



Mini Review

Inspiring Medical Professionals^{\$\$} Imp-2- Maurice Hilleman

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Conspectus:

Birth and Childhood: Maurice Hilleman was the eighth child of poor peasants (Gustave Hilleman and Anna Uelsmann) in Miles city. His twin-sister was still-born and mother died two days after his birth on 30th August of 1919. Maurice's paternal uncle and his wife who were childless graciously adopted him. The

Livelihood of those depending on farms was treacherous during those great depression days. They sent Maurice at the age four to local market for selling strawberries (unsuccessfully). Later he was involved for long hours of hard work in all types of farm chores. He also helped in family business of selling all farm products.

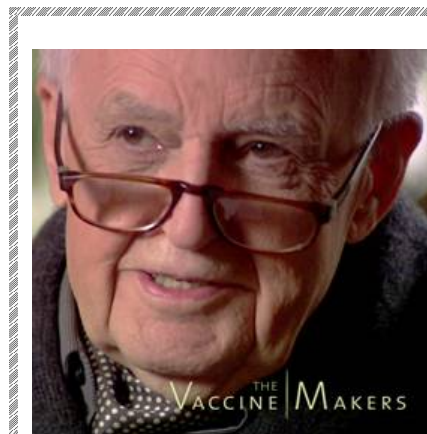
Educational profile: After high school graduation in 1937, he joined at the J.C. Penney co in a career-track job. Since childhood, he has a bent to hear radio programs in science and was inspired by Charles Darwin's book "Origin of Species" Luckily, he got a fellowship in Montana State college and so could pursue graduation in chemistry and micro-biology. He came out with first rank in his class in 1941. Medical education was beyond his financial status, and so made up his mind to do Ph.D. He joined University of Chicago to pursue research career in microbiology with full scholarship. Yet, he lived on single meal a day. After a doctoral degree in 1944, he had a strong mind set of pursuing medical applications of science for society to at least partially pay back the support with gratitude. He proved that Chlamydia was bacterial disease against a popular belief that it was viral. This revolutionized treatment of this common STD easily with antibiotics.



Employment and Vaccine development: In 1947 at E.R. Squibb pharmaceutical company, Hilleman developed a vaccine which saved U.S. soldiers from Japanese encephalitis who were fighting in World War II. This was Maurice's first vaccine. As chief of the Department at Walter Reed Army Institute of Research during 1949 to 1957, Hilleman discovered the antigenic shift and antigenic drift in influenza (respiratory) viruses. This necessitates a yearly flu vaccination. On the last day of 1957, Dr. Maurice took charge as head of Merck's new virus and cell biology research department. His role was an overall command of development/research of vaccines. He formally retired in 1985 at the

age of 65 as vice-president of Merck research lab. But he was reinstated as full-time consultant and contributed significant knowledge and products till his death in 2005. Hilleman developed around forty vaccines over long and productive career of 45 years.

Awards, honours and appreciations: In 1988, Ronald Reagan, President of United States of America presented National Medal of Science (America's highest award for science) to Dr. Hilleman. MSU awarded an honorary doctorate in 1966. 'The MSU Hilleman Scholars Program' created by MSU President Waded Cruzado was to bring 50 low-income Montana high school graduates to campus each year. A Chair in Vaccinology in the name of Maurice R. Hilleman was created in March 2005 by the University of Pennsylvania School of Medicine's Department of Pediatrics, Children's Hospital of Philadelphia and The Merck Company Foundation. In 2008, Merck named its centre in Durham, North Carolina as "Maurice Hilleman Center for Vaccine Manufacturing". Dr. Anthony Fauci, the director of the National Institute of Allergy and Infectious Diseases, told Maurice Hilleman has the irreverent, no-nonsense, let's-get-it-done attitude.



Keywords: Prediction of pandemic; antigenic shift and antigenic drift; Vaccines for viral infections; Japanese encephalitis; MMR (measles, mumps and rubella); MMRV (MMR, and varicella chickenpox); bacterial meningitis; flu; hepatitis B

Abstract in one sentence (AIOS): Maurice Hilleman, Ph. D (in microbiology and virology for award-winning study on the chlamydia infections) worked hard in Merck & Co for 48 years with a proliferating output of development of around 40 viral vaccines (among which eight out of fourteen widely used ones in US to prevent disastrous infections in children) saving tens of millions of children from permanent disabilities and death since nineteen sixties.

