer, and the young men went off for two weeks of vacation. When they came back, they took their two-week-old culture of chicken cholera out of the cupboard and injected it into a hen; but the hen didn't die. They decided that while they had been on vacation, the culture must have lost its strength; and after some effort, they obtained a new specimen of active chicken cholera bacteria, which they injected into their hens. All the hens died except one. The hen which had previously been inoculated with two-week-old culture didn't even get sick!

When Pasteur returned to his laboratory, the two young men hesitated to tell him about this strange result because they were afraid that he might be angry with them for going off on a holiday and breaking off the series of experiments. However, they finally confessed what had happened, and added the strange detail about the chicken which had not died. In the middle of their apologies, Pasteur raised his hand. "Please be quiet for a moment", he said, "I want to think". After a few moments of silence, Pasteur looked at Roux and Chamberland and said, "That's it! The hen that didn't die was *vaccinated* by the old culture!"

This was the big breakthrough - a turning point in medical history. Pasteur, Roux and Chamberland had discovered by chance a method of weakening a culture of bacteria so that it would not produce the fatal disease with which it was usually associated; but on the other hand, it was still able to alert the body's defense mechanisms, so that the inoculated animal became immune. This great discovery was made by chance, but, as Pasteur was fond of saying, "In research, chance favors the prepared mind".

Pasteur, Roux and Chamberland dropped everything else and began a series of experiments to find the best way of weakening their cultures of chicken cholera. They found that the critical factor was the proper amount of exposure to air. (Probably the culture contained a few mutant bacteria, able to grow well in air, but not able to produce chicken cholera; and during the exposure of a culture, these mutants multiplied rapidly, until the entire population was composed of mutants.)

Pasteur now began research on a vaccine against anthrax - a disease which was causing serious economic loss to farmers, and which could affect humans as well as animals. With anthrax, the problem was to keep the bacilli from forming spores. After much experimentation, the group found that if they held their anthrax cultures at a temperature between 42 C and 43 C, the bacilli would still grow, but they did not form spores.

Pasteur and his coworkers allowed their cultures to grow at 42 C in shallow dishes, where there was good contact with the air. They found that after two weeks, the cultures

Figure 2.7: **Louis Pasteur at work in his laboratory.**

were weakened to the point where they would make a sheep sick, but not kill it. They developed a method for inoculating animals in two stages - first with a very much weakened culture, and later with a stronger one. After the second inoculation, the animals could stand an injection of even the most virulent anthrax bacilli without becoming ill.

When Pasteur published these results, there was much sarcasm among veterinarians. The editor of the *Veterinary Press*, a surgeon named Rossignol, wrote: "Monsieur Pasteur's discovery, *if it were genuine*, should not be kept in the laboratory". Rossignol proposed a public trial of the anthrax vaccine, and he started a campaign to collect money for the purchase of experimental animals.

Pasteur's friends warned him against accepting the risk of a public trial at such an early stage. He had not tested his vaccine sufficiently, and a failure would make him the laughing stock of Europe. However, Pasteur saw the trial as a chance to focus public attention on microorganisms and vaccines. Like Galileo, Pasteur had a flair for dramatic gestures and public debate; and the impact of his career was greatly enhanced by his ability to attract widespread attention.

A farm near Melun called Poully le Fort was chosen as the site for the experiment; and sixty sheep, together with several cows, were put at Pasteur's disposal. Thousands of people made the journey from Paris to Melun to watch the first injections, which were made on May 5, 1881. Twelve days later, the same sheep were inoculated with a stronger vaccine. Then, on May 31, the big test was made - both the vaccinated and unvaccinated animals were inoculated with a highly lethal culture of anthrax. Pasteur went back to Paris. There was nothing to do but wait.

The next afternoon, a telegram from Rossignol shattered Pasteur's confidence: It said that one of the vaccinated sheep was dying. Pasteur spent a sleepless night. The following morning, however, at nine o'clock, another telegram arrived from Rossignol: All the vaccinated sheep were well, even the one which had seemed to be dying; and all the unvaccinated sheep were either dying or already dead! Rossignol, who had been Pasteur's enemy, was completely converted; and his telegram ended with the words, "Stunning success!" When the aging Pasteur limped onto the field at Poully le Fort that afternoon, a great cheer went up from the thousands of people present.

Rabies

The next disease which Pasteur attempted to conquer was rabies, the terrifying and invariably fatal disease which often follows the bite of a mad dog. The rabies virus travels slowly through the body from the wounds to the spinal cord, where, after one or two months, it attacks the nervous system. If a victim is offered water and attempts to swallow, his head jerks back in terrible spasms, which make rabies extremely frightening, both for the victim and for the onlooker. For this reason, the disease is sometimes called hydrophobia - fear of water.

Pasteur and his coworkers soon discovered that even with their best microscopes, they were unable to see the organism which causes rabies. In fact, the disease is caused by a

Figure 2.8: **A French stamp commemorating Pasteur's fight against rabes.**

virus, much too small to be seen with an optical microscope. Thus the aging Pasteur was confronted with an entirely new technical problem, never before encountered in microbiology.

He soon found that it was impossible to culture the rabies virus in a flask or dish, as he was in the habit of doing with bacteria. Absorbed in his research, he forgot his wedding anniversary. Marie Pasteur, however, remembered; and she wrote in a letter to her daughter:

"Your father is absorbed in his thoughts. He talks little, sleeps little, rises at dawn, and in a word, continues the life which which I began with him this day thirty-five years ago."

Besides being technically difficult, the work on rabies was also dangerous. When Pasteur, Roux and Chamberland took samples of saliva from the foaming jaws of mad dogs, they risked being bitten by accident and condemned to an agonizing death from the convulsions of rabies. Since they could not culture the rabies virus in a dish or a flask of nutrient fluid, they were forced to grow it inside the nervous systems of experimental animals. After four years of difficult and hazardous work, they finally succeeded in developing a vaccine against rabies.

In the method which finally proved successful, they took a section of spinal cord from a rabbit with rabies and exposed it to air inside a germproof bottle. If the section of spinal cord remained in the bottle for a long time, the culture was very much weakened or "attenuated", while when it was exposed to air for a shorter time, it was less attenuated. As in the case of anthrax, Pasteur built up immunity by a series of injections, beginning with a very much attenuated culture, and progressing to more and more virulent cultures.

At last, Pasteur had a method which he believed could be used to save the lives of the victims of mad dogs and wolves; and he found himself faced with a moral dilemma: Everyone who developed rabies died of it; but not everyone who was bitten by a mad dog developed rabies. Therefore if Pasteur gave his vaccine to a human victim of a mad dog, he might harm someone who would have recovered without treatment.

He had published the results of his research, and he was inundated with requests for treatment, but still he hesitated. If he treated someone, and the person afterward died, he might be accused of murder; and all the work which he had done to build up public support for the new movement in medicine might be ruined.

Finally, on July 6, 1885, Pasteur's indecision was ended by the sight of a man and woman who had come to him with their frightened nine-year-old son. The boy, whose name was Joseph Meitner, had been severely bitten by a mad dog. It was one thing to write letters refusing requests for treatment, and another thing to look at a doomed and frightened child and turn him away.

Pasteur felt that he had to help the boy. He consulted Alfred Vulpian, a specialist in rabies, and Vulpian assured him that Joseph Meitner had been bitten so severely that without treatment, he would certainly develop rabies and die. Pasteur also consulted Dr. Granchier, a young physician who had joined his staff, and together the three men agreed that there was no time to lose - they would have to begin inoculations immediately if they were to save the boy's life. They decided to go ahead. To Pasteur's great joy, Joseph Meitner remained completely well.

The second rabies victim to be treated by Pasteur was a fourteen-year-old shepard named Jupille. He had seen a mad dog about to attack a group of small children, and he had bravely fought with the maddened animal so that the children could escape. Finally he had managed to tie its jaws together, but his hands were so badly bitten that without treatment, he was certain to die. Like Joseph Meitner, Jupille was saved by the Pasteur treatment. A statue of Jupille in front of the Pasteur Institute commemorates his bravery.

Pasteur had now grown so old, and was so worn out by his labors that he could do no more. The task of winning a final victory over infectious diseases was not finished - it was barely begun; but at least the feet of researchers had been placed on the right road; and there were younger men and women enthusiastically taking up the task which Pasteur laid down.

On December 27, 1892, physicians and scientists from many countries assembled in Paris to celebrate Pasteur's seventieth birthday. The old man was so weak that he was unable to reply in his own words to the address of Sir Joseph Lister and to the cheers of the crowd; but his words were read by his son. Pasteur spoke to the young men and women who would take his place in the fight against disease:

"Do not let yourselves be discouraged by the sadness of certain hours which pass over nations. Live in the serene peace of your laboratories and libraries. Say to yourselves first, 'What have I done for my instruction?', and as you gradually advance, 'What have I done for my country?', until the time comes when you may have the intense happiness of thinking that you have contributed in some way to the progress and good of humanity."

Figure 2.9: **Institut Pasteur de Lille.**

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Chapter 3

FARADAY AND MAXWELL

3.1 Michael Faraday's great experiments

The electrochemical experiments of Davy, and the electromagnetic discoveries of Ørsted and Ampère, were further developed by the great experimental physicist and chemist, Michael Faraday (1791-1867). He was one of ten children of a blacksmith, and as a boy, he had little education. At the age of 14, he was sent out to work, apprenticed to a London bookbinder. Luckily, the bookbinder sympathized with his apprentice's desire for an education, and encouraged him to read the books in the shop (outside of working hours). Faraday's favorites were Lavoisier's textbook on chemistry, and the electrical articles in the Encyclopedia Britannica.

In 1812, when Michael Faraday was 21 years old, a customer in the bookshop gave him tickets to attend a series of lectures at the Royal Institution, which were to be given by the famous chemist Humphry Davy. At that time, fashionable London socialites (particularly ladies) were flocking to the Royal Institution to hear Davy. Besides being brilliant, he was also extremely handsome, and his lectures, with their dramatic chemical demonstrations, were polished to the last syllable.

Michael Faraday was, of course, thrilled to be present in the glittering audience, and he took careful notes during the series of lectures. These notes, to which he added beautiful colored diagrams, came to 386 pages. He bound the notes in leather and sent them to Sir Joseph Banks, the President of the Royal Society, hoping to get a job related to science. He received no reply from Banks, but, not discouraged, he produced another version of his notes, which he sent to Humphry Davy.

Faraday accompanied his notes with a letter saying that he wished to work in science because of "the detachment from petty motives and the unselfishness of natural philosophers". Davy told him to reserve judgement on that point until he had met a few natural philosophers, but he gave Faraday a job as an assistant at the Royal Institution.

In 1818, Humphry Davy was knighted because of his invention of the miner's safety lamp. He married a wealthy and fashionable young widow, resigned from his post as Director of the Royal Institution, and set off on a two-year excursion of Europe, taking

Michael Faraday with him. Lady Davy regarded Faraday as a servant; but in spite of the humiliations which she heaped on him, he enjoyed the tour of Europe and learned much from it. He met, and talked with, Europe's most famous scientists; and in a sense, Europe was his university.

Returning to England, the modest and devoted Faraday finally rose to outshine Sir Humphry Davy, and he became Davy's successor as Director of the Royal Institution. Faraday showed enormous skill, intuition and persistence in continuing the electrical and chemical experiments begun by Davy.

In 1821, a year after H.C. Ørsted's discovery of the magnetic field surrounding a current-carrying wire, Michael Faraday made the first electric motor. His motor was simply a current-carrying wire, arranged so that it could rotate around the pole of a magnet; but out of this simple device, all modern electrical motors have developed. When asked what use his motor was, Faraday replied: "What use is a baby?"

Ørsted had shown that electricity could produce magnetism; and Faraday, with his strong intuitive grasp of the symmetry of natural laws, believed that the relationship could be reversed. He believed that magnetism could be made to produce electricity. In 1822, he wrote in his notebook: "Convert magnetism to electricity". For almost ten years, he tried intermittently to produce electrical currents with strong magnetic fields, but without success. Finally, in 1831, he discovered that a *changing* magnetic field would produce a current.

Faraday had wrapped two coils of wire around a soft iron ring; and he discovered that at precisely the instant when he started a current flowing in one of the coils, a momentary current was induced in the other coil. When he stopped the current in the first coil, so that the magnetic field collapsed, a momentary current in the opposite direction was induced in the second coil.

Next, Faraday tried pushing a permanent magnet in and out of a coil of wire; and he found that during the time when the magnet was in motion, so that the magnetic field in the coil was changing, a current was induced in the coil. Finally, Faraday made the first dynamo in history by placing a rotating copper disc between the poles of a magnet. He demonstrated that when the disc rotated, an electrical current flowed through a circuit connecting the center with the edge. He also experimented with static electricity, and showed that insulating materials become polarized when they are placed in an electric field.

Faraday continued the experiments on electrolysis begun by Sir Humphry Davy. He showed that when an electrical current is passed through a solution, the quantities of the chemical elements liberated at the anode and cathode are directly proportional to the total electrical charge passed through the cell, and inversely proportional to the valence of the elements. He realized that these laws of electrolysis supported Dalton's atomic hypothesis, and that they also pointed to the existence of an indivisible unit of electrical charge.

Faraday believed (correctly) that light is an electromagnetic wave; and to prove the connection of light with the phenomena of electricity and magnetism, he tried for many years to change light by means of electric and magnetic fields. Finally, towards the end of his career, he succeeded in rotating the plane of polarization of a beam of light pass-

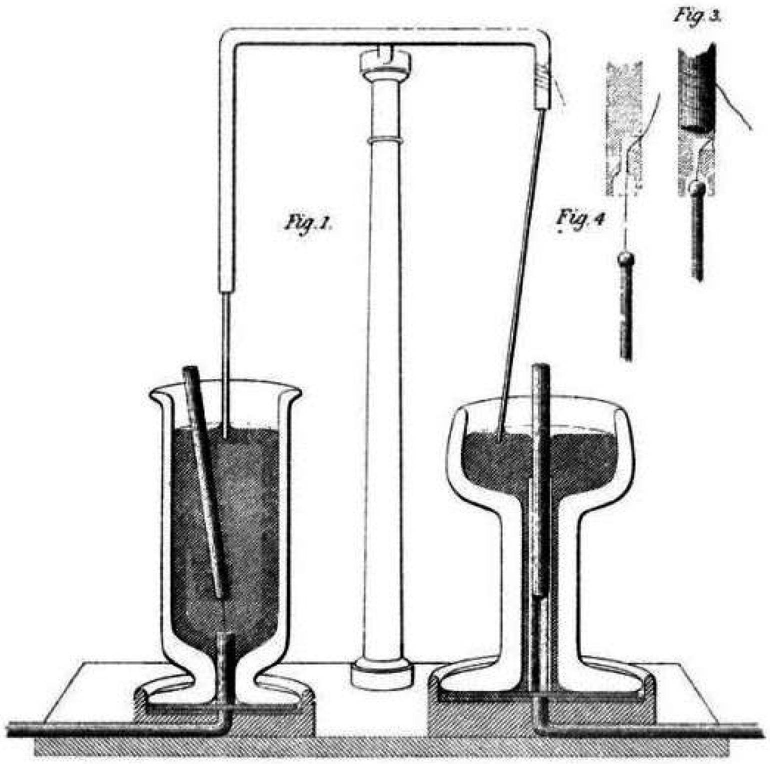

Figure 3.1: **Faraday's experiment showing that an electric current could produce mechanical rotation in a magnetic field. This was the first electric motor! On the right side of the figure, a current-carrying rod rotates about a fixed magnet in a pool of mercury. On the left, the rod is fixed and the magnet rotates.**

ing through a piece of heavy glass by placing the glass in a strong magnetic field. This phenomenon is now known as the "Faraday effect".

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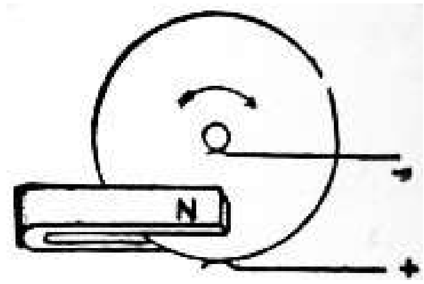

Figure 3.2: **Faraday also showed that a copper disc, rotating between the poles of a magnet could produce an electric current.**

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Because of his many contributions both to physics and to chemistry (including the discovery of benzene and the first liquefaction of gases), and especially because of his contributions to electromagnetism and electrochemistry, Faraday is considered to be one of the greatest masters of the experimental method in the history of science. He was also a splendid lecturer. Fashionable Londoners flocked to hear his discourses at the Royal Institution, just as they had flocked to hear Sir Humphrey Davy. Prince Albert, Queen Victoria's husband, was in the habit of attending Faraday's lectures, bringing with him

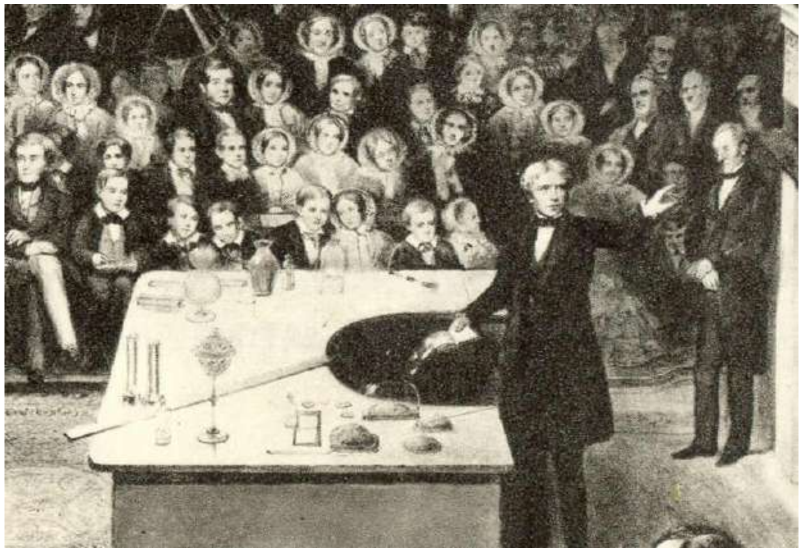

Figure 3.3: **A Christmas lecture at the Royal Institution by Michael Faraday.**

Crown Prince Edward (later Edward VII).

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As Faraday grew older, his memory began to fail, probably because of mercury poisoning. Finally, his unreliable memory forced him to retire from scientific work. He refused both an offer of knighthood and the Presidency of the Royal Society, remaining to the last the simple, modest and devoted worker who had first gone to assist Davy at the Royal Institution.

3.2 Maxwell and Hertz

Michael Faraday had no mathematical training, but he made up for this lack with his powerful physical intuition. He visualized electric and magnetic fields as "lines of force" in the space around the wires, magnets and electrical condensers with which he worked. In the case of magnetic fields, he could even make the lines of force visible by covering a piece of cardboard with iron filings, holding it near a magnet, and tapping the cardboard until the iron filings formed themselves into lines along the magnetic lines of force.

In this way, Faraday could actually see the magnetic field running from the north pole of a magnet, out into the surrounding space, and back into the south pole. He could also see the lines of the magnetic field forming circles around a straight current-carrying wire. Similarly, Faraday visualized the lines of force of the electric field as beginning at the positive charges of the system, running through the intervening space, and ending at the negative charges.

Meanwhile, the German physicists (especially the great mathematician and physicist, Johann Karl Friedrich Gauss (1777-1855)), had utilized the similarity between Coulomb's law of electrostatic force and Newton's law of gravitation. Coulomb's law states that the force between two point charges varies as the inverse square of the distance between them - in other words, it depends on distance in exactly the same way as the gravitational force. This allowed Gauss and the other German mathematicians to take over the whole "action at a distance" formalism of theoretical astronomy, and to apply it to electrostatics.

Faraday was unhappy with the idea of action at a distance, and he expressed his feelings to James Clerk Maxwell (1831-1879), a brilliant young mathematician from Edinburgh who had come to visit him. The young Scottish mathematical genius was able to show Faraday that his idea of lines of force did not in any way contradict the German conception of action at a distance. In fact, when put into mathematical form, Faraday's picture of lines of force fit beautifully with the ideas of Gauss.

During the nine years from 1864 to 1873, Maxwell worked on the problem of putting Faraday's laws of electricity and magnetism into mathematical form. In 1873, he published *A Treatise on Electricity and Magnetism*, one of the truly great scientific classics. Maxwell achieved a magnificent synthesis by expressing in a few simple equations the laws governing electricity and magnetism in all its forms. His electromagnetic equations have withstood the test of time; and now, a century later, they are considered to be among the most fundamental laws of physics.

Maxwell's equations not only showed that visible light is indeed and electromagnetic wave, as Faraday had suspected, but they also predicted the existence of many kinds of invisible electromagnetic waves, both higher and lower in frequency than visible light. We now know that the spectrum of electromagnetic radiation includes (starting at the low-frequency end) radio waves, microwaves, infra-red radiation, visible light, ultraviolet rays, X-rays and gamma rays. All these types of radiation are fundamentally the same, except that their frequencies and wave lengths cover a vast range. They all are oscillations of the electromagnetic field; they all travel with the speed of light; and they all are described by Maxwell's equations.

Maxwell's book opened the way for a whole new category of inventions, which have had a tremendous impact on society. However, when the *Treatise on Electricity and Magnetism* was published, very few scientists could understand it. Part of the problem was that the scientists of the 19th century would have liked a mechanical explanation of electromagnetism.

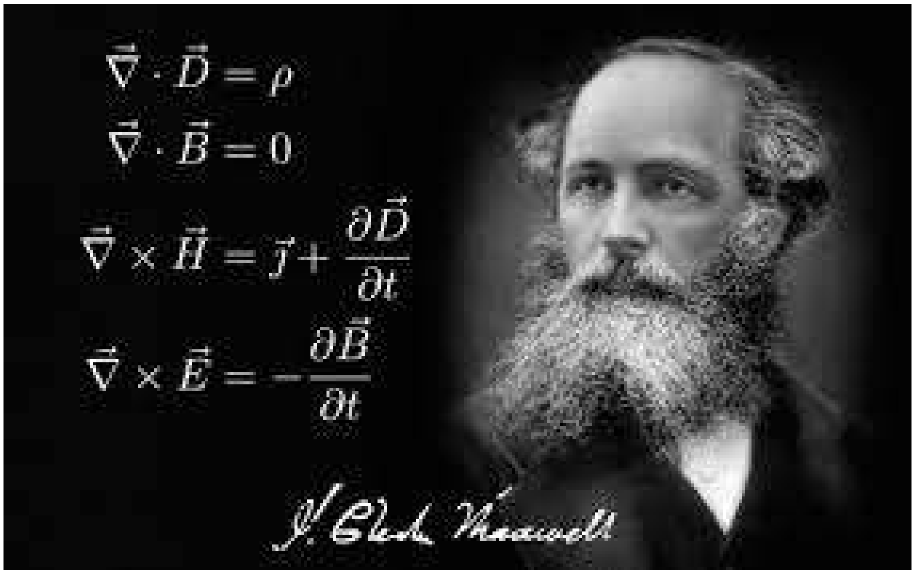

Figure 3.4: **James Clerk Maxwell (1831-1879).**

Figure 3.5: **Heinrich Hertz (1857-1894).**

3.3 History of the electrical telegraph

Many people contributed to the development of the telegraph. Here is a timeline showing some important events:

1774	Georges-Louis Le Sage (26 separate wires)
1800	Alessandro Volta invents the electric pile
1809	Samuel Thomas von Sömmering (up to 35 wires for letters and numerals)
1816	Francis Ronalds demonstrates an electrostatic telegraph at Hammersmith
1820	H.C. Ørsted discovers that an electric current produces a magnetic field
1821	André Marie Ampere suggests telegraph using a galvanometer
1828	Joseph Henry invents an improved electromagnet
1830	Joseph Henry demonstrates magnetic telegraph to Albany Academy
1832	Baron Schilling von Canstatt's 16-key transmitting device (binary system)
1833	C.F. Gauss and W. Weber install 1200-meter-long telegraph in Göttingen
1835	C.F. Gauss installs a telegraph along a German railway line
1835	Joseph Henry and Edward Davy invent electrical relay
1836	David Alter's telegraph system in America
1837	Edward Davy demonstrates his telegraph system in Regents Park
1837	Samuel Morse develops and patents recording telegraph
1837	W.F. Cooke and C. Wheatstone patent the first commercial telegraph
1838	Morse and his assistant Alfred Vale develop Morse code
1840	Charles Wheatstone's ABC system could be used by an unskilled operator
1846	Royal Earl House develops and patents letter printing telegraph
1855	David Edward Hughes invents a printing telegraph using a spinning type wheel
1861	Overland telegraph connects east and west coasts of the United States

Figure 3.6: **An early telegraph key**

Figure 3.7: **A girl operating an early telegraph**

Figure 3.8: **Professor Samuel F.B. Morse (1791-1872). For many years, most telegraph systems throughout the world made use of Morse code, which allowed messages to be sent over a single wire.**

3.4 The transatlantic cable

The first durable translantic cable was laid in 1866 by Isambard Kingdom Brunel's unprecedentedly large ship, the Great Eastern. Brunel had pioneered many engineering innovations, including the Great Western Railway, the first tunnel under a navigable river, and the first propeller-driven ocean-going iron steamship, the SS Great Britain. launched in 1843. He had realized that in order to carry enough coal for a transatlantic crossing, a ship had to be very large, since water resistance to be overcome is proportional to surface area, while the amount of coal (and cargo) that can be carried is proportional to volume. As a ship becomes larger, the ratio of volume to surface increases.

At first, transatlantic telegraphic transmissions were extremely slow, because the designers of the cable had not realizer that for efficient signal transmission the ratio of the cable's inductance to capacitance had to be correctly adjusted.

The first message sent was "Directors of Atlantic Telegraph Company, Great Britain, to Directors in America: Europe and America are united by telegraph. Glory to God in the highest; on earth peace, good will towards men." The second message was from Queen Victoria to President Buchanan of the United States, expressing the hope that the cable link would prove to be "an additional link between the nations whose friendship is founded on their common interest and reciprocal esteem." Buchanan replied that "it is a triumph more glorious, because far more useful to mankind, than was ever won by conqueror on the field of battle. May the Atlantic telegraph, under the blessing of Heaven, prove to be a bond of perpetual peace and friendship between the kindred nations, and an instrument destined by Divine Providence to diffuse religion, civilization, liberty, and law throughout the world."

Public enthusiasm for the transatlantic cable was enormous. In New York, 100 guns were fired, the streets were decorated with flags, and church bells were rung.

Figure 3.9: **Landing of the Atlantic Cable of 1866, Heart's Content, Newfoundland, a painting by by Robert Charles Dudley.**

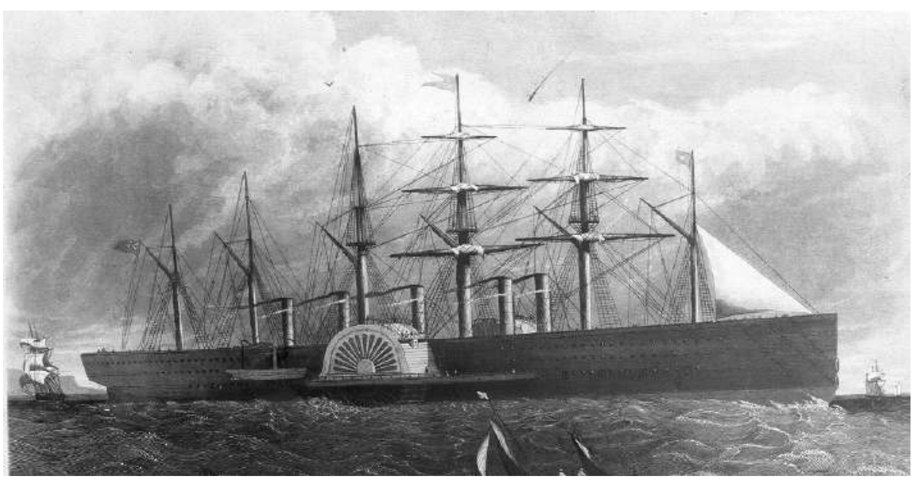

Figure 3.10: **Under Sir James Anderson, the Great Eastern laid 4,200 kilometers (2,600 mi) of the 1865 transatlantic telegraph cable. Under Captains Anderson and then Robert Halpin, from 1866 to 1878 the ship laid over 48,000 kilometers (30,000 mi) of submarine telegraph cable including from Brest, France to Saint Pierre and Miquelon in 1869, and from Aden to Bombay in 1869 and 1870.**

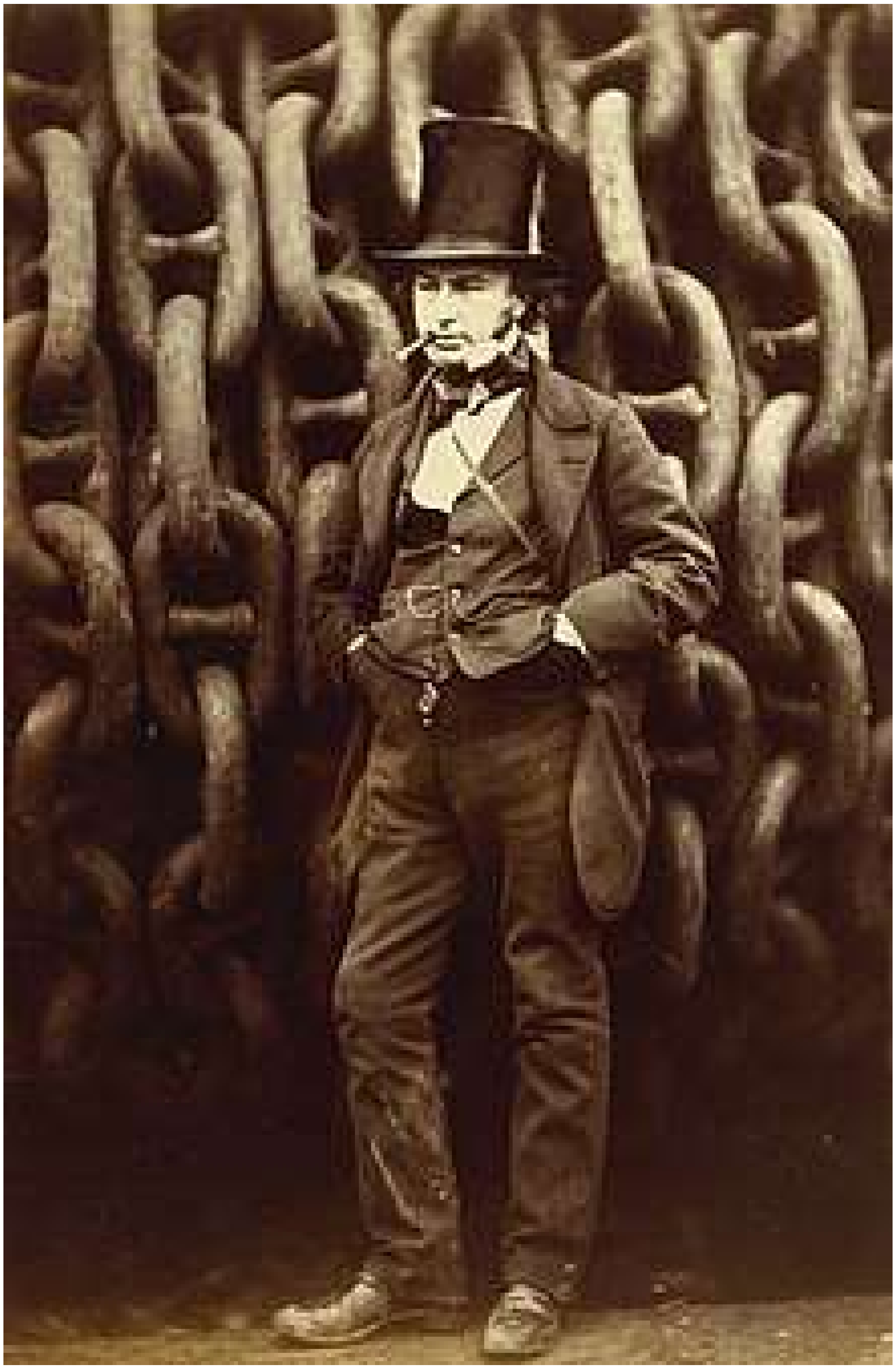

Figure 3.11: **The great 19th century engineer, Isambard Kingdom Brunel (1806-1959), beside the launching chain of the Great Eastern.**

3.5 Marconi

The waves detected by Hertz were, in fact, radio waves; and it was not long before the Italian engineer, Guglielmo Marconi (1874-1937), turned the discovery into a practical means of communication. In 1898, Marconi used radio signals to report the results of the boat races at the Kingston Regatta, and on December 12, 1901, using balloons to lift the antennae as high as possible, he sent a signal across the Atlantic Ocean from England to Newfoundland.

In 1904, a demonstration of a voice-carrying radio apparatus developed by Fessenden was the sensation of the St. Louis World's Fair; and in 1909, Marconi received the Nobel Prize in physics for his development of radio communications. In America, the inventive genius of Alexander Graham Bell (1847-1922) and Thomas Alva Edison (1847-1931) turned the discoveries of Faraday and Maxwell into the telephone, the electric light, the cinema and the phonograph.

Figure 3.12: **Marconi's wireless telegraph**

3.6 Alexander Graham Bell

Alexander Graham Bell (1847-1922) is credited with inventing the first workable telephone, but in addition, his inventions and scientific work reached many other fields. Bell was born in Edinburgh, Scotland, where his father. Professor Alexander Melville Bell, worked in phonetics, a branch of linguistics that studies the sounds of human speech and their physical properties. Alexander Graham Bell's grandfather and his two brothers also worked in this field.

At the age of 12, Alexander Graham Bell invented a dehusking machine that was used for many years to prepare grain to be milled into flour. As a reward, the local mill owner and gave young Bell the materials and workshop that he needed to work on other inventions.

Motivated not only by the fact that so many of his family members worked in phonetics but also by his mother's gradually increasing deafness, Bell began experiments on the mechanical reproduction of sound. When he was 19, a report on Bell's work in this field was sent to Alexander Ellis[1]. Ellis informed Bell that very similar work had been done in Germany by Hermann von Helmholtz. Unable to read German, Bell studied a French translation of the work of von Helmholtz. He later said:

"Without knowing much about the subject, it seemed to me that if vowel sounds could be produced by electrical means, so could consonants, so could articulate speech. I thought that Helmholtz had done it ... and that my failure was due only to my ignorance of electricity. It was a valuable blunder ... If I had been able to read German in those days, I might never have commenced my experiments!"

When Bell was 23, he and his family moved to Canada because several family members were threatened with tuberculosis[2]. They hoped that Canada's climate would help their struggles with the disease. Two years later Bell moved to Boston, Massachusetts, where he opened his School of Vocal Physiology and Mechanics of Speech. Among his numerous students was Helen Keller.

Because the late nights and overwork resulting from combining electrical voice transmission experimentation with teaching was affecting his health, Bell decided to keep only two students, 6 year old Georgie Sanders and 15 year old Mable Hubbard. Georgie Sanders' wealthy father provided Bell with free lodging and a laboratory. Mable was a bright and attractive girl, ten years younger than Bell, and she later became his wife.

