
Realism in Science and the Arts

Just as political leaders of the last half of the 19th century turned away from strict ideologies toward the *realpolitik* of practical nation-building, scientists and artists also reflected the realism of the age. Scientific knowledge grew rapidly, as did its impact on the western worldview, and romanticism in literature and art shifted to realism, with its focus on the outer, material world.

New Scientific Developments

The Scientific Revolution of the 16th and 17th centuries emphasized a modern, rational approach to the study of the natural world, and during the 18th century, the Enlightenment had extended that view to society and politics. During the 19th century – as the Industrial Revolution progressed – science came to be valued for its ability to improve technology, and so new scientific research was promoted and appreciated for its practical application to industrial technology. For example, the study of thermodynamics – the relationship between heat and mechanical energy – helped to improve the steam engine. The laws of thermodynamics, in turn, led to the development of modern physics. Germ theory disease, as explored by Louis Pasteur, had practical applications in the development of modern medical practices. Michael Faraday explored electromagnetic induction and laid the foundations for the efficient generation of electricity by the 1870s.

As these examples illustrate, science became increasingly specialized during the 19th century. In the 18th century, the scientist had been a well-educated amateur practicing a hobby. In the 19th century, the state and industry became more involved in promoting scientific research, and so scientists became professional employees of universities, hospitals, and the government. Scientific journals appeared, and specialists attended international meetings where they learned about the latest research. In chemistry, new elements were discovered almost every year, and in 1869 Russian chemist Dmitri Mendeleev developed the periodic table that arranged the elements according to their atomic weight. Many breakthroughs occurred in medicine, too, with the development of anesthesia and disinfectant and Pasteur's discovery of disease-carrying germs that could be killed by heat.

The New Physics

From the 17th century through most of the 19th century, most western

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views of the universe were shaped by the mechanical conception provided by Isaac Newton. Newton described the universe as a giant machine in which matter, space, and time existed independently of the individuals observing them. Scientists had discovered that atoms make up matter, but they believed that they were indivisible and solid.

By the end of the 19th century, these traditional views were questioned. The French scientist Marie Curie and her husband Pierre first discovered that atoms were composed of subatomic particles – such as electrons and protons – through their studies of rays of radiation that came from within the atom. In Berlin, Max Planck discovered that a heated body radiates energy discontinuously, in irregular streams that he called “quanta.” Most notably, in the early 20th century, German-born Albert Einstein came up with new theories that replaced Newton’s concept of the universe. He published his theory of relativity in 1905, which explained that space and time are not absolute – as Newton had said – but relative to the observer, and that neither has an existence independent of human experience. He also theorized that matter and energy reflect the relativity of time and space, and his famous formula $E = mc^2$ explained that each particle of matter is equal to its mass times the square of the velocity of light. Matter, then, contains huge amounts of energy that may be used for many purposes, including the building of an atomic bomb.

Charles Darwin and the Impact of Evolution

Of all the natural sciences, biology and the life sciences had the greatest impact upon general thinking. The most famous biologist of the day was Charles Darwin, whose 1859 publication of *On the Origin of Species* was a landmark that had profound influence far beyond the field of biology. Darwin argued that each new species of plants and animals evolved as a result of natural selection and survival of the fittest, with some small variations being more useful than others. Those with variations that helped them to survive passed them down to their offspring, and over time the whole species gradually changed. This theory stirred up great controversy first in Great Britain but eventually in many parts of the world because it seemed to contradict the account of creation in Genesis, the first book of the Bible of Christianity and Judaism. Many people also found Darwin’s theory disturbing because they believed it implied a world in which aggression, violence, and destruction of rivals were the only means to assure survival. Darwin himself

was concerned only with the origin and interrelations of species, and did not draw any general philosophical conclusions from his theories. Another book, *The Descent of Man*, fanned even more controversy by tracing human ancestry to the great apes, a theory that many thought to be contradictory to the creation of man in the image of God. Others supported Darwin's theory as a reflection of the new practical realism: adaptation to nature simply brought about the success of survival, and no norms of good or bad should be attached to the facts of evolution.