\$\$: Invited contribution

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Highlights:

- ✓ Maurice Ralph Hilleman (1919-2005) was a microbiologist with vaccinology specialization from Montana State University
- ✓ Discovered shift and antigenic drift in virus mutations
- ✓ Discovered cold-producing adenoviruses, the hepatitis viruses, and potentially cancer-causing SV40 virus
- ✓ Unparalleled record of productivity-developed more than 40 vaccines
- ✓ Hilleman did not have in his mandate to stop, relax and enjoy success whenever he figured out one vaccine or vaccine was licensed
- ✓ He started to tackle the next virus in the list on the paper he prepared and carried in his pocket always.
- ✓ Of the 14 vaccines in use in U S , he developed eight: those for measles, mumps, hepatitis A, hepatitis B, chickenpox, meningitis, pneumonia and Haemophilus influenzae bacteria
- ✓ He is credited with saving more lives than any other medical scientist of the 20th century.
- ✓ Recipient of National Medal of Science (America's highest award for science) in 1988, Ronald Reagan, President of United States of America presented it to Dr. Hilleman.

1 Introduction

1.1 Parents and birth place of M Hilleman: Maurice Hilleman was born on August 30, 1919 in Custer County, Montana, USA. He was the eighth Child to his parents Gustave Hilleman and Anna Uelsmann. The mishap was his twin sister was still-born and mother died two days after his birth. Robert Hilleman was his father's brother who lived 100 yards away from the same family farm. Robert and his wife Edith were childless and agreed to adopt the baby Maurice to lessen the burden on poor widower. Maurice survived a childhood diphtheria infection.

The deaths in the beginning of the 19th century were of high frequency due to pandemic diseases. The death toll of influenza in 1918-19 was around 675,000 Americans and tens of millions of people worldwide. The infectious diseases viz. measles, mumps, and rubella were common resulting in permanent disabilities or end of life of patients.

Miles City, located in Custer County was originally based around a frontier fort. The city was well-known for drunkenness and came to life only in the 1880s after relocating two miles away from the old army barracks. Guinness World Records recognized in January 1887 the 15 inches across (biggest) snowflake fell there. Montana was admitted to the Union as the 41st U.S. State on November 8, 1889.

1.2 Back drop of upbringing in childhood: In economically underdeveloped societies, life on a farm was not an easy task even in western countries. Maurice was sent to local market for selling strawberries (unsuccessfully) at the age four. Later he raised chickens, tended cattle, harvested hay, grew vegetables, manufactured horseradish/ brooms, helped with the family's side business and selling. He, did a great deal of manual labor and knew what it meant to work hard in tough upbringing. He never dreamt of ten-to-five clock hour skilled or even pseudo-brainy chores in rosy world life.



1.3 Inspiration: Maurice showed a strong aptitude for science, even as a young boy. He used to listen to a Meet the Scientists radio program (originated at the University of Chicago) on Sunday afternoon transmitted from Bismarck, North Dakota. When he as in eighth grade, he found the book "Origin of Species", in which Charles Darwin extensively described his theory of evolution by natural selection. The book, "Microbe Hunters" was another source of influence and resulted in consistent aptitude in browsing textbooks to learn more and more about science.

2 Academic profile:

High School: In 1937, Hilleman graduated from Custer County High School. America was still in the grip of the great depression. Millions of people were unemployed and the national unemployment rate was about 17 percent. In such hard times, a study in college seemed out of the question for a poor farm boy, He joined a coveted career-track job at the J.C. Penney in Miles City.



Montana State College: Howard Hilleman, his older brother, came home on break from ministerial school and asked their parenteral Uncle Bob whether they like to send Maurice to college. When the boy said that he wants surely to go, the two brothers drove nearly 300 miles in a Model A to Bozeman. Maurice won a scholarship in Montana State College (now Montana State University) there. He loved the freedom to pursue his interests in science. So, he left the job and put into practice there the lessons he'd learned during his childhood, working like a Trojan. In 1941, he graduated with a bachelor's degree majoring in chemistry and microbiology as a topper of his class.