At that time, in 1874, the telegraph was becoming more and more commercially important, and William Orton, the President of the Western Union telegraph company had hired Thomas Edison and Elisha Gray to invent a method for sending multiple messages over the same wire. When Bell confided to the wealthy fathers of his two pupils that he was working on a method to send multiple voice messages over the same wire, the two fathers supported Bell's race with Edison and Gray to be first with a practical method and a patent.

[1] later portrayed as Henry Higgins in Shaw's play *Pygmalion*

[2] Both of Bell's brothers eventually died of tuberculosis.

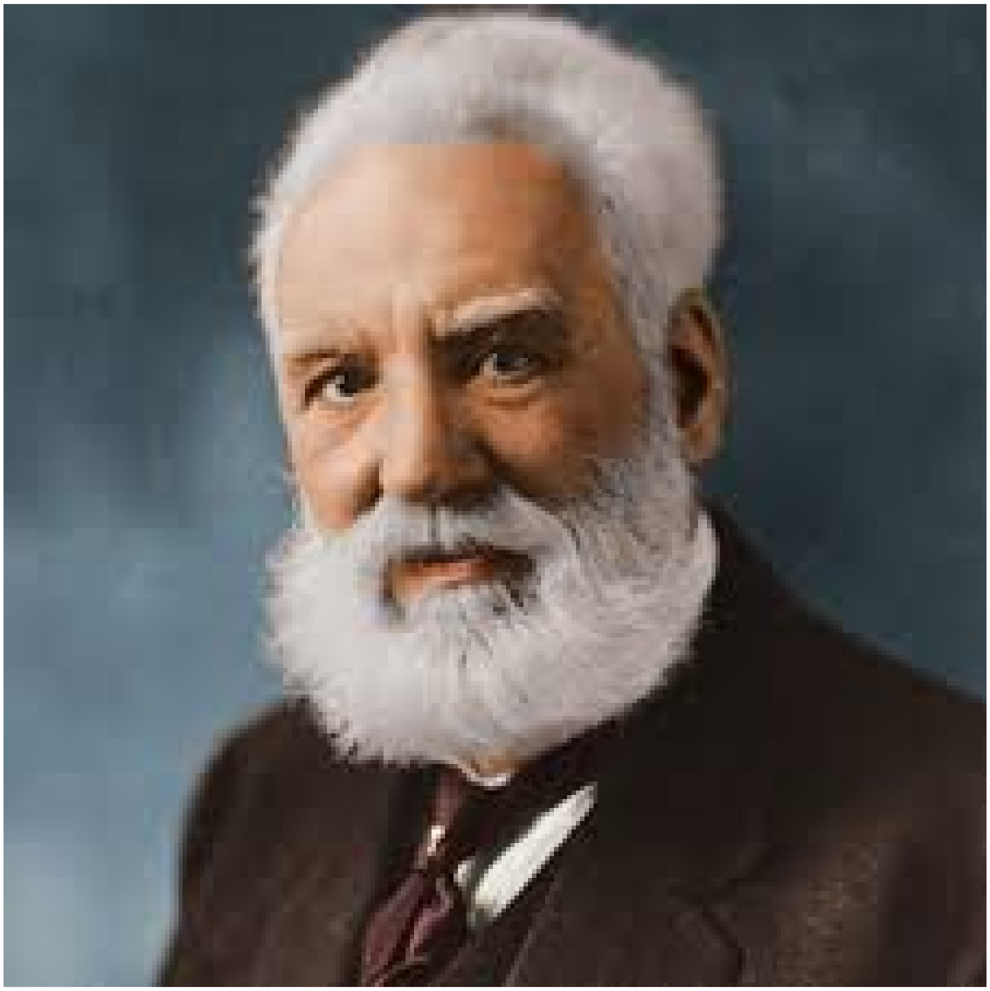

Figure 3.13: **Alexander Graham Bell (1847-1922).**

In the same year, Bell happened to meet Thomas A. Watson, an experienced designer of electrical machines. With the financial help of Sanders and Hubbard, Bell hired Watson as his assistant. In 1876, Bell spoke the first intelligible words over his newly invented telephone: "Mr. Watson, come here. I need you." That same year U.S. and U.K patents were granted to Bell, but a somewhat similar patent application from Elisha Gray had arrived almost simultaneously, initiating a controversy over priority.

Bell and his supporters offered to sell another patent which covered their method for sending multiple messages over the same telegraph wire to Western Union for $100,000, but the offer was refused. Two years later the President of Western Union said that if he could obtain the patent for $25,000,000, he would consider it a bargain, but by that time, the Bell Telephone Company no longer wished to sell.

Although Bell is best known for the telephone, his interests were very wide According to Wikipedia,

Bell's work ranged "unfettered across the scientific landscape" and he often went to *bed voraciously reading the Encyclopedia Britannica, scouring it for new areas of interest. The range of Bell's inventive genius is represented only in part by the 18 patents granted in his name alone and the 12 he shared with his collaborators. These included 14 for the telephone and telegraph, four for the photophone, one for the phonograph, five for aerial vehicles, four for "hydroairplanes", and two for selenium cells. Bell's inventions spanned a wide range of interests and included a metal jacket to assist in breathing, the audiometer to detect minor hearing problems, a device to locate icebergs, investigations on how to separate salt from seawater, and work on finding alternative fuels.*

Bell worked extensively in medical research and invented techniques for teaching speech to the deaf. During his Volta Laboratory period, Bell and his associates considered impressing a magnetic field on a record as a means of reproducing sound. Although the trio briefly experimented with the concept, they could not develop a workable prototype. They abandoned the idea, never realizing they had glimpsed a basic principle which would one day find its application in the tape recorder, the hard disc and floppy disc drive, and other magnetic media.

Bell's own home used a primitive form of air conditioning, in which fans blew currents of air across great blocks of ice. He also anticipated modern concerns with fuel shortages and industrial pollution. Methane gas, he reasoned, could be produced from the waste of farms and factories. At his Canadian estate in Nova Scotia, he experimented with composting toilets and devices to capture water from the atmosphere. In a magazine interview published shortly before his death, he reflected on the possibility of using solar panels to heat houses.

As of today, the Bell Laboratories, funded by the Bell Telephone Company, has produced 13 Nobel Prize winners. Most notably, the 1956 Nobel Prize in Physics was shared by Bell Laboratory scientists John Bardeen, Walter Brattain, and William Shockley for the invention of the transistor, a device that has made the astonishing modern stages of the information explosion possible.

Even Maxwell himself, in building up his ideas, made use of mechanical models, "..replete with ropes passing over pulleys, rolled over drums, pulling weights, or at times comprising tubes pumping water into other elastic tubes which expanded and contracted, the whole mass of machinery noisy with the grinding of interlocked gear wheels". In the end, however, Maxwell abandoned as unsatisfactory the whole clumsy mechanical scaffolding which he had used to help his intuition; and there is no trace of mechanical ideas in his final equations. As Synge has expressed it, "The robust body of the Cheshire cat was gone, leaving in its place only a sort of mathematical grin".

Lord Kelvin (1824-1907), a prominent English physicist of the time, was greatly disappointed because Maxwell's theory could offer no mechanical explanation for electromagnetism; and he called the theory "a failure - the hiding of ignorance under the cover of a formula". In Germany, the eminent physicist, Hermann von Helmholtz (1821-1894), tried hard to understand Maxwell's theory in mechanical terms, and ended by accepting Maxwell's equations without ever feeling that he really understood them.

In 1883, the struggles of von Helmholtz to understand Maxwell's theory produced a dramatic proof of its correctness: Helmholtz had a brilliant student named Heinrich Hertz (1857-1894), whom he regarded almost as a son. In 1883, the Berlin Academy of Science offered a prize for work in the field of electromagnetism; and von Helmholtz suggested to Hertz that he should try to win the prize by testing some of the predictions of Maxwell's theory.

Hertz set up a circuit in which a very rapidly oscillating electrical current passed across a spark gap. He discovered that electromagnetic waves were indeed produced by this rapidly-oscillating current, as predicted by Maxwell! The waves could be detected with a small ring of wire in which there was a gap. As Hertz moved about the darkened room with his detector ring, he could see a spark flashing across the gap, showing the presence of electromagnetic waves, and showing them to behave exactly as predicted by Maxwell.

The waves detected by Hertz were, in fact, radio waves; and it was not long before the Italian engineer, Guglielmo Marconi (1874-1937), turned the discovery into a practical means of communication. In 1898, Marconi used radio signals to report the results of the boat races at the Kingston Regatta, and on December 12, 1901, using balloons to lift the antenae as high as possible, he sent a signal across the Atlantic Ocean from England to Newfoundland.

In 1904, a demonstration of a voice-carrying radio apparatus developed by Fessenden was the sensation of the St. Louis World's Fair; and in 1909, Marconi received the Nobel Prize in physics for his development of radio communications. In America, the inventive genius of Alexander Graham Bell (1847-1922) and Thomas Alva Edison (1847-1931) turned the discoveries of Faraday and Maxwell into the telephone, the electric light, the cinema and the phonograph.

3.7 A revolution in communication

The modern communication revolution began with the prediction of electromagnetic waves by James Clerk Maxwell, their discovery by Heinrich Hertz, Marconi's wireless telegraph messages across the Atlantic, and the invention of the telephone by Alexander Graham Bell. Radio and television programs were quick to follow. Today cell phones and Skype allow us to talk across vast distances with little effort and almost no expense. The Internet makes knowledge universally and instantly available.

Suggestions for further reading

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2. F.K. Richtmeyer and E.H. Kennard, *Introduction to Modern Physics*, McGraw-Hill (1947).
3. E.T. Whittaker, *A History of the Aether and Electricity*, Cambridge University Press (1953).
4. D.K.C. Macdonald, *Faraday, Maxwell and Kelvin*, Heinemann, London (1964).
5. Otto Glasser, *Wilhelm Conrad Röntgen and the Early History of Röntgen Rays*, Charles C. Thomas, Springfield Illinois (1934).

Chapter 4

MENDELEEV

4.1 Mendeléev's family and education

Among the distinguished delegates listening to Cannizzaro at the Karlsruhe Congress in 1860, was the brilliant young Russian chemist, Dmitri Ivanovich Mendeléev (1834-1907). He had been born in Tobolsk, Siberia, the youngest child in a family of 14 (some accounts even say 17!). His grandfather had brought the first printing press to Siberia, and had published Siberia's first newspaper. His father had been the principal of the high-school in Tobolsk, before blindness forced his retirement. Mendeléev's mother, a part-Mongol woman of incredible energy, then set up a glass factory to support her large family.

When Mendeléev was in his teens, two disasters struck the family: His father died and the glass factory burned down. His mother then gathered her last remaining strength, and traveled to St. Petersburg, where a friend of her dead husband obtained a university place for her favorite son, Dmitri. Soon afterward, she died.

After graduating from the university at the top of his class, Dmitri Mendeléev went to Germany to do postgraduate work under Bunsen, (the inventor of the spectroscope and the "Bunsen burner"). In 1860, he attended the First International Congress of Chemistry at Karlsruhe; and like Lothar Meyer, he was profoundly impressed by Cannizzaro's views on atomic weights. In 1861, Mendeleév published a textbook entitled *Organic Chemistry*, which won him the Demidov Prize of the Petersburg Academy of Sciences.

4.2 Mendeléev and the periodic table

Returning to St. Petersburg, (where he became a professor of chemistry in 1866), Mendeléev began to arrange the elements in order of their atomic weights. He soon noticed that when the elements were arranged in this way, their chemical properties showed a periodic variation. Arranged in order of their atomic weights, the first few elements were hydrogen, (helium was then unknown), lithium, beryllium, boron, carbon, nitrogen, oxygen and fluorine. Mendeléev noticed that lithium was a very active metal, with a valence (combining power) of 1; beryllium was a metal, with valence 2; boron had valence 3; and carbon had valence 4. Next came the non-metals: nitrogen with valence 3; oxygen with valence 2; and finally came fluorine, a very active non-metal with valence 1.

Continuing along the list of elements, arranged in order of their atomic weights, Mendeléev came next to sodium, a very active metal with valence 1; magnesium, a metal with valence 2; aluminum, with valence 3; silicon, with valence 4; phosphorus, a non-metal, with valence 3; sulphur, a non-metal with valence 2; and finally chlorine, a very active non-metal with valence 1. Mendeléev realized that there is a periodicity in the chemical properties of the elements: The elements of the first period, arranged in order of increasing atomic weight, had the valences 1,2,3,4,3,2,1. The second period exhibited the same pattern: 1,2,3,4,3,2,1.

When he arranged all of the known elements in a table which exhibited the periodicity of their chemical properties, Mendeléev could see that there were some gaps. These gaps, he reasoned, must correspond to undiscovered elements! By studying the rows and columns of his periodic table, he calculated the chemical properties and the approximate atomic weights which these yet-unknown elements ought to have.

Mendeléev's predictions, made in 1869, were dramatically confirmed a decade later, when three of the elements whose discovery he had prophesied were actually found, and when their atomic weights and chemical properties turned out to be exactly as he had predicted! The discovery of these elements made Mendeléev world-famous, and it was clear that his periodic table contained some deep truth. However, the underlying meaning of the periodic table was not really understood; and it remained a mystery until it was explained by quantum theory in 1926.

Remembering his work on the periodic table, Mendeleév wrote: "I saw in a dream a table where all elements fell into place as required. Awakening, I immediately wrote it down on a piece of paper, only in one place did a correction later seem necessary."

For the eight elements whose properties he predicted, Mendeleév used Sanskrit prefaces to relate them to known elements. For example, he called germanium (then undiscovered) *ekasilicon*, while gallium became *ekaaluminium* and scandium *ekaboron*.

Dmitri Mendeleév made many other contributions to science besides the periodic table. For example, he investigated the composition and properties of petroleum and founded Russia's petroleum industry. He recognized the importance of petroleum as a starting point for the synthesis of organic compounds, and remarked that burning petroleum as a fuel "would be akin to firing up a kitchen stove with bank notes".

The Russian historian of science Lev Chugaev has characterized Mendeleév as "a chemist of genius, first-class physicist, a fruitful researcher in the fields of hydrodynamics, meteorology, geology, certain branches of chemical technology (explosives, petroleum, and fuels, for example) and other disciplines adjacent to chemistry and physics, a thorough expert of chemical industry and industry in general, and an original thinker in the field of economy." Mendeleev was one of the founders, in 1869, of the Russian Chemical Society. He worked on the theory and practice of protectionist trade and on agriculture."

Shortly after Mendeleév's publication of his periodic table of the known elements and his prediction of the properties of several as yet undiscovered ones, Lothar Meyer, in Germany, published a very similar, independently-derived table, but without Mendeleév's

Figure 4.1: **Dmitri Mendeleev, (1834-1907) in an early portrait.**

predictions.

Figure 4.2: **Dmitri Mendeleev in 1897.**

Figure 4.3: **Julius Lothar Meyer (1830-1895). He independently proposed a periodic table almost identical to that of Mendeleév, but published slightly later. Both men had worked with Robert Bunsen.**

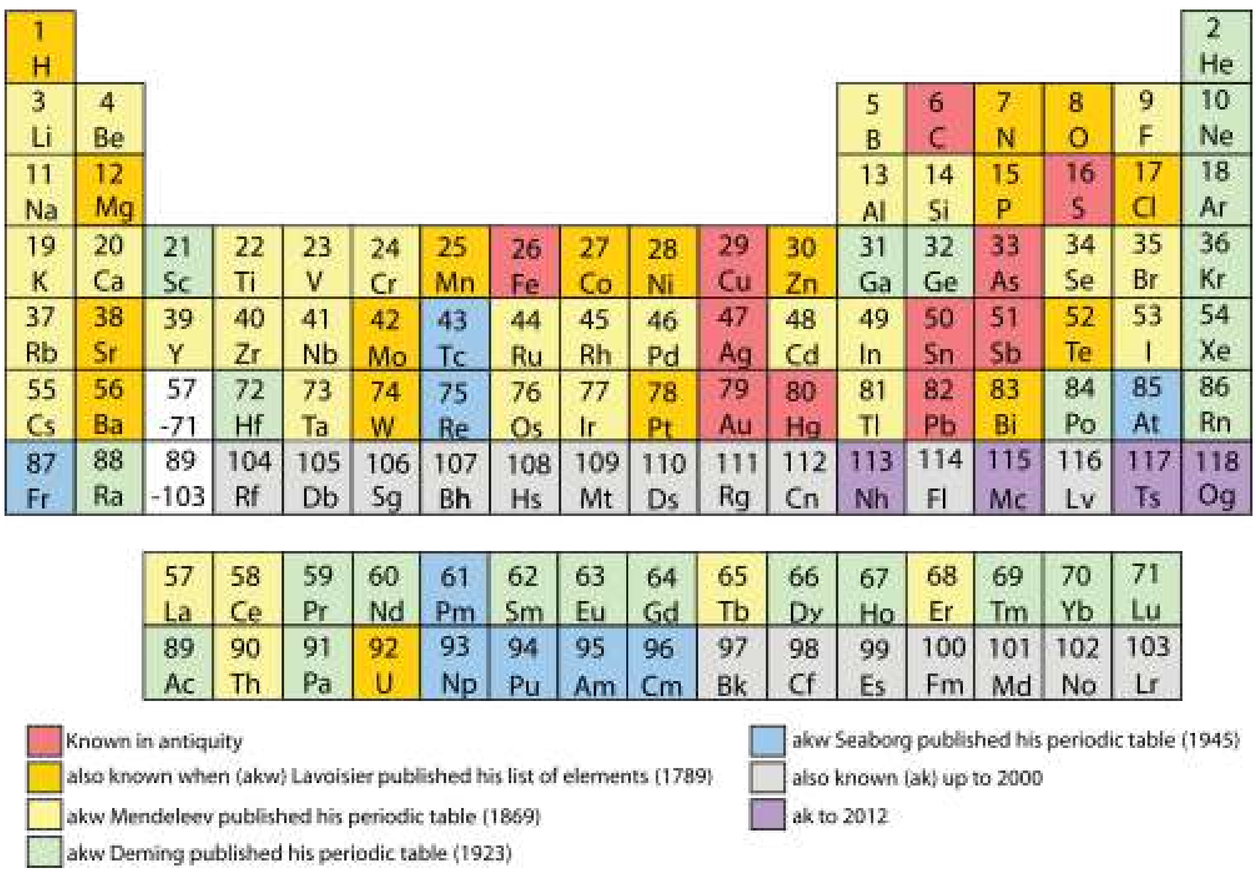

Figure 4.4: **The periodic table of the elements.**

Suggestions for further reading

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Chapter 5

QUEEN VICTORIA AND PRINCE ALBERT

5.1 Victoria's lonely childhood

Wikipedia states that

> **"Victoria was raised largely isolated from other children under the so-called 'Kensington System', an elaborate set of rules and protocols devised by the Duchess and her ambitious and domineering comptroller, Sir John Conroy, who was rumored to be the Duchess's lover. The system prevented the princess from meeting people whom her mother and Conroy deemed undesirable (including most of her father's family), and was designed to render her weak and dependent upon them. The Duchess avoided the court because she was scandalized by the presence of King William's illegitimate children. Victoria shared a bedroom with her mother every night, studied with private tutors to a regular timetable, and spent her play-hours with her dolls and her King Charles Spaniel, Dash."**

Victoria was, at that time, the heir presumptive to the British throne. The Duchess mentioned in the quotation from Wikipedia, was Victoria's German mother, Princess Victoria of Saxe-Coburg-Saalfeld, who later became the Duchess of Kent and Strathearn. Victoria bravely resisted the tyranny that her mother and Conroy imposed on her.

Figure 5.1: **Victoria at age four, by Stephen Poyntz Denning (1823).**

Figure 5.2: **Portrait of Victoria with her spaniel Dash by George Hayter, 1833.**

Figure 5.3: **Self-portrait, 1835.**

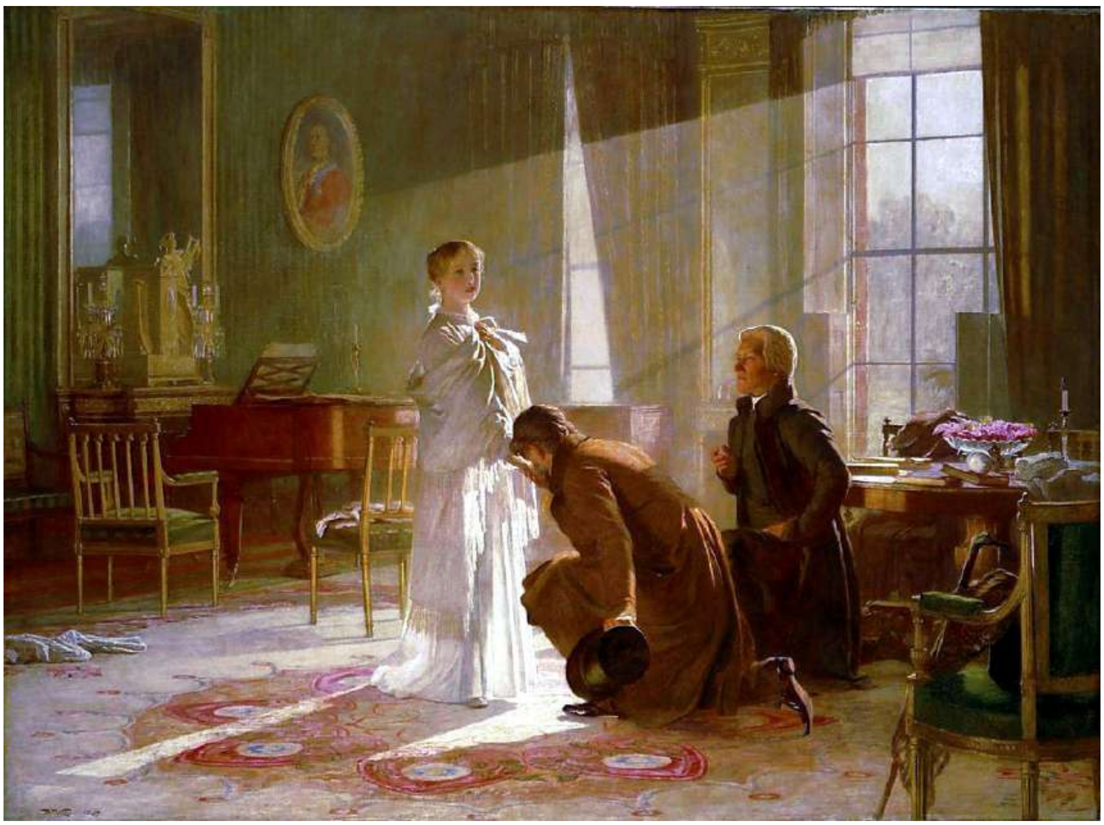

Figure 5.4: **Victoria receives the news of her accession from Lord Conyngham (left) and the Archbishop of Canterbury. Painting by Henry Tanworth Wells, 1887.**

Figure 5.5: **Coronation portrait by George Hayter.**

5.2 Victoria meets and marries Prince Albert

Victoria was aware of the various matrimonial plans and critically appraised a parade of eligible princes to whom she was introduced. According to her diary, she enjoyed Albert's company from the beginning. After the visit she wrote, "[Albert] is extremely handsome; his hair is about the same colour as mine; his eyes are large and blue, and he has a beautiful nose and a very sweet mouth with fine teeth; but the charm of his countenance is his expression, which is most delightful."

Victoria wrote to King Leopold of Belgium, whom she considered her "best and kindest adviser", to thank him "for the prospect of great happiness you have contributed to give me, in the person of dear Albert ... He possesses every quality that could be desired to render me perfectly happy. He is so sensible, so kind, and so good, and so amiable too. He has besides the most pleasing and delightful exterior and appearance you can possibly see."

Victoria and Albert were married on 10 February 1840, in the Chapel Royal of St James's Palace, London. Victoria was love-struck. She wrote in her diary, "I NEVER, NEVER spent such an evening!!! MY DEAREST DEAREST DEAR Albert ... his excessive love & affection gave me feelings of heavenly love & happiness I never could have hoped to have felt before! He clasped me in his arms, & we kissed each other again & again! His beauty, his sweetness & gentleness - really how can I ever be thankful enough to have such a Husband! "

Albert was Victoria's first cousin. Their children married into royal and noble families across the continent, earning Victoria the sobriquet "the grandmother of Europe" and spreading hemophilia in European royalty.

Besides being a good and much-loved husband for Victoria, Prince Albert was an extremely idealistic person. He wished to promote culture, science and industry in Britain. His greatest triumph in this respect was the Great Exhibition of 1850, which he was very largely instrumental in organizing. When the Great Exhibition was over, everyone wondered what should be done with the many buildings that had been constructed to house it. Prince Albert proposed that some of the buildings should become museums, while others should house a Royal College if Science. His plan was followed, and today the region of South Kensington, London, near to Exhibition Road, has become a great center of culture. The Royal College of Science, founded by Prince Albert, has become today's Imperial College of Science and Technology. The whole region north of the South Kensington underground station up to the Royal Albert Hall and the Albert Memorial, is affectionately known as "Albertsville".

After Prince Albert's early death in 1861, Queen Victoria withdrew from public life and went into a period of prolonged mourning.

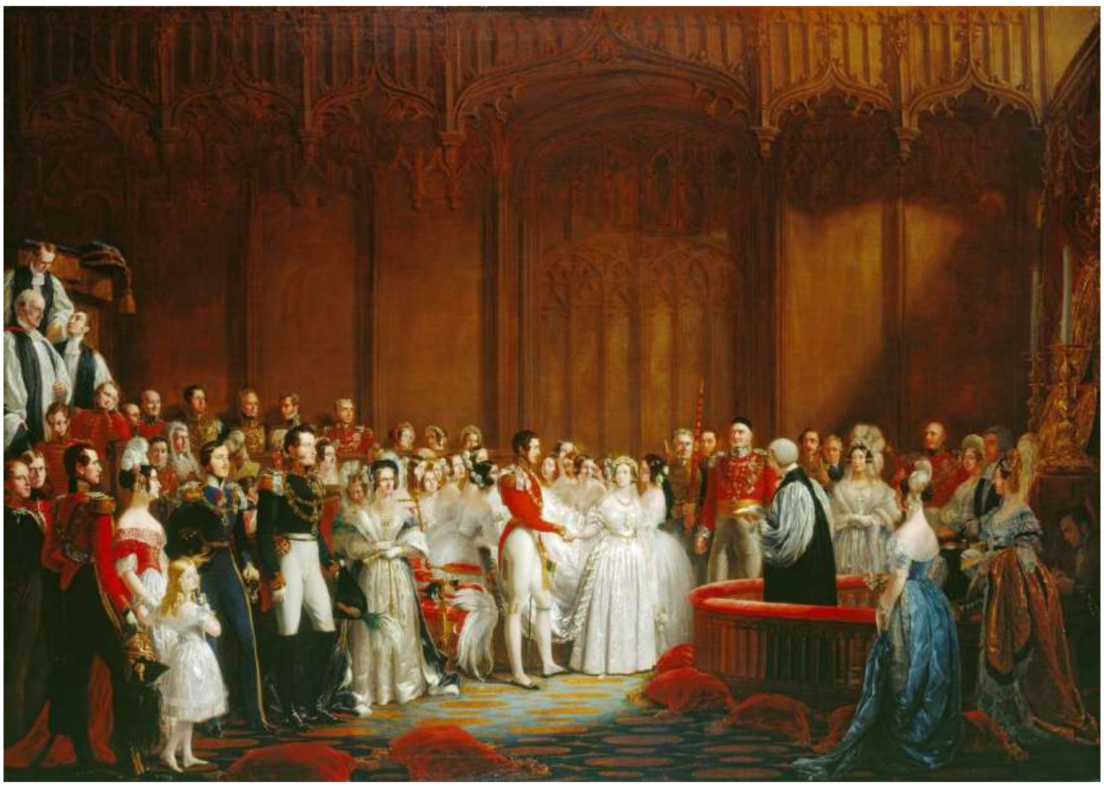

Figure 5.6: **Marriage of Victoria and Albert, painted by George Hayter.**

Figure 5.7: **Earliest known photograph of Victoria.**

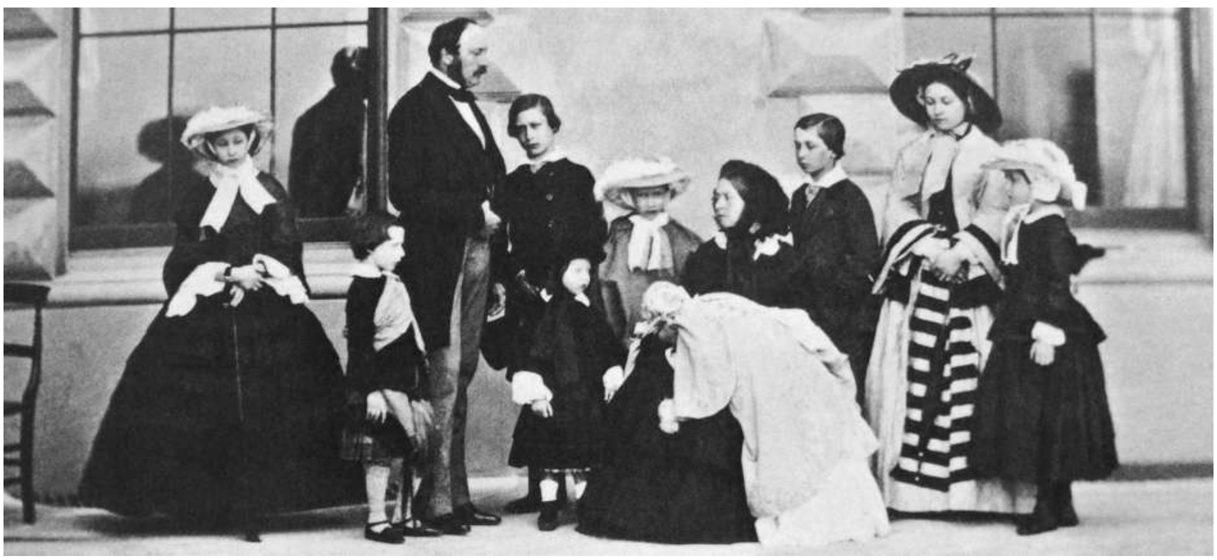

Figure 5.8: **Albert, Victoria and their nine children, 1857. Left to right: Alice, Arthur, Prince Albert, Albert Edward, Leopold, Louise, Queen Victoria with Beatrice, Alfred, Victoria and Helena.**

Figure 5.9: **Victoria and John Brown at Balmoral, 1863. Photograph by G. W. Wilson.**

Figure 5.10: **Photograph of Queen Victoria, 1882.**

Figure 5.11: **Queen Victoria aged 80, 1899.**

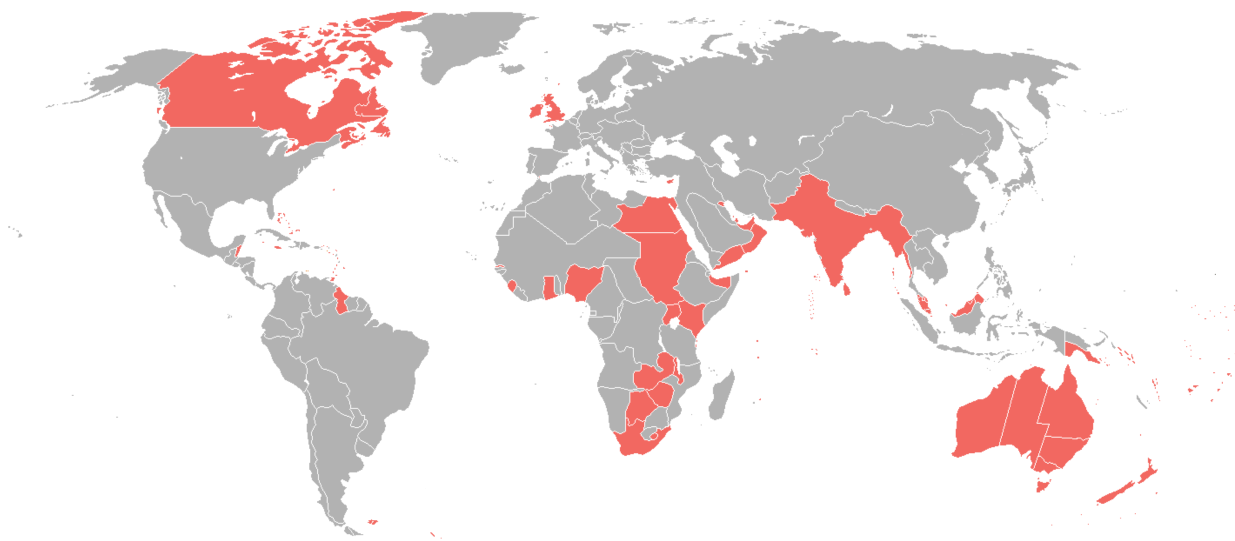

Figure 5.12: **Extent of the British Empire in 1898. Gladstone and Disraeli often alternated as Prime Ministers during Victoria's reign. Victoria preferred Disraeli, who flattered her. Unfortunately he advocated imperialism, while Gladstone opposed it. British imperialism conferred some benefits on the countries subject to British rule, but it also involved unspeakable cruelties. For example, during the Great Famine of 1876-1878, Lord Robert Bulwer-Lytton, the Viceroy of India, ordered that grain should continue to be exported, despite the fact that millions of people were starving. The excess mortality in India resulting from Lytton's policies has been estimated to be between 5.5 million and 9.6 million deaths.**

Chapter 6

JOHN TYNDALL AND SVANTE ARRHENIUS

6.1 John Tyndall

Tyndall's early life in Ireland

John Tyndall (1820-1893) was an important pioneer of climate science. He was born in Ireland, and as a young man worked as a surveyor for railway companies. In an era of rapid railway expansion, it was lucrative work.

Study of experimental physics in Germany

Later, when the railway building work slackened, he became a teacher of mathematics and surveying at Queenwood College. At the college, Tyndall became the close friend of Edward Frankland, who was later knighted for founding the field of organo-metalic chemistry. The two friends decided that they needed further education in experimental physics, and that this could only be obtained in Germany. Accordingly, they enrolled at the University of Marburg where they studied under the famous experimental physicist Robert Bunsen, as well as Professor Heinrich Gustav Magnus.

Professor of physics at the Royal Institution

Returning to England, Tyndall used his experimental proficiency to study the phenomenon of diamagneism, and its relationship to the arrangement of molecules in diamagnetic materials. This work brought him to the favorable attention of Michael Faraday, the Director of the Royal Institution. Faraday appointed Tyndall as Professor of Physics at the Royal Institution. It was here that Tyndall performed his pioneering experiments which led to his discovery of infrared radiation, and to his measurements of the absorption of radiation by many gases that are found in the earth's atmosphere. He studied many gases, including water vapor, carbon dioxide, methane, oxygen and nitrogen, and concluded that water vapor is the strongest absorber of infrared radiation. His experiments required great skill and dexterity, in addition to scientific understanding.