Although Darwin's arguments had to do strictly with biological evolution, Social Darwinists applied survival of the fittest to social situations as well. The best known Social Darwinist was Herbert Spencer, who argued that successful individuals and races emerged to dominate others as a result of "survival of the fittest." His ideas were used to justify both the wealth of entrepreneurs in opposition to their laborers, as well as the domination of European imperialists over subject peoples. Spencer's theory was one of many that shaped newly-developing fields in the social sciences.

Birth of the Social Sciences

Growing feelings of nationalism led many people to study their own national histories, encouraging the development of a modern view of history – one that emphasized the objective and dispassionate (scientific) study of the past. The term "social sciences" came to describe not only history, but also new, specialized fields of study, such as anthropology, psychology, and sociology. Anthropology – the comparative study of people in different societies – became popular as more Europeans came into contact with people from other continents, and a favorite topic was human race, with anthropologists theorizing about the causes of differences among races. Psychologist Ivan Pavlov "conditioned" dogs to salivate automatically at the ringing of a bell, implying that a great part of animal behavior – and presumably human behavior – could be explained by conditioned response. Auguste Comte – often called the "father of sociology" – inspired social scientists to study their societies objectively. By the end of the century, professional historians, anthropologists, psychologists, and sociologists were teaching at universities and engaged in social research.

One of the most significant of all the developments in the study of human behavior was the work of Sigmund Freud, a Viennese physician who founded psychoanalysis at the turn of the 20th century. He came to believe that an

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individual's emotional disturbances may be traced to earlier episodes of his or her life, and if the source could be identified, the patient could be cured or helped. After first trying various techniques – including hypnosis – he developed a method called “free association,” or free recall, in which the patient brought disturbing memories to the conscious level as a starting point for recovery from the illness. Freud's work led him to believe that the unconscious plays an important role in all human behavior, and he particularly stressed the sexual drive. In *The Interpretation of Dreams*, he identified dreams as key to understanding the unconscious. Freudian concepts shaped developing fields of human behavior, not only among professional social scientists, but also in the popular culture. Although Freud identified with the scientific traditions of the Enlightenment, his theories revealed wide areas of human behavior outside conscious control, calling into question just how rational human behavior actually is.

Realism in Literature

The literary realists rejected the importance that romantics attached to heroes in unusual settings. Instead, they focused on ordinary characters from real life, often with the intent of examining important social issues. The influence of science is apparent in their concern with careful observation and accurate description, as well as in their avoidance of the elaborate, sentimental language used by the romantics. As the development of schooling spread literacy, all types of readers responded to novels and biographies of political leaders, past and present. Realism in literature, then, fed the nationalism of the age, avoiding the drama of heroes and revolutions, but reinforcing the concern for practical reform.

One leading novelist was Gustave Flaubert, whose *Madame Bovary* was set in provincial France. It examined the sterile blandness of bourgeois society through the eyes of Emma Bovary, who was a free spirit trapped in a dull life as a doctor's wife. Flaubert's straightforward description of Emma's life was characteristic of the realist novelists even if his frank picture of women's sexuality was considered to be somewhat scandalous. William Thackeray's *Vanity Fair* deliberately flaunted Romantic conventions with its subtitle: *A Novel Without a Hero*. Perhaps the best-known novelist of the age was Charles Dickens, whose books first appeared in serial forms in magazines and periodicals. His characters included starving orphans, intrusive judges, and ruthless opportunists, whose lives provided evidence for the need for serious social reform. In Russia, writers – including Fyodor Dostoevsky – explored

the meaning of Russian culture and the sources of Russian nationalism. In Dostoevsky's famous *Crime and Punishment*, highly intelligent characters who were forced to lead absurd lives allowed the author to emphasize traditional Russian values, especially as they influenced the lives of ordinary people.