Academic profile of Maurice Hilleman		
1937	Graduation	Custer County High School
1941	Chemistry Microbiology as majors	Montana State College (now Montana State University)
1944	Ph D (Chlamydia infections)	University of Chicago
	Award for thesis	Best results of research in pathology and bacteriology

University of Chicago: His financial status was not adequate to go for a medical school. Maurice looked on himself as a country bumpkin. Deciding to do Ph.D in microbiology, he applied to 10 graduate schools. To his astonishment, all ten institutes offered him full scholarship. Hilleman chose University of Chicago to pursue research career microbiology. Even then, life was not easier in the Windy City. The fellowship amount was not sufficient and he was forced to survive on a single meal each day and lived in a squalid apartment. The six-foot-tall Hilleman was only 63 kgs. The studies were rigorous and the professors fierce with their expectations.

Chlamydia, a common STD (sexually transmitted disease), was believed to be a viral one. Hilleman proved a species of bacterium, *Chlamydia trachomatis*, that grows only inside of cells is the cause. Thus, Chlamydia, being bacterial, it can be treated with antibiotics. In 1944, Hilleman obtained a Ph D degree in microbiology and virology for his award-winning dissertation on the chlamydia infections. This bit, remarkable in itself, was a testimony for his genius and ability. Maurice and one of his professors taught the first course ever offered in virology at the University of Chicago.

3 Employment time-line of M Hilleman:

The mentors in the university wished Hilleman to continue in academic pursuit. But he opted a career in vaccine industry, since it opens best opportunity of expediting clinical applications and ensuring comfort for humans from suffering and avoiding fatal consequences. He entered the vaccine research industry when the studies were at cross roads with advanced instruments like electron microscope to look at small organisms.



Soup kitchen offering free soup to unemployed people in 1930s Chicago

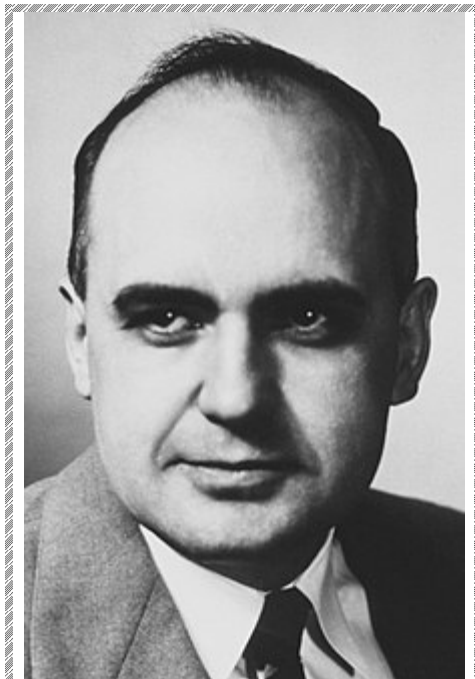
Dr.Maurice accomplished the tasks with hard work, great-tenacity, ethics and even greater humility. Even now, he is remembered as one the world's top scientists responsible for global public health diminishing permanent disabilities and death rate.

3.1 E.R. Squibb pharmaceutical company (New Brunswick, New Jersey):

Maurice developed in 1947, an effective vaccine for Japanese encephalitis which leads to swelling of the brain and death. The vaccine protected U.S. soldiers fighting Pacific Ocean theatre of World War II. It was the first vaccine Hilleman invented and the company E.R. Squibb is now Bristol-Myers Squibb.

Employment/scholarships of M Hilleman		
1937	Manager training at J.C. Penney's store	
1937	Quit the job as he was offered a scholarship to Montana State University	
1947	E.R. Squibb pharmaceutical company	
1948	Walter Reed Army Institute of Research in Washington, D.C.	
1957-1985	Vaccine developer	Merck & Co
Up to 2005	Consultant	