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- Tyndall, J. (1865), *On Radiation: One Lecture*, (40 pages)
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- Tyndall, J. (1869), *Natural Philosophy in Easy Lessons* (180 pages) (a physics book intended for use in secondary schools)
- Tyndall, J. (1870), *Faraday as a discoverer*, Longmans, Green, London
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- Tyndall, J. (1872), *Contributions to Molecular Physics in the Domain of Radiant Heat, (a compilation of 1860s research reports)*, (1873 edition), D. Appleton and Company, New York
- Tyndall, J. (1873), *The forms of water in clouds & rivers, ice & glaciers*, H. S. King &*Co., London*
- Tyndall, J. (1873), *Six Lectures on Light* (290 pages)
- Tyndall, J. (1876), *Lessons in Electricity at the Royal Institution* (100 pages), (intended for secondary school students)
- Tyndall, J. (1878), *Sound; delivered in eight lectures*, (1969 edition), Greenwood Press, New York
- Tyndall, J. (1882), *Essays on the floating matter of the air, in relation to putrefaction and infection*, D. Appleton, New York
- Tyndall, J. (1887), *Light and electricity: notes of two courses of lectures before the Royal institution of Great Britain*, D. Appleton and Company, New York
- Tyndall, J. (1892), *New Fragments (miscellaneous essays for a broad audience)*, D. Appleton, New York

Figure 6.1: **Jean Baptiste Joseph Fourier (1768-1830), French mathematician and natural philosopher, did groundbreaking work in mathematics and the theory of heat. He was the first to propose that the Earth's atmosphere acts to raise the planet's temperature.**

Figure 6.2: **Eunice Newton Foote (1819-1888) was the first person to perform measurements on the absorption of radiation by CO_2. Since she worked in the United States and published her results there, John Tyndall did not know of her work**

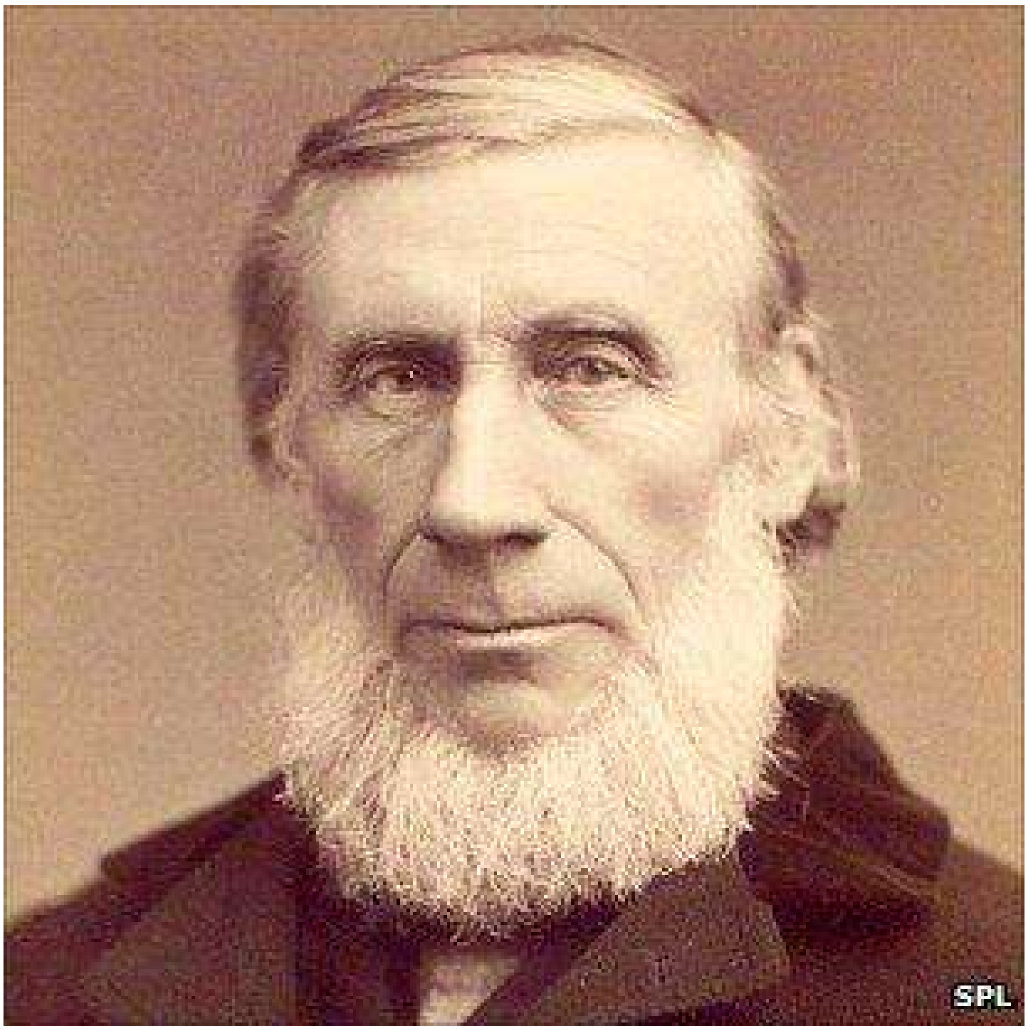

Figure 6.3: **John Tyndall (1820-1893) was a physicist who discovered, among many other things, infrared radiation. Because of his studies of the absorption of radiation by CO_2 and many other gases, he is considered to be an important pioneer of climate science.**

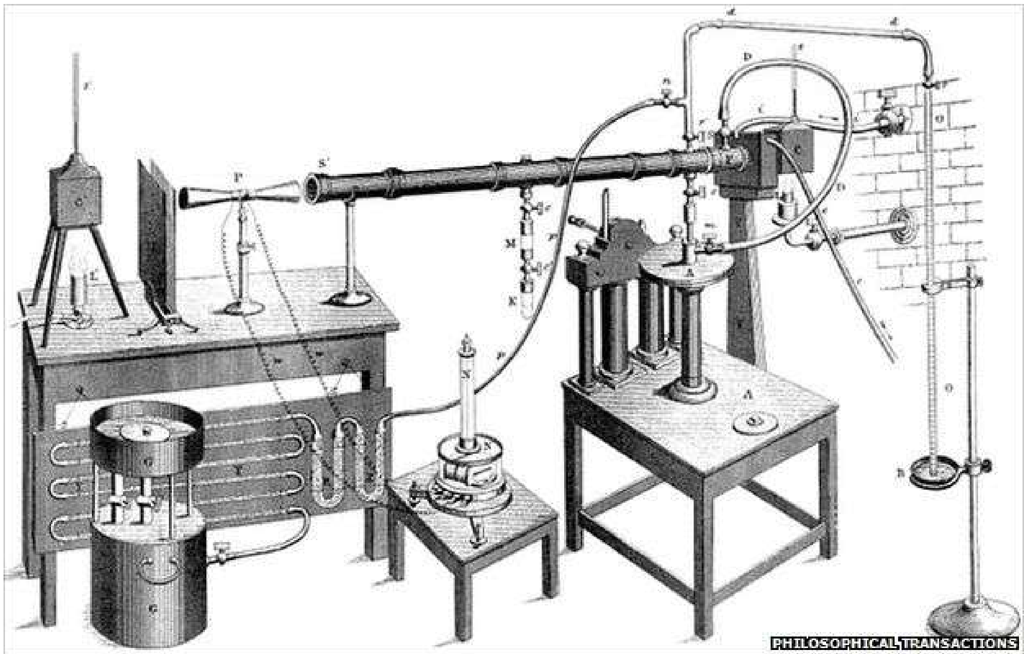

Figure 6.4: **Tyndall's experiment for measuring the absorption of radiation by various gases. It required tremendous dexterity, as well as experimental understanding.**

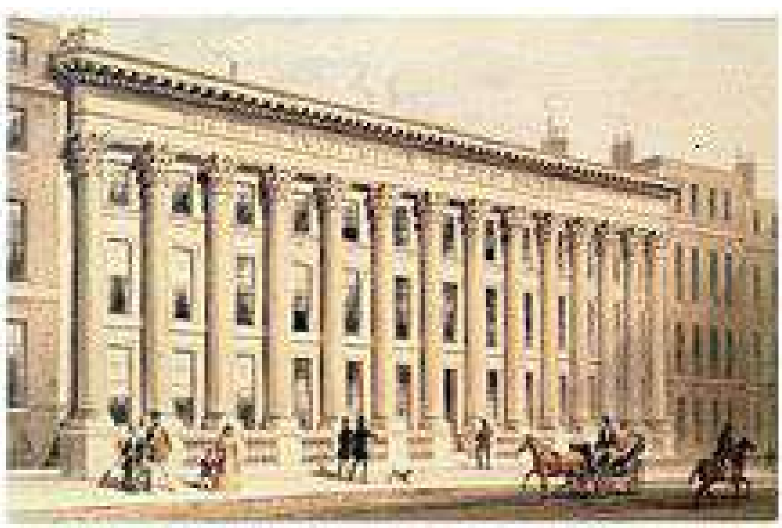

Figure 6.5: **The Royal Institution building on Albemarle Street, London, circa 1838. Queen Victoria's husband, Prince Albert, often attended lectures there together with his sons.**

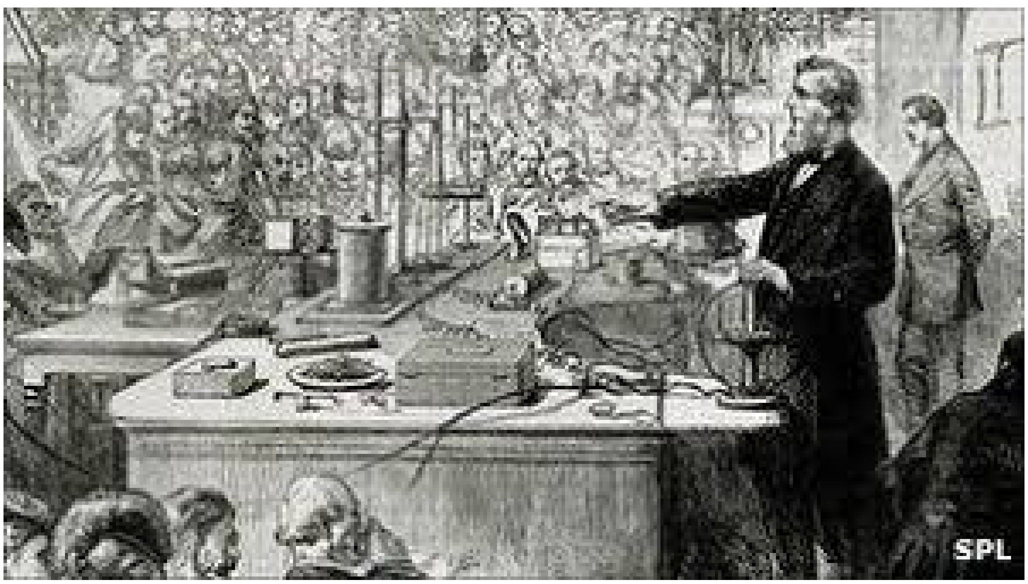

Figure 6.6: **Tyndall lecturing at the Royal Institution.**

6.2 Svante Arrhenius

Svante Augustus Arrhenius was born in Wik Castle, Sweden in 1859, the son of Svante Gustav and Carolina Thunberg Arrhenius. He was a child prodigy, who without encouragement from his parents, taught himself to read at the age of 3. As a very young child, he also became an arithmetical prodigy by watching his father add numbers in his account books.

Arrhenius started research at the University of Uppsala, but he was dissatisfied with the instruction in physics and chemistry. In 1881 he moved to the Swedish Academy of Sciences in Stockholm. There he produced a Ph.D. dissertation which focused on conductivity of electrolytes. The dissertation was so contrary to the chemical ideas of the time that it was accepted only grudgingly by the committee judging it, and Arrhenius was only granted a 4th class degree. Nevertheless, the 56 propositions put forward in the dissertation are universally accepted today, almost entirely without modification, and they won Arrhenius the 1903 Nobel Prize in Chemistry.

Michael Faraday (1791-1867) had previously shown that charged particles, which he named "ions", could carry an electrical current through a solution. Arrhenius developed Faraday's concept of ions by demonstrating that when salts are dissolved in water, ions are present even without an electrical current. He also defined acids to be substances which produce solutions in which H^+ ions predominate, while in bases, when dissolved, produce solutions in which OH^- ions predominate.

In chemical reaction theory, Arrhenius introduced the idea of an activation energy, E_a, which can be thought of as the height of an energy barrier which must be surmounted in order for the reaction to take place. Thus most chemical reactions become more probable when the temperature T is raised, since the rapid motion of the reactants at higher temperatures can supply the energy needed to overcome the reaction barrier E_a. Arrhenius connected the concept of activation energy with the statistical mechanics of Ludwig Boltzmann (1844-1906) by means of his famous equation:

$$k = A\ e^{-E_a/RT}$$

In the Arrhenius equation, k is the reaction rate, A is a constant proportional to the frequency of reactant collisions with the proper orientation, T is the absolute temperature, and R is the constant that appears in the equation of state of a perfect gas, $PV = nRT$.

Climate science

Wikipedia states that "In developing a theory to explain the ice ages, Arrhenius, in 1896, was the first to use basic principles of physical chemistry to calculate estimates of the extent to which increases in atmospheric carbon dioxide (CO_2) will increase Earth's surface temperature through the greenhouse effect.

"These calculations led him to conclude that human-caused CO2 emissions, from fossil-fuel burning and other combustion processes, are large enough to cause global warming.

Figure 6.7: **Svante Arrhenius (1859-1927) was one of the main founders of physical chemistry and a pioneer of climate science. A child prodigy, he taught himself to read and to calculate at the age of three. He was related to climate activist Greta Thunberg, and Greta's father, Svante Thunberg, is named after him. Arrhenius received the Nobel Prize in Chemistry in 1903 for work that he had done much earlier when he was writing his doctoral dissertation.**

This conclusion has been extensively tested, winning a place at the core of modern climate science.

"Arrhenius, in this work, built upon the prior work of other famous scientists, including Joseph Fourier, John Tyndall and Claude Pouillet. Arrhenius wanted to determine whether greenhouse gases could contribute to the explanation of the temperature variation between glacial and inter-glacial periods. Arrhenius used infrared observations of the moon - by Frank Washington Very and Samuel Pierpont Langley at the Allegheny Observatory in Pittsburgh - to calculate how much of infrared (heat) radiation is captured by CO2 and water (H2O) vapour in Earth's atmosphere...

"Based on information from his colleague Arvid Högbom, Arrhenius was the first person to predict that emissions of carbon dioxide from the burning of fossil fuels and other combustion processes were large enough to cause global warming. In his calculation Arrhenius included the feedback from changes in water vapor as well as latitudinal effects, but he omitted clouds, convection of heat upward in the atmosphere, and other essential factors. His work is currently seen less as an accurate quantification of global warming than as the first demonstration that increases in atmospheric CO2 will cause global warming, everything else being equal."

Some quotations from Arrhenius' book, *Worlds in the Making*

To a certain extent the temperature of the earth's surface, as we shall presently see, is conditioned by the properties of the atmosphere surrounding it, and particularly by the permeability of the latter for the rays of heat. (p46)

That the atmospheric envelopes limit the heat losses from the planets had been suggested about 1800 by the great French physicist Fourier. His ideas were further developed afterwards by Pouillet and Tyndall. Their theory has been styled the hot-house theory, because they thought that the atmosphere acted after the manner of the glass panes of hot-houses. (p51)

If the quantity of carbonic acid [CO_2] in the air should sink to one-half its present percentage, the temperature would fall by about 4^o; a diminution to one-quarter would reduce the temperature by 8^o. On the other hand, any doubling of the percentage of carbon dioxide in the air would raise the temperature of the earth's surface by 4^o; and if the carbon dioxide were increased fourfold, the temperature would rise by 8^o. (p53)

Although the sea, by absorbing carbonic acid, acts as a regulator of huge capacity, which takes up about five-sixths of the produced carbonic acid, we yet recognize that the slight percentage of carbonic acid in the atmosphere may by the advances of industry be changed to a noticeable degree in the course of a few centuries. (p54)

Since, now, warm ages have alternated with glacial periods, even after man appeared on the earth, we have to ask ourselves: Is it probable that we shall in the coming geological ages be visited by a new ice period that will drive us from our temperate countries into the hotter climates of Africa? There

does not appear to be much ground for such an apprehension. The enormous combustion of coal by our industrial establishments suffices to increase the percentage of carbon dioxide in the air to a perceptible degree. (p61)

Suggestions for further reading

1. Eve, A.S.; Creasey, C.H. (1945). *Life and Work of John Tyndall*. London: Macmillan. 430 pages. This is the "official" biography.
2. William Tulloch Jeans wrote a 100-page biography of Professor Tyndall in 1887 (the year Tyndall retired from the Royal Institution). Downloadable.
3. Louisa Charlotte Tyndall, his wife, wrote an 8-page biography of John Tyndall that was published in 1899 in Dictionary of National Biography (volume 57). It is readable online (and a 1903 republication of the same biography is also readable online).
4. Edward Frankland, a longtime friend, wrote a 16-page biography of John Tyndall as an obituary in 1894 in a scientific journal. It is readable online.
5. D. Thompson (1957). *John Tyndall (1820-1893): A study in vocational enterprise*. Journal of Vocational Education & Training. 9 (18): 38-48. Gives an account of Tyndall's vocational development prior to 1853.
6. Brock, W.H. (1981). *John Tyndall, Essays on a Natural Philosopher*. Dublin: Royal Dublin Society. 220 pages.
7. Arthur Whitmore Smith, a professor of physics, wrote a 10-page biography of John Tyndall in 1920 in a scientific monthly. Readable online.
8. Anon (1894). *Obituary notices*. Journal of the Chemical Society, Transactions. 65: 389-393.
9. John Walter Gregory, a naturalist, wrote a 9-page obituary of John Tyndall in 1894 in a natural science journal. Readable online.
10. An early, 8-page profile of John Tyndall appeared in 1864 in *Portraits of Men of Eminence in Literature, Science and Art*, Volume II, pages 25-32.
11. A brief profile of Tyndall based on information supplied by Tyndall himself appeared in 1874 in *Scientific worthies, IV.–John Tyndall*. Nature. 10 (251): 299-302. Bibcode:1874Natur..10..299.
12. Claud Schuster, *John Tyndall as a Mountaineer*, 56-page essay included in Schuster's book Postscript to Adventure, year 1950 (New Alpine Library: Eyre & Spottiswoode, London).
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Chapter 7

HENRY DAVID THOREAU

In the distant future (and perhaps even in the not-so-distant future) industrial civilization will need to abandon its relentless pursuit of unnecessary material goods and economic growth. Modern society will need to re-establish a balanced and harmonious relationship with nature. In preindustrial societies harmony with nature is usually a part of the cultural tradition. In our own time, the same principle has become central to the ecological counter-culture while the main-stream culture thunders blindly ahead, addicted to wealth, power and growth.

In the 19th century the American writer, Henry David Thoreau (1817-1862), pioneered the concept of a simple life, in harmony with nature. Today, his classic book, *Walden*, has become a symbol for the principles of ecology, simplicity, and respect for nature.

Thoreau was born in Concord Massachusetts, and he attended Harvard from 1833 to 1837. After graduation, he returned home, worked in his family's pencil factory, did odd jobs, and for three years taught in a progressive school founded by himself and his older brother, John. When John died of lockjaw in 1842, Henry David was so saddened that he felt unable to continue the school alone.

Nonviolent civil disobedience

Thoreau refused to pay his poll tax because of his opposition to the Mexican War and to the institution of slavery. Because of his refusal to pay the tax (which was in fact a very small amount) he spent a night in prison. To Thoreau's irritation, his family paid the poll tax for him and he was released. He then wrote down his ideas on the subject in an essay entitled *The Duty of Civil Disobedience*, where he maintains that each person has a duty to follow his own individual conscience even when it conflicts with the orders of his government.

In his essay, Thoreau said: "A common and natural result of an undue respect for law is that you may see a file of soldiers, colonel, captain, corporal, privates, powder-monkeys, and all marching in admirable order over hill and dale to the wars, against their wills, ay, against their common sense and consciences, which makes it very steep marching indeed, and produces a palpitation of the heart. They have no doubt that it is a damnable business in which they are concerned; they are all peaceably inclined. Now, what are they? Men at all? or small movable forts and magazines, at the service of some unscrupulous man in power?"

"Under a government that which imprisons any unjustly", Thoreau wrote, "the true place for a just man is in prison." Civil Disobedience influenced Tolstoy, Gandhi and Martin Luther King, and it anticipated the Nuremberg Principles.

7.1 Harmony with nature

Thoreau became the friend and companion of the transcendentalist writer Ralph Waldo Emerson (1803 1882), who introduced him to a circle of New England writers and thinkers that included Ellery Channing, Margaret Fuller and Nathaniel Hawthorne.

Nathaniel Hawthorne described Thoreau in the following words: "Mr. Thorow [sic] is a keen and delicate observer of nature, a genuine observer, which, I suspect, is almost as rare a character as even an original poet; and Nature, in return for his love, seems to adopt him as her especial child, and shows him secrets which few others are allowed to witness. He is familiar with beast, fish, fowl, and reptile, and has strange stories to tell of adventures, and friendly passages with these lower brethren of mortality. Herb and flower, likewise, wherever they grow, whether in garden, or wild wood, are his familiar friends. He is also on intimate terms with the clouds and can tell the portents of storms. It is a characteristic trait, that he has a great regard for the memory of the Indian tribes, whose wild life would have suited him so well; and strange to say, he seldom walks over a plowed field without picking up an arrow-point, a spear-head, or other relic of the red men, as if their spirits willed him to be the inheritor of their simple wealth."

Walden, an experiment in simple living

At Emerson's suggestion, Thoreau opened a journal, in which he recorded his observations concerning nature and his other thoughts. Ultimately the journal contained more than 2 million words. Thoreau drew on his journal when writing his books and essays, and in recent years, many previously unpublished parts of his journal have been printed.

From 1845 until 1847, Thoreau lived in a tiny cabin that he built with his own hands. The cabin was in a second-growth forest beside Walden Pond in Concord, on land that belonged to Emerson. Thoreau regarded his life there as an experiment in simple living. He described his life in the forest and his reasons for being there in his book *Walden*,

"Most of the luxuries", Thoreau wrote, "and many of the so-called comforts of life, are not only not indispensable, but positive hindrances to the elevation of mankind. With respect to luxuries, the wisest have ever lived a more simple and meager life than the poor. The ancient philosophers, Chinese, Hindoo, Persian, and Greek, were a class than which none has been poorer in outward riches, none so rich in inward."

Elsewhere in "Walden", Thoreau remarks, "It is never too late to give up your prejudices", and he also says, "Why should we be in such desperate haste to succeed, and in

Figure 7.1: **Henry David Thoreau (1817-1862). Daguerreotype by Benjamin D. Maxham, 1856).**

such desperate enterprises? If a man does not keep pace with his companions, perhaps it is because he hears a different drummer." Other favorite quotations from Thoreau include "Rather than love, than money, than fame, give me truth", "Beware of all enterprises that require new clothes", "Most men lead lives of quiet desperation" and "Men have become tools of their tools."

Thoreau's closeness to nature can be seen from the following passage, written by his friend Frederick Willis, who visited him at Walden Pond in 1847, together with the Alcott family: "He was talking to Mr. Alcott of the wild flowers in Walden woods when, suddenly stopping, he said: 'Keep very still and I will show you my family.' Stepping quickly outside the cabin door, he gave a low and curious whistle; immediately a woodchuck came running towards him from a nearby burrow. With varying note, yet still low and strange, a pair of gray squirrels were summoned and approached him fearlessly. With still another note several birds, including two crows flew towards him, one of the crows nestling upon his shoulder. I remember that it was the crow resting close to his head that made the most vivid impression on me, knowing how fearful of man this bird is. He fed them all from his hand, taking food from his pocket, and petted them gently before our delighted gaze; and then dismissed them by different whistling, always strange and low and short, each wild thing departing instantly at hearing his special signal."

Thoreau's views on religion

Towards the end of his life, when he was very ill, someone asked Thoreau whether he had made his peace with God. "We never quarreled", he answered.

In an essay published by the Atlantic Monthly in 1853, Thoreau described a pine tree in Maine with the words: "It is as immortal as I am, and perchance will go to as high a heaven, there to tower above me still." However, the editor (James Russell Lowell) considered the sentence to be blasphemous, and removed it from Thoreau's essay.

In one of his essays, Thoreau wrote: "If a man walk in the woods for love of them half of each day, he is in danger of being regarded as a loafer; but if he spends his whole day as a speculator, shearing off those woods and making the earth bald before her time, he is esteemed an industrious and enterprising citizen."

A few more things that Thoreau said

It is the beauty within us that makes it possible for us to recognize the beauty around us. The question is not what you look at, but what you see.

Simplify your life. Don't waste the years struggling for things that are unimportant. Don't burden yourself with possessions. Keep your needs and wants simple and enjoy what you have. Don't destroy your peace of mind by looking back, worrying about the past. Live in the present. Simplify!

Go confidently in the direction of your dreams. Live the life you've imagined.

Happiness is like a butterfly; the more you chase it, the more it will elude you, but if you turn your attention to other things, it will come and sit softly on your shoulder.

You must live in the present, launch yourself on every wave, find your eternity in each moment. Fools stand on their island of opportunities and look toward another land. There is no other land; there is no other life but this

Be not simply good, be good for something,

Books are the treasured wealth of the world and the fit inheritance of generations and nations.

If you have built castles in the air, your work need not be lost; that is where they should be. Now put the foundations under them.

If a man does not keep pace with his companions, perhaps it is because he hears a different drummer. Let him step to the music he hears, however measured or far away.

The greatest compliment that was ever paid me was when one asked me what I thought, and attended to my answer.

We need the tonic of wildness...At the same time that we are earnest to explore and learn all things, we require that all things be mysterious and unexplorable, that land and sea be indefinitely wild, unsurveyed and unfathomed by us because unfathomable. We can never have enough of nature.

I see young men, my townsmen, whose misfortune it is to have inherited farms, houses, barns, cattle, and farming tools; for these are more easily acquired than got rid of. Better if they had been born in the open pasture and suckled by a wolf, that they might have seen with clearer eyes what field they were called to labor in.

A man is rich in proportion to the number of things which he can afford to let alone.

The man who goes alone can start today; but he who travels with another must wait till that other is ready

I would not have any one adopt my mode of living on any account; for, beside

that before he has fairly learned it I may have found out another for myself, I desire that there may be as many different persons in the world as possible; but I would have each one be very careful to find out and pursue his own way, and not his father's or his mother's or his neighbor's instead. The youth may build or plant or sail, only let him not be hindered from doing that which he tells me he would like to do. It is by a mathematical point only that we are wise, as the sailor or the fugitive slave keeps the polestar in his eye; but that is sufficient guidance for all our life. We may not arrive at our port within a calculable period, but we would preserve the true course.

Be a Columbus to whole new continents and worlds within you, opening new channels, not of trade, but of thought.

I never found the companion that was so companionable as solitude.

For more than five years I maintained myself thus solely by the labor of my hands, and I found, that by working about six weeks in a year, I could meet all the expenses of living. The whole of my winters, as well as most of my summers, I had free and clear for study.

Perhaps we are led oftener by the love of novelty, and a regard for the opinions of men, in procuring it, than by a true utility.

Our inventions are wont to be pretty toys, which distract our attention from serious things. They are but improved means to an unimproved end, an end which it was already but too easy to arrive at; as railroads lead to Boston or New York. We are in great haste to construct a magnetic telegraph from Maine to Texas; but Maine and Texas, it may be, have nothing important to communicate.

The grass flames up on the hillsides like a spring fire,–"et primitus oritur herba imbribus primoribus evocata,"–as if the earth sent forth an inward heat to greet the returning sun; not yellow but green is the color of its flame;–the symbol of perpetual youth, the grass-blade, like a long green ribbon, streams from the sod into the summer, checked indeed by the frost, but anon pushing on again, lifting its spear of last year's hay with the fresh life below.... So our human life but dies down to its root, and still puts forth its green blade to eternity.

I sometimes wonder that we can be so frivolous, I may almost say, as to attend to the gross but somewhat foreign form of servitude called Negro Slavery, there are so many keen and subtle masters that enslave both north and south. It is hard to have a southern overseer; it is worse to have a northern one; but worst of all when you are the slave-driver of yourself.

I learned this, at least, by my experiment: that if one advances confidently in the direction of his dreams, and endeavors to live the life which he has imagined, he will meet with a success unexpected in common hours.

Books are the treasured wealth of the world and the fit inheritance of generations and nations.

We need the tonic of wildness...At the same time that we are earnest to explore and learn all things, we require that all things be mysterious and unexplorable, that land and sea be indefinitely wild, unsurveyed and unfathomed by us because unfathomable. We can never have enough of nature.

Live in each season as it passes; breathe the air, drink the drink, taste the fruit, and resign yourself to the influence of the earth.

However mean your life is, meet it and live it; do not shun it and call it hard names. It is not so bad as you are. It looks poorest when you are richest. The fault-finder will find faults even in paradise. Love your life, poor as it is. You may perhaps have some pleasant, thrilling, glorious hours, even in a poorhouse. The setting sun is reflected from the windows of the almshouse as brightly as from the rich man's abode; the snow melts before its door as early in the spring. I do not see but a quiet mind may live as contentedly there, and have as cheering thoughts, as in a palace.

As if you could kill time without injuring eternity.

Heaven is under our feet as well as over our heads.

Every generation laughs at the old fashions, but follows religiously the new.

I went to the woods because I wished to live deliberately, to front only the essential facts of life, and see if I could not learn what it had to teach, and not, when I came to die, discover that I had not lived.

The mass of men lead lives of quiet desperation. What is called resignation is confirmed desperation. From the desperate city you go into the desperate country, and have to console yourself with the bravery of minks and muskrats. A stereotyped but unconscious despair is concealed even under what are called the games and amusements of mankind. There is no play in them, for this comes after work. But it is a characteristic of wisdom not to do desperate things.

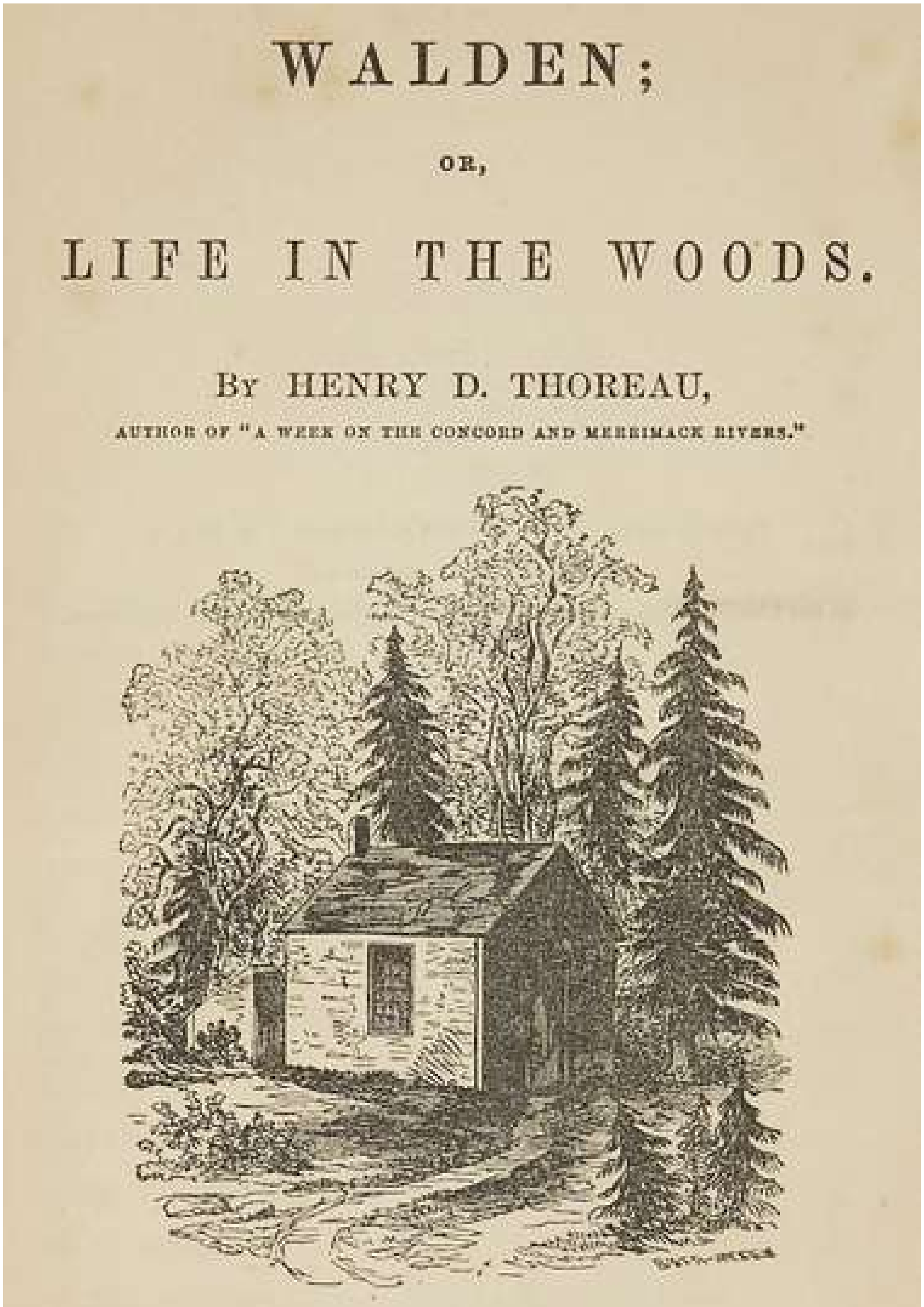

Figure 7.2: **The frontpiece of Thoreau's book, *Walden.***

Figure 7.3: **A portrait of Ralph Waldo Emerson by Eastman Johnson, 1856. Expressing ideas that he would later develop in his his famous essay *Nature*, Emerson wrote, "Nature is a language and every new fact one learns is a new word; but it is not a language taken to pieces and dead in the dictionary, but the language put together into a most significant and universal sense. I wish to learn this language, not that I may know a new grammar, but that I may read the great book that is written in that tongue."**

Figure 7.4: **Walden Pond, as it looks today. The small cabin which Thoreau built with his own hands was near to the pond. Today Walden has become a place of pilgrimage for the environmental movement. Thoreau's complete *Journals*, which are in fact his major work, have today been published. They contain roughly seven thousand pages, and two million words.**

7.2 On the Duty of Civil Disobedience

Here are a few quotations from Thoreau's essay:

Let every man make known what kind of government would command his respect, and that will be one step toward obtaining it.

