History of Medicine The Rise of Scientific Medicine: The Nineteenth Century

SOURCE: SEED On Line (Schlumberger Excellence in Education Development)

Medical practice starts to catch up to the science

In the 19th century medical practice finally began to change. At this same time, scientists and physicians made the discoveries that truly revolutionized medicine. Improvements in the microscope made possible more detailed studies of tissues, a field called histology. This led to the new science of cells, called cytology. These studies paved the way for the major theories and practical developments that formed the basis of medicine as we know it today.

Cell Theory. Robert Hooke saw and named cells in the early 17th century, when he viewed dead plant cells. Van Leeuwenhoek was the first to see live cells under a microscope. In the 19th century the work of three German scientists, Theodore Schwann (1810-82), Matthias Jakob Schleiden (1804-81), and above all, Rudolf Virchow (1821-1902), led to the development of cell theory. In summary, it says that all living things are composed of cells, that cells are the basic unit of structure and function in living things, and that all cells are produced from other cells. Using cell theory, Virchow was able to explain biological processes such as fertilization and growth. He also demonstrated that changes in cells cause diseases such as cancer. Cell theory is one of the cornerstones of modern medicine.

Germ Theory. The other cornerstone was the development of germ theory. Even in the heyday of humoral medicine, there were healers who recognized that some diseases were spread by contagion. The earliest mention of "minute creatures" that cause disease came in the Vedas, the sacred texts of Hinduism, which were written between 1500 and 500 BCE. Avicenna understood that tuberculosis and other diseases were contagious. Later Muslim scholars attributed the bubonic plague to microorganisms. Fracastoro, as noted above, proposed that disease was spread by "seeds." In general, however, most scientists believed that disease-causing germs arose from spontaneous generation, just as creatures such as flies, worms, and other small animals appeared to arise spontaneously from decaying matter. Aristotle believed this, and the idea persisted into the 19th century.

Another theory from the Greeks continued to hold sway into the 19th century. This theory was based on the idea that diseases such as the plague and cholera were caused by foul-smelling miasmas, air containing particles of rotting matter. The theory that such air was poisonous seemed believable because it associated disease with poor sanitation, and the importance of hygiene was recognized early. The British nursing pioneer, Florence Nightingale (1820-1910) who cared for British soldiers during the Crimean War (1853-1856), firmly believed that miasmas caused disease.

By then, however, studies were well under way that finally put to rest both these misconceptions. In 1854 the English physician John Snow (1813-58) traced the source of a cholera outbreak in London to water contaminated by sewage. His detailed study was a key event in the history of both public health and epidemiology.

Shortly afterwards, the great French chemist Louis Pasteur (1822-95) conducted the experiments that conclusively overturned the idea that life could be spontaneously generated. He demonstrated that there are microorganisms everywhere, including in the air. He further demonstrated that they were the source of the chemical process by which milk soured. The process he developed that heats milk (and other liquids) to kill the microbes bears his name: pasteurization. When widely adopted, pasteurization ensured that milk ceased to be a source of tuberculosis and other diseases.

Pasteur believed passionately that microorganisms were responsible for infectious diseases in humans and animals and for their transmission among them. And he developed effective vaccines against anthrax and rabies by harvesting tissue from animals that had died from these diseases. But it was the work of a German doctor, Robert Koch (1843-1910), which finally validated the germ theory of disease. He identified the specific bacteria that caused anthrax, tuberculosis, and cholera. He developed a set of rules (Koch's postulates) for determining conclusively whether a microorganism is the source of a disease in a person rather than simply being present. The science of bacteriology was born.

Other branches of microbiology soon arose. Numerous tropical diseases were found to be due to parasitic microbes, many of them spread by mosquitoes. Among these were two great killers—malaria and yellow fever. Yellow fever, though, like smallpox and rabies, could not be associated with any bacterium. Building on the studies of a Russian pathologist, Dmitry Ivanovsky (1864-1920), the American surgeon Walter Reed (1851-1902) discovered in 1901 that yellow fever was caused by a virus, something even smaller than a bacterium.

Viruses were thought to be invisible until the invention of the electron microscope in the 1940s, but they were eventually identified as the cause of a host of diseases. These include not only smallpox, but also influenza, the common cold, chickenpox, polio, and more recently, AIDS. They are also thought to play a major role in cancer.

Anesthesia and Antiseptics. In the middle of the 19th century other discoveries finally made extensive surgery practical. Until then surgical options had been limited by the pain of operating on a person who was awake, and the danger of infection after the operation. In the 1840s several American dentists pioneered the use first of nitrous oxide and then ether as anesthetics. The latter was soon adopted in Europe for surgical purposes, finally allowing surgeons time to perform long and delicate surgeries.

It was about the same time that Hungarian physician Ignaz Semmelweiss established that infections following childbirth were probably due the unwashed hands of physicians in hospitals. In the late 1860s the British surgeon Joseph Lister (1827-1912), who was aware of Pasteur's research, began dipping bandages and ligatures into carbolic acid and pouring the acid into wounds to sterilize them. He thus greatly reduced the rate of death from gangrene and

established antiseptic surgery. By the turn of the 20th century the operating room was supposed to be a sterile environment.

The 20th century brought the worldwide spread of scientific medicine.

Questions:

1) What effects did improvements in the microscope have on medicine?
2) Summarize cell theory.
3) Summarize germ theory.
4) Until the 19th Century what was the general belief for the cause of disease?
5) What are Koch's postulates?
6) Explain how Joseph Lister improved medicine.