Keio Business School

Discovery of Penicillin

Penicillin was the world's first antibiotic to be used in practice, and is said to be the greatest drug of the twentieth century. Countless lives have been saved in the past because of penicillin. Some people also imagine that, without antibiotics, infectious disease would have caused the global population to be far smaller than it was during the twentieth century. Penicillin was not a discovery attributable to some corporate research and development. (Patents for semisynthetic penicillins have been acquired by many different companies.) British scientist Alexander Fleming (1881–1955), who discovered penicillin, said:

"Adventurous steps toward some new subject matter always hinge on an individual's conception and determination. If I had been attached to any organization at the time of the serendipitous advent of penicillin a long time ago, I doubt I would have ever noticed this 'abnormality' which had absolutely nothing to do with my primary research. It is because I did not belong to any group at the time that my personal interests led me to be sidetracked so completely unexpectedly." (excerpt from Hideki Takamatsu, Souzou-wa Tensai-dake no Mono-ka [Is Creation Confined Merely to Geniuses?])

Doctor Fleming

During the World War I, Fleming was in wartime France as a researcher with the Royal Army Medical Corps. Soldiers during this war were more likely to lose their lives to infected and festering wounds than they were to be killed directly by a bullet or explosion. Antiseptic and antipyic drugs at the time could not be used on gaping war wounds because they would cause too much damage to living tissue. Almost every day, young soldiers died in vain while suffering their wounds. With all his skills as a physician, Fleming could not help them. Fleming was impelled by the desire to create a potent drug by any means necessary.

Discovery of Penicillin

After the war, Fleming resumed his research at St Mary's Hospital in London, directing his attention to the bactericidal action of white blood cells. One day, Fleming sneezed over a Petri dish in which he was culturing bacteria. Several days later, spots appeared in the Petri dish where the bacteria failed to grow. Fleming, whose focus had been on the natural healing power of organisms and their internal sterilizing power, took an interest in this happening, and by way of experiment, he tried dripping nasal mucus and tears into test tubes in which bacteria were growing. In each case, the bacteria disappeared (bacteriolysis). However, as soon as the relevant enzyme is removed from the body, it loses its effectiveness, so it was not developed into a drug.

Ten years after the war, in 1928, Fleming was researching the properties of Staphylococcus aureus (golden staph) which was raging at the time. Just before going on summer vacation, he left a Petri dish, in which he had been growing the bacteria, near an open window. On his return, he found that mold had grown in the Petri dish. Although the test material was no longer usable, he noticed that the bacteria had lysed around the blue-green mold. Fleming showed this to his colleagues, but they displayed no interest. They said that mold pushing bacteria aside is a common phenomenon, so though they had witnessed this before, they had thought nothing of it and thrown the mold away.

Fleming separated and cultured the mold. He found that this blue mold (Penicillium notatum) acts to kill many kinds of pathogenic bacteria. He observed that, rather than the penicillia killing the pathogenic bacteria directly, it seemed that the bacteria were being killed by a substance produced by the penicillia. Since the antiseptic effect was resilient, Fleming thought that perhaps a drug could be produced from this substance. Fleming named the substance "penicillin." He documented his observations and submitted a report to the British Journal of Experimental Pathology in 1929, but it failed to elicit a reaction. Nevertheless, Fleming photographed this phenomenon, and preserved the mold spores.

Ten years later at the start of World War II in 1939, demand for potent antibacterial agents once again increased, and attention turned to antibiotics. Many scientists had attempted to conduct follow-up tests on Fleming's discovery, but rediscovery proved extremely difficult. Fleming too was unable to reproduce his initial discovery even once during the intervening decade. Later, it was understood that certain conditions had been necessary for penicillin to be discovered, such as: (1) Bacteria were introduced into the Petri dish after the mold was already present (at the time of the discovery, the Petri dish had been contaminated from the beginning); and (2) There had been a temperature environment where mold grows faster than bacteria (fortunately, the Petri dish had been left in the open during an unusually cool summer—an unfeasible situation in the normal process). Fleming should be regarded as having seized a serendipitous opportunity.

In 1940, two scientists at Oxford University, Howard Florey and Ernst Boris Chain, succeeded in refining and extracting penicillin by culturing the blue mold preserved by Fleming. They went on to develop the method used in human treatment as well as a method for producing penicillin. Subsequently, many kinds of penicillin derivatives were synthesized and put to practical use, primarily as a result of systematic research and development conducted by companies in the US. Fleming, Florey and Chain were to share the Nobel Prize in Physiology or Medicine in 1945. Since then, companies in countries around the world have continued in the search for and study of new antibiotics.

Keio Business School

KCC 2019.6 PDF