After all, the practical reason why, when the power is once in the hands of the people, a majority are permitted, and for a long period continue, to rule, is not because they are most likely to be in the right, nor because this seems fairest to the minority, but because they are physically the strongest. But a government in which the majority rule in all cases can not be based on justice, even as far as men understand it. Can there not be a government in which the majorities do not virtually decide right and wrong, but conscience? - in which majorities decide only those questions to which the rule of expediency is applicable? Must the citizen ever for a moment, or in the least degree, resign his conscience to the legislator? Why has every man a conscience, then? I think that we should be men first, and subjects afterward. It is not desirable to cultivate a respect for the law, so much as for the right. The only obligation which I have a right to assume, is to do at any time what I think right. It is truly enough said that a corporation has no conscience; but a corporation of conscientious men is a corporation with a conscience. Law never made men a whit more just; and, by means of their respect for it, even the well-disposed are daily made the agents of injustice. A common and natural result of an undue respect for the law is, that you may see a file of soldiers, colonel, captain, corporal, privates, powder-monkeys and all, marching in admirable order over hill and dale to the wars, against their wills, aye, against their common sense and consciences, which makes it very steep marching indeed, and produces a palpitation of the heart. They have no doubt that it is a damnable business in which they are concerned; they are all peaceably inclined. Now, what are they? Men at all? or small movable forts and magazines, at the service of some unscrupulous man in power? Visit the Navy Yard, and behold a marine, such a man as an American government can make, or such as it can make a man with its black arts, a mere shadow and reminiscence of humanity, a man laid out alive and standing, and already, as one may say, buried under arms with funeral accompaniment, though it may be...

Unjust laws exist: shall we be content to obey them, or shall we endeavor to amend them, and obey them until we have succeeded, or shall we transgress them at once? Men generally, under such a government as this, think that they ought to wait until they have persuaded the majority to alter them. They think that, if they should resist, the remedy would be worse than the evil. But it is the fault of the government itself that the remedy is worse than the evil.

It makes it worse. Why is it not more apt to anticipate and provide for reform? Why does it not cherish its wise minority? Why does it cry and resist before it is hurt? Why does it not encourage its citizens to be on the alert to point out its faults, and do better than it would have them? Why does it always crucify Christ, and excommunicate Copernicus and Luther, and pronounce Washington and Franklin rebels?...

Under a government which imprisons any unjustly, the true place for a just man is also a prison.

Thoreau's essay "On the Duty of Civil Disobedience" influenced Mahatma Gandhi and Rev. Martin Luther King Jr. Here are Dr. King's words about Thoreau's essay:

Here, in this courageous New Englander's refusal to pay his taxes and his choice of jail rather than support a war that would spread slavery's territory into Mexico, I made my first contact with the theory of nonviolent resistance. Fascinated by the idea of refusing to cooperate with an evil system, I was so deeply moved that I reread the work several times. I became convinced that noncooperation with evil is as much a moral obligation as is cooperation with good. No other person has been more eloquent and passionate in getting this idea across than Henry David Thoreau. As a result of his writings and personal witness, we are the heirs of a legacy of creative protest. The teachings of Thoreau came alive in our civil rights movement; indeed, they are more alive than ever before. Whether expressed in a sit-in at lunch counters, a freedom ride into Mississippi, a peaceful protest in Albany, Georgia, a bus boycott in Montgomery, Alabama, these are outgrowths of Thoreau's insistence that evil must be resisted and that no moral man can patiently adjust to injustice.

Suggestions for further reading

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Chapter 8

HANS CHRISTIAN ANDERSEN

8.1 Son of a poor washerwoman in Odense

Hans Christian Andersen (1805-1875) was born in Odense, Denmark. His mother was an illiterate washerwoman, but his father had received an elementary education, and he introduced his son to literature by reading to him from *Arabian Nights*. Andersen's father maintained that he was related to nobility, but this has been disproved. There are also persistent assertions that Hans Christian Andersen was the illegitimate son of King Christian VIII. Whether this is true or not is unknown.

8.2 On foot to Copenhagen

When he was 14 years old, Hans Christian Andersen walked all the way from Odense to Copenhagen, intending to seek employment as an actor. Since he had an excellent soprano voice, he was accepted by the Royal Theatre, However his voice soon changed. Meanwhile, a colleague at the theatre told Andersen that he considered him to be a poet. As a result of this encouragement, Hans Christian Andersen decided to focus on writing.

8.3 Welcomed by the Collin family

The Director of the Royal Danish Theatre was a man named Jonas Collin. He took a great interest in Andersen, and sent him to a school in Slagelse, persuading King Frederick VI to pay part of the costs. (The willingness of the king to do so gives some support to the assertion that Andersen was the illegitimate son of King Christian VIII). In any case, for many years, Jonas Collin treated Andersen as part of his family.

8.4 An author of poems, plays, novels, travelogues and fairy tales

Hans Christian Andersen became an incredibly prolific author in many genres, He received a royal travel grant, which allowed him to travel widely in Europe, and to write travelogues about the places that he had visited. He also wrote novels, poems, plays and fairy tales. His contemporary, the physicist Hans Christian Ørsted, told Andersen that while his other writing might make him famous, his fairy tales would make him immortal.

8.5 Famous throughout Europe and later, the world

Hans Christian Andersen's fairy tales consist of 156 stories, and they were published in nine volumes. They have been translated into 125 languages and are part of the world's cultural heritage. Ørsted's prediction proved correct. While Andersen's other writing made him famous, his fairy tales have made him immortal. Here are a few of his best-known tales:

- "Blockhead Hans" (1855)
- "The Elf Mound" (1845)
- "The Emperor's New Clothes" (1837)
- "The Fir-Tree" (1844)
- "The Garden of Paradise" (1839)
- "The Goblin and the Grocer" (1852)
- "Golden Treasure" (1865)
- "The Happy Family" (1847)
- "The Ice-Maiden" (1861)
- "It's Quite True" (1852)
- "The Jumpers" (1845)
- "Little Claus and Big Claus" (1835)
- "Little Ida's Flowers" (1835)
- "The Little Match Girl" (1845)
- "The Little Mermaid" (1837)
- "The Nightingale" (1843)
- "The Princess and the Pea" (1835)
- "The Red Shoes" (1845)
- "The Shadow" (1847)
- "The Shepherdess and the Chimney Sweep" (1845)
- "The Snow Queen" (1844) "The Snowman" (1861)
- "The Steadfast Tin Soldier" (1838)
- "The Story of a Mother" (1847)
- "Thumbelina" (1835) "
- "The Tinderbox" (1835)
- "The Ugly Duckling" (1843)
- "The Wild Swans" (1838)

Figure 8.1: **Andersen in 1869.**

Figure 8.2: **Hanfstaengl portrait of Andersen dated July 1860.**

Figure 8.3: **Postage stamp, Denmark, 1935.**

Figure 8.4: **Postage stamp, Kazakhstan, 2005.**

Figure 8.5: **Statue in Central Park, New York commemorating Andersen and *The Ugly Duckling.***

Figure 8.6: **Andersen statue at the Rosenborg Castle Gardens, Copenhagen.**

Figure 8.7: **Statue in Solvang, California, a city built by Danish immigrants.**

Figure 8.8: **Statue in Bratislava, Slovakia.**

Figure 8.9: **Portrait bust in Sydney unveiled by the Crown Prince and Princess of Denmark in 2005.**

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Chapter 9

CHARLES DICKENS

9.1 A passionate social reformer

Charles Dickens (1812-1870) is regarded as one of the greatest English-language novelist of the Victorian era. His novels and short stories were immensely popular during his own lifetime. They have been translated into many languages, and they continue to be read and loved throughout the world.

Dickens' early childhood was very happy. He spent time outdoors, but also read voraciously. This wide reading and his excellent memory later helped him as an author.

This idyllic period ended when he was 12 years old. His father was thrown into debtors' prison, and to help support the family, Charles was forced to work in a shoe-blacking factory. Here is his own description of the work:

"The blacking-warehouse was the last house on the left-hand side of the way, at old Hungerford Stairs. It was a crazy, tumble-down old house, abutting of course on the river, and literally overrun with rats. Its wainscoted rooms, and its rotten floors and staircase, and the old grey rats swarming down in the cellars, and the sound of their squeaking and scuffling coming up the stairs at all times, and the dirt and decay of the place, rise up visibly before me, as if I were there again. The counting-house was on the first floor, looking over the coal-barges and the river. There was a recess in it, in which I was to sit and work. My work was to cover the pots of paste-blacking; first with a piece of oil-paper, and then with a piece of blue paper; to tie them round with a string; and then to clip the paper close and neat, all round, until it looked as smart as a pot of ointment from an apothecary's shop. When a certain number of grosses of pots had attained this pitch of perfection, I was to paste on each a printed label, and then go on again with more pots. Two or three other boys were kept at similar duty down-stairs on similar wages. One of them came up, in a ragged apron and a paper cap, on the first Monday morning, to show me the trick of using the string and tying the knot. His name was Bob Fagin; and

I took the liberty of using his name, long afterwards, in Oliver Twist."

In 1832, when Dickens was 20. he began working as a journalist, covering the Houses of Parliament. His writings were collected and published in 1836 as *Sketches of Boz*, "Boz" being his nickname within his family, and his chosen pen-name.

Sketches of Boz was a great success with the reading public, and it led the publishers Chapman and Hall to propose that Dickens should supply the text for a serial publication illustrated by engravings. The result was *Pickwick Papers*. The first few installments did not sell very well, but in the fourth installment, Dickens introduced the Cockney character, Sam Wells, and after that the series became hugely popular. making Dickens famous at the age of 24.

Wikipedia states that:

"The unprecedented success led to numerous spin-offs and merchandise ranging from Pickwick cigars, playing cards, china figurines, Sam Weller puzzles, Weller boot polish and joke books."

Marriage

In 1836, Dickens married Catherine Thomson Hogarth (1815-1879), the daughter of George Hogarth, editor of the Evening Chronicle. They had ten children together. However, they separated in 1858, when Catherine discovered that Dickens had begun an affair with the young actress, Ellen Ternan.

Queen Victoria

Young Queen Victoria was an avid reader of Dickens. After reading *Pickwick Papers* and *Oliver Twist*, she stayed up until midnight discussing the books.

Public readings

During the later part of his life, much of Dickens' energy went into public reading of his work, in England, Scotland, Ireland and the United States. Sometimes he donated the proceeds to charity. For example, he helped in this way to put Great Drumond Street Hospital on a sound financial basis.

Campaigning for social reform

Charles Dickens campaigned tirelessly for social reform. He did this not only through his novels and short stories, but also more directly, for example with speeches. Among his special goals were better treatment of poor workers, and securing the rights of children.

Figure 9.1: **Illustration by Fred Bernard of Dickens at work in a shoe-blacking factory after his father had been sent to the Marshalsea, published in the 1892 edition of Forster's Life of Charles Dickens.**

Figure 9.2: **Catherine Hogarth Dickens by Samuel Lawrence (1838). She met the author in 1834, and they became engaged the following year before marrying in April 1836.**

Figure 9.3: **Dickens at his desk, 1858.**

Figure 9.4: **Dickens and Little Nell statue in Philadelphia, Pennsylvania.**

Figure 9.5: **Tiny Tim, from Charles Dickens' *A Christmas Carol.* When he is informed that Tiny Tim will die unless he receives medical treatment, Scrooge remarks, "Then he had better die and reduce the surplus population!". Many of the events in Dickens' books can be viewed as protests against the ideas of Malthus regarding population.**

Figure 9.6: **Charles Dickens Oliver Twist asks for a second portion of gruel, provoking a storm of outrage.**

9.2 Novels by Charles Dickens

Here is a list of Dickens' novels. They were usually first serialized, and then published as books.

- The Pickwick Papers (The Posthumous Papers of the Pickwick Club; monthly serial, April 1836 to November 1837)
- Oliver Twist (The Adventures of Oliver Twist; monthly serial in Bentley's Miscellany, February 1837 to April 1839)
- Nicholas Nickleby (The Life and Adventures of Nicholas Nickleby; monthly serial, April 1838 to October 1839)
- The Old Curiosity Shop (weekly serial in Master Humphrey's Clock, April 1840 to November 1841)
- Barnaby Rudge (Barnaby Rudge: A Tale of the Riots of Eighty; weekly serial in Master Humphrey's Clock, February to November 1841)
- A Christmas Carol (A Christmas Carol in Prose: Being a Ghost-story of Christmas; 1843)
- Martin Chuzzlewit (The Life and Adventures of Martin Chuzzlewit; monthly serial, January 1843 to July 1844)
- The Chimes (The Chimes: A Goblin Story of Some Bells That Rang an Old Year Out and a New Year In; 1844)
- The Cricket on the Hearth (The Cricket on the Hearth: A Fairy Tale of Home; 1845)
- The Battle of Life (The Battle of Life: A Love Story; 1846)
- Dombey and Son (Dealings with the Firm of Dombey and Son: Wholesale, Retail and for Exportation; monthly serial, October 1846 to April 1848)
- The Haunted Man (The Haunted Man and the Ghost's Bargain: A Fancy for Christmas-time; 1848)
- David Copperfield (The Personal History, Adventures, Experience and Observation of David Copperfield the Younger of Blunderstone Rookery [Which He Never Meant to Publish on Any Account]; monthly serial, May 1849 to November 1850)
- Bleak House (monthly serial, March 1852 to September 1853)
- Hard Times (Hard Times: For These Times; weekly serial in Household Words, 1 April 1854, to 12 August 1854)
- Little Dorrit (monthly serial, December 1855 to June 1857)
- A Tale of Two Cities (weekly serial in All the Year Round, 30 April 1859, to 26 November 1859)
- Great Expectations (weekly serial in All the Year Round, 1 December 1860 to 3 August 1861)
- Our Mutual Friend (monthly serial, May 1864 to November 1865)
- The Signal-Man (1866), first published as part of the Mugby Junction collection in the 1866 Christmas edition of All the Year Round.
- Edwin Drood (The Mystery of Edwin Drood; monthly serial, April 1870 to September 1870), left unfinished due to Dickens's death

A Tale of Two Cities

Charles Dickens' *A Tale of Two Cities* is one of the best-selling historical novels of all time. It opens with the famous sentence:

"It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way - in short, the period was so far like the present period, that some of its noisiest authorities insisted on its being received, for good or for evil, in the superlative degree of comparison only."

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Chapter 10

COUNT LEO TOLSTOY

Leo Tolstoy was born in 1828. While he was still a child, his parents died, and he became Count Tolstoy, with responsibility for the family estate at Yasnaya Polyana. As a young man, he was attracted to the gay and worldly social life of Moscow, but his diary during this period shows remorse over his pursuit of sensual pleasures. Disgusted with himself, he entered the army, and during idle periods he began his career as a writer. While still a soldier, he published a beautiful nostalgic work entitled "Childhood" as well as a number of skillful stories describing army life.

10.1 Schools and textbooks for peasants

At the age of 28, Tolstoy left the army and spent a brief period as a literary idol in St. Petersburg. He then became concerned about lack of education among Russian peasants, and he traveled widely in Europe, studying educational theory and methods. Returning to Yasnaya Polyana, he established schools for the peasants, published an educational magazine and compiled a number of textbooks whose simplicity and attractiveness anticipated modern teaching methods.

10.2 *War and Peace*

Tolstoy married in 1862 at the age of 34. His wife, Sonya Bers, shared his wide intellectual interests, and they had a happy family life with thirteen children1 . During this period, Tolstoy managed his estate with much success, and he produced his great literary masterpieces "War and Peace" and "Anna Karenina". He modeled the characters in "War and Peace" after members of his own family. For example, Tolstoy's famous heroine, Natassia, is modeled after his sister-in-law, Tanya Bers. Pierre in "War and Peace" and Levin in "Anna Karenina" reflect Tolstoy's own efforts to understand the meaning of life, his concern with the misery of the Russian peasants, and his ultimate conclusion that true happiness and peace of mind can only be found in a simple life devoted to the service of others.

10.3 *Anna Karinina*

10.4 Search for life's meaning

By the time Tolstoy had finished "Anna Karenina", he had become very dissatisfied with the life that he was leading. Despite having achieved in great measure all of the goals for which humans usually strive, he felt that his existence lacked meaning; and in 1879 he even contemplated suicide. He looked for life's purpose by systematically studying the writings of scientists and philosophers, but he could not find an answer there that satisfied him.

Finally Tolstoy found inspiration in the humble and devout lives of the peasants. He decided that the teachings of Jesus, as recorded in the New Testament, could provide the answer for which he was searching. Tolstoy published an account of his spiritual crisis in a book entitled "A Confession", in which he says:

"I searched for enlightenment everywhere in the hard-won accumulated knowledge of mankind. I searched passionately and long, not in a lazy way, but with my whole soul, day and night. I searched like a drowning man looking for safety - and found nothing. I searched all the sciences, and not only did I find nothing, but I also came to the conclusion that everyone who, like myself, had searched in the sciences for life's meaning had also found nothing."

"I then diligently studied the teachings of Buddhism and Islam in the holy books of those religions; but most of all I studied Christianity as I met it in the holy Scriptures and in the living Christians around me..."

10.5 Love for the poor

"I began to approach the believers among the poor, simple ignorant people: pilgrims, monks and peasants... The whole life of Christians of our own circle seemed to be a contradiction of their faith. By contrast, the whole life of Christians of the peasant class was an affirmation of the view of life which their religious faith gave to them. I looked more and more deeply into the faith of these people, and the more deep my insight became, the more I became convinced that they had a genuine belief, that their faith was essential to them, and that it was their faith alone which gave their life a meaning and made it possible for them to live... I developed a love for these simple people."

Moved by the misery of the urban poor whom he encountered in the slums of Moscow, Tolstoy wrote: "Between us, the rich and the poor, there is a wall of false education, and before we can help the poor, we must first tear down that wall. I was forced to the conclusion that our own wealth is the true cause of the misery of the poor."

10.6 *What Then Must We Do?*

Tolstoy's book, "What Then Must We Do?", tells of his experiences in the slums and analyses the causes of poverty. Tolstoy felt that the professed Christian belief of the Czarist state was a thin cosmetic layer covering a structure that was fundamentally built on violence. Violence was used to maintain a huge gap between the rich and the poor, and violence was used in international relations. Tolstoy felt especially keenly the contradiction between Christianity and war. In a small book entitled "The Kingdom of God is Within Us" he wrote:

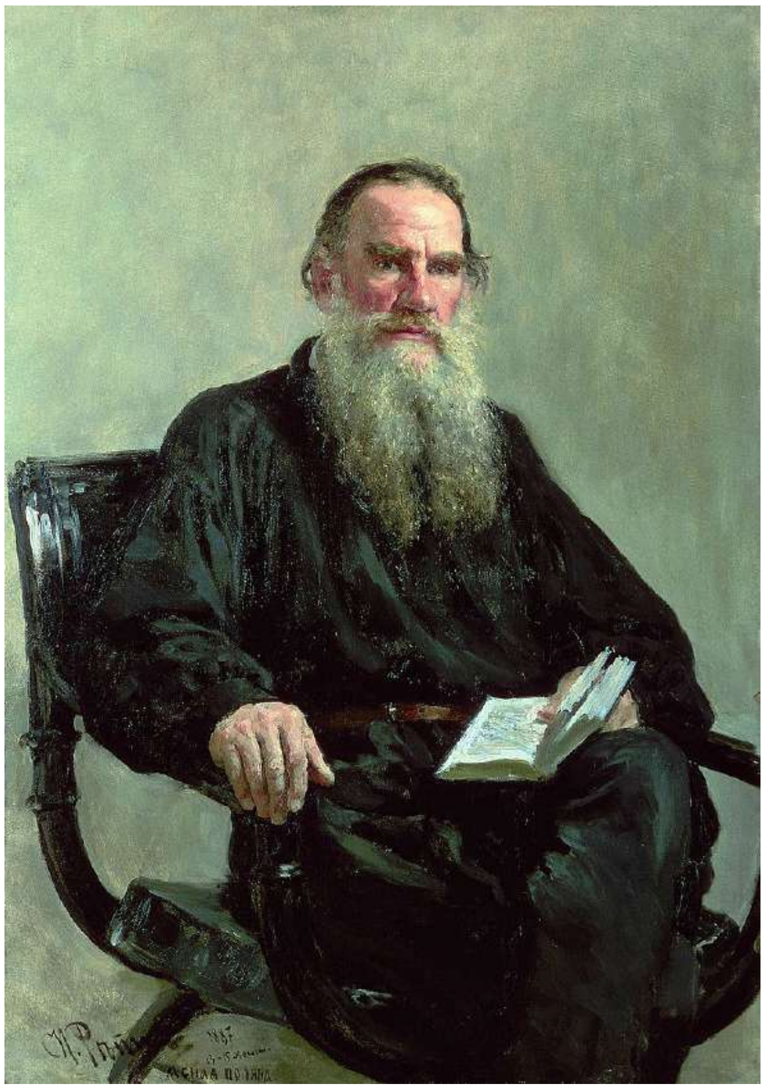

Figure 10.1: **Portrait of Count Leo Tolstoy made in 1887 by Ilia Repin. Public domain, Wikimedia Commons**

10.7 The contradiction between Christianity and war

"All other contradictions are insignificant compared with the contradiction which now faces humankind in international relations, and which cries out for a solution, since it brings the very existence of civilization into danger. This is the contradiction between the Christian conscience and war."

"All of the Christian peoples of the world, who all follow one and the same spiritual life, so that any good and fruitful thought which is put forward in any corner of the world is immediately communicated to all of Christiandom, where it arouses feelings of pride and happiness in us regardless of our nationality; we who simply love the thinkers, humanitarians, and poets of other countries; we who not only admire their achievements, but also feel delight in meeting them and greet them with friendly smiles; we will all be forced by the state to participate in a murderous war against these same people, a war which if it does not break out today will do so tomorrow."

"...The sharpest of all contradictions can be seen between the government's professed faith in the Christian law of the brotherhood of all humankind, and the military laws of the state, which force each young man to prepare himself for enmity and murder, so that each must be simultaneously a Christian and a gladiator."

10.8 Banned and excommunicated

Tolstoy's writings on Christianity and on social questions were banned by the public censor, and he was excommunicated from the Russian Orthodox Church. However, his universally recognized stature as one of the world's greatest writers was undiminished, and his beliefs attracted many followers, both inside and outside of Russia.

10.9 Tolstoy and Gandhi

In 1894, the young Indian lawyer, Mohandas K. Gandhi, (who was then working for the civil rights of Indians in South Africa), read Tolstoy's books on Christianity and was greatly influenced by them. Gandhi wrote a review of "The Kingdom of God is Within Us", and in 1909 he sent Tolstoy an account of the activities of the civil rights movement in South Africa. He received a reply in which Tolstoy said:

"...The longer I live, and especially now, when I vividly feel the nearness of death, the more I want to tell others what I feel so particularly clearly and what to my mind is of great importance, namely that which is called passive resistance, but which is in reality nothing else but the teaching of love, uncorrupted by false interpretations. That love, i.e. the striving for the union of human souls and the activity derived from that striving, is the highest and only law of human life, and in the depth of his soul every human being knows this (as we most clearly see in children); he knows this until he is entangled in the false teachings of the world. This law was proclaimed by all, by the Indian as by the Chinese, Hebrew, Greek and Roman sages of the world. I think that this law was most clearly expressed by Christ, who plainly said that in this alone is all the law and the prophets..."

"...The peoples of the Christian world have solemnly accepted this law, while at the same time they have permitted violence and built their lives on violence; and that is why the whole life of the Christian peoples is a continuous contradiction between what they profess, and the principles on which they order their lives - a contradiction between love accepted as the law of life, and violence which is recognized and praised, acknowledged even as a necessity in different phases of life, such as the power of rulers, courts, and armies..."

10.10 Nonviolent resistance to governmental violence

Tolstoy believed that violence can never under any circumstances be justified, and that therefore an individual's resistance to governmental violence must be passive and non-violent. He also believed that each individual ought to reduce his needs to a minimum in order to avoid exploiting the labor of others.

Tolstoy gave up meat, alcohol, tobacco, and hunting. He began to clean his own room, wore simple peasant clothes, worked in the fields, and made his own boots. He participated in famine relief, and he would have liked to give away all of his great wealth to feed the poor, but bowing to the protests of his family, he gave his wealth to them instead. Because he had been unable to convert his family to his beliefs, Tolstoy left home secretly on a November night in 1910, accompanied, like King Lear, by his youngest daughter. He died of pneumonia a few days later at a remote railway junction.

Figure 10.2: **Count Leo Tolstoy**

Figure 10.3: **Mahatma Gandhi firmly rejected the pernicious doctrine that "the end justifies the mens". Gandhi said: "They say 'means are after all means'. I would say 'means are after all everything'. As the means so the end...... There is no wall of separation between means and end. Indeed the Creator has given us control (and that too very limited) over means, none over the end... The means may be likened to a seed, the end to a tree, and there is just the same inviolable connection between the means and the end as there is between the seed and the tree."**

10.11 ***The Kingdom of God Is Within You***

Wikipedia states that **"the book was first published in Germany in 1894 after being banned in his home country of Russia. It is the culmination of 30 years of Tolstoy's thinking, and lays out a new organization for society based on an interpretation of Christianity focusing on universal love."**

Suggestions for further reading

1. Craraft, James. *Two Shining Souls: Jane Addams, Leo Tolstoy, and the Quest for Global Peace* (Lanham: Lexington, 2012). 179 pp.
2. Lednicki, Waclaw (April 1947). *Tolstoy through American eyes.* The Slavonic and East European Review. 25 (65).
3. *Trotsky's 1908 tribute to Leo Tolstoy* Published by the International Committee of the Fourth International (ICFI).
4. *The Life of Tolstoy: Later years* by Aylmer Maude, Dodd, Mead and Company, 1911 at Internet Archive
5. *Why We Fail as Christians* by Robert Hunter, The Macmillan Company, 1919 at Wikiquote
6. *Why we fail as Christians* by Robert Hunter, The Macmillan Company, 1919 at Google Books

Chapter 11

PAINTING IN THE 19TH CENTURY

11.1 Japanese woodblock prints

11.2 Hiroshige and Hokusai

During the 18th and 19th centuries, artists in Japan developed highly sophisticated techniques for woodblock printing. Among the greatest of these artists were Hiroshige and Hokusai.

Ando Hiroshige (1787-1858) is best known for his landscape series *The Fifty-three Stations of the Tokaido* and for vertical format landscape series *One Hundred Famous Views of Edo*.

Hiroshige was born into a family with a samurai background, and some of his ancestors had held positions of power in Japan. His father was the fire warden at Edo Castle, and after his father's death, these duties fell to the young Hiroshige. However, the duties were not heavy, and they left Hiroshige much leisure for painting. He started painting at the age of 14.

Hiroshigi's early paintings were of female beauties and kebuki actors. However, influenced by the publication of Hokosai's popular series of woodblock prints, *Thirty-six Views of Mount Fuji*, he changed to landscapes.

Katsushika Hokusai (1760-1849) created his famous series of woodblock prints, *Thirty-six Views of Mount Fuji* in response to a domestic travel boom, accompanied by public interest in picturesque places; but he also had a personal obsession with Mount Fuji. The art historian Richard Lane remarked, "Indeed, if there is one work that made Hokusai's name, both in Japan and abroad, it must be this monumental print-serie". The series includes his iconic print, *The Great Wave off Kanagawa.*

Figure 11.1: **Ando Hiroshige, *The Plum Garden in Kameido*, 1857, woodblock print from *One Hundred Famous Views of Edo*.**

Figure 11.2: **Ando Hiroshige, *The Iris Garden*, ca. 1833-1834, woodblock print from *One Hundred Famous Views of Edo*.**

Figure 11.3: **Katsushika Hokusai, *The Great Wave off Kanagawa*, ca. 1829-1833.**

Figure 11.4: **Katsushika Hokusai, *Barrier Town on the Sumida River*, ca. 1829-1833. Like *The Great Wave*, this print is part of Hokusai's series, *Thirty-six Views of Mount Fuji.***

11.3 Influence on French painting

Vincent van Gogh made meticulous copies of Hiroshigi's prints, and in general the innovative boldness of the Japanese compositions greatly influenced French painting.

Wikipedia states that:

> **Hiroshige's The Fifty-three Stations of the Tokaido (1833-1834) and One Hundred Famous Views of Edo (1856-1858) greatly influenced French Impressionists such as Monet. Vincent van Gogh copied two of the One Hundred Famous Views of Edo which were among his collection of ukiyo-e prints. Hiroshige's style also influenced the Mir iskusstva, a 20th-century Russian art movement in which Ivan Bilibin was a major artist. Cézanne and Whistler were also amongst those under Hiroshige's influence. Hiroshige was regarded by Louise Gonse, director of the influential Gazette des Beaux-Arts and author of the two volume L'Art Japonais in 1883, as the greatest painter of landscapes of the 19th century.**

11.4 Manet

Born into a wealthy and influential family

Édouard Manet (1832-1883) was a French painter whose pioneering work shocked the world of art and proved to be a turning point. Young painters rallied around his revolutionary work, and this led to the beginning of the Impressionist movement.

Manet was born into a wealthy and well-connected family. His mother, Eugénie-Desirée Fournier, was the god-daughter of the Swedish crown prince, Charles Bernadotte, from whom the Swedish royal family is descended. His father, Auguste Monet was a judge, and he expected his son Édouard to follow a career in law. However, Édouard Manet's uncle, Edmond Fournier, encouraged his nephew's wish to become a painter. On his uncle's advice, Manet enrolled in a special course in drawing, where he met the future French Minister of Fine Arts, Antonin Proust, who was destined to become his lifelong friend.

Pioneer of modernism: Déjeuner sur l'herbe and Olympia

One of Manet's major early paintings was entitled *Le Déjeuner sur l'herbe*, or in English, *The Luncheon on the Grass*. He submitted this painting to the official French Salon in 1863, but it was rejected. Manet then decided to exhibit it in the "Salon des Refusés", an exhibition hall that had been instituted by Napoleon III because an excessive number of paintings were being rejected by the official Salon. Here the painting attracted great attention, and also dismay. Viewers were shocked by both the subject matter and sketch-like painterly style, where the brushwork was not hidden. On the other hand, young artists recognized the painting's revolutionary qualities, and rallied behind Manet.

Figure 11.5: ***Le Déjeuner sur l'herbe*, 1863, by Édouard Manet, Musée d'Orsay, Paris. Wikipedia comments: "Despite the mundane subject, Manet deliberately chose a large canvas size, measuring 81.9 x 104.1 in (208 by 264.5 cm), normally reserved for historical, religious, and mythological subjects. The style of the painting breaks with the academic traditions of the time. He did not try to hide the brush strokes; the painting even looks unfinished in some parts of the scene. The nude is also starkly different from the smooth, flawless figures of Cabanel or Ingres. A nude woman casually lunching with fully dressed men was an affront to audiences' sense of propriety, though Émile Zola, a contemporary of Manet's, argued that this was not uncommon in paintings found in the Louvre."**

Another painting by Manet, *Olympia*, was accepted by the Salon in 1865, where it created a similar scandal. Like *Le Déjeuner sur l'herbe*, *Olympia* was hailed by young artists as a breakthrough.

Figure 11.6: ***Olympia*, 1863, by Édouard Manet, Musée d'Orsay, Paris. Wikipedia comments: "What shocked contemporary audiences was not Olympia's nudity, nor the presence of her fully clothed maid, but her confrontational gaze and a number of details identifying her as a demi-mondaine or prostitute. These include the orchid in her hair, her bracelet, pearl earrings and the oriental shawl on which she lies, symbols of wealth and sensuality. The black ribbon around her neck, in stark contrast with her pale flesh, and her cast-off slipper underline the voluptuous atmosphere. 'Olympia' was a name associated with prostitutes in 1860s Paris."**

Figure 11.7: ***A Bar At The Follies Bergère*, 1862, by Edouard Manet, Courtauld Gallery, London.**

Figure 11.8: ***The Fifer*, 1866, by Edouard Manet, Musée d'Orsay, Paris.**

11.5 Monet

Monet's early life

Claude Monet (1840-1926) was born in Paris, but his family soon moved to Le Havre in Normandy, where the family had a business supplying ships with supplies, and a grocery business. As a young boy, Claude Monet showed an early talent for drawing. He made charcoal caricatures of local people, and sold these for 10 or 20 francs. Monet's father wanted him to go into the family business, but his mother, who was a singer, encouraged him to follow his desire to become an artist. When Monet was 16, he met the painter Eugéne Boudin, who became his mentor. Boudin taught Monet to use oil paints, and encouraged him to work on scenes in the open air.

The father of Impressionism

By 1865, Monet was studying painting in Paris, but he became disillusioned with the traditional schools, and instead joined the more interesting studio of Charles Gleyre. Here he met Pierre-Auguste Renoir, Frédéric Bazille and Alfred Sisley. Together, they began to paint in a new way, painting outdoor scenes using bright colors mixed with white, and rapid, visible brush-strokes. Their aim was to capture the fleeting effects of light, shade and color.

In 1874, these artists and their other like-minded colleagues, finding their paintings largely rejected by the official Salon, organized their own independent exhibition. Thirty artist, led by Monet, Degas, Pissaro, Renoir and Sisley exhibited over 300 paintings, and these were seen by about 4,000 people. In his review of the exhibition, the art critic Louis Leroy referred disparagingly to Monet's painting, *Impression, Sunrise*, and called the exhibition "L'Exposition des Impressionnistes". Although the term "Impressionist" was intended as a sarcasm by Leroy, the young artists participating in the 1874 exhibition adopted it proudly as the name of their movement.

Old age, prosperity and fame

Claude Monet lived long enough to see Impressionism accepted and celebrated. Purchases of his own paintings also made him wealthy enough to first rent and then in 1890 to buy a large house and gardens in the village of Gerveny, about 80 kilometers from Paris. He moved there with his second wife, Alice Hoschedé, and their large family. Alice had six children from her first marriage, while Monet had two sons. One of Monet's sons married one of Alice's daughters.

At Gerveny, Monet meticulously constructed the extensive gardens that he wished to paint. In the midst of these gardens, there was a pond full of water-lilies and crossed by a Japanese bridge. Monet's very large paintings of this scene are among his most famous. The house and gardens and the Impressionist Museum now located at Gerveny are now major tourist attractions.

Figure 11.9: ***Impression, Sunrise*, 1872, by Claude Monet, Musée Marmottan Monet, Paris. This famous painting gave its name to the movement that aimed at capturing fleeting effects of light and color in outdoor scenes. Claude Monet, who painted it, became the most consistent practitioner of the Impressionist philosophy. He lived long enough to experience the acceptance and celebration of Impressionism.**

Figure 11.10: ***Houses of Parliament, stormy sky*****, 1904, by Claude Monet, Palais des Beaux-Arts de Lille, Lille, France.**

Figure 11.11: ***Wheatstacks (End of Summer)*, 1890-1891, by Clause Monet, Art Institute of Chicago.**

Figure 11.12: ***The Four Trees*, 1891, by Clause Monet, Metropolitan Museum of Art.**

11.6 Renoir

Painting pretty girls on teapots

Pierre-Auguste Renoir (1841-1919) was born into a family of such modest means that he had to leave school at the age of 13 and become an apprentice at a porcelain factory, where he became adept at painting heartbreakingly beautiful images of Marie Antoinette onto teapots. Often, when tired by this work, he would go to the Louvre to be inspired by the paintings there. The owners of the factory recognized Renoir's unusual talent and communicated it to his parents. This ended with the young Pierre-Auguste taking lessons to prepare for entry into the École des Beaux Artes. In 1862, Renoir began to study under Charles Gleyre in Paris, where, as mentioned above, he met he met Alfred Sisley, Frédéric Bazille, and Claude Monet. Together, they began to paint open-air scenes in a new style, later to be called Impressionism.