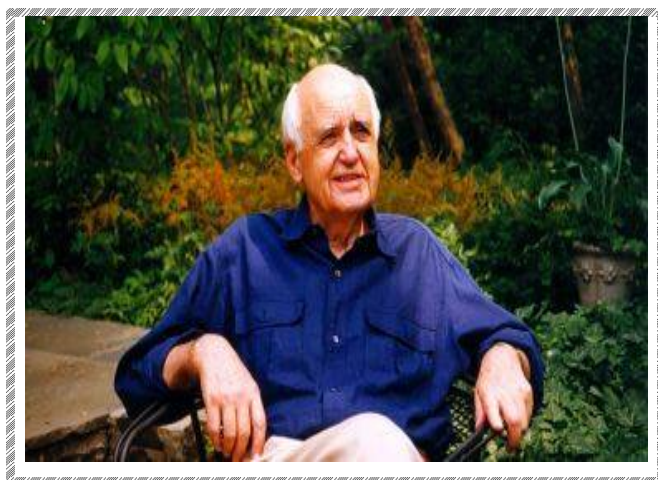
3.2 Walter Reed Army Institute of Research: Hilleman was the chief of the Department (1949 to 1957) of respiratory diseases at Army Medical Center (now the Walter Reed Army Institute of Research). During 1948 to 1957, he conducted key research on respiratory viruses. He discovered the genetic changes viz. antigenic shift and antigenic drift that occur when the influenza virus mutates and theorized that a yearly influenza vaccination was required. If virus undergoes a large number and drastic mutations (antigenic shift) resulting in major genetic change, the result is a new virus different from previous ones. So, people had no immunity for it and it creates deadly pandemic episode. But when the changes were small (for example flu virus undergoes some small mutations every year), people who had been infected with a previous version of the strain were still naturally immune to the new one.



Hilleman c. 1958, Chief of Dept. of Virus Diseases, Walter Reed Army Medical Center

3.3 Merck & Co: On 31st December of 1957, Hilleman joined Merck & Co. (Kenilworth, New Jersey) in West Point, Pennsylvania. Incidentally, it was shortly after his first daughter Jeryl Lynn was born, a key guy in the invention of mumps vaccine in nineteen sixties. He started his career as head of Merck's new virus and cell biology research department to oversee their vaccine research and development. He remained at Merck for the rest of his career and also his life. He literally worked at the laboratory bench and provided scientific leadership in the entire life cycle of Vaccine development, mass production, clinical/post clinical use/problems. Almost forty experimental and licensed human/animal vaccines were the outcome under his stewardship. Some of the most important ones are for *pneumococcus*, *meningococcus*, measles, mumps, rubella, combined MMR, chickenpox, hepatitis A, hepatitis B. He was also the first person to combine three viral vaccines in a single vaccine viz. MMR. With two shots against six shots in separate vaccines, many children were protected from permanent disabilities/death. Working along with colleagues, he created two versions of the hepatitis B vaccine.

Dr. Hilleman retired as senior vice president of the Merck Research Labs in 1984 at the age of 65 conforming with the mandate service rules. But the company rehired him as a 'consultant' to continue office hours. Dr. Maurice, an inveterate workaholic, continued to work and contribute to science of human welfare for further 20 years as director of the Merck Institute for Vaccinology. This was until his death in 2005. He remained to be a mentor off or those working to stop infectious diseases from harming or killing earthlings. He consulted with national and international public health organizations, believing vaccines for malaria, tuberculosis and AIDS were indispensable in ongoing health policies/programs of any time.



4. Hilleman era of Vaccines development: Some of famous medical scientists earlier were Louis Pasteur for the rabies vaccine, Jonas Salk, Edward Jenner for smallpox and Albert Sabin for polio

vaccines. Hilleman developed 40 vaccines in an unusually long and productive career of 60 years including twenty full-time-consultant period after-formal-retirements at the age of 65. Of the fourteen vaccinations routinely recommended for youngsters, Hilleman developed eight. The number of marketed vaccines is really an enormous compared with those from more celebrated scientists. Dr. Hilleman's contributions continue to save more lives worldwide compared to any other scientist in the epidemiological database. As an individual, his positive impact on the health of the world is enormous compared to any other scientist/virologist/vaccinologist in history. For no reason, it appears that it is hard if not impossible to break the Hilleman's vaccine-discovery/ vaccines-in-use record for the coming generations.

Some of typical vaccines he developed are for Japanese encephalitis, measles, rubella, chickenpox, bacterial meningitis, flu, and hepatitis B. In developed countries, his vaccines have virtually wiped out many of these once-common childhood maladies.

