Addresses.**THE RELATION OF MEDICAL SCIENCE TO COMMERCE.¹**

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I HAVE been informed that there is no rule of the association which fixes the subject of this address. I hope I may be pardoned when I depart from the custom which my predecessors have usually followed when they confined the subject of the address to the progress of medicine during the year just past.

We live in a period of the greatest activity in the history of the world. Modern inventions annihilate time and distance. Electricity and steam approximate the most distant parts of the civilized globe. Vast amounts of capital are invested in electrical, steam and other related interests. Large commercial enterprises are carried on or launched into new fields, which require money, the employment of the brightest intellects and skilled and common labor.

Competition is great in all the affairs of men. The struggle for supremacy between nations and between men was never so fiercely contended as now. The world is richer than ever before. Great individual fortunes, the result of the efforts of the few years of a single span of life, are seen everywhere. The wage of the laborer in our country is larger than ever before and he may command the necessities as well as many of the comforts of life.

This modern restless activity, with its nerve-racking; the evil results of a luxurious life; the moral obliquity which it may breed, as well as many other conditions which affect the health of individuals, while of interest to medicine, do not concern us in the consideration of the broader subject of this paper.

THE BROADER APPLICATION OF MEDICAL SCIENCE.

Medical science is interested in and is of greater importance to the world than ever before in protecting individuals, states and nations from infectious diseases, which are rendered more dangerous than formerly because of a denser population, increased facilities of communication between the peoples of the earth, by travel, and by national and international interchange of food and other commercial products.

Medical science, too, is closely identified with the vast moneyed interests of the merchant marine and of national and international commerce. Quarantine against the spread of infectious disease is applied wisely or foolishly in direct ratio to our knowledge or ignorance of the cause, the means of transmission and the evolution of disease. So, too, medicine has to do with the knowledge which will enable man to escape from and finally remove the conditions which cause

infection and which render a country uninhabitable to civilized man.

Medical science must safeguard man against infection and intoxication from parasitic diseases of animals used for food and from contaminated and adulterated food and drink. Not only from a humanitarian standpoint is medical science related to commercial pursuits, but the sciences related to medicine have done much to preserve animals used for food and to protect agricultural interests of many kinds from disease and destruction.

One may say, I think, that in no other pursuit which engages the serious attention of men are there as many earnest, unselfish and philanthropic workers as there are today in the broad field of medicine. In the various departments of science related to medicine one finds educated, skilled, energetic, earnest workers after truth, willing to sacrifice home, friends, health and life for the advancement of the science which has for its primary object the conservation and prolongation of human life. Pecuniary reward for them is never large and never commensurate with the character of the work. Furthermore, great and astounding as are the modern commercial inventions, the progress made in medical science during the last twenty years is equally great.

Is modern medicine prepared to meet the demands of modern progress concerning the questions which interest humanity and commerce? Let us answer the question by a brief retrospect of the progress of medicine and by a statement of the present status of medical science.

FIRST APPLICATION OF PHYSICAL SCIENCE TO MEDICINE.

From the latter part of the eighteenth to the beginning of the last quarter of the nineteenth century the science of medicine developed steadily upon a rational physical basis. Jenner's discovery of the protection of the human race against variola by vaccination with cowpox, illuminates with noonday splendor an era otherwise gloomy with its hypotheses, theories and superstitions concerning disease. This single brilliant achievement of the end of the eighteenth century was the beginning of the evolution in medical science which made the nineteenth century notable. The application early in the nineteenth century of physics, of physiology, of pathologic anatomy and of chemistry, to the study of disease, developed a more exact knowledge than before existed. To Auenbrugger that early period owes much through the discovery of methods of physical examination which were slowly developed and perfected by Corvisart, Laennec, Piorry, Skoda, Wintrich, Traube, Louis, Cheyne Stokes, Graves, Corrigan, Flint, Scudamore and others. Pathologic anatomy made wonderful strides under the labors of Virchow, Rokitsansky, Arnold, Stilling and their students. Physiology was developed by the labors of Johannes, Müller, Brücke, Helmholtz, Trouseau, Vierordt, Foster, Carpenter, Magendie, and their disciples; and the fuller knowledge embraced in

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physiologic chemistry was added to the rapidly broadening field of medicine by Hoppe-Seyler, Schwann, Stricker, Prout, Liebig and others.