Renoir exhibits with the Impressionists

Renoir did much of the work in organizing the First Impressionist Exhibition in 1874. Wikipedia comments about his participation in later exhibitions of the group: **"Hoping to secure a livelihood by attracting portrait commissions, Renoir displayed mostly portraits at the second Impressionist exhibition in 1876. He contributed a more diverse range of paintings the next year when the group presented its third exhibition; they included Dance at Le Moulin de la Galette and The Swing. Renoir did not exhibit in the fourth or fifth Impressionist exhibitions, and instead resumed submitting his works to the Salon. By the end of the 1870s, particularly after the success of his painting Mme Charpentier and her Children (1878) at the Salon of 1879, Renoir was a successful and fashionable painter."**

Painting with crippled hands

Renoir continued to paint during the last twenty years of his life, even though his hands were painfully crippled by arthritis. His hands were wrapped in bandages to prevent irritation. Then, when an assistant placed a brush in his hands, he was still able to grasp it and to paint. He continued heroically in this way until his death in 1919.

Throughout his life, Renoir was a very thin man, in surprising contrast to the buxom girls in his paintings.

Renoir's sons continued his creative tradition. They included the actor Pierre Renoir (1885-1952), filmmaker Jean Renoir (1894-1979) and ceramic artist Claude Renoir (1901-1969). Renoir's grandson was the filmmaker Claude Renoir (1913-1993), son of Pierre.

Figure 11.13: ***The Theatre Box*, 1874, by Pierre-Auguste Renoir, Courtauld Gallery, London.**

Figure 11.14: ***Danseuse*, 1874, by Pierre-Auguste Renoir, National Gallery of Art, Washington, DC.**

Figure 11.15: ***Luncheon of the Boating Party*, 1881, by Pierre-Auguste Renoir, Musée d'Orsay, Paris.**

11.7 Degas

The early life of Edgar Degas

Hilaire-Germain-Edgar De Gas (1834-1917), now known simply as Edgar Degas. was born into a well-off family in Paris. His father, Augustin De Gas was a banker, while his mother was a Creole from New Orleans, Louisiana.

Degas began to paint early in life. He wished to be an historical painter. By the time he was 18, he had turned a room in his large home into a studio. However, his father wished him to study law, and he dutifully entoled for law studies at the University of Paris; but his heart was not in his legal studies. It was in his painting and drawing at the Louvre. In 1855 he met the famous classical painter Jean-Auguste-Dominique Ingres,who gave him advice that he never forgot: "Draw lines, young man, and still more lines, both from life and from memory, and you will become a good artist". In April of the same year, Degas dropped his law studies and entered the École des Beaux-Arts.

Was Degas an Impressionist?

Degas himself said, "You know what I think of people who work out in the open. If I were the government I would have a special brigade of gendarmes to keep an eye on artists who paint landscapes from nature. Oh, I don't mean to kill anyone; just a little dose of bird-shot now and then as a warning" He also said, "No art was ever less spontaneous than mine. What I do is the result of reflection and of the study of the great masters; of inspiration, spontaneity, temperament, I know nothing." Nevertheless, he was closer to the Impressionists than to any other group. Like them, his method of composition was influenced by the bold innovative style of Japanese woodblock prints. The paintings of Degas also capture fleeting moments, as do those of the Impressionists.

Working in many media

Degas is famous for his many paintings of ballerina. He specialized in portraying movement and horse-racing is another subject in which he excelled. Besides paintings, he also produced many drawings and prints, as well as pastels and bronze sculptures. Wikipedia says of him: **"Degas was a superb draftsman, and particularly masterly in depicting movement, as can be seen in his rendition of dancers and bathing female nudes. In addition to ballet dancers and bathing women, Degas painted race horses and racing jockeys, as well as portraits. His portraits are notable for their psychological complexity and for their portrayal of human isolation."**

Figure 11.16: ***The Dancing Class*, 1870, by Edgar Degas, Metropolitan Museum of Art, New York City.**

Figure 11.17: ***Waiting*, 1880-1882, by Edgar Degas, Paul Getty Museum, Pasadena, Los Angeles.**

Figure 11.18: ***Before the Race*, 1882-1884, by Edgar Degas, The Walters Art Museum, Baltimore.**

11.8 Morisot

Berthe Morisot's early life

Berthe Marie Pauline Morisot (1841-1895) was born into an eminent family. She was the daughter of an important government official, the senior administrator of the departement (district) of Cher, and great-niece of the famous artist, Jean-Honoré Fragonard.

At that time, it was usual for the daughters of well-to-do families to receive lessons in painting, and so both Berthe Morisot and her sisters Yves and Edma received instruction. The sisters planned that each of them should make a drawing for their father's birthday.

Berthe Morisot continued her painting lessons at the Louvre, where she met some of the important artists of the time, Édouard Manet, Claude Monet and Jean-Baptiste-Camille Corot. Corot encouraged Berthe Morisot to work on open-air subjects.

Wikipedia says of Berthe Morisot's connection with the Impressionists: **"Morisot's first appearance in the Salon de Paris came at the age of twenty-three in 1864, with the acceptance of two landscape paintings. She continued to show regularly in the Salon, to generally favorable reviews, until 1873, the year before the first Impressionist exhibition. She exhibited with the Impressionists from 1874 onwards, only missing the exhibition in 1878 when her daughter was born."**

Berthe's two sisters gave up painting after their marriages, but they continued to long for it. Edma wrote to Berthe, "... I am often with you in thought, dear Berthe. I'm in your studio and I like to slip away, if only for a quarter of an hour, to breathe that atmosphere that we shared for many years..."

Édouard Manet painted a portrait of the other sister, Yves, entitled *Mrs Theodore Gobillard*. It is now at the Metropolitan Museum of Art in New York.

Marriage to Édouard Manet's brother

Berthe Morisot met Édouard Manet in 1868, and this led to a longtime friendship. Manet painted many portraits of her. Their correspondence over many years shows the great warmth of their friendship. Wikipedia writes: **"By the introduction of Manet, Morisot was married to Édouard's brother, Eugène Manet in 1874. On November 14, 1878, she gave birth to her only child, Julie, who posed frequently for her mother and other Impressionist artists, including Renoir and her uncle Édouard.**

"Correspondence between Morisot and Édouard Manet shows warm affection, and Manet gave her an easel as a Christmas present. Morisot often posed for Manet and there are several portrait painting of Morisot such as Repose (Portrait of Berthe Morisot) and Berthe Morisot with a Bouquet."

Berthe Morisot died of pneumonia in 1895 while attending to her daughter Julie who was suffering from the same illness. She is remembered, along with Marie Cassatt and Marie Bracquemond, as one of the three great ladies of the Impressionist movement.

Figure 11.19: ***The Cradle*, 1872, by Berthe Morisot, Musée d'Orsay.**

Figure 11.20: ***Reading*, 1873, by Berthe Morisot, Cleveland Museum of Art.**

11.9 Gauguin

The Bishop of Orléans' catechism

When he was between the ages of 11 and 16, Paul Gauguin[1] attended a Catholic boarding school in France. At the school, the Bishop Dupanloup of Orléans himself taught the class in liturgy. The bishop had devised a catechism in which three main questions were asked: "Where does humanity come from? Where is it going? How do we proceed?"

Gauguin's painting and attempted suicide

It is possible that these questions influenced Gauguin when, many years later, he began an enormous painting whose title asked very similar questions. By this time Gauguin had become an influential post-impressionist artist, the leader of the symbolist movement. Gauguin was admired by a small circle of artists but, like his close friend Vincent van Gogh, he was unrecognized by the larger public until after his death.[2]

In 1891, when he began the the huge painting, Gauguin was living on the island of Tahiti, where he had gone in search of a society free from European prejudices. Dogged

[1](1848-1903)

[2]Gauguin's prices reached a new peak in February 2015 when the New York Times revealed that his Nafea Faa Ipoipo (Quand te maries-tu ?) had been acquired in a private deal for $300 million. At the time, the painting was part of a Paul Gauguin retrospective at the Beyeler Foundation. Sold by the artist for FF 500 in 1895, the painting suddenly became the most expensive artwork in the world!

Figure 11.21: **Where do we come from?**

by failing health and financial worries, he planned to commit suicide after finishing what he regarded as his best painting. He did, indeed, attempt suicide by taking an overdose of arsenic, but the attempt failed, and he lived until 1903.

Figure 11.22: **What are we?**

Figure 11.23: **Where are we going?**

Figure 11.24: **Both religion and science have attempted to answer these questions.**

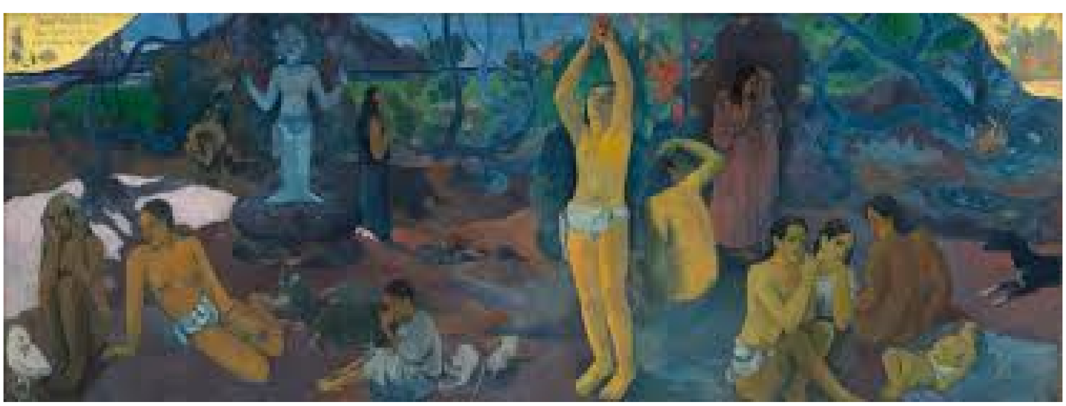

Figure 11.25: **D’où Venons Nous - Que Sommes Nous - Où Allons Nous.**

Figure 11.26: **A self-portrait by Gauguin with his painting, *The Yellow Christ.***

11.10 Van Gogh

Wikipedia says of him:

Vincent Willem van Gogh... 30 March 1853 - 29 July 1890) was a Dutch post-impressionist painter who is among the most famous and influential figures in the history of Western art. In just over a decade, he created about 2,100 artworks, including around 860 oil paintings, most of which date from the last two years of his life. They include landscapes, still lifes, portraits and self-portraits, and are characterized by bold colors and dramatic, impulsive and expressive brushwork that contributed to the foundations of modern art. He was not commercially successful, and his suicide at 37 came after years of mental illness and poverty.

Born into an upper-middle-class family, Van Gogh drew as a child and was serious, quiet, and thoughtful. As a young man he worked as an art dealer, often travelling, but became depressed after he was transferred to London. He turned to religion and spent time as a Protestant missionary in southern Belgium. He drifted in ill health and solitude before taking up painting in 1881, having moved back home with his parents. His younger brother Theo supported him financially, and the two kept up a long correspondence by letter. His early works, mostly still lifes and depictions of peasant laborers, contain few signs of the vivid color that distinguished his later work. In 1886, he moved to Paris, where he met members of the avant-garde, including Émile Bernard

and Paul Gauguin, who were reacting against the Impressionist sensibility. As his work developed he created a new approach to still lifes and local landscapes. His paintings grew brighter in color as he developed a style that became fully realized during his stay in Arles in the south of France in 1888. During this period he broadened his subject matter to include series of olive trees, wheat fields and sunflowers.

As mentioned by Wikipedia, Vincent van Gogh's painting was supported both morally and financially by his younger brother Theo, who was an art dealer. Their letters to each other, published in 1914, as a moving testimony to Theo's devoted support for his older brother, and the letters also serve as Vincent's autobiography. Theo died soon after his brother, but his widow, Johanna van Gogh-Bonger, out of loyalty to Theo, took up the cause of bringing Vincent's paintings to the world. It was she who translated and published the letters between the two brothers, and it was she who worked tirelessly to make the world of art aware of Vincent's innovative genius as a painter.

Figure 11.27: ***Self-Portrait*, by Vincent van Gogh, 1887, Art Institute of Chicago.**

Figure 11.28: ***Sorrow*, 1882, a drawing in chalk by van Gogh, the Garman Ryan Collection, at The New Art Gallery Walsall.**

Figure 11.29: ***Miners' Wives Carrying Sacks of Coal*, painted by Vincent van Gogh in 1882.**

Figure 11.30: ***The Potato Eaters*, painted by van Gogh in 1885, Van Gogh Museum, Amsterdam.**

Figure 11.31: ***Sunflowers* (4th version), painted by van Gogh in 1888, Van Gogh Museum, Amsterdam.**

Figure 11.32: ***Bedroom in Arles*** **(1st version), painted by van Gogh in 1888, Van Gogh Museum, Amsterdam.**

Figure 11.33: ***The Starry Night*, painted by van Gogh in 1889, Museum of Modern Art, New York City.**

Figure 11.34: ***Portrait of Dr. Gachet*, painted by van Gogh in 1890, private collection.**

11.11 Cézanne

Son of a banker

Paul Cézanne (1839-1906) was the son of a French banker. Encouraged by his close friend, the writer Emil Zpla, and against his father's wishes, Paul Césezanne became a painter. Eventually his father was reconciled to this decision, and he gave his son financial support. Later, after his father's death, Cézanne inherited a large fortune. Thus, unlike many artists, he never had financial worries. This was lucky, because during his lifetime, Cézanne's paintings were rejected by both the public and the critics.

Father of Cubism

Today, however, he is recognized as a transitional figure between Impressionism and Cubism. Both Matisse and Picasso said of him, "Cezanne is the father of us all." In 2011 Cézanne's painting *The Card Players* was sold to the Royal Family of Qatar for an estimated $250 million, which was, at that time the highest price ever paid for a painting.

In his painting, Cézanne tried to find the geometrical structure of the subject, and to reduce it to planes, spheres, cylinders and cones. These characteristics formed the basis of Cubism.

Wikipedia says of him:

Along with the work of Vincent van Gogh and Paul Gauguin, the work of Cézanne, with its sense of immediacy and incompletion, critically influenced Matisse and others prior to Fauvism and Expressionism. After CÃ©zanne died in 1906, his paintings were exhibited in a large museum-like retrospective in Paris, September 1907. The 1907 Cézanne retrospective at the Salon d'Automne greatly affected the direction that the avant-garde in Paris took, lending credence to his position as one of the most influential artists of the 19th century and to the advent of Cubism...

Cézanne's explorations of geometric simplification and optical phenomena inspired Picasso, Braque, Metzinger, Gleizes, Gris and others to experiment with ever more complex views of the same subject and eventually to the fracturing of form. Cézanne thus sparked one of the most revolutionary areas of artistic enquiry of the 20th century, one which was to affect profoundly the development of modern art. Picasso referred to Cézanne as "the father of us all" and claimed him as "my one and only master!" Other painters such as Edgar Degas, Pierre-Auguste Renoir, Paul Gauguin, Kasimir Malevich, Georges Rouault, Paul Klee, and Henri Matisse acknowledged Cézanne's genius.

Figure 11.35: **Cézanne's *Rideau, Cruchon et Compotier*, 1893-1894, private collection.**

Figure 11.36: **Cézanne's *Mont Sainte-Victoire seen from Bellevue*, 1895, Barnes Foundation, Pennsylvania.**

Figure 11.37: **Cézanne's *The Card Players*, 1894-1895, Royal Family of Qatar.**

Figure 11.38: ***The Bathers*, 1898-1905, Philadelphia Museum of Art, Philadelphia, United States.**

11.12 Toulouse-Lautrec

Born into an aristocratic but inbred family

Henri Marie Raymond de Toulouse-Lautrec-Monfa (1864-1901) was the son of Alphonse Charles Comte de Toulouse-Lautrec-Monfa. Had he outlived his father, Henri would have been doubly a count, both of the region of Lautrec and of Monfa. Has a young boy, Lautrec showed great ability as an artist, and he was given lessons in painting by one of his father's friends.

Henri de Toulouse-Lautrec's parents were first cousins, and this inbreeding seems to have resulted in genetic weakness of his bones. At the age of 13, he broke his right femur, and at 14 his left femur. The fractures did not heal properly, and as he grew to adulthood, his torso became that of a full-grown man, but his legs remained those of a child.

Painter of decedent life in Montmartre

In 1882, st the age of 18, Henri de Toulouse-Lautrec moved to Paris to study painting under Léon Bonnat. While studying in Paris, Toulouse-Lautrec was attracted to Montmartre, the center of entertainment and night life in Paris. He was destined to become a legendary portrayer of the decadent life in Montmartre.

Wikipedia says of Toulose-Lautrec and the ladies of Montmartre: **"The girls in the brothels inspired Toulouse-Lautrec. He would frequently visit one located in Rue d'Amboise, where he had a favorite called Mireille. He created about a hundred drawings and fifty paintings inspired by the life of these women. In 1892 and 1893, he created a series of two women kissing called Le Lit, and in 1894 painted *Salón de la Rue des Moulins* from memory in his studio...**

He was well appreciated by the ladies, saying, 'I have found girls of my own size! Nowhere else do I feel so much at home'."

Alchoholism

Life on Montmartre took its toll. Mocked for his physical appearance, Toulouse-Lautrec turned to alcohol for comfort, at first beer and wine, but later a potent mixture of absinthe and cognac. He walked with the aid of a cane, and this was hollowed out and filled with alcohol, so that he would never be without it.

In February, 1899, Henri de Toulouse-Lautrec collapsed from exhaustion and from the effects of his alcoholism. His family then had him committed to a sanatorium. While there, he produced a series of 36 circus paintings.

After Toulouse-Lautrec's early death in 1901 at the age of 35, his mother set up a museum to exhibit his works.

Figure 11.39: ***The Laundress*, 1884-1888, by Henri de Toulouse-Lautrec, private collection.**

Figure 11.40: ***At the Moulin-Rouge, The Dance*, 1890, by Henri de Toulouse-Lautrec, Philadelphia Museum of Art.**

Figure 11.41: ***Jean Avril*, 1893, lithograph poster by Henri de Toulouse-Lautrec.**

Figure 11.42: ***Divan Japonaise*, 1894, by Henri de Toulouse-Lautrec, crayon, brush, spatter and transferred screen lithograph, printed in 4 color-layers.**

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Chapter 12

SOME 19TH CENTURY COMPOSERS

12.1 Johannes Brahms

Brahms and the Schumanns

Johannes Brahms (1833-1897) was a major composer of the romantic era. His name is sometimes associated with Bach and Beethoven as on of the "three B's" of music. The extraordinary talent of the then 20-year-old Brahms was recognized by Robert and Clara Schumann when Brahms visited them, and they wrote an article predicting that Brahms would soon take a place in musical history. Brahms fell deeply in love with Clara Schumann, and after Robert Schumann's confinement to a mental hospital and death, a warm relationship between Brahms and Clara continued to the end of their lives.

Composer, virtuoso pianist, and conductor

Johannes Brahms became famous, not only as a composer, but also as a virtuoso pianist and conductor. Among his most famous compositions are his piano concertos and symphonies, the *German Requiem* and the enormously charming *Liebeslieder Waltzes*. Brahms' compositions were based on the polyphonic structures of previous masters, such as Bach and Beethoven. He was sometimes criticized for being too formal and academic.

An essential bridge between two eras

Today Johannes Brahms is recognized as the composer who formed the essential bridge between Beethoven's romantic era, and the modern musical era,

Figure 12.1: **Ede Reményi (l.) and Brahms in 1852.**

Figure 12.2: **Brahms in 1853.**

Figure 12.3: **Clara Schumann in 1857, photograph by Franz Hanfstaengl.**

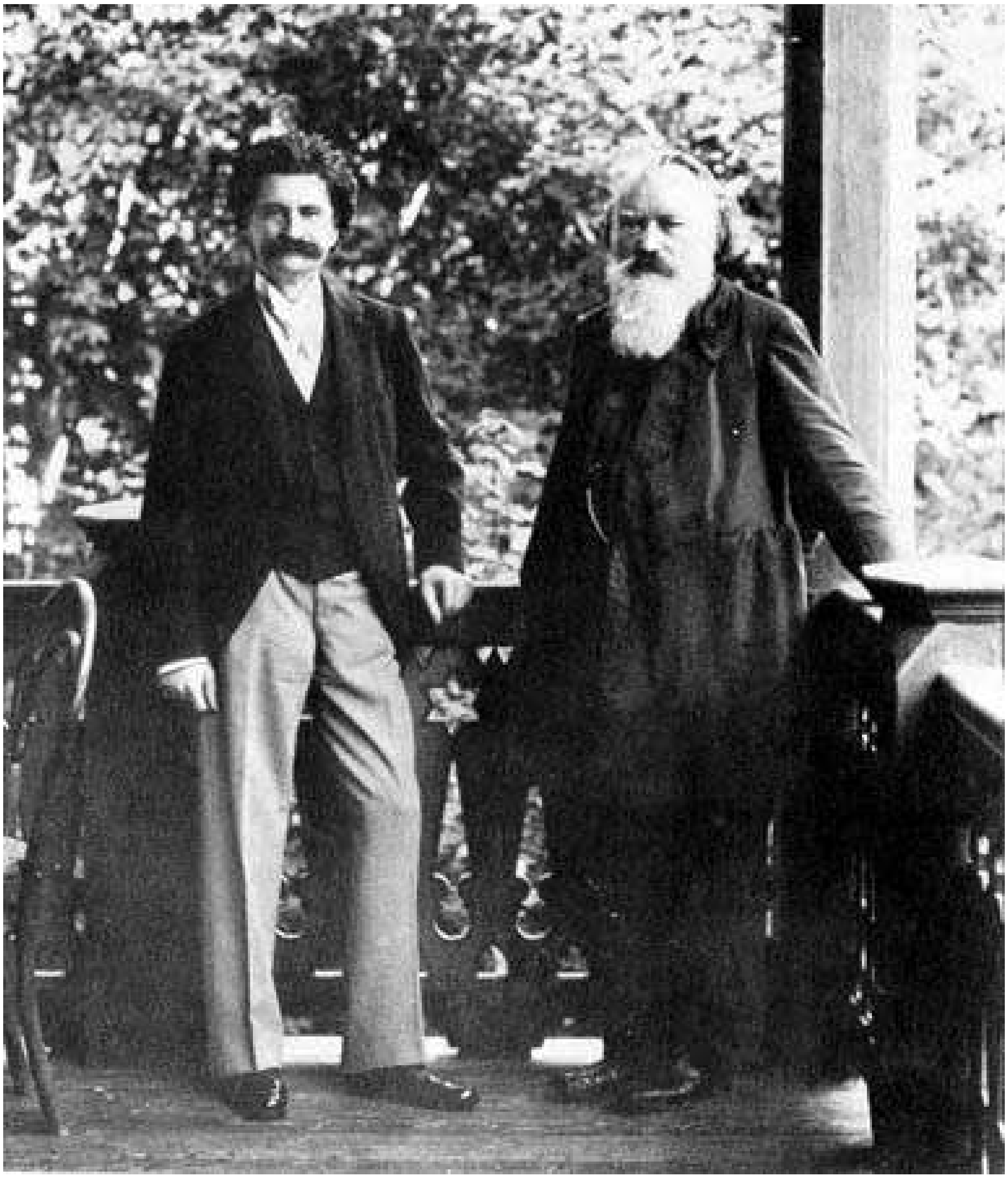

Figure 12.4: **Johann Strauss II (or Johann Strauss the Younger, or Johann Strauss Jr., 1825-1899) with Johannes Brahms (1833-1897).**

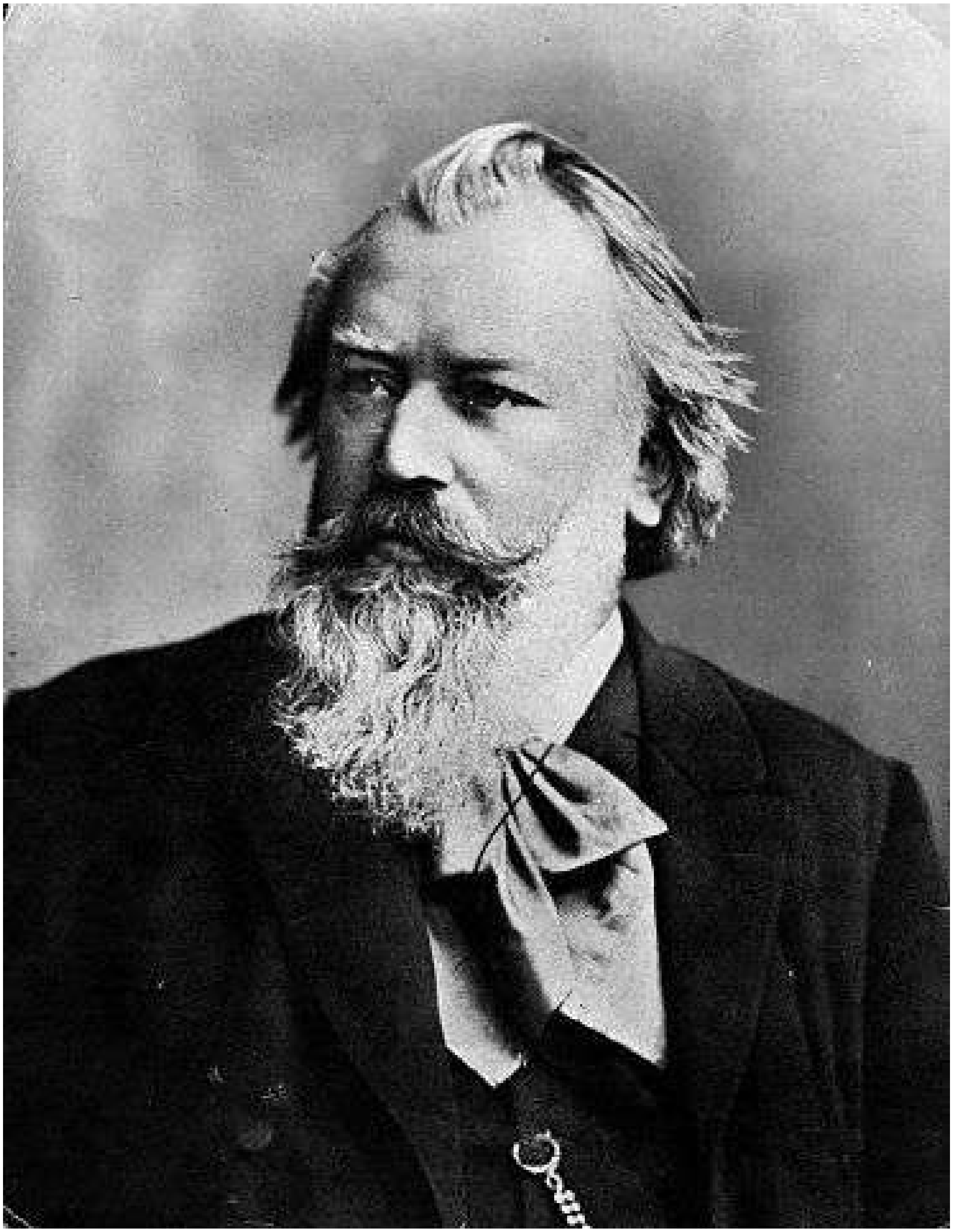

Figure 12.5: **Johannes Brahms, 1889.**

12.2 Franz Liszt

A child prodigy

Franz Liszt (1811-1886) was born in Hungary, which was then a part of the Austro.Hungarian Empire. His father, Adam Liszt, was a musician in the service of Prince Nickolaus II Esterházy. Adam Liszt had personally known such great figures as Beethoven and Hayden. He began giving piano lessons to his son when Franz was seven. By the time Franz Liszt was nine years old he was an established concert pianist and composer. His talents so much impressed a group of wealthy sponsors that they offered to pay for his musical education in Vienna.

Liszt's children with Countess Marie d'Agoult

In 1833, Liszt began an affair with Countess Marie d'Agoult, who left her husband and family to join him in Geneva. Their children were

- Blandine Rachel (1835-1862), who was the first wife of future French prime minister Émile Ollivier but died at the age of 26
- Francesca Gaetana Cosima (1837-1930), who first married pianist and conductor Hans von Bülow and then composer Richard Wagner
- Daniel (1839-1859), who was already a promising pianist and gifted scholar when he died of tuberculosis.

Philanthropies

Liszt gave much of the money that he earned from his concerts to various charities. For example, he made generous donations to the Beethoven monument, the Hungarian National School of Music, the building fund of Cologne Cathedral, the establishment of a Gymnasium at Dortmund, and the construction of the Leopold Church in Pest. He also made donations to many hospitals, schools, and charitable organizations.

Lisztomania

According to Wikipedia,

> **"After 1842, 'Lisztomania' - coined by 19th-century German poet and Liszt's contemporary, Heinrich Heine - swept across Europe. The reception that Liszt enjoyed, as a result, can be described only as hysterical. Women fought over his silk handkerchiefs and velvet gloves, which they ripped to shreds as souvenirs. This atmosphere was fuelled in great part by the artist's mesmeric personality and stage presence. Many witnesses later testified that Liszt's playing raised the mood of audiences to a level of mystical ecstasy."**

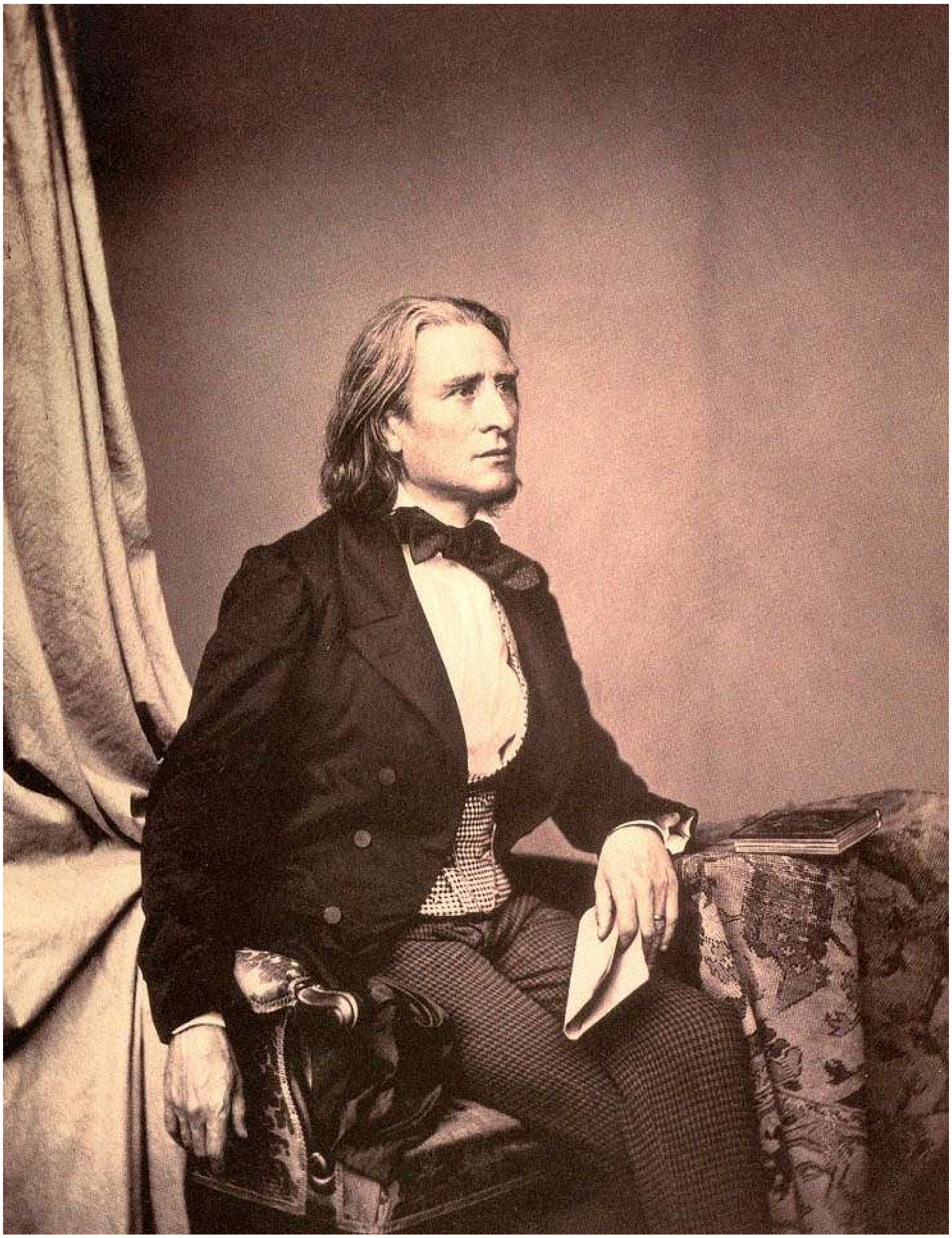

Figure 12.6: **Composer and pianist Franz Liszt in 1858.**

Figure 12.7: **Franz Liszt, portrait by Hungarian painter Miklós Barabás, 1847.**

Figure 12.8: **Franz Liszt Fantasizing at the Piano (1840), by Danhauser, commissioned by Conrad Graf. The imagined gathering shows seated Alfred de Musset or Alexandre Dumas, George Sand, Liszt, Marie d'Agoult; standing Hector Berlioz or Victor Hugo, Niccolo Paganini, Gioachino Rossini; a bust of Beethoven on the grand piano, a portrait of Lord Byron on the wall, and a statue of Joan of Arc on the far left.**

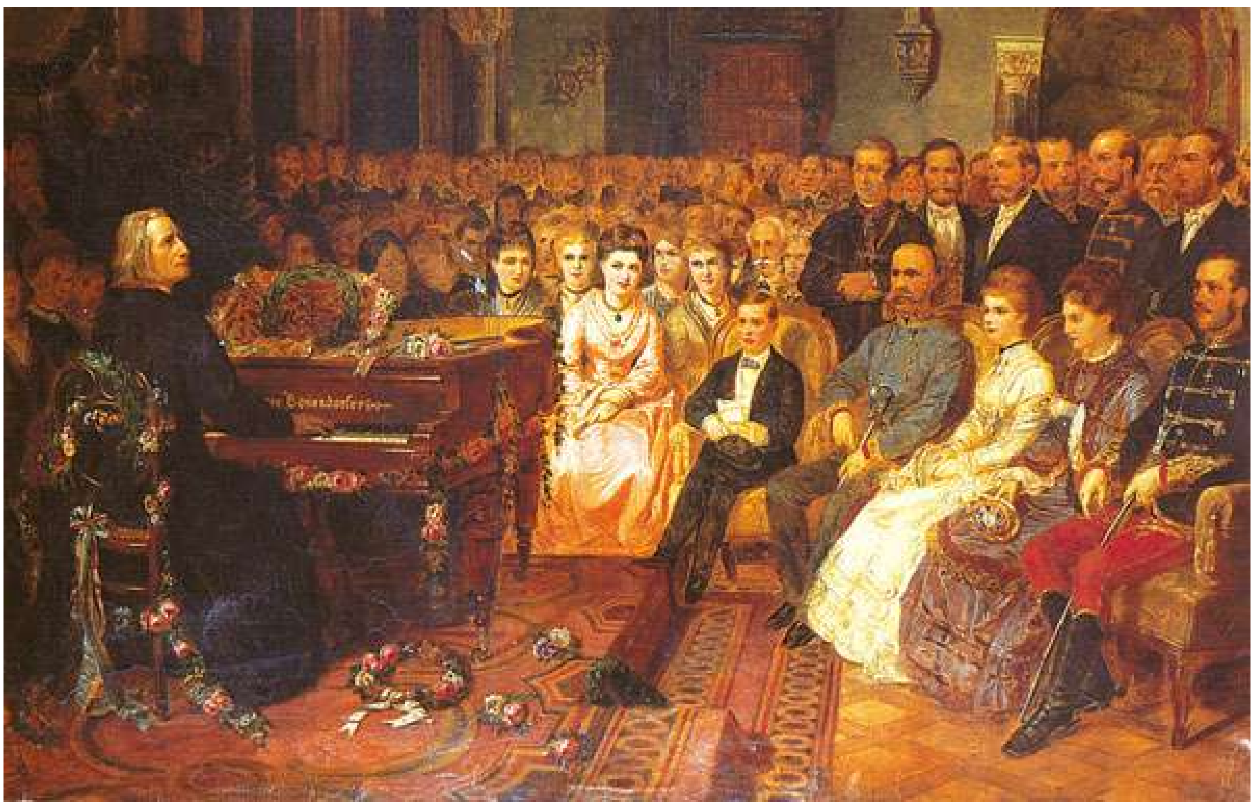

Figure 12.9: **Liszt giving a concert for Emperor Franz Joseph I .**

12.3 Frédéric Chopin

Chopin's genius was recognized early

Frédéric Chopin (1810-1849) was born in the Polish town of Zelazowa Wola, 46 kilometers west of Warsaw. His father and mother both played instruments and Chopin was given a musical education and piano lessons. It soon became apparent that he was a child prodigy. By the age of seven, he had begun giving public concerts. In 1817, when Chopin was still only seven years old, he composed two polonaises, in G minor and B-flat major.