Maurice adopted the Pasteur and other scientists' idea of attenuation of live virus (causing viral catastrophe) as the basis of combating against pandemics. The unit operations are isolation of virus from infected human individual, weakening it and vaccination of healthy individual through shots. The attenuation is affected often by passing the virus through cells (from chicken embryos). The weakening process is continued until it was too weak to cause the full-blown disease, but still potent enough to spark immune system to produce immune cells for the new virus. The live, attenuated mumps vaccine used today in the United States was licensed in 1967.

4.1 Flu Pandemic 1957-in Hong Kong: In April of 1957, Hilleman saw the news published in New York Times about widespread influenza outbreak in Hong Kong. The pandemic affected 250,000 people and he understood that earlier flu virus should have undergone a major shift. He recollected a similar mishap of Spanish flu pandemic with drastic shift of virus in 1918. The worldwide death toll at that time was 20 million people, including approximately 600,000 U.S. citizens.

4.2 Prediction of Flu Pandemic for U.S.: Dr. Maurice's gut feeling was there will be a huge flu-pandemic with high price (in terms fatal consequences) unless preventive measures will be designed and meticulously implemented at right time. Dr. Hilleman was first Human-Health-scientist in history to predict a pandemic. If the new virus hits the continent, there will be more than a million deaths in America. At the Army lab he confirmed it was the same strain that caused a pandemic 67 years before. Only a few elderly people had immunity against it.

4.3 H2N2 bird flu: Beginning in China, a H2N2 bird flu pandemic was beginning to sweep the world with up to million lives thought lost by 1959. Working nine straight 14-hour days to isolate the virus, Hilleman and his team were able to prove H2N2 was a whole new strain of flu. They also found that there was virtually no American had immunity to it, meaning the pandemic could have potentially disastrous consequences in the U.S.

4.4 Vaccine for Flu virus: To check his theory, Hilleman collected throat swabs from the Hong Kong victims through the military services. After receiving the samples, Hilleman along with a colleague worked on a hunch for nine-14-hour days. They isolated and found that it was a new strain of flu which could kill millions of humans. Further, his group analyzed blood samples of people worldwide and found that no one had antibodies to that form of the flu.

This proved Hilleman's prediction to be true that pandemic was ahead. The vaccine from live virus was grown in fertilized chicken eggs, thus weakening it and making it fit for human inoculation. The output of Merck & Company was 150,000 eggs per day. On war footing priority, forty million doses of vaccines were ready by negotiating with chicken breeders and vaccine was distributed at right time.

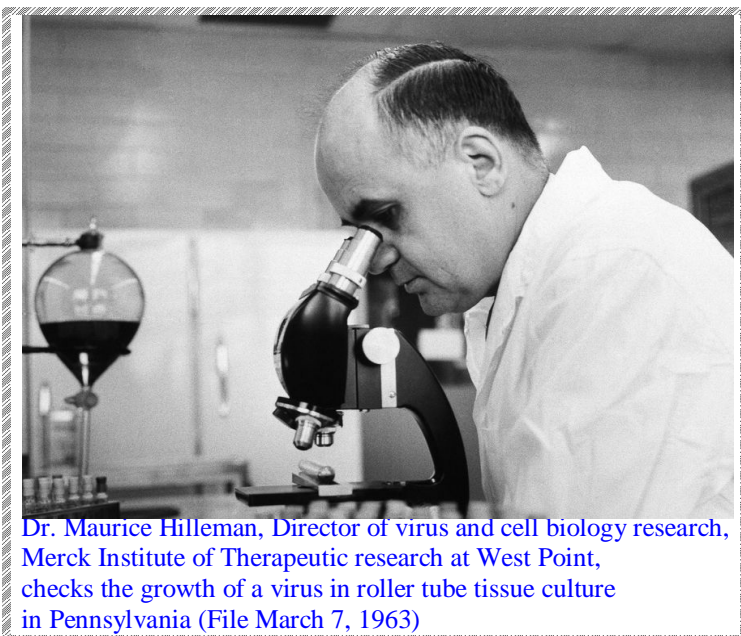


Maurice Hilleman with a tray of chicken eggs

4.5 Reduced catastrophic effects of Flu Pandemic in U.S: The flu did hit the United States. But the death toll was 69,000 human lives. The pandemic should have swallowed more than a million victims, had there been no large-scale vaccination program of Maurice.