BACTERIOLOGY.

The development of the microscope during the second and third quarters of the past century added a mighty weapon to the armamentarium of the physicist. The microscope was an aid to the investigators of pathologic anatomy, of physiology, of chemic physiology and of other subjects, and it was the one necessary means by which the teeming world of bacteria was made visible. This discovery and the knowledge which has come from a study of these infinite and yet often mighty beings have revolutionized medicine.

It was Pasteur's brilliant studies of the infective microbes of air which led to the discovery of the source of contamination of wounds and which made it possible for Lister to evolve a method of protection of wounds from air infection. The aseptic surgery of today is but the evolution of Listerism which had its basis of existence in the discoveries of Pasteur. With the microscope Pasteur rid the world of the superstition of spontaneous generation. He proved the infectiousness of dust-borne air through the microbes it carried. He blazed the way for others in the study of bacteria as agents of putrefaction, fermentation and of pathologic infection in animals.

Bacteriology became an exact science with the discovery of Robert Koch of cultural methods which made differentiation of bacteria possible. The causative relation of bacteria to all infective processes was practically proved by the laws promulgated by Koch. In twenty years the bacterial cause of tuberculosis, typhoid fever, cholera, diphtheria, pneumonia, pyogenic processes, erysipelas, gonorrhea, epidemic meningitis, epidemic dysentery, the plague, charbon, glanders, tetanus, influenza, and lepra has been proved.

PARASITES.

The discovery of the hematozoön of malaria by Laveran; the recognition of the ameba of dysentery by Loesch; of the ray fungi, and especially the actinomyces as infective agents in the lower animals and in man, and the more exact knowledge of other animal parasites infecting man and animals, which the microscope has made clear, have been as epoch-making in parasitology as the discoveries of Pasteur and Koch in bacteriology.

TRANSMISSION OF INFECTION.

The recognition of the relation of bacteria, protozoa and animal parasites to infective disease has been the means of a more exact knowledge of the clinical phenomena of disease, of morbid anatomy, of physiology and of physiologic chemistry than would have been possible without it.

The knowledge of the cause has led to a study of the life history of infective organisms outside

of as well as in the animal body. The mode of propagation, the means of transmission of infective micro-organism, by fomites, and other agents, has become known. The rôle which insects, which infect animals, play as definitive or intermediate hosts, has been studied and proved. The discovery of Manson of the transmission of *Malaria sanguinis hominis* by the mosquito was of vast importance as a suggestion of the mosquito as a definitive host in malaria. The investigations of Manson, Ross, Celli, Grassi, Dionise, Marchiafava, Bignami, Koch and others have made our knowledge of malaria exact. With the microscope we may now not only recognize malaria and differentiate it from the other infective fevers, but we may also at the same time recognize by an examination of the blood the type of malarial infection and foretell its course. Not only may we recognize the disease definitely and apply the drug treatment more rationally, but the knowledge of the means of its transmission from man to man enables us to apply preventive measures which, as we shall see later, are of the greatest importance from a commercial as well as from a humanitarian point of view. The recognition of rôle of the mosquito in malaria has been, furthermore, a stimulus to the study of the same insect in relation to other infections.

The brilliant research work of our own Reed and Carroll in 1900 in Cuba, by which they proved that the mosquito of the genus *stegomyia* is the sole means of the transmission of yellow fever from man to man is of great importance as a scientific fact. The influence of this discovery upon mankind as a prophylactic against a disease which has killed multitudes and also from a monetary point of view, in reference to commercial pursuits, is not appreciated at this time as it should be.

Hardly less important is the fact that the *bacillus pestis* may infect fleas and these in turn infect rats, mice and man. It is important, too, to know that pests like the housefly may be carriers of infective bacteria from refuse filth to our kitchens and tables and contaminate food and thus infect us with typhoid fever, cholera and perhaps other diseases which are propagated by filth.