Living in Paris, Chopin still felt Polish

Chopin arrived in Paris in late September 1831 at the age of 21. Although he never returned to Poland, he always felt Polish rather than French. Often, inspiration for his compositions came from Polish folk music.

After one of Chopin's concerts, a music critic wrote, "Here is a young man who ... taking no model, has found, if not a complete renewal of piano music, ... an abundance of original ideas of a kind to be found nowhere else..." Also, Robert Schumann, reviewing the Op. 2 Variations, wrote: " Hats off, gentlemen! A genius."

In Paris, Chopin formed a close friendship with Franz Liszt. However, the friendship was later marred by professional jealousy.

A winter visit to Majorca with George Sand

At a party in Paris, Chopin was introduced to the writer Amantine Lucile Aurore Dupin, better known by her pen-name, George Sand. At that time, Sand was one of the most popular authors in Europe, but her appearance initially repelled Chopin. She was very short and dark, wore men's clothing, and smoked cigars. Chopin remarked, "Is this really a woman?" However, George Sand fell in love with Chopin, who was at that moment very dejected because of the news that his marriage to Maria Wodzińska could never take place because of the opposition of her parents. By the end of June, 1838, Chopin and Sand had become lovers.

During the winter of 1938. Chopin and Sand travelled to Majorca with Sand's two children, in the hope of improving Chopin's health. However, when they discovered that Chopin and Sand were not married, the deeply religious people of Majorca refused to give them accommodation. The party was forced to live in a former monastery, which offered them very little protection from the cold. Thus, instead of improving Chopin's health, the visit to Majorca worsened it.

Chopin died in 1849 at the early age of 39. His death was primarily due to tuberculosis, but is additional illnesses may also have contributed to his death. People came from many parts of Europe to attend his funeral, and many were unable to enter the church because they did not have tickets.

Today, Chopin's piano compositions are known and loved throughout the world.

Figure 12.10: **Chopin, daguerreotype by Bisson, 1849.**

Figure 12.11: **Chopin plays for the Radziwills, 1829 (painting by Henryk Siemiradzki, 1887).**

Figure 12.12: **Chopin at 25, by his fiancée Maria Wodzińska, 1835.**

Figure 12.13: **Chopin at 28, from Delacroix's joint portrait of Chopin and Sand, 1838.**

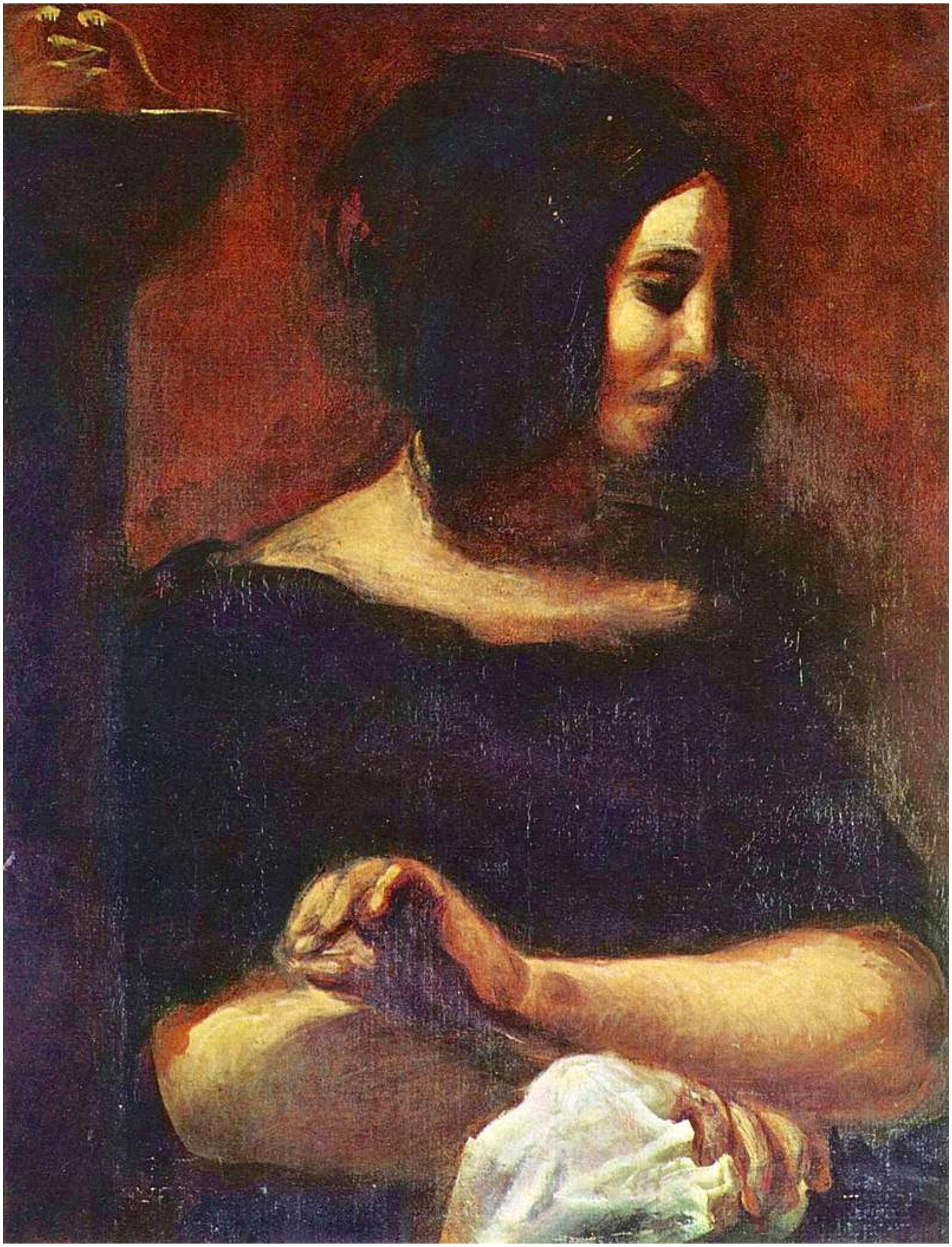

Figure 12.14: **George Sand sewing, from Delacroix's joint portrait of Chopin and Sand, 1838.**

12.4 Giuseppe Verdi

Verdi's childhood and education

Giuseppe Verdi (1813-1901) was born in the village of Le Roncole, in a region of Italy which was then a part of the French Empire. His father was an innkeeper and landowner. As a young boy, Verdi showed a strong interest in music, and this was encouraged by his ambitious father. By the time that Giuseppe Verdi was eight years old, he already held a paid position as a church organist. He was given an excellent education, both in humanities and in music.

Remembering his youthful days, Verdi wrote: "From the ages of 13 to 18 I wrote a motley assortment of pieces: marches for band by the hundred, perhaps as many little sinfonie that were used in church, in the theatre and at concerts, five or six concertos and sets of variations for pianoforte, which I played myself at concerts, many serenades, cantatas (arias, duets, very many trios) and various pieces of church music, of which I remember only a Stabat Mater."

Verdi's Operas

Although he composed much non-operatic music, Verdi is best remembered for his operas. Here is a list of them:

1. **Roberto, Comte di San Bonifacio, 1839**
2. **Un giorno di regno, 1840**
3. **Nabucodonosor, 1842**
4. **I Lombardi alla prima crociata, 1843**
5. **Ernani, 1844**
6. **I due Foscari, 1844**
7. **Giovanna d'Arco, 1845**
8. **Alzira, 1845**
9. **Attila, 1846**
10. **Macbeth, 1847**
11. **I masnadieri, 1847**
12. **Il corsaro, 1848**
13. **La battaglia di Legnano, 1849**

14. **Luisa Miller, 1849**
15. **Stiffelio, 1850**
16. **Rigoletto, 1851**
17. **Il trovatore, 1853**
18. **La traviata, 1853**
19. **Les vepres siciliennes, 1855**
20. **Simon Boccanegra, 1857**
21. **Un ballo in maschera, 1859**
22. **La forza del destino, 1862**
23. **Don Carlos, 1867**
24. **Aida, 1871**
25. **Otello, 1887**
26. **Falstaff, 1893**

Today, Verdi's operas are performed and loved throughout the world.

Verdi and the movement to unify and liberate Italy

Verdi was strongly dedicated ti the movement that sought to unify Italy and to liberate it from foreign control. Some of the songs from Verdi's operas became marching songs or theme songs for this political movement. Ultimately the movement was successful, and a united Italy freed itself from foreign rule.

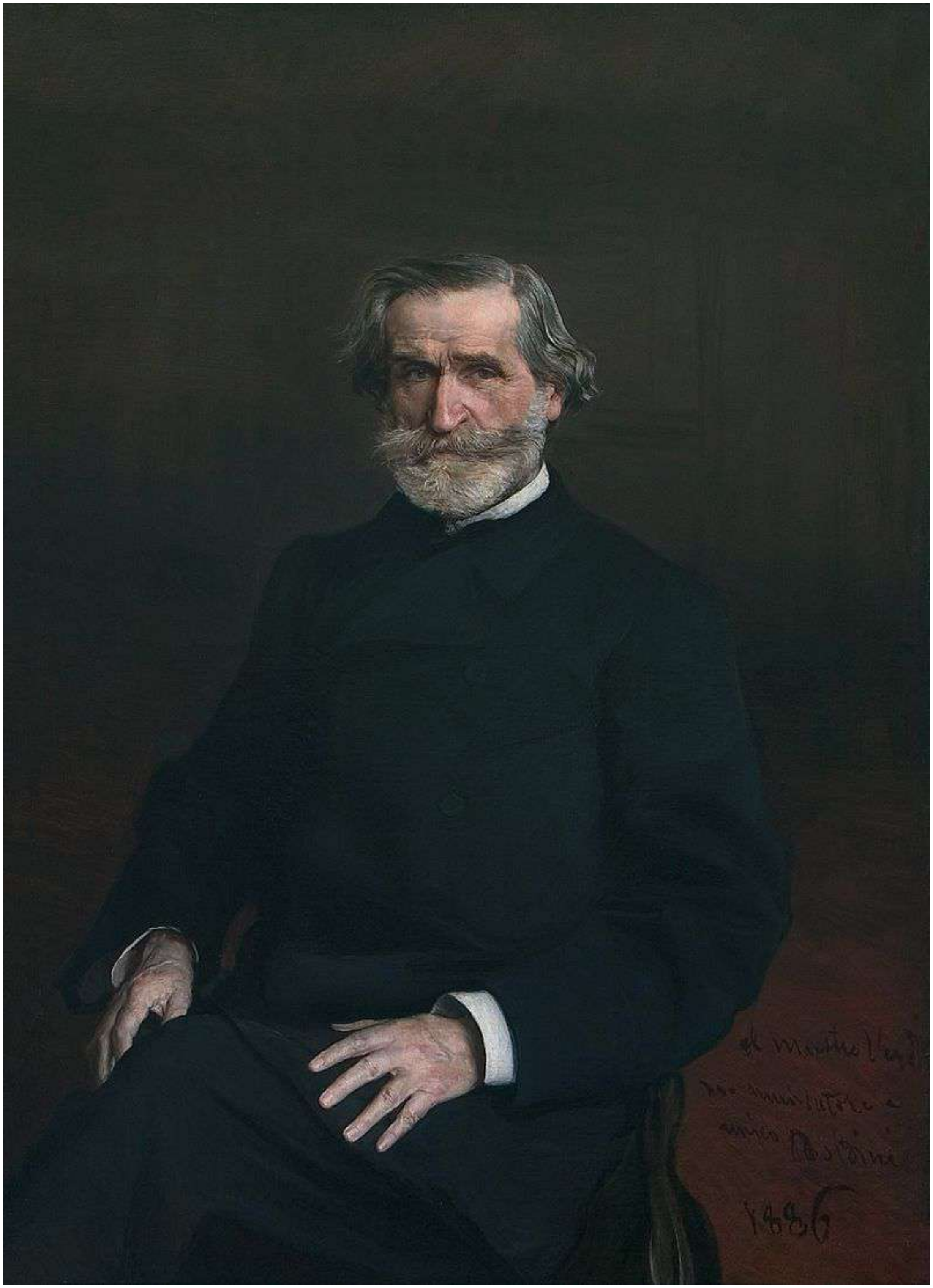

Figure 12.15: **Portrait of Giuseppe Verdi by Giovanni Boldini, 1886.**

Figure 12.16: **Painting “Viva Verdi” slogans.**

Figure 12.17: **Verdi in Russia, 1861-62.**

VERDI CONDUISANT L'ORCHESTRE DE L'OPÉRA DANS LA REPRÉSENTATION D'*AIDA*

Figure 12.18: **Verdi conducting the Paris Opera premiere of Aida in 1880.**

12.5 Franz Schubert

Schubert's childhood and education

Franz Schubery (1797-1828) was the son of an Austrian schoolmaster, who began giving him lessons at the age of five. He was also given instruction in the piano by his brother Ignaz, but the young Franz soon surpassed his brother, and required no further lessons from him. Ignaz wrote later, "I was amazed when Franz told me, a few months after we began, that he had no need of any further instruction from me, and that for the future he would make his own way. And in truth his progress in a short period was so great that I was forced to acknowledge in him a master who had completely distanced and out stripped me, and whom I despaired of overtaking."

When Franz Schubert was eight, his father began giving him violin lessons, and very soon he was able to play duets with great proficiency. He was also given organ lessons by the local church organist, who would often assure Schubert's father, with tears in his eyes, that he had never had such a pupil.

Franz Schubert's important musical works

Wikipedia states that **"Despite his short lifetime, Schubert left behind a vast oeuvre, including more than 600 secular vocal works (mainly lieder), seven complete symphonies, sacred music, operas, incidental music, and a large body of piano and chamber music. His major works include "Erlkönig" (D. 328), the Piano Quintet in A major, D. 667 (Trout Quintet), the Symphony No. 8 in B minor, D. 759 (Unfinished Symphony), the 'Great' Symphony No. 9 in C major, D. 944, the String Quintet (D. 956), the three last piano sonatas (D. 958-960), the opera Fierrabras (D. 796), the incidental music to the play Rosamunde (D. 797), and the song cycles Die schöne Müllerin (D. 795) and Winterreise."**

Final years and death

Schubert's musical reputation had greatly increased, but nevertheless, his hopeless love for his student,C Countess Caroline Esterhazy, went unrequited. Later, his health began to worsen, There is speculation that his symptoms may have been due to mercury poisoning. At that time mercury was commonly used as a treatment for syphilis.

Schubert died in Vienna, aged 31. The cause of his death was officially given as typhoid fever, but, as discussed above, other causes may have contributed.

Shortly before Schubert's death, his friend Karl Holz, and his string quartet visited to play for him. The musical work that Schubert wanted to hear was Beethoven's String Quartet No. 14 in C-sharp minor. Schubert was buried next to Beethoven, whom he had admired throughout his life.

Figure 12.19: **Oil painting of Franz Schubert by Wilhelm August Rieder (1875), made from his own 1825 watercolour portrait.**

Figure 12.20: **Schubert, 1814, painted by Josef Abel.**

Figure 12.21: **Portrait of Franz Schubert by Franz Eybl (1827).**

Figure 12.22: **Franz Schubert by Josef Kriehuber (1846).**

12.6 Georges Bizet

A brilliant student

Georges Bizet (1838-1875) was born in Paris. His father was a singing teacher, and his mother was an accomplished pianist from a highly cultured and musical family. As a child, Georges Bizet received musical instruction, especially from his mother.

Georges Bizet was admitted to the Conservitoire while still only nine years old, He was a brilliant student, and he won many prizes, including the prestigious Prix de Rome. He was also awarded a travel grant which allowed him to live and study in other European countries for five years.

Bizet's lack of success during his last years

After his travel grant had expired, Bizet was without a steady source of income. None of his operas had met with immediate success. Only his incidental music to the play, L'Arlésienne gained immediate popularity. Bizet was reduced to making a living by taking pupils, and by arranging the music of other composers. He died in 1875 from a heart attack after swimming in the Seine. The fact that he was a heavy smoker probably contributed to his death. More than 4,000 people were present at his funeral.

After Bizet's death many of his manuscripts were lost or scattered. During the 20th century, his music became extremely popular and widely performed, and some of his lost compositions were rediscovered.

Carmen: the world's best loved and widely performed opera

A decade after Bizet's death- Carmen achieved great popularity, at first abroad, and later in France. Today. Carmen is the ,most frequently performed and best loved opera it the entire repertoire. Bizet's ,music is acclaimed for its brilliance, its harmonization, and for the way in which it expresses the emotions of the characters in the story.

In the United States, the Metropolitan Opera has performed Carmen more than a thousand times. According to Wikipedia, **"In February 1906 Enrico Caruso sang José at the Met for the first time; he continued to perform in this role until 1919, two years before his death."**

There have also been many adaptions of Carmen. An example is he film Carmen Jones (1954). The film uses Bizet's music, but the members of the cast are black, and the scene modern. The toriador Escamillio becomes the prize-fighter Husky Miller, and his song becomes, "Stand up and fight until you hear the bell. Stand toe to toe. Trade blow for blow. Keep on punching 'til you make your punches tell. Show that crowd what you know. Until you hear that bell, that final bell, stand up and fight like hell." In the film, Don José becomes Joe, and his abandoned sweetheart laments (to Bizet's music) "Joe! You was always my Joe. And you certainly showed it. Reckon everyone knowed it."

Figure 12.23: **Georges Bizet photographed in about 1860.**

Figure 12.24: **Geneviève Bizet, painted in 1878 by Jules-Élie Delaunay. She and Georges Bizet had one son.**

Figure 12.25: **Poster for the opera, Carmen.**

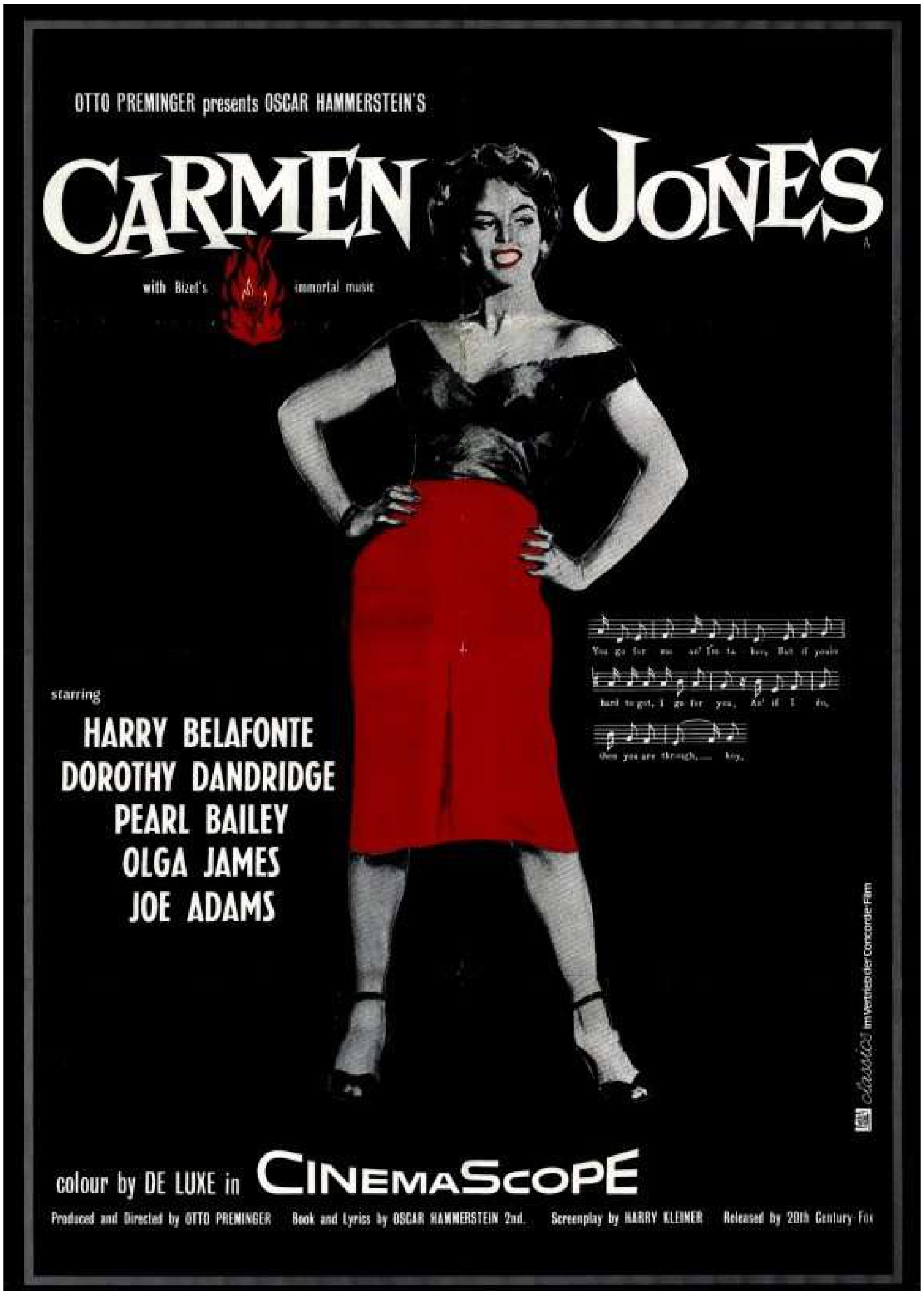

Figure 12.26: **Theatrical poster for the film Carmen Jones (1954). The film uses Bizet's music, but the members of the cast are black, and the scene modern. The toriador Escamillio becomes the prize-fighter Husky Miller, and his song becomes, "Stand up and fight until you hear the bell. Stand toe to toe. Trade blow for blow. Keep on punching 'til you make your punches tell. Show that crowd what you know. Until you hear that bell, that final bell, stand up and fight like hell"**

12.7 Clara Schumann

Clara Wieck, a child prodigy

Clara Wieck (later Clara Schumann, 1819-1896) was born in Leipzig, where her father was a professional pianist and teacher, and her mother an accomplished singer. Clara Wieck was a child prodigy, acclaimed for her piano performances in Vienna, Paris and other cities at the age of eleven. She played her entire repertoire from memory, rather than reading the notes. At the time, this was a completely new practice. Her career as one of the most famous pianists of the Romantic Era stretched over 51 years.

Marriage to Robert Schumann

The composer, Robert Schumann, was eight years older than Clara Wieck. In 1837, when she was eighteen, he proposed to her, and she accepted. They had eight children together. The Schumanns met and encouraged Johannes Brahms, who fell in love with Clara.

In 1854, Robert Schumann had a mental breakdown and attempted suicide. He was then admitted, at his own request, to a mental hospital, where he died two years later. Clara was left alone to care for their large family, in addition to all her other duties.

The friendship and love that Brahms gave to her was a help in these difficult times. Clara also formed a strong friendship with the violinist Joseph Joachim. Hearing Joachim play the solo part in Beethoven's violin Concerto, Clara wrote that he played "with a finish, a depth of poetic feeling, his whole soul in every note, so ideally, that I have never heard violin-playing like it, and I can truly say that I have never received so indelible an impression from any virtuoso."

A lasting friendship developed between Clara Schumann and Joseph Joachim, which lasted forty years, and was a great help to her.

One of the very few woman composers

Despite her heavy duties, both as a famous concert pianist and as a mother, caring for a very large family, Clara Schumann composed a very large number of excellent musical works, She composed solo piano pieces, piano concertos, chamber music, choral pieces and songs. A list of her compositions can be found on the Wikipedia website entitled "List of Compositions of Clara Schumann"

Figure 12.27: **Clara Wieck, from an 1835 lithograph.**

Figure 12.28: **Joseph Joachim and Schumann, after a lost 1854 drawing by Adolph Menzel.**

Figure 12.29: **Clara and Robert Schumann, illustration from *Famous Composers and their Works.***

Figure 12.30: **Schumann on the 100 DM banknote.**

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Chapter 13

SOME 19TH CENTURY ECONOMISTS

13.1 Robert Owen

During the early phases of the Industrial Revolution in England, the workers suffered greatly. Enormous fortunes were made by mill and mine owners, while workers, including young children, were paid starvation wages for cruelly long working days. However, trade unions, child labor laws, and the gradual acceptance of birth control finally produced a more even distribution of the benefits of industrialization.

One of the most interesting pioneers of these social reforms was Robert Owen (1771-1858), who is generally considered to have been the father of the Cooperative Movement. Although in his later years not all of his projects developed as he wished, his life started as an amazing success story. Owen's life is not only fascinating in itself; it also illustrates some of the reforms that occurred between 1815 and 1850.

Robert Owen was born in Wales, the youngest son of a family of iron-mongers and saddle-makers. He was a very intelligent boy, and did well at school, but at the age of 9, he was apprenticed to a draper, at first in Wales. Later, at the age of 11, he was moved to London, where he was obliged to work eighteen hours a day, six days a week, with only short pauses for meals. Understandably, Robert Owen found this intolerable, and he moved again, this time to Manchester, where he again worked for a draper.

While in Manchester, Robert Owen became interested in the machines that were beginning to be used for spinning and weaving. He borrowed a hundred pounds from his brother, and entered (as a partner) a small business that made these machines. After two years of moderate success as a small-scale industrialist, Owen saw the newspaper advertisement of a position for manager of a large spinning mill, owned by a Mr. Drinkwater.

"I put on my hat", Owen wrote later, "and proceeded straight to Mr. Drinkwater's counting house. 'How old are you?' 'Twenty this May', was my reply. 'How often do you get drunk in the week?'... 'I was never', I said, 'drunk in my life.' blushing scarlet at this unexpected question. 'What salary do you ask?' 'Three hundred a year', was my reply.

'What?', Mr. Drinkwater said with some surprise, repeating the words, 'Three hundred pounds! I have had this morning I know not how many seeking the situation and I do not think that all of their askings would amount to what you require.' 'I cannot be governed by what others seek', said I, 'and I cannot take less.'

Apparently impressed by Robert Owen's success as a small-scale industrialist, and perhaps also impressed by his courage, Mr. Drinkwater hired him. Thus, at the age of 19, Owen became the manager of a large factory. Mr. Drinkwater had no cause to regret his decision, since his new manager quickly became the boy wonder of Manchester's textile community. Within six months, Drinkwater offered Owen a quarter interest in his business.

After several highly successful years in his new job, Robert Owen heard of several mills that were for sale in the village of New Lanark, near to Glasgow. The owner, Mr. Dale, happened to be the father of the girl with whom Robert Owen had fallen in love. Instead of directly asking Dale for permission to marry his daughter, Owen (together with some business partners) first purchased the mills, after which he won the hand of the daughter.

Ownership of the New Lanark mills gave Robert Owen the chance to put into practice the ideas of social reform that he had been developing throughout his life. Instead of driving his workers by threats of punishment, and instead of subjecting them to cruelly long working hours (such as he himself had experienced as a draper's apprentice in London), Owen made the life of his workers at New Lanark as pleasant as he possibly could. He established a creche for the infants of working mothers, free medical care, concerts, dancing, music-making, and comprehensive education, including evening classes. Instead of the usual squalid one-room houses for workers, neat two-room houses were built. Garbage was collected regularly instead of being thrown into the street. New Lanark also featured pleasant landscaped areas.

Instead of leading to bankruptcy, as many of his friends predicted, Robert Owen's reforms led to economic success. Owen's belief that a better environment would lead to better work was vindicated. The village, with its model houses, schools and mills, became internationally famous as a demonstration that industrialism need not involve oppression of the workers. Crowds of visitors made the journey over narrow roads from Glasgow to learn from New Lanark and its visionary proprietor. Among the twenty thousand visitors who signed the guest-book between 1815 and 1825 were the Grand Duke Nicholas of Russia (who later became Czar Nicholas I), and Princes John and Maximilian of Austria.

Robert Owen's ideas of social reform can be seen in the following extract from an "Address to the Inhabitants of New Lanark", which he presented on New Year's Day, 1616: "What ideas individuals may attach to the term 'Millennium' I know not; but I know that society may be formed so as to exist without crime, without poverty, with health greatly improved, with little, if any, misery. and with intelligence and happiness increased a hundredfold; and no obstacle whatsoever intervenes at this moment except ignorance to prevent such a state of society from becoming universal."

Robert Owen believed that these principles could be applied not only in New Lanark but also in the wider world. He was soon given a chance to express this belief. During the years from 1816 to 1820, apart from a single year, business conditions in England were very bad, perhaps as a result of the Napoleonic Wars, which had just ended. Pauperism

Figure 13.1: **New Lanark World Heritage village in Scotland. A view of the school.**

and social unrest were widespread, and threatened to erupt into violence. A committee to deal with the crisis was formed under the leadership of the Dukes of Kent and York.

Because of Owen's reputation, he was asked for his opinion, but the committee was hardly expecting the answer that they received from him. Robert Owen handed the two Dukes and the other committee members a detailed plan for getting rid of pauperism by making paupers productive. They were to be settled in self-governing Villages of Cooperation, each with between 800 and 1,200 inhabitants. Each family was to have a private apartment, but there were to be common sitting rooms, reading rooms and kitchens. Near to the houses, there were to be gardens tended by the children, and farther out, fields to be cultivated by the adults. Still farther from the houses, there was to be a small factory.

Owen's idea for governmentally-planned paupers' collectives was at first rejected out of hand. The early 19th century was, after all, a period of unbridled *laissez-faire* economics. Owen then bombarded the Parliament with pamphlets advocating his scheme. Finally a committee was formed to try to raise the money to establish one Village of Cooperation as an experiment; but the money was never raised.

Unwilling to accept defeat, Robert Owen sold his interest in New Lanark and sailed for America, where he believed that his social experiment would have a better chance of success. He bought the town of Harmonie and 30,000 acres of land on the banks of the Wabash River in Indiana. There he established a Village of Cooperation which he named "New Harmony". He dedicated it on the 4th of July, 1826. It remained a collective for only two years, after which individualism reasserted itself. Owen's four sons and one of his daughters made their homes in New Harmony, and it also became the home of numerous scientists, writers and artists.

Owen's son, Robert Dale Owen, became a member of the U.S. House of Representatives, where he introduced the bill establishing the Smithsonian Institution. In 1862 he wrote an eloquent letter to Abraham Lincoln urging emancipation of the slaves. Three days later, probably influenced by Owen's letter, Lincoln read the Emancipation Proclamation to his cabinet. Another son, Richard Owen, served as President of the University of Indiana, and was later elected as the first President of Purdue University.

The cooperative movement

When Robert Owen returned to England shortly after dedicating New Harmony, he found that he had become a hero of the working classes. They had read his writings avidly, and had begun to establish cooperatives, following his principles. There were both producer's cooperatives and consumer's cooperatives. In England, the producer's cooperatives failed, but in Denmark they succeeded[1].

One of the early consumer's cooperatives in England was called the Rochdale Society of Equitable Pioneers. It was founded by 28 weavers and other artisans, who were being forced into poverty by mechanization. They opened a small cooperative store selling butter, sugar, flour, oatmeal and candles. After a few months, they also included tobacco and tea. From this small beginning, the Cooperative Movement grew, finally becoming one of the main pillars of the British Labour Party.

Trade unions

Robert Owen's attention now turned from cooperatives to the embryonic trade union movement, which was struggling to establish itself in the face of fierce governmental opposition. He assembled the leaders of the working class movement and proposed the formation of the "Grand National Moral Union of Productive and Useful Classes". The name was soon shortened to "The Grand National Consolidated Trades Union" or simply the "Grand National".

Owen's Grand National was launched in 1833, and its membership quickly grew to half a million. It was the forerunner of modern nationwide trade unions, but it lasted only two years. Factory-owners saw the Grand National as a threat, and they persuaded the government to prosecute it under anti-union laws. Meanwhile, internal conflicts helped to destroy the Grand National. Owen was accused of atheism by the working class leaders, and he accused them of fermenting class hatred.

Robert Owen's influence helped to give raw *laissez faire* capitalism a more human face, and helped to spread the benefits of industrialization more widely. Through the work of other reformers like Owen, local trade unions succeeded, both in England and elsewhere; and in the end, successful national unions were finally established. The worst features of the

[1] The success of Danish agricultural producer's cooperatives was helped by the People's High School movement, founded by N.F.S. Grundvig (1783-1872).

Figure 13.2: **Robert Owen, (1771-1858), founder of the Cooperative Movement.**

early Industrial Revolution were moderated by the growth of the trade union movement, by child labor laws, by birth control and by minimum wage laws.