Hilleman was awarded the Distinguished Service Medal from the American military for his noble endeavor of saving hundreds of thousands of precious human lives. Even after half a century, public-health agencies adapt Hilleman's discoveries concerning virus mutations in annual flu vaccine.

4.6 Vaccine Mumps: Even in early 1960s, mumps a disease caused by a virus that grows in the salivary glands was prevalent infecting about 200,000 U.S. children every year. Mostly, mumps caused a painful swelling of the glands in the neck of children. About fifty percentage of victims use to develop an infection of the brain, a mild form of meningitis. Sometimes it led to permanent deafness or death. In 1963 Jeryl Lynn, five-year-old daughter of Hilleman came down and woke her father up in the middle of the night whining about a sore throat. Seeing her swollen glands, he understood that she contracted mumps. Next day, Dr Hilleman was scheduled to leave on a trip to South America the and aware the virus would go by the time he returns. So, he drove in that midnight to the Merck lab to pick up some swabs. He then swabbed his daughter's throat, immersed the swabs in beef broth and took them to the laboratory freezer in the middle of the night. He later used the specimen to isolate the mumps virus, grow it in the cells of chicken embryos and produce a very weak version of the virus, basis of a safe and effective mumps vaccine. The attenuated live mumps virus (now vaccine) is enough to



Dr. Maurice Hilleman, Director of virus and cell biology research, Merck Institute of Therapeutic research at West Point, checks the growth of a virus in roller tube tissue culture in Pennsylvania (File March 7, 1963)

trigger the body's defense and generate immune cells the system. He named it as Jeryl Lynn strain, after that eight-year-old daughter. Jeryl recently expressed that what all she did was getting sickness at the right time, sickness with right virus and much more having right father, Hilleman.

Adhering to practice of that era, the vaccine was initially tested in children with intellectual disabilities who lived in group homes. This is because those children represent high risk group because of poor hygiene and cramped quarters of their accommodation.

Dr. Robert E. Weibel immunized Kirsten Jeanne Hilleman, his second daughter of two and years old by injecting vaccine. The mumps vaccine was licensed in 1967 and is still a part of the standard MMR vaccine used today.

4.7 MMR: Dr. Maurice Hilleman, the prolific vaccine researcher, was the first to combine three different live viral strains into one shot in MMR (measles, mumps and rubella) trivalent vaccine. This big breakthrough was licensed in 1971 and biggest advantage was instead of a series of six shots, children needed just two injections. He was credited with saving 8 million lives every year. In 1979, the rubella strain of the vaccine was changed. However, mumps and measles vaccine viruses remained the same in the United States since 1971. The newer MMRV (measles, mumps, rubella, and varicella) combination vaccine, protects against chickenpox also.

4.7.1 Setback: In 1998, Dr. Andrew Wakefield, a medical doctor published in British medical journal named "The Lancet" that MMR vaccine caused autism in children. The consequence was that many parents were not only afraid but ran panic to get their kids immunized. The crystal-clear successful evidences of closing the death gates against devastating measles, mumps and rubella were rebuked. Dr. Hilleman who should have been adored with even Nobel Prize was cursed with hate mail and death threats. Lorraine recalled that their mail was X-rayed were not allowed to open any box arrived their house.

Kirsten Hilleman Vaccinated with



Investigational Jeryl Lynn Strain Mumps Vaccine as Jeryl Lynn Hilleman Offers Comfort

Colin, Son of Jeryl Lynn Hilleman, Receiving MMR Immunization



4.7.2 Hilleman's Response: Dr. Maurice worried about children not getting vaccinated. His hue and cry was for children going to be infected again with disastrous diseases. The reality was that it happened for over a decade.

4.8 Correction of Grave mistake: Several critical intensive studies discredited Wakefield's paper. In 2011, five years after Maurice's death, Britain stripped of Wakefield's right to practice medicine. The Lancet retracted the 1998 published paper, a rare event in science-research-publications of high impact factor.