Art: Realism and Impressionism

The development of photography had a direct impact on painting, since the new technology allowed a scene to be depicted in a very realistic fashion. Various experiments in the late 18th century, as well as the inventions of Louis Daguerre, made the camera usable by the 1830s. Its widespread use began in the 1890s with the introduction of celluloid film and George Eastman's invention of the Kodak camera, which made photography affordable for the general public. Photographic services became more and more available as people began to make a living as photographers.

Examining the Evidence: Realism in Charles Dickens' *Hard Times*

British novelist Charles Dickens wrote about 19th century English society with a realist's eye, describing everyday people and events. His novel *Hard Times* was a stinging indictment of the squalor of English industrial cities, and his writing stimulated social reform. In the excerpt below, Dickens described the need for one of his characters, Stephen Blackpool, to escape the industrial city where he lived.

“As Coketown cast ashes not only on its own head, but on the neighbourhood's too – after the manner of those pious persons who do penance for their own sins by putting other people into sackcloth – it was customary for those who now and then thirsted for a draught of pure air, which is not absolutely the most wicked among the vanities of life, to get a few miles away by the railroad, and then begin their walk, or their lounge in the fields Though the green landscape was blotted here and there with heaps of coal, it was green elsewhere, and there were trees to see, and there were larks singing (although it was Sunday), and there were pleasant scents in the air, and all was over-arched by a bright blue sky. In the distance one way, Coketown showed as a black mist; in another distance hills began to rise; in a third, there was a faint change in the light of the horizon where it shone upon the far-off sea.”

Photography encouraged some painters to be true to reality, to reproduce on canvas something similar to a photograph. Others reacted by rejecting realism, believing that since photography was capturing reality, the mission of

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a painter was to produce something that the new technology could not. Two French painters – Gustave Courbet and Jean-François Millet – favored peasants and manual laborers as subjects, but did not romanticize them as earlier artists had. Instead they depicted the bleak reality of harsh working conditions and tedious work. In England painters who called themselves “pre-Raphaelites” concentrated on the realistic simplicity of nature, as painters had done in the days prior to Raphael during the Renaissance.

A group that rebelled against realism came to be called impressionists, after the title of a painting – *Impression: Sunrise* – by Claude Monet, one of the leaders of the movement. The impressionists were influenced by new theories of physics that explained that images were transmitted to the brain as small light particles that the brain then reconstituted. Their aims were to depict scenes as they appear before the brain distorts them and to capture that single moment by focusing on ever-changing light and color. This style called for spontaneity because painters were looking for just the right moment to capture light from just the right angle. Using splotches and dots, impressionists moved away from precise realism, and their unique style drew many critics. The new style was encouraged, however, by the manufacture of a broader range of pigments, allowing artists to use a wider, more intense spectrum of colors than ever before. Besides Monet, famous impressionist artists included Edgar Degas, Camille Pissarro, and Auguste Renoir.

By the 1880s a new movement known as post-impressionism started in France and spread to other countries. Post-impressionism emphasized light and color, just as impressionism did, but it strayed even further from realism. Post-impressionists focused on expressing inner feelings to make their own personal statements, and their paintings withdrew from the artist’s traditional task of depicting the external world. As such, these painters were the forerunners of modern art. The most famous post-impressionist was probably Vincent Van Gogh, whose originality and power of expression made a strong impact on later artists. Whereas he often painted objects – such as buildings or plants – as they look in reality, the focus of his art was color used to convey a spiritual experience.

By the beginning of the 20th century, many painters had deserted the reproduction of reality almost completely, marking the earliest forms of modern art. By 1905, one of the most important modern artists was Pablo Picasso, perhaps one of the most flexible painters of all times. He developed a style called cubism that used geometric designs to re-create reality in the

viewer's mind. By 1910 abstract painting had evolved, in which no reference to visual reality is made, but like impressionism and post-impressionism, the emphasis was on color.