Rusting of the Iron Law

David Ricardo's Iron Law of Wages maintained that workers must necessarily live at the starvation level: Their wages are determined by the law of supply and demand, Ricardo said. If the wages should increase above the starvation level, more workers' children would survive, the supply of workers would increase, and the wages would fall again. This gloomy pronouncement was enthusiastically endorsed by members of the early 19th century Establishment, since it absolved them from responsibility for the miseries of the poor. However, the passage of time demonstrated that the Iron Law of Wages held only under the assumption of an economy totally free from governmental intervention.

Both the growth of the political power of industrial workers, and the gradual acceptance of birth control were important in eroding Ricardo's Iron Law. Birth control is especially important in countering the argument used to justify child labor under harsh conditions. The argument (still used in many parts of the world) is that child labor is necessary in order to save the children from starvation, while the harsh conditions are needed because if a business provided working conditions better than its competitors, it would go out of business. However, with a stable population and appropriate social legislation prohibiting both child labor and harsh working conditions, the Iron Law argument fails.

13.2 William Morris and John Ruskin

News From Nowhere

The Utopian novel, *News from Nowhere*[2], is written in the form of a dream, in which the dreamer finds himself in a future society where work is not motivated by money but by the pleasure of creative craftsmanship. Here are some excerpts in which Ruskin criticizes the Victorian society in which he lived:

Said he, settling himself in his chair again for a long talk: "It is clear from all that we hear and read, that in the last age of civilization men had got into a vicious circle in the matter of production of wares. They had reached a wonderful facility of production, and in order to make the most of that facility they had gradually created (or allowed to grow, rather) a most elaborate system of buying and selling, which has been called the World-Market; and that World-Market, once set a-going, forced them to go on making more and more of these wares, whether they needed them or not. So that while (of course) they could not free themselves from the toil of making real necessaries, they created in a never-ending series sham or artificial necessaries, which became, under the

[2] https://www.gutenberg.org/files/3261/3261-h/3261-h.htm

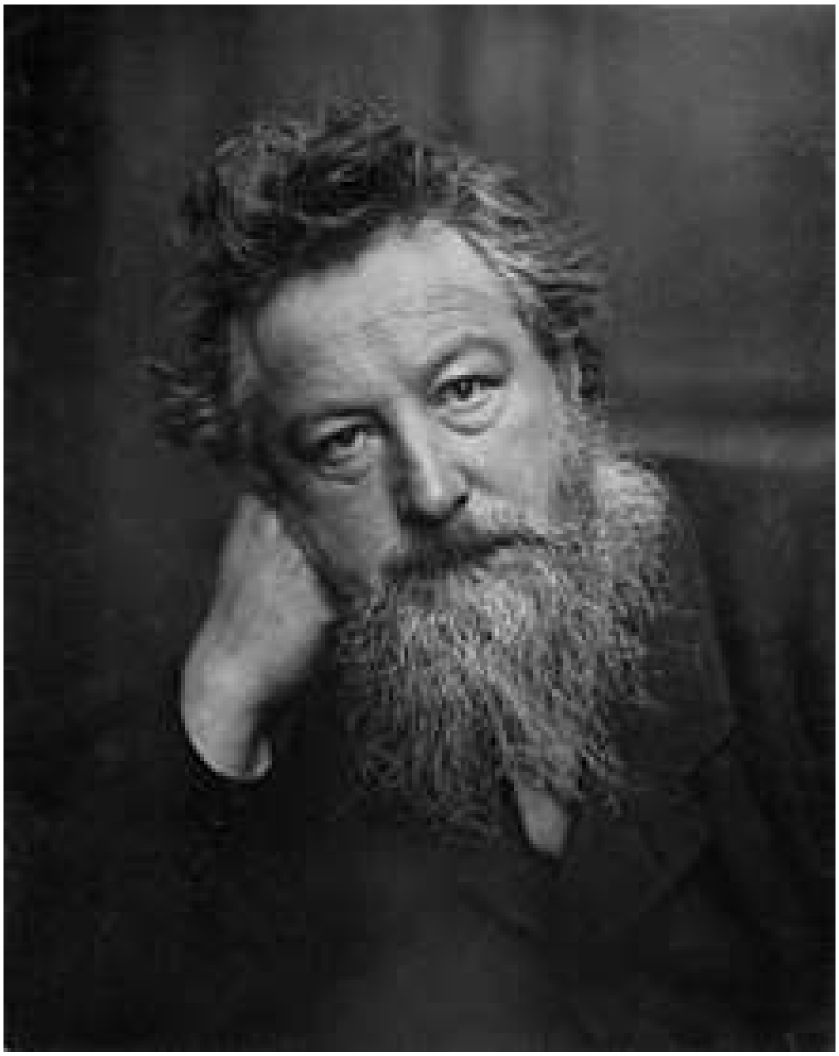

Figure 13.3: **William Morris, (1834-1896), founder of the Arts and Crafts movement and author of the Utopian novel, "News From Nowhere".**

Figure 13.4: **A floral design by William Morris.**

Figure 13.5: **...and another.**

Figure 13.6: **...and another.**

Figure 13.7: **...and another.**

iron rule of the aforesaid World-Market, of equal importance to them with the real necessaries which supported life. By all this they burdened themselves with a prodigious mass of work merely for the sake of keeping their wretched system going."

"Yes - and then?" said I.

"Why, then, since they had forced themselves to stagger along under this horrible burden of unnecessary production, it became impossible for them to look upon labour and its results from any other point of view than one - to wit, the ceaseless endeavour to expend the least possible amount of labour on any article made, and yet at the same time to make as many articles as possible. To this 'cheapening of production', as it was called, everything was sacrificed: the happiness of the workman at his work, nay, his most elementary comfort and bare health, his food, his clothes, his dwelling, his leisure, his amusement, his education - his life, in short - did not weigh a grain of sand in the balance against this dire necessity of 'cheap production' of things, a great part of which were not worth producing at all. Nay, we are told, and we must believe it, so overwhelming is the evidence, though many of our people scarcely can believe it, that even rich and powerful men, the masters of the poor devils aforesaid, submitted to live amidst sights and sounds and smells which it is in the very nature of man to abhor and flee from, in order that their riches might bolster up this supreme folly. The whole community, in fact, was cast into the jaws of this ravening monster, 'the cheap production' forced upon it by the World-Market."...

His estimate of the life of the nineteenth century made me catch my breath a little; and I said feebly, "But the labour-saving machines?"

"What's that you are saying? the labour-saving machines? Yes, they were made to 'save labour' (or, to speak more plainly, the lives of men) on one piece of work in order that it might be expended - I will say wasted - on another, probably useless, piece of work. Friend, all their devices for cheapening labour simply resulted in increasing the burden of labour. The appetite of the World-Market grew with what it fed on: the countries within the ring of 'civilization' (that is, organized misery) were glutted with the abortions of the market, and force and fraud were used unsparingly to 'open up' countries outside that pale. This process of 'opening up' is a strange one to those who have read the professions of the men of that period and do not understand their practice; and perhaps shows us at its worst the great vice of the nineteenth century, the use of hypocrisy and cant to evade the responsibility of vicarious ferocity. When the civilized World-Market coveted a country not yet in its clutches, some transparent pretext was found - the suppression of a slavery different from and

not so cruel as that of commerce; the pushing of a religion no longer believed in by its promoters; the 'rescue' of some desperado or homicidal madman whose misdeeds had got him into trouble amongst the natives of the 'barbarous' country - any stick, in short, which would beat the dog at all. Then some bold, unprincipled, ignorant adventurer was found (no difficult task in the days of competition), and he was bribed to 'create a market' by breaking up whatever traditional society there might be in the doomed country, and by destroying whatever leisure or pleasure he found there. He forced wares on the natives which they did not want, and took their natural products in 'exchange,' as this form of robbery was called, and thereby he 'created new wants,' to supply which (that is, to be allowed to live by their new masters) the hapless, helpless people had to sell themselves into the slavery of hopeless toil so that they might have something wherewith to purchase the nullities of 'civilization.'

John Ruskin's book, *Unto This Last*

In his autobiography, Mahatma Gandhi says: "Three moderns have left a deep impression on my life and captivated me: Raychandbhai (the Indian philosopher and poet) by his living contact; Tolstoy by his book 'The Kingdom of God is Within You'; and Ruskin by his book 'Unto This Last'."

Ruskin's book, "Unto This Last", which Gandhi read in 1904, is a criticism of modern industrial society. Ruskin believed that friendships and warm interpersonal relationships are a form of wealth that economists have failed to consider. He felt that warm human contacts are most easily achieved in small agricultural communities, and that therefore the modern tendency towards centralization and industrialization may be a step backward in terms of human happiness. While still in South Africa, Gandhi founded two religious Utopian communities based on the ideas of Tolstoy and Ruskin. Phoenix Farm (1904) and Tolstoy Farm (1910).

Here are some quotations from Ruskin's book, *Unto This Last*:

The assumption which lies at the root of nearly all erroneous reasoning on political economy - namely, that its object is to accumulate money or exchangeable property - may be shown in few words to be without foundation. For no economist would admit national economy to be legitimate which proposed to itself only the building of a pyramid of gold. He would declare the gold to be wasted, were it to remain in the monumental form, and would say it ought to be employed. But to what end? Either it must be used only to gain more gold, and build a larger pyramid, or to some purpose other than the gaining of gold. And this other purpose, however at first apprehended, will be found to resolve itself finally into the service of man - that is to say, the extension, defense, or comfort of his life. The golden pyramid may perhaps be providently built, perhaps improvidently; but, at all events, the wisdom or folly of the accumu-

lation can only be determined by our having first clearly stated the aim of all economy, namely, the extension of life.

If the accumulation of money, or of exchangeable property, were a certain means of extending existence, it would be useless, in discussing economical questions, to fix our attention upon the more distant object - life - instead of the immediate one - money. But it is not so. Money may sometimes be accumulated at the cost of life, or by limitations of it; that is to say, either by hastening the deaths of men, or preventing their births. It is therefore necessary to keep clearly in view the ultimate object of economy, and to determine the expediency of minor operations with reference to that ulterior end. It has been just stated that the object of political economy is the continuance not only of life, but of healthy and happy life. But all true happiness is both a consequence and cause of life; it is a sign of its vigour, and means of its continuance. All true suffering is in like manner a consequence and cause of death. I shall therefore, in future, use the word "Life" singly: but let it be understood to include in its signification the happiness and power of the entire human nature, body and soul.

Ruskin believed that warm personal relationships are a form of wealth that economists have neglected, and that these relationships are most easily achieved in small communities where people know each other very well because of working together. He thought that the goal of economics should not be the increase of wealth, but the increase of happiness.

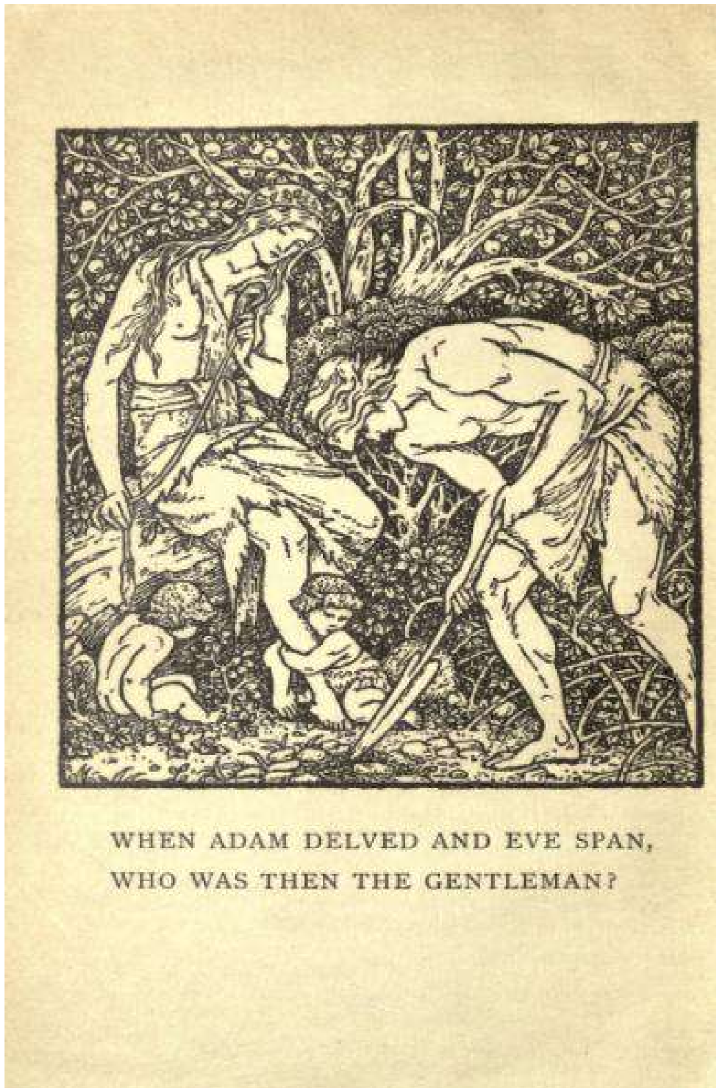

Figure 13.8: **A design by William Morris (1834-1896). Together with John Ruskin (1819-1900) and others in the Arts and Crafts Movement, Morris criticized the Industrial Revolution and division of labor for destroying craftsmanship, traditions of design, traditional skills, and pride in work. His Utopian book, "News from Nowhere", is a plea for a return to cooperative workshops where good design and craftsmanship would flourish. Ruskin's Book, "Unto This Last" (which later greatly influenced Gandhi), points out that the pleasure of warm friendships with coworkers in small cooperative communities is not given sufficient weight by the economic systems of industrial societies. Gandhi later put these principles into practice when he introduced spinning and weaving in the home as a means for eliminating the unemployment that had been produced by the importation of factory-made cloth into India.**

13.3 Influence on later economic thought

The Utopian Socialists mentioned in this chapter had different messages, which reflected the epochs in which they lived. Saint-Simon and Fourier, who lived at the time of the French Revolution, criticized feudalism and lauded industrial society and science. Robert Owen lived a little later, and he had an opportunity to witness the horrors of the early Industrial Revolution in England. But Owen maintained, and indeed proved, that an industrial society could benefit the workers, instead of mercilessly exploiting them. Finally, Morris and Ruskin, who came still later, criticized industrial society from a partly aesthetic and partly moral standpoint. Production was being maximized, but what about social justice and human happiness?

Whatever influence they may have had during their own lifetimes, the long-term influence of the Utopian Socialists is undeniable. Saint-Simon influenced August Compte, Karl Marx, John Stuart Mill and many others. Fourier's ideas about turning work into play influenced the young Karl Marx, and helped him to form his ideas about aleanation. Robert Owen's work led to the foundation of national trade unions and the cooperative movement.

The Utopian Socialist movement led to the foundation of many experimental communities around the world. In America, one can think of New Harmony, Indiana, founded by Robert Owen in 1825; Clermont Phalanx, Ohio, Sodus Bay Phalanx, New York, Spring Farm Colony, Wisconsin and Wisconsin Phalanx, Wisconsin, founded by followers of Charles Fourier in the 1840's. Followers of the French Utopian Socialist Étienne Cabet founded Icarian communities in Louisiana, Texas, Illinois, Iowa, Missouri, and California.

13.4 The dark satanic mills

The poems "Jerusalem" and "London" by William Blake, (1757-1827), can be thought of as protests against the conditions of the early Industrial Revolution in England:

Jerusalem

And did those feet in ancient time
Walk upon England's mountains green?
And was the holy Lamb of God
On England's pleasant pastures seen?

And did the Countenance Divine
Shine forth upon our clouded hills?
And was Jerusalem builded here
Among these dark Satanic Mills?

Bring me my bow of burning gold!
Bring me my arrows of desire!
Bring me my spear! O clouds, unfold!
Bring me my chariot of fire!

I will not cease from mental fight,
Nor shall my sword sleep in my hand,
Till we have built Jerusalem
In England's green and pleasant land.

London

I wandered through each chartered street
Near which the chartered Thames doth flow.
A mark in every face I meet,
Marks of weakness, marks of woe.

In every cry of every man,
In every infant's cry of fear,
In every voice, in every ban,
The mind-forged manacles I hear.

How the chimney-sweeper's cry
Every blackening church appalls,
And how the hapless soldier's sigh
Runs in blood down palace-walls.

But most, through midnight streets I hear
How the youthful harlot's curse
Blasts the new-born infant's tear,
And blights with plagues the marriage-hearse.

13.5 Working conditions in 19th century England

According to the new rules by which industrial society began to be governed, traditions were forgotten and replaced by purely economic laws. Labor was viewed as a commodity, like coal or grain, and wages were paid according to the laws of supply and demand, without regard for the needs of the workers. Wages fell to starvation levels, hours of work increased, and working conditions deteriorated.

John Fielden's book, "The Curse of the Factory System" was written in 1836, and it describes the condition of young children working in the cotton mills. "The small nimble fingers of children being by far the most in request, the custom instantly sprang up of procuring 'apprentices' from the different parish workhouses of London, Birmingham and elsewhere... Overseers were appointed to see to the works, whose interest it was to work the children to the utmost, because their pay was in proportion to the quantity of pay that they could exact."

"Cruelty was, of course, the consequence; and there is abundant evidence on record to show that in many of the manufacturing districts, the most heart-rending cruelties were practiced on the unoffending and friendless creatures... that they were flogged, fettered and tortured in the most exquisite refinements of cruelty, that they were in many cases starved to the bone while flogged to their work, and that they were even in some instances driven to commit suicide... The profits of manufacture were enormous, but this only whetted the appetite that it should have satisfied."

Dr. Peter Gaskell, writing in 1833, described the condition of the English mill workers as follows:

"The vast deterioration in personal form which has been brought about in the manufacturing population during the last thirty years... is singularly impressive, and fills the mind with contemplations of a very painful character... Their complexion is sallow and pallid, with a peculiar flatness of feature caused by the want of a proper quantity of adipose substance to cushion out the cheeks. Their stature is low - the average height of men being five feet, six inches... Great numbers of the girls and women walk lamely or awkwardly... Many of the men have but little beard, and that in patches of a few hairs... (They have) a spiritless and dejected air, a sprawling and wide action of the legs..."

"Rising at or before daybreak, between four and five o'clock the year round, they swallow a hasty meal or hurry to the mill without taking any food whatever... At twelve o'clock the engine stops, and an hour is given for dinner... Again they are closely immured from one o'clock till eight or nine, with the exception of twenty minutes, this being allowed for tea. During the whole of this long period, they are actively and unremittingly engaged in a crowded room at an elevated temperature."

Dr. Gaskell described the housing of the workers as follows:

"One of the circumstances in which they are especially defective is that of drainage and water-closets. Whole ranges of these houses are either totally undrained, or very partially... The whole of the washings and filth from these consequently are thrown into the front or back street, which, often being unpaved and cut into deep ruts, allows them to collect into stinking and stagnant pools; while fifty, or even more than that number, having only a single convenience common to them all, it is in a very short time choked with excrementous matter. No alternative is left to the inhabitants but adding this to the already defiled street."

"It frequently happens that one tenement is held by several families... The demoralizing effects of this utter absence of domestic privacy must be seen before they can be thoroughly appreciated. By laying bare all the wants and actions of the sexes, it strips them of outward regard for decency - modesty is annihilated - the father and the mother, the brother and the sister, the male and female lodger, do not scruple to commit acts in front of each other which even the savage keeps hid from his fellows."

13.6 Ricardo's Iron Law of Wages

Malthus continued a life of quiet scholarship, unperturbed by the heated public debate which he had caused. At the age of 38, he married a second cousin. The marriage produced only three children, which at that time was considered to be a very small number. Thus he practiced the pattern of late marriage which he advocated. Although he was appointed rector of a church in Lincolnshire, he never preached there, hiring a curate to do this in his place. Instead of preaching, Malthus accepted an appointment as Professor of History and Political Economy at the East India Company's College at Haileybury. This appointment made him the first professor of economics in England, and probably also the first in the world. Among the important books which he wrote while he held this post was *Principles of Political Economy, Considered with a View to their Practical Application*. Malthus also published numerous revised and expanded editions of his *Essay on the Principle of Population*. The third edition was published in 1806, the fourth in 1807, the fifth in 1817, and the sixth in 1826.

Ricardo's theory of rent

. Among Malthus' closest friends was the financier David Ricardo (1772-1823). Ricardo had been born into a Jewish family that had moved to London from Portugal. However, at the age of 21 he had broken relations with his family and rejected his orthodox Jewish faith in order to marry a Quaker girl. Ricardo, who had worked with his father on the London Sock Exchange since the age of 14, then proceeded to become a financier in his own right, amassing a fortune worth over a million pounds, in those days an immense sum.

Having read a copy of Adam Smith's *Wealth of Nations*, Ricardo became interested in theoretical economics, and at the age of 37 he began to write about this subject. His articles and books were admired by Malthus, and the two became close friends, although they disagreed on many issues.

Malthus had been brought up as a member of the British landowning class. He valued the beauty of the countryside, and was disturbed by the growth of industrialism. By contrast, Ricardo's sympathies lay with the rising and vigorous class of industrialists. The theory of rent, developed by Ricardo, showed that there is an inevitable conflict between these two classes.

Ricardo's theory of rent dealt with the effect of economic growth on prices, wages and profits. He and Malthus both agreed with Adam Smith's picture of growth: The virtuous industrialist does not spend his profits on luxuries, but instead reinvests them. New factories are built, the demand for workers increases, wages rise, and more workers are "produced" in response to the demand, i.e., more of the worker's children survive, and their numbers grow.

Figure 13.9: **The economist David Ricardo (1772-1823), a close friend of Malthus. The joint pessimism of Ricardo and Malthus caused Carlyle to call economics "the dismal science".**

With each turn of the spiral of economic growth, there is an increased demand for food, since the population of workers increases. The most fertile land is already in use, but to meet the larger demand for food, marginal land is tilled, for example land on steep hillside slopes. It costs more to grow grain on marginal land, and therefore grain prices rise. According to Ricardo, the only people who benefit from economic growth are the owners of especially fertile land. The factory owners do not benefit, because they must pay higher wages to meet the increased price of food for their workers, and their profits remain the same. The workers do not benefit, because regardless of the price of grain, each of them is given only enough food to survive. The true beneficiaries of economic growth, according to Ricardo, are the owners of the most fertile land, i.e., the landowning aristocracy.

Ricardo defines "rent" to be the difference, per acre, between the cost of growing grain on good land, and the cost on marginal land. This difference is pocketed by the owners of good land. They do not really deserve it because ownership of fertile land is something that they inherited, rather than something that they produced by their own efforts.

The Corn Laws

At the time when Ricardo was writing, imports of cheap foreign grain were effectively blocked by the Corn Laws, a series of acts of Parliament which were in force between 1815 and 1846. These laws imposed prohibitively high tariffs on the import of foreign grain. Ricardo's theory of rents showed that the Corn Laws benefited the landowning aristocracy at the expense of the industrialists. His sympathies were with the industrialists, because he felt that the Corn Laws were forcing England back into feudalism and economic stagnation. By contrast, Malthus favored the Corn laws because he felt that it was dangerous for England to become dependent on imports of foreign grain. What would the country do in case of war?, Malthus asked. What would England do if it lost its industrial edge and became unable to export its manufactured products? How would the country then support its overgrown population?

In the end, the aristocracy lost its control of Parliament, the Corn Laws were repealed, and the population of England continued to grow. It has grown from 8.3 million in 1801, the year of the first census, to 50.7 million in 2006. Today, England could not possibly support its population on home-grown food. Like the Netherlands and Japan, Britain is dependent on exports of manufactured goods and imports of grain.

The Iron Law of Wages

Ricardo believed that the "natural price" of any commodity is the lowest possible cost of its production, and that in the long run, prices of any commodity would approach this natural value. When he applied this idea to labor, the result was his "Iron Law of Wages". Since the lowest cost of "producing" workers is the cost of keeping them alive at the subsistence level, he reasoned, the natural price of labor is determined by the lowest possible cost of sustenance. If workers are paid less than this, they will die, their numbers will decrease, the demand for workers will increase, and the price of labor will rise. If they are paid more, a greater number of their children will survive, the number of workers will increase above demand, and wages will fall. According to this argument, starvation wages are inevitable.

Ricardo's reasoning assumes industrialists to be completely without social conscience or governmental regulation; it fails to anticipate the development of trade unionism; and it assumes that the working population will multiply without restraint as soon as their wages rise above the starvation level. This was an accurate description of what was happening in England during Ricardo's lifetime, but it obviously does not hold for all times and all places.

Malthus became a close friend of the wealthy financier and economic theorist, David Ricardo (1772-1823). He and Ricardo met frequently to discuss economic problems, and when circumstances prevented them from meeting, they exchanged endless letters. Ricardo and Malthus differed on the subject of the Corn Laws, but they never allowed this difference of opinion to affect their friendship.

Although shortages of food had produced drastic increases in the price of grain, the import of cheap foreign grain was effectively prevented by the Corn Laws. These laws had been introduced by the large landowners, who controlled Parliament, but they were opposed by the manufacturers, who wished to make less expensive food available to their workers. On this issue, Malthus sided with the landowners, arguing that if England became dependent on imports of foreign grain, the country would be insecure: What if England's ability to export manufactured goods in exchange for the grain should later be undermined by foreign competition? Malthus pointed out that the country would then face starvation. Ricardo, on the other hand, sided with the rising class of manufacturers. In 1832 the Reform Bill gave the manufacturers control of Parliament, the Corn Laws were repealed, and England's rapidly-growing population became dependent on imports of foreign grain.

Ricardo accepted Malthus' principle of population, and from it he deduced what came to be called his "Iron Law of Wages". According to Ricardo, labor is a commodity, and wages are determined by the law of supply and demand: When wages fall below the starvation level, the workers' children die. Labor then becomes a scarce commodity, and wages rise. On the other hand, when wages rise above the starvation level, the working population multiplies rapidly, labor becomes a plentiful commodity, and wages fall again.

Thus, according to Ricardo, there is an Iron Law which holds wages at the minimum level at which life can be supported. The combined pessimism of Malthus and Ricardo caused Carlyle to call economics "the dismal science".

13.7 Marx and Engels in England

Here is an excerpt from Frederich Engels' book *The Condition of the Working Class in England in 1844*:

A town, such as London, where a man may wander for hours together without reaching the beginning of the end, without meeting the slightest hint which could lead to the inference that there is open country within reach, is a strange

thing. This colossal centralization, this heaping together of two and a half millions of human beings at one point, has multiplied the power of this two and a half millions a hundredfold; has raised London to the commercial capital of the world, created the giant docks and assembled the thousand vessels that continually cover the Thames. I know nothing more imposing than the view which the Thames offers during the ascent from the sea to London Bridge. The masses of buildings, the wharves on both sides, especially from Woolwich upwards, the countless ships along both shores, crowding ever closer and closer together, until, at last, only a narrow passage remains in the middle of the river, a passage through which hundreds of steamers shoot by one another; all this is so vast, so impressive, that a man cannot collect himself, but is lost in the marvel of England's greatness before he sets foot upon English soil.

But the sacrifices which all this has cost become apparent later. After roaming the streets of the capital a day or two, making headway with difficulty through the human turmoil and the endless lines of vehicles, after visiting the slums of the metropolis, one realizes for the first time that these Londoners have been forced to sacrifice the best qualities of their human nature, to bring to pass all the marvels of civilisation which crowd their city; that a hundred powers which slumbered within them have remained p. 24inactive, have been suppressed in order that a few might be developed more fully and multiply through union with those of others. The very turmoil of the streets has something repulsive, something against which human nature rebels. The hundreds of thousands of all classes and ranks crowding past each other, are they not all human beings with the same qualities and powers, and with the same interest in being happy? And have they not, in the end, to seek happiness in the same way, by the same means? And still they crowd by one another as though they had nothing in common, nothing to do with one another, and their only agreement is the tacit one, that each keep to his own side of the pavement, so as not to delay the opposing streams of the crowd, while it occurs to no man to honour another with so much as a glance. The brutal indifference, the unfeeling isolation of each in his private interest becomes the more repellant and offensive, the more these individuals are crowded together, within a limited space. And, however much one may be aware that this isolation of the individual, this narrow self-seeking is the fundamental principle of our society everywhere, it is nowhere so shamelessly barefaced, so self-conscious as just here in the crowding of the great city. The dissolution of mankind into monads, of which each one has a separate principle, the world of atoms, is here carried out to its utmost extreme.

Hence it comes, too, that the social war, the war of each against all, is here openly declared. Just as in Stirner's recent book, people regard each other only as useful objects; each exploits the other, and the end of it all is, that the stronger treads the weaker under foot, and that the powerful few, the capital-

ists, seize everything for themselves, while to the weak many, the poor, scarcely a bare existence remains.

What is true of London, is true of Manchester, Birmingham, Leeds, is true of all great towns. Everywhere barbarous indifference, hard egotism on one hand, and nameless misery on the other, everywhere social warfare, every man's house in a state of siege, everywhere reciprocal plundering under the protection of the law, and all so shameless, so openly avowed that one shrinks before the consequences of our social state...

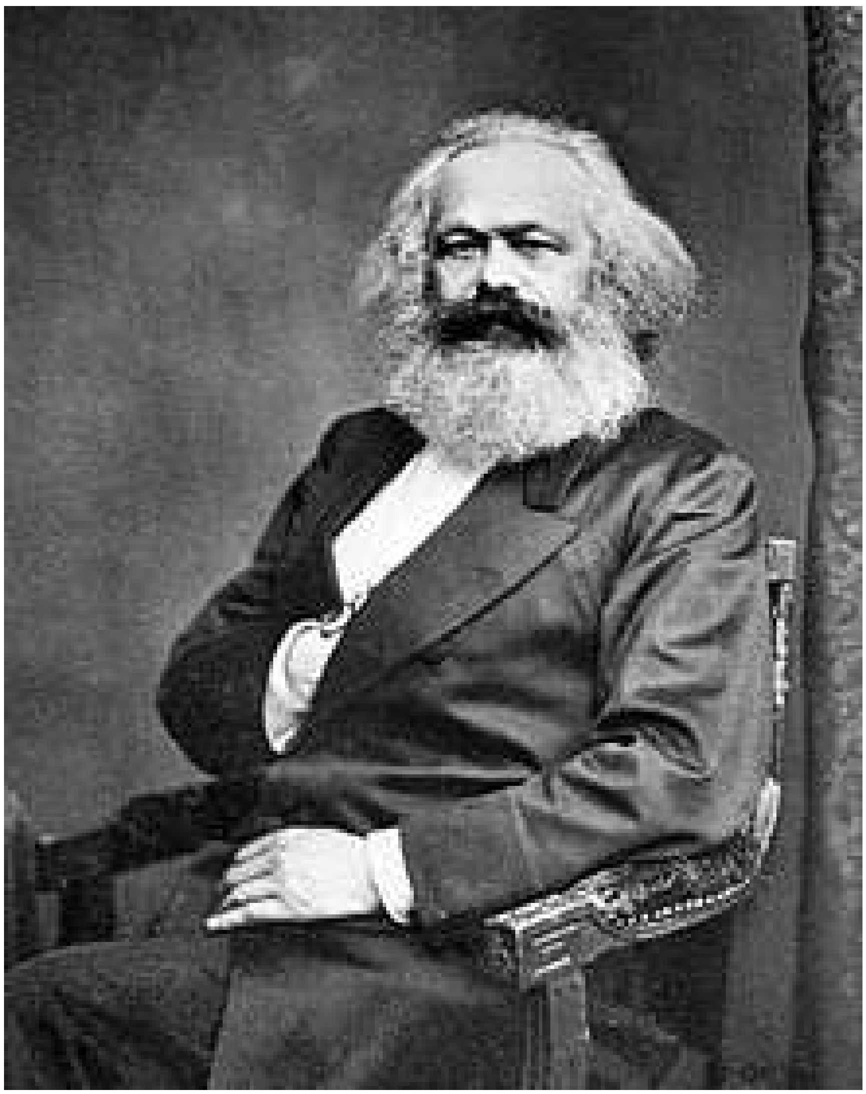

Figure 13.10: **Karl Marx, (1818-1883). Born in Prussia, Marx did his most important writing in London, and he died in poverty there at the age of 64.**

Figure 13.11: **Jenny von Westphalen, (1814-1881), the much-loved aristocratic wife of Karl Marx.**

Figure 13.12: **Frederich Engels, (1820-1895). He met Karl Marx in 1844, and the two became lifelong friends and collaborators.**

13.8 The slow acceptance of birth control in England

With the gradual acceptance of birth control in England, the growth of trade unions, the passage of laws against child labor and finally minimum wage laws, conditions of workers gradually improved, and the benefits of industrialization began to spread to the whole of society.

One of the arguments which was used to justify the abuse of labor was that the alternative was starvation. The population of Europe had begun to grow rapidly for a variety of reasons: - because of the application of scientific knowledge to the prevention of disease; because the potato had been introduced into the diet of the poor; and because bubonic plague had become less frequent after the black rat had been replaced by the brown rat, accidentally imported from Asia.

It was argued that the excess population could not be supported unless workers were employed in the mills and factories to produce manufactured goods, which could be exchanged for imported food. In order for the manufactured goods to be competitive, the labor which produced them had to be cheap: hence the abuses. (At least, this is what was argued).

Industrialization benefited England, but in a very uneven way, producing great wealth for some parts of society, but also extreme misery in other social classes. For many, technical progress by no means led to an increase of happiness. The persistence of terrible poverty in 19th-century England, and the combined pessimism of Ricardo and Malthus, caused Thomas Carlyle to call economics "the Dismal Science".

Among the changes which were needed to insure that the effects of technical progress became beneficial rather than harmful, the most important were the abolition of child labor, the development of unions, the minimum wage law, and the introduction of birth control.

Francis Place (1771-1854), a close friend of William Godwin and James Mill, was one of the earliest and most courageous pioneers of these needed changes. Place had known extreme poverty as a child, but he had risen to become a successful businessman and a leader of the trade union movement.

Place and Mill were Utilitarians, and like other members of this movement they accepted the demographic studies of Malthus while disagreeing with Malthus' rejection of birth control. They reasoned that since abortion and infanticide were already widely used by the poor to limit the size of their families, it was an indication that reliable and humane methods of birth control would be welcome. If marriage could be freed from the miseries which resulted from excessive numbers of children, the Utilitarians believed, prostitution would become less common, and the health and happiness of women would be improved.

Francis Place and James Mill decided that educational efforts would be needed to make the available methods of birth control more widely known and accepted. In 1818, Mill cautiously wrote "The great problem of a real check to population growth has been miserably evaded by all those who have meddled with the subject... And yet, if the superstitions of the nursery were discarded, and the principle of utility kept steadily in view, a solution might not be very difficult to be found."

Figure 13.13: **The Utilitarian philosopher and economist James Mill (1773-1836) was an early advocate of birth control. (He was the father of John Stuart Mill.)**

A few years later, Mill dared to be slightly more explicit: “The result to be aimed at”, he wrote in his *Elements of Political Economy* (1821), “is to secure to the great body of the people all the happiness which is capable of being derived from the matrimonial union, (while) preventing the evils which the too rapid increase of their numbers would entail. The progress of legislation, the improvement of the education of the people, and the decay of superstition will, in time, it may be hoped, accomplish the difficult task of reconciling these important objects.”