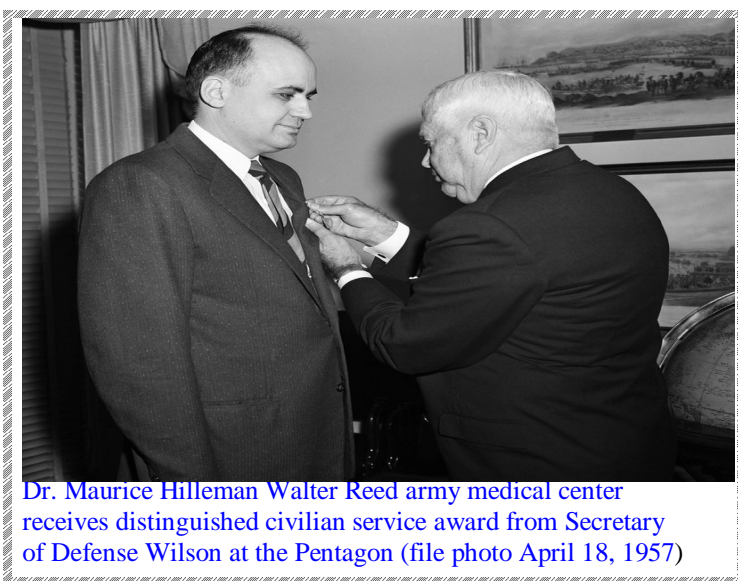
4.9 Hilleman's legacy in COVID-19 Vaccines: Hilleman's legacy continues today in Merck in spite of his belligerent characteristic execution. It brought out a vaccine for COVID-19 and is on the cusp of Phase III clinical trials in the U.S.

4.10 Output (Discoveries, inventions, scale-up ventures, Task-based real-time, quantum of work):Dr. Hilleman's research programs were highly productive and saved millions lives every year.

5. Awards: In 1988, Hilleman at the age of 68 received National Medal of Science (America's highest award for science) from President Ronald Reagan. He got Golden Plate Award (1975) of the American Academy of Achievement, Prince Mahidol Award (2002), from the King of Thailand for the advancement of public health, Mary Woodard Lasker Award for Public Service, Robert Koch Prize (1989), Albert B. Sabin Gold Medal (1997) and special lifetime achievement award from WHO.

He was Adjunct Professor of Pediatrics at the University of Pennsylvania in Philadelphia. MSU awarded an honorary doctorate in 1966 and later his photo was hung on the wall of microbiology department. In 2016, MSU President Waded Cruzado created a program to bring 50 low-income Montana high school graduates to campus each year. The

criterion of selection was to trace committed students to raise their education performance beyond ordinary expectations. The program provides lots of support for those who can never go for college education otherwise. This venture was named as 'The MSU Hilleman Scholars Program'. A Chair in Vaccinology in the name of Maurice R. Hilleman was created in March 2005 by the University of Pennsylvania School of Medicine's Department of Pediatrics, Children's Hospital of Philadelphia and The Merck Company Foundation. In 2008, Merck named its centre in Durham, North Carolina as Maurice R. Hilleman Center for Vaccine Manufacturing. Medical History Pictures, Inc released a documentary film titled Hilleman: A Perilous Quest to Save the World's Children, in 2016. It chronicles Hilleman's life and career very nicely.



Dr. Maurice Hilleman Walter Reed army medical center receives distinguished civilian service award from Secretary of Defense Wilson at the Pentagon (file photo April 18, 1957)

President Reagan Awarding Dr. Maurice Hilleman the National Medal of Science in a White House ceremony on July 15, 1988



"For his brilliant discoveries in basic research and ingenious inventiveness in creating vaccines that are the foundation for control of infectious diseases through immunologic intervention, preventing death and disability in millions of persons worldwide."

He was an elected member of the National Academy of Sciences, the Institute of Medicine, the American Academy of Arts and Sciences, and the American Philosophical Society. Dr. Maurice was on several advisory boards and committees of academic, governmental and private boards like AIDS Research Program Evaluation (National Institutes of Health's Office), Advisory Committee on Immunization Practices (National Immunization Program), Advisory board of WHO.

6. Personality

6.1 Unique personal traits: Maurice was a forceful man; possesses intensive work ethic and sustained it. Yet, he aspired only modest claims throughout his professional life. Hilleman never imagined of tagging his name for the vaccines he brought out. But he was never hesitant to use profanity and tirades freely in driving his arguments home. Merck Co intended once a mandatory "charm school" course to render middle managers softer and more civil. He flatly disagreed and even refused to attend. Lorraine (now 86 years old) recently in 2019 briefed that Hilleman couldn't stand to see either children or even adults suffer.