In 1822, Francis Place took the considerable risk of publishing a four-page pamphlet entitled *To the Married of Both Sexes of the Working People*, which contained the following passages:

“It is a great truth, often told and never denied, that when there are too many working people in any trade or manufacture, they are worse paid than they ought to be paid, and are compelled to work more hours than they ought to work. When the number of working people in any trade or manufacture has for some years been too great, wages are reduced very low, and the working people become little better than slaves.”

“When wages have thus been reduced to a very small sum, working people can no longer maintain their children as all good and respectable people wish to maintain their children, but are compelled to neglect them; - to send them to different employments; - to Mills and Manufactories, at a very early age. The miseries of these poor children cannot be described, and need not be described to you, who witness them and deplore them every day of your lives.”

“The sickness of yourselves and your children, the privation and pain and premature death of those you love but cannot cherish as you wish, need only be alluded to. You know all these evils too well.”

“And what, you will ask, is the remedy? How are we to avoid these miseries? The answer is short and plain: the means are easy. Do as other people do, to avoid having more children than they wish to have, and can easily maintain.”

“What is to be done is this. A piece of soft sponge is tied by a bobbin or penny ribbon, and inserted just before the sexual intercourse takes place, and is withdrawn again as soon as it has taken place. Many tie a sponge to each end of the ribbon, and they take care not to use the same sponge again until it has been washed. If the sponge be large enough, that is, as large as a green walnut, or a small apple, it will prevent conception... without diminishing the pleasures of married life...”

“You cannot fail to see that this address is intended solely for your good. It is quite impossible that those who address you can receive any benefit from it, beyond the satisfaction which every benevolent person and true Christian, must feel, at seeing you comfortable, healthy and happy.”

The publication of Place’s pamphlet in 1822 was a landmark in the battle for the acceptance of birth control in England. Another important step was taken in 1832, when a small book entitled *The Fruits of Philosophy or, the Private Companion of Young Married People* was published by a Boston physician named Dr. Charles Knowlton. The book contained simple contraceptive advice. It reviewed the various methods of birth control available at the time. In order for the sponge method to be reliable, Knowlton’s book pointed out, use of a saline douching solution was necessary.

The battle for these social reforms was not easily won. For example, in 1876, "The Fruits of Philosophy" was ruled by an English court to be obscene, and a bookseller was sentenced to two years imprisonment for distributing it. The liberal politician Charles Bradlaugh and his friend, the feminist author Annie Besant then decided to provoke a new trial by selling the book themselves. They wrote polite letters to the Chief Clerk of the Magistrates, the Detective Department, and the City Solicitor announcing the time and the place at which they intended to sell the book, and they asked to be arrested. The result was a famous trial in which the two reformers were acquitted, but the jury again ruled " The Fruits of Philosophy" to be obscene.

As the nineteenth century progressed, birth control gradually came to be accepted in England, and the average number of children per marriage fell from 6.16 in 1860 to 4.13 in 1890. By 1915 this figure had fallen to 2.43. Because of lowered population pressure, combined with the growth of trade unions and better social legislation, the condition of England's industrial workers improved; and under the new conditions, Ricardo's Iron Law of Wages fortunately no longer seemed to hold.

13.9 Trade unions and child labor laws

Nor was the battle to establish trade unions easily won. At the start of the 19th century, many countries had laws prohibiting organizing unions, and these invoked penalties up to and including death. In England, the Reform Act of 1832 made unions legal, but nevertheless in 1834, six men from Dorset who had formed the "Friendly Society of Agricultural Workers" were arrested and sentenced to a seven years' transportation to Australia. An obscure law from 1797 was invoked, which prohibited swearing secret oaths. This they had in fact done, but their main crime seems to have been refusing to work for less than 10 shillings a week. Despite bitter opposition, trade unions gradually developed both in England and in other industrial countries.

One of the important influences for reform was the Fabian Society, founded in London in 1884. The group advocated gradual rather than revolutionary reform (and took its name from Quintus Fabius Maximus, the Roman general who defeated Hannibal's Carthaginian army by using harassment and attrition rather than head-on battles). The Fabian Society came to include a number of famous people, including Sydney and Beatrice Webb, George Bernard Shaw, H.G. Wells, Annie Besant, Leonard Woolf, Emaline Pankhurst, Bertrand Russell, John Maynard Keynes, Harold Laski, Ramsay MacDonald, Clement Attlee, Tony Benn and Harold Wilson. Jawaharlal Nehru, India's first Prime Minister, was greatly influenced by Fabian economic ideas.

The group was instrumental in founding the British Labour Party (1900), the London School of Economics and the New Statesman. In 1906, Fabians lobbied for a minimum wage law, and in 1911 they lobbied for the establishment of a National Health Service.

Adam Smith had praised division of labor as one of the main elements in industrial efficiency, but precisely this aspect of industrialism was criticized by Thomas Carlyle (1795-

Figure 13.14: **Beatrice Webb (1858-1943). Together with her husband Sidney Webb, Graham Wallace and George Bernard Shaw, she founded the London School of Economics using money left to the Fabian Society by Henry Hutchinson. The Fabians also founded the British Labour Party, and they lobbied for a minimum wage law and National Health Service.**

1891), John Ruskin (1819-1900) and William Morris (1834-1896). They considered the numbingly repetitive work of factory laborers to be degrading, and they rightly pointed out that important traditions of design were being lost and replaced by ugly mass produced artifacts. The Arts and Crafts movement founded by Ruskin and Morris advocated cooperative workshops, where creative freedom and warm human relationships would make work rewarding and pleasant. In several Scandinavian countries, whose industrialization came later than England's, efforts were made to preserve traditions of design. Hence the present artistic excellence of Scandinavian furniture and household articles.

Through the influence of reformers, the more brutal aspects of Adam Smith's economic model began to be moderated. Society was learning that free market mechanisms alone do not lead to a happy and just society. In addition, ethical and ecological considerations and some degree of governmental regulation are also needed.

The Reform Movement aimed at social goals, but left ecological problems untreated. Thus our economic system still does not reflect the true price to society of environmentally damaging activities. For example, the price of coal does not the reflect the cost of the environmental damage done by burning it. This being so, our growth-worshiping economic system of today thunders ahead towards an environmental mega-catastrophe, as we will see in the next chapter.

13.10 John Stuart Mill

He was not allowed to have a childhood

John Stuart Mill (1806-1873) showed his genius at an early age, and his father, the Utilitarian philosopher and political economist James Mill, immediately began to groom him to replace Jeremy Bentham as the leader of the Utilitarian movement. From the age of 3 onwards, Mill was deliberately kept away from children of his own age and made to spend all his waking hours in study. Play was not allowed, since it would break the habit of continual diligence.

At the age of three, Mill was taught Greek. By the time he reached eight, he had read Aesop's Fables, Xenophon's Anabasis, and all the works of Herodotus. He was also acquainted with Lucian, Diogenes Laërtius, Isocrates and six dialogues of Plato, in their original language. Furthermore, he had also read a great deal of history in English and had been taught arithmetic, physics and astronomy.

When he was twelve, Mill began a thorough study of the scholastic logic, at the same time reading Aristotle's logical treatises in the original language. At thirteen, he was introduced to political economy and studied the classical economists Adam Smith and David Ricardo. In fact Ricardo, who was a close friend of his father, used to invite the young Mill to his house for a walk in order to talk about political economy.

At the age of fourteen, Mill spent a year in France, where he attended the winter courses on chemistry, zoology, logic of the Faculté des Sciences, as well as taking a course of the higher mathematics. He also met the economist Jean-Baptiste Say, a friend of his father,

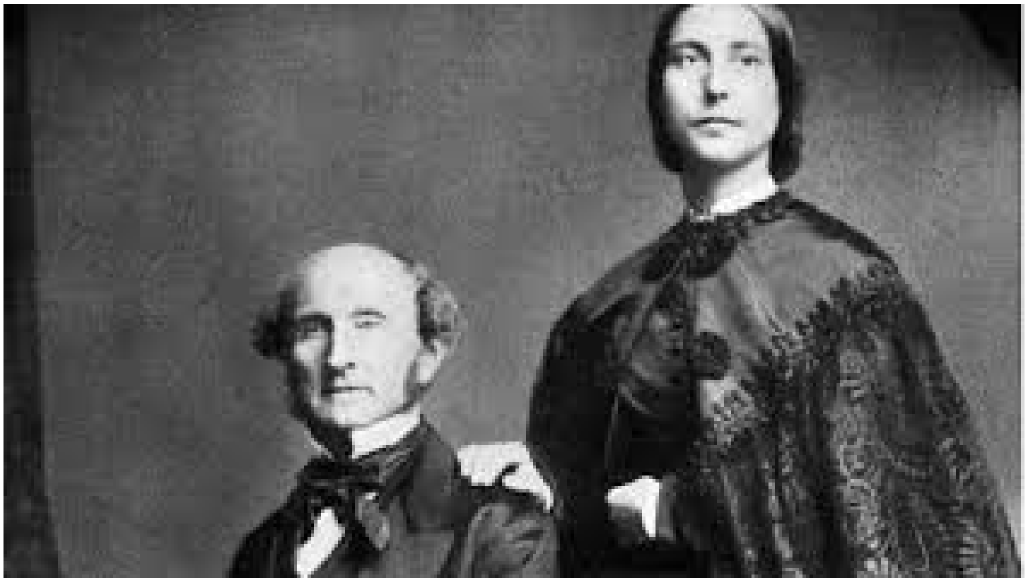

Figure 13.15: **John Stuart Mill and his stepdaughter Helen Taylor, with whom he worked for fifteen years after the death of his wife, Harriet Taylor Mill (Wikipedia).**

and the political philosopher Henri Saint-Simon.

Limits to growth

John Stuart Mill pioneered the concept of a steady.state economy. He realized that on a finite earth, neither the population of humans nor the economy can continue to grow forever. In 1848 (when there were just over one billion people in the world), he described the optimal global population in the following words:

"The density of population necessary to enable mankind to obtain, in the greatest degree, all the advantages of cooperation and social intercourse, has, in the most populous countries, been attained. A population may be too crowded, although all be amply supplied with food and raiment."

"... Nor is there much satisfaction in contemplating the world with nothing left to the spontaneous activity of nature; with every rood of land brought into cultivation, which is capable of growing food for human beings; every flowery waste or natural pasture plowed up, all quadrupeds or birds which are not domesticated for man's use exterminated as his rivals for food, every hedgerow or superfluous tree rooted out, and scarcely a place left where a wild shrub or flower could grow without being eradicated as a weed in the name of improved agriculture. If the earth must lose that great portion of its pleasantness which it owes to things that the unlimited increase of wealth and population would extirpate from it, for the mere purpose of enabling it to support a larger, but not better or happier population, I sincerely hope, for the sake of posterity, that they will be content to be stationary, long before necessity compels them to it."

Contributions to Utilitarian theory

Jeremy Bentham (1748-1832) had written that "it is the greatest happiness of the greatest number that is the measure of right and wrong". Mill refined this basic principle of Utilitarianism by pointing out the difference between higher pleasures, for example moral or intellectual pleasures, and lower ones, such as pleasures of the flesh. Mill remarked that "It is better to be a human being dissatisfied than a pig satisfied; better to be Socrates dissatisfied than a fool satisfied. And if the fool, or the pig, are of a different opinion, it is because they only know their own side of the question."

Ideas on economics and on individual liberty

According to David Ricardo's "Iron Law of Wages", laborors must always live on the exact borderline between starvation and survival. Wages, Ricardo argued, are determined by the laws of supply and demand. If wages increase above the starvation level, more children of workers survive, the supply of workers increases, and the wages fall once more.

Mill rebelled against Ricardo's dismal "Iron Law" by pointing out that although the means of production might be regulated by the necessities of economics, social conscience can determine the way in which the goods are distributed. (Later Mahatma Gandhi extended this idea by showing that social conscience can also play a role in the way that goods are produced).

John Stuart Mill also contributed importantly to the idea of individual liberty as opposed to unlimited control by the state or by social opinion. He is the author of the following influential principle: "The only purpose for which power can be rightfully exercised over any member of a civilized community, against his will, is to prevent harm to others."

Opposition to slavery

Regarding slavery, Mill wrote: "This absolutely extreme case of the law of force, condemned by those who can tolerate almost every other form of arbitrary power, and which, of all others, presents features the most revolting to the feeling of all who look at it from an impartial position, was the law of civilized and Christian England within the memory of persons now living: and in one half of Angle-Saxon America three or four years ago, not only did slavery exist, but the slave trade, and the breeding of slaves expressly for it, was a general practice between slave states. Yet not only was there a greater strength of sentiment against it, but, in England at least, a less amount either of feeling or of interest in favour of it, than of any other of the customary abuses of force: for its motive was the love of gain, unmixed and undisguised: and those who profited by it were a very small numerical fraction of the country, while the natural feeling of all who were not personally interested in it, was unmitigated abhorrence."

Member of Parliament and advocate of for votes for women

During the years between 1865 and 1868, John Stuart Mill served simultaneously as a Member of Parliament and as Lord Rector of the University of St. Andrews. In Parliament, Mill was the first person to call for votes for women. His motion was defeated, but it set an important precedent. Mill may have been influenced by his wife, Harriet Taylor Mill, who was a brilliant person in her own right.

Together with his wife and stepdaughter, Mill composed a book entitled *The Subjugation of Women*, which was completed in 1861. It contains a passage arguing that "the legal subordination of one sex to another - is wrong in itself, and now one of the chief hindrances to human improvement; and that it ought to be replaced by a system of perfect equality, admitting no power and privilege on the one side, nor disability on the other.

Some quotations

Bad men need nothing more to compass their ends, than that good men should look on and do nothing.

A person may cause evil to others not only by his actions but by his inaction, and in either case he is justly accountable to them for the injury.

I have learned to seek my happiness by limiting my desires, rather than in attempting to satisfy them.

In this age, the mere example of non-conformity, the mere refusal to bend the knee to custom, is itself a service. Precisely because the tyranny of opinion is such as to make eccentricity a reproach, it is desirable, in order to break through that tyranny, that people should be eccentric. Eccentricity has always abounded when and where strength of character has abounded; and the amount of eccentricity in a society has generally been proportional to the amount of genius, mental vigor, and moral courage which it contained. That so few now dare to be eccentric, marks the chief danger of the time.

The only freedom which deserves the name is that of pursuing our own good in our own way, so long as we do not attempt to deprive others of theirs, or impede their efforts to obtain it. Each is the proper guardian of his own health, whether bodily, or mental or spiritual. Mankind are greater gainers by suffering each other to live as seems good to themselves, than by compelling each to live as seems good to the rest.

It is not because men's desires are strong that they act ill; it is because their consciences are weak

Every man who says frankly and fully what he thinks is so far doing a public service. We should be grateful to him for attacking most unsparingly our most cherished opinions.

Those only are happy (I thought) who have their minds fixed on some object other than their own happiness; on the happiness of others, on the improvement of mankind, even on some art or pursuit, followed not as a means, but as itself an ideal end. Aiming thus at something else, they find happiness by the way. The enjoyments of life (such was now my theory) are sufficient to make it a pleasant thing, when they are taken en passant, without being made a principal object.

Whatever we may think or affect to think of the present age, we cannot get out of it; we must suffer with its sufferings, and enjoy with its enjoyments; we must share in its lot, and, to be either useful or at ease, we must even partake its character.

What is called the Law of Nations is not properly law, but a part of ethics: a set of moral rules, accepted as authoritative by civilized states.

If all mankind minus one, were of one opinion, and only one person were of the contrary opinion, mankind would be no more justified in silencing that one person, than he, if he had the power, would be justified in silencing mankind.

Member of Parliament and advocate of for votes for women

During the years between 1865 and 1868, John Stuart Mill served simultaneously as a Member of Parliament and as Lord Rector of the University of St. Andrews. In Parliament, Mill was the first person to call for votes for women. His motion was defeated, but it set an important precedent. Mill may have been influenced by his wife, Harriet Taylor Mill, who was a brilliant person in her own right.

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Ricardo's model accurately described the condition of industrial workers at the time when he was living. However, this model did not take into account the possibility of trade unions and social legislation fixing the minimum wage; nor did Ricardo's model take into account the possibility that workers would use birth control to limit their population growth.

We have seen that Malthus himself was opposed to birth control, advocating late marriage and "moral restraint" instead as the proper means for avoiding excessive population growth. However others in England, notably the Utilitarians, while accepting Malthus' ideas concerning population pressure, advocated birth control as a means of relieving it. In 1821, the Utilitarian philosopher James Mill (the father of John Stuart Mill) wrote in his Elements of Political Economy: "The result to be aimed at is to secure to the great body of the people all the happiness which is capable of being derived from the matrimonial union, (while) preventing the evils which the too rapid increase of their numbers would entail. The progress of legislation, the improvement of the education of the people, and the decay of superstition will, in time, it may be hoped, accomplish the difficult task of reconciling these important objects."

This somewhat vague advocacy of birth control was made much more explicit by the trade union leader Francis Place (1771-1854). In 1822 Place published, at considerable risk to himself, a pamphlet entitled To the Married of Both Sexes of the Working People. Place's pamphlet contains the following passages:

"It is a great truth, often told and never denied, that when there are too many working people in any trade or manufacture, they are worse paid than they ought to be paid, and are compelled to work more hours than they ought to work. When the number of working people in any trade or manufacture has for some years been too great, wages are reduced very low, and the working people become little better than slaves." "When wages have thus been reduced to a very small sum, working people can no longer maintain their children as all good and respectable people wish to maintain their children, but are compelled to neglect them; - to send them to different employments; - to Mills and Manufactories, at a very early age."

"The miseries of these poor children cannot be described, and need not be described to you, who witness them and deplore them every day of your lives."

"The sickness of yourselves and your children, the privation and pain and premature death of those you love but cannot cherish as you wish, need only be alluded to. You know all these evils too well." "And what, you will ask, is the remedy? How are we to avoid these miseries? The answer is short and plain: the means are easy. Do as other people do, to avoid having more children than they wish to have, and can easily maintain."

Place's pamphlet then goes on to describe very explicitly the sponge method of contraception. "What is to be done is this. A piece of soft sponge is tied by a bobbin or penny ribbon, and inserted just before intercourse takes place. Many tie a sponge to each end of a ribbon, and they take care not to use the same sponge again until it has been washed. If the sponge be large enough, that is, as large as a green walnut, or a small apple, it will prevent conception.... without diminishing the pleasures of married life..."

In 1832, Dr. Charles Knowlton, a Boston physician, published a book entitled *The Fruits of Philosophy, or the Private Companion of Young Married People*. It reviewed the various methods of birth control then available, and it pointed out that in order to be reliable, the sponge method required the use of a saline douching solution. This small book was reprinted in England and sold for a number of years without opposition. However, in 1876, the book was classified as obscene under a new law, and a bookseller was sentenced to two years in prison for selling it. The feminist leader, Annie Besant, and the liberal politician, Charles Bradlaugh, then provoked a new trial by selling the book themselves. They sent a polite letter to the magistrates announcing when and where they intended to sell Knowlton's book, and asking to be arrested. The result was a a famous trial, at which the arguments of Malthus were quoted both by the judge and by the defense. The result of trial was inconclusive, however: Annie Besant and Charles Bradlaugh were acquitted, but Knowlton's book was held to be obscene.

As the nineteenth century progressed, birth control gradually came to be accepted in England, and the average number of children per marriage fell from 6.16 in 1860 to 4.13 in 1890. By 1915 this figure had fallen to 2.43. Because of lowered population pressure, combined with the growth of trade unions and better social legislation, the condition of England's industrial workers improved; and under the new conditions, Ricardo's Iron Law of Wages fortunately no longer seemed to hold.

Figure 13.16: **Francis Place (1771-1854), was a trade union leader and reformer who was anxious to improve the lives of workers. His political activities brought him into contact with William Godwin, James Mill, John Stuart Mill, Robert Owen and Jeremy Bentham. He courageously advocated birth control at a time when it was dangerous to do so.**

Figure 13.17: **Annie Besant (1847-1933). She and the Liberal politician Charles Bradlaugh sent a polite letter to the magistrates announcing when and where they intended to sell Knowlton's book on birth control methods, and asking to be arrested. The result was a a famous trial, at which the arguments of Malthus were quoted both by the judge and by the defense. The result of trial was inconclusive, however: Annie Besant and Charles Bradlaugh were acquitted, but Knowlton's book was held to be obscene.**

Figure 13.18: **Marie Stopes (1880-1958). She founded the first birth control clinic in Britain, and authored the controversial sex manual *Married Love*. Stopes disapproved of abortion and believed that birth control methods should be used to make abortion unnecessary. She edited the newsletter *Birth Control News*, which gave explicit practical advice.**

13.11 The Fabians

With the gradual acceptance of birth control in England, the growth of trade unions, the passage of laws against child labor and finally minimum wage laws, conditions of workers gradually improved, and the benefits of industrialization began to spread to the whole of society.

One of the important influences for reform was the Fabian Society, founded in London in 1884. The group advocated gradual rather than revolutionary reform (and took its name from Quintus Fabius Maximus, the Roman general who defeated Hannibal's Carthaginian army by using harassment and attrition rather than head-on battles). The Fabian Society came to include a number of famous people, including Sydney and Beatrice Webb, George Bernard Shaw, H.G. Wells, Annie Besant, Leonard Woolf, Emmeline Pankhurst, Bertrand Russell, John Maynard Keynes, Harold Laski, Ramsay MacDonald, Clement Attlee, Tony Benn and Harold Wilson. Jawaharlal Nehru, India's first Prime Minister, was greatly influenced by Fabian economic ideas.

The group was instrumental in founding the British Labour Party (1900), the London School of Economics and the New Statesman. In 1906, Fabians lobbied for a minimum wage law, and in 1911 they lobbied for the establishment of a National Health Service.

Figure 13.19: **The sociologist, economist, socialist, labour historian and social reformer, Beatrice Webb (1858-1943), played an important role in the founding of the Fabian Society and the British Labour Party.**

13.12 John A. Hobson

The colonial era

The rapid development of technology in the Europe also opened an enormous gap in military strength between the industrialized nations and the rest of the world. Taking advantage of their superior weaponry, the advanced industrial nations rapidly carved the remainder of the world into colonies, which acted as sources of raw materials and food, and as markets for manufactured goods.

Throughout the American continent, the native Indian population had proved vulnerable to European diseases, such as smallpox, and large numbers of them had died. The remaining Indians were driven westward by streams of immigrants arriving from Europe.

In the 18th and 19th centuries, the continually accelerating development of science and science-based industry began to affect the whole world. As the factories of Europe poured out cheap manufactured goods, a change took place in the patterns of world trade: Before the Industrial Revolution, trade routes to Asia had brought Asian spices, textiles and luxury goods to Europe. For example, cotton cloth and fine textiles, woven in India, were imported to England. With the invention of spinning and weaving machines, the trade was reversed. Cheap cotton cloth, manufactured in England, began to be sold in India, and the Indian textile industry withered, just as the hand-loom industry in England itself had done a century before.

Often the industrialized nations made their will felt by means of naval bombardments: In 1854, Commodore Perry forced Japan to accept foreign traders by threatening to bombard Tokyo. In 1856, British warships bombarded Canton in China to punish acts of violence against Europeans living in the city. In 1864, a force of European and American warships bombarded Choshu in Japan, causing a revolution. In 1882, Alexandria was bombarded, and in 1896, Zanzibar.

Much that was beautiful and valuable was lost, as mature traditional cultures collapsed, overcome by the power and temptations of modern industrial civilization. For the Europeans and Americans of the late 19th century and early 20th century, progress was a religion, and imperialism was its crusade.

Between 1800 and 1875, the percentage of the earth's surface under European rule increased from 35 percent to 67 percent. In the period between 1875 and 1914, there was a new wave of colonial expansion, and the fraction of the earth's surface under the domination of colonial powers (Europe, the United States and Japan) increased to 85 percent, if former colonies are included.

The unequal (and unfair) contest between the industrialized countries, armed with modern weapons, and the traditional cultures with their much more primitive arms, was summarized by the English poet Hilaire Belloc in a cynical couplet:

> Whatever happens, we have got
> The Maxim gun, and they have not.

Figure 13.20: **The Maxim gun was one of the world's first automatic machine guns. It was invented in the United States in 1884 by Hiram S. Maxim. The explorer and colonialist Henry Morton Stanley (1841-1904) was extremely enthusiastic about Maxim's machine gun, and during a visit to the inventor he tried firing it, demonstrating that it really could fire 600 rounds per minute. Stanley commented that the machine gun would be "a valuable tool in helping civilization to overcome barbarism".**

During the period between 1880 and 1914, British industrial and colonial dominance began to be challenged. Industrialism had spread from Britain to Belgium, Germany and the United States, and, to a lesser extent, to France, Italy, Russia and Japan. By 1914, Germany was producing twice as much steel as Britain, and the United States was producing four times as much.

New techniques in weaponry were introduced, and a naval armaments race began among the major industrial powers. The English found that their old navy was obsolete, and they had to rebuild. Thus, the period of colonial expansion between 1880 and 1914 was filled with tensions, as the industrial powers raced to arm themselves in competition with each other, and raced to seize as much as possible of the rest of the world. Industrial and colonial rivalry contributed to the outbreak of the First World War, to which the Second World War can be seen as a sequel.

Hobson's explanation

The English economist John Atkinson Hobson (1858-1940) offered a famous explanation for the colonial era in his book *Imperialism: A study* (1902). Hobson graduated from Lincoln College, Oxford, and later taught classics and English literature at schools in Faversham and Exeter. In 1887, he joined the Fabian Society and, during the last decade of the 19th century, he wrote several influential books: *Problems of Poverty*, (1891); *Evolution of Modern Capitalism*, (1894); *Problem of the Unemployed*, (1896); and *John Ruskin: Social Reformer*, (1898).

Hobson agreed with Ruskin's belief that economics should not be exclusively concerned with money matters but ought to contain ethical and humanitarian values as well, and he advocated the formation of cooperative labor guilds where human contacts would make work more pleasurable and rewarding.

The editor of the Manchester Guardian recruited John Hobson as a correspondent to cover the Second Boer War. His experiences in Africa as well as in England convinced Hobson that the war was being fought for economic reasons. In his book, *Imperialism*, published in 1902, Hobson analyzed the economic motivations behind the colonial era.

According to Hobson, the basic problem is an excessively unequal distribution of incomes in industrial countries like England. The result of this unequal distribution is that neither the rich nor the poor are in a position to buy back the total output of the highly industrialized nations. The poor cannot consume enough because their incomes are inadequate. Meanwhile the rich, who have enough money, are very few in number, and each of them has only finite needs. Therefore the rich cannot consume enough either, and they tend to save their excess money. The total effect is that the society is producing more than it can consume.

In this situation, Adam Smith would have proposed a simple solution: The rich (Smith would say) ought to reinvest their excess income in new factories. But, as Hobson pointed out, this would only aggravate the situation. If society is already unable to buy back its output, the new factories would only make matters worse by increasing production.

Figure 13.21: **A French cartoon from the 1890's showing England, Germany, Russia, France and Japan slicing up the pie of China.**

This situation, Hobson pointed out, provides a powerful economic motivation for imperialism. The excess output of industries can be sold to colonial peoples, and the excess savings of the rich can be invested abroad. This was in fact what was happening on a very large scale at the end of the 19th century. However, having personally witnessed the Second Boer War, Hobson believed imperialism to be immoral, since it entailed great suffering both among the colonial peoples and among the poor in the highly industrialized countries. The cure that Hobson recommended was a more equal distribution of incomes in the manufacturing nations.

Hobson was very popular as a lecturer and writer, but his ideas were too unorthodox to be accepted by the established economists of the time. His theory was, however, enthusiastically adopted by by V.I. Lenin, and Hobson's economic analysis of imperialism became a central part of Marxist-Leninist doctrine. This gave Hobson's ideas wide circulation, but in a political context that the mild mannered English economist would hardly have endorsed. Hobson's political opinions were in fact close to those of Ruskin and the Fabians, who believed in gradual progress rather than violent revolution.

The neocolonial era?

For a long time, Britain held its position as the leading industrial and colonial power, but from 1890 onwards its dominance was challenged by Germany, the United States, Belgium, France, Italy, Russia and Japan. Rivalry between these industrial powers, competing with each other for colonies, natural resources, markets, and military power, contributed to the start of World War I. At the end of "the Great War", the League of Nations assigned "protectorates" to the victors. These "protectorates" were, in fact, colonies with a new name, although in principle protectorates were supposed to be temporary.

The Second World War was terrible enough to make world leaders resolve to end the institution of war once and for all, and the United Nations was set up for this purpose. Despite the flaws and weaknesses of the UN Charter, the organization was successful in formally ending the era of colonialism. One must say "formally ending" rather than "ending", because colonialism persisted in a new guise: During the classical era of colonialism, there was direct political power, with Viceroys and Governors General acting as formal rulers of colonies. During the decades following the Second World War, almost all colonies were granted formal independence, but nevertheless the influence of the industrialized nations was strongly felt in the developing world. Direct political power was replaced by indirect methods.

13.13 Reforms undermined by globalization

The reform movement's efforts, especially those of the Fabians, overcame the worst horrors of early 19th century industrialism, but today their hard-won achievements are being undermined and lost because of uncritical and unregulated globalization. Today, a factory owner or CEO, anxious to avoid high labor costs, and anxious to violate environmental regulations merely moves his factory to a country where laws against child labor and rape of the environment do not exist or are poorly enforced. In fact, he must do so or be fired, since the only thing that matters to the stockholders is the bottom line.

The movement of a factory from Europe or North America to a country with poorly enforced laws against environmental destruction, child labor, and slavery, puts workers into unfair competition. Unless they are willing to accept revival of the unspeakable conditions of the early Industrial Revolution, they are unable to compete.

Today, child labor accounts for 22% of the workforce in Asia, 32% in Africa, and 17% in Latin America. Large-scale slavery also exists today, although there are formal laws against it in every country. There are more slaves now than ever before. Their number is estimated to be between 12 million and 27 million. Besides outright slaves, who are bought and sold for as little as 100 dollars, there many millions of workers whose lack of options and dreadful working conditions must be described as slavelike. [3]

Adam Smith had praised division of labor as one of the main elements in industrial efficiency, but precisely this aspect of industrialism was criticized by Thomas Carlyle (1795-1891), John Ruskin (1819-1900) and William Morris (1834-1896). They considered the numbingly repetitive work of factory laborers to be degrading, and they rightly pointed out that important traditions of design were being lost and replaced by ugly mass produced artifacts. The Arts and Crafts movement founded by Ruskin and Morris advocated cooperative workshops, where creative freedom and warm human relationships would make work rewarding and pleasant. In several Scandinavian countries, whose industrialization came later than England's, efforts were made to preserve traditions of design. Hence the present artistic excellence of Scandinavian furniture and household articles.

Through the influence of reformers, the more brutal aspects of Adam Smith's economic model began to be moderated. Society was learning that free market mechanisms alone do not lead to a happy and just society. In addition, ethical and ecological considerations and some degree of governmental regulation are also needed.

The Reform Movement aimed at social goals, but left ecological problems untreated. Thus our economic system still does not reflect the true price to society of environmentally damaging activities. For example, the price of coal does not the reflect the cost of the environmental damage done by burning it. This being so, our growth-worshiping economic system of today thunders ahead towards an environmental mega-catastrophe.

[3]http://www.commondreams.org/news/2015/08/04/state-dept-accused-watering-down-human-rights-ratings-advance-obama-trade-agenda
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Chapter 14

EUROPEAN FAMINES AND EMIGRATION

14.1 The Irish potato famine of 1845

In Ireland, anti-Catholic laws prevented the Irish cottagers from improving their social position; and instead they produced large families, fed almost exclusively on a diet of milk and potatoes. The potato and milk diet allowed a higher density of population to be supported in Ireland than would have been the case if the Irish diet had consisted primarily of wheat. As a result, the population of Ireland grew rapidly: In 1695 it had been approximately one million, but by 1821 it had reached 6,801,827. By 1845, the population of Ireland was more than eight million; and in that year the potato harvest failed because of blight. All who were able to do so fled from the country, many emigrating to the United States; but two million people died of starvation. As the result of this shock, Irish marriage habits changed, and late marriage became the norm. After the Potato Famine of 1845, Ireland maintained a stable population of roughly four million.

Figure 14.1: **The Irish Potato Famine.**

Figure 14.2: **The Irish Potato Famine.**

14.2 Crofters forced off their land

Highland Clearances and Enclosure Acts

In pre-industrial Europe, peasant farmers held a low but nevertheless secure position, protected by a web of traditional rights and duties. Their low dirt-floored and thatched cottages were humble but safe refuges. If a peasant owned a cow, it could be pastured on common land.

With the invention of the steam engine and the introduction of spinning and weaving machines towards the end of the 18th Century, the pattern changed, at first in England, and afterwards in other European countries. Land-owners in Scotland and Northern England realized that sheep were more profitable to have on the land than "crofters" (i.e., small tenant farmers), and families that had farmed land for generations were violently driven from their homes with almost no warning. The cottages were afterwards burned to prevent the return of their owners.

The following account of the Highland Clearances has been left by Donald McLeod, a crofter in the district of Sutherland: "The consternation and confusion were extreme. Little or no time was given for the removal of persons or property; the people striving to remove the sick or helpless before the fire should reach them; next struggling to save the most valuable of their effects. The cries of the women and children; the roaring of the affrighted cattle, hunted at the same time by the yelling dogs of the shepherds amid the smoke and fire, altogether presented a scene that completely baffles description - it required to be seen to be believed... The conflagration lasted for six days, until the whole of the dwellings were reduced to ashes and smoking ruins."

Between 1750 and 1860, the English Parliament passed a large number of "Enclosure Acts", abolishing the rights of small farmers to pasture their animals on common land that was not under cultivation. The fabric of traditional rights and duties that once had protected the lives of small tenant farmers was torn to pieces. Driven from the land, poor families flocked to the towns and cities, hoping for employment in the textile mills that seemed to be springing up everywhere. Others emigrated

14.3 The Swedish famine of 1867-1869

According to Wikipedia, **"The spring and summer of 1867 was extremely cold all over Sweden. In Burträsk, for example, it was not possible to start sowing before Midsummer: snow was still left in June. The late spring was followed by a very short summer and an early autumn. This caused not just bad harvests, but also made it difficult to feed the cattle. The consequence was rising food prices.[1] This caused widespread famine. The famine struck throughout Sweden, but was particularly severe in the northern provinces. Because early ice and snow disturbed communications, it was hard to transport and distribute**

emergency food supplies to the starving areas.[1] The year of 1868 was, in contrast to the previous year, not cold, but a widespread drought caused a failed harvest and starving animals nonetheless, which caused a continuation of the famine."

14.4 Emigration

The result of the Enclosure Acts and the famines was that many people emigrated to the United States or to Canada. Boston and New York owe their large Irish populations to the Irish Potato Famine of 1845. Many Scottish crofters who were thrown off their traditional lands by the Enclosure Acts emigrated to Canada, founding the province of Nova Scotia (New Scotland). Large numbers of Swedes, fleeing from the famine of 1867-1869, settled in the US state of Wisconsin.

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