6.2 Professional perspective: He was a serious and focused scientist to the core, but down to earth in targets. His intent was that Science must produce useful applications for humankind, and that is how one pays back to society for its support. His concern was more with preventing disease than laurels for the efforts. The reward is the smile on the faces of recovered patients and their parents. He argued that many a time politics stood in the way of science's ability to improve public health. BMJ once described him as an often harsh, impatient man who was not hesitant to tangle with industry and government bureaucracies.

In virology and vaccinology, the search/activity is around winning a battle over the viruses (damned bugs). Hilleman said that he would even prefer do it over again and again because there's

great joy in being useful to mankind and even animals. The bonus is satisfaction that you get out of doing science with latest knowledge and state-of-art tools at that dot time.

6.3 Work ethics in lab: Maurice worked seven-day a week and sometimes even 14-hous continuously for seven-eight days. Not only that, he expected all staff he directed at Merck to do likewise. If any person does not measure up to his expectations or do not adhere to tough discipline, he imposed or quickly fired to meet uncompromised work-schedule.

Maurice was keen to watch and command all phases of vaccine development viz. Basic/clinical research, development, vaccine trials and production. He never was aloof even when vaccine was in manufacturing stage. He insisted on his supervision of facility and its function to ensure and minimising compromises in quality control.

This total-quality-control under one head approach (not in routine practice by many scientists) made his peers nervous. But committed scientists adored his ingenuity/ functioning and remained loyal to him.

He ran his laboratory like a military unit, he alone being commander-in-chief. The co-scientists and others also had a single opinion that Maurice was an enigma of sorts, irascible, profane, tough, and at times ill-tempered and a notoriously prickly man. He never restrained to yell at light hearted professionals working with him. At one time he kept a row of "shrunk heads" representing select fired employees. They were model figures prepared by his second daughter (Kirsten) from dried apples (Vincent Price shrunk head kit) obtained as Christmas gift by her father.

7. Family: Maurice's biological father, Gustavo, was a very religious man and a member of the Lutheran Church. But, as his adopted father Robert was not religious, and more open-minded than Gustav. This likely allowed more room for Maurice's curiosity and intellect to flourish. Maurice was grown up in a non-religious social-environment. But he craved the approval of his biological father. This most likely drove Maurice's lifelong goal to succeed.

Maurice Hilleman married Thelma Mason in 1943 and they had their first daughter Jeryl Lynn 1957, Sadly, Thelma died in 1962. He married Lorraine Witmer, a nurse in 1963, who more easy-going. They had a daughter, Kirsten, in 1965. Lorraine admired Maurice as a very caring person, kind hearted, extremely nice father, a very good husband and great teacher.

7.1 Time for family: Maurice made it home for family dinner each night in spite of his committed long hour professional chores. May be often he drove back to the lab afterwards. And vacations were occasional treats in their calendar. Once he took his family to Greece and England so that the girls could see both an ancient and a modern civilization.

8. Death: Maurice Hilleman died of cancer at the age 85 of on April 11, 2005 in Philadelphia. He was survived by his second wife, Lorraine Witmer, two daughters Jeryl Lynn and Kirsten, and five grandchildren.

9. Appreciations: Dr. Anthony Fauci, the director of the National Institute of Allergy and Infectious Diseases, told the Washington Post in 2005 that Maurice Hilleman has the irreverent, no-nonsense, let's-get-it-done attitude. Among scientists of last century, he is a legend with highly sophisticated intellect, but he is the world's best kept secret to the general public. Jeryl Lynn Hilleman, said that father lived with a work culture to be of use to people, of use to humanity when needed in pandemic situations. The work-minded scientific team members idolized him as an icon of science-in action.

It is not a hyperbole that Maurice is a true gigantic and terrific figure in science, medicine and public health of the 20th century. He freed the world from morbidities and follow-up fatal

consequences with development of vaccines. Millions of children are saved every year from viral diseases since 1970s. On average, human life-span increased by 30 years longer than a century ago.

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