The study of bacteria in the laboratory and in the blood tissues of infected animals has led to the discovery of the means by which bacteria disturb the animal economy and produce phenomena expressive of disease. The fact that the blood and tissues of infected animals contained a toxin which could also be isolated from pure bacterial cultures in the laboratory and that this toxin when introduced into an animal was capable of exciting the same phenomena of disease as the bacteria themselves, was positive proof that bacteria excite disease phenomena by means of a toxin which they form. The elaboration of anti-toxins in the body of the infected animal was also promptly recognized and served to explain not only the self-limitation of many of the infective diseases, but it also helped us to understand the

immunity which one attack of some of the bacterial diseases affords.

PROTECTIVE INOCULATION.

Long before bacterial toxins were recognized as the cause of disease phenomena, Pasteur established the principle of protective inoculation with bacteria of lessened virulence, which was brought about by attenuation of the bacteria by a modification of cultural methods and also by serial inoculation of certain lower animals. This he successfully applied to charbon in sheep and cattle and to chicken cholera. In both of these diseases the bacteria were known and the problems of attenuation could be carried on in the laboratory by direct study of the bacteria before inoculation and afterward when they were recovered from the bodies of the animals experimented on.

His final life's work was no less important, in firmly fixing the immunizing influence of attenuated bacterial inoculation in rabies. Here the discovery of the infecting bacterium escaped every known means of recognition by examination of the tissues and blood of the infected animals microscopically and culturally. Apparently there are pathogenic bacteria which we do not know because we have not yet recognized the proper culture material for the successful artificial cultivation of them, nor have we discovered the tinctorial reaction which they may possess and, finally, it is not improbable that they may be infinitely smaller than other bacteria and, therefore, considerably more difficult to recognize.

Pasteur recognized the fact that in hydrophobia the brain and other nervous tissue of an infected animal are capable, when inoculated into another animal's brain, of producing the disease. That the infected brain, used for inoculating animals, contained the bacteria, which caused the disease, was proved by the fact that a stage of incubation occurred in the inoculated animal and that a series of animals were successfully inoculated consecutively from the first. Pasteur then successfully attenuated the unknown bacterium of hydrophobia present in the nervous tissues of an inoculated animal by dessication of the nervous tissue in a sterile apparatus by methods too well known to repeat. Nor is it necessary to occupy time in repeating the well-known methods pursued by Pasteur and his pupils in the use of the graduated doses of attenuated bacteria contained in the nerve tissues in the prophylactic treatment of rabies. To Pasteur, therefore, do we owe the scientific recognition of the principle of protective inoculation.

It is now a well-known fact, however, that inoculation against disease was practised by the Chinese 1,000 years ago. They inoculated the healthy with smallpox as a protection against the disease. Variolization was also practised in Europe in the seventeenth and eighteenth centuries. We read that in 1718 Lady Montague caused a son to be inoculated with variola in Italy and that two

years later her daughter was inoculated in England. The practice was followed in Ireland long after the successful establishment of vaccine as a protection against variola. Inoculation against syphilis, or syphilization, was also practised in Europe during the nineteenth century.

To Jenner, however, do we owe the first example of the protective inoculation by means of an attenuated virus. This attenuation we now know was established by the accidental inoculation of milch cows with smallpox, producing a modified disease, vaccinia. That vaccinia, produced in man by inoculation direct from the cow, would protect against smallpox was proved when, in 1798, Jenner successfully vaccinated, direct from the cow, the five-year-old lad, William Summers.

The thousands of successful vaccinations which have since been performed and the thousands of lives which have been saved by vaccination are proof of its validity and utility. The immunity established by protective inoculation is apparently the same as that induced by an unmodified attack of variola.

SERUM THERAPY.

When chemistry had revealed the nature of bacterial poisons and experiments established their relation to the phenomena of disease, it was proved that substances were formed in artificial culture media and in the blood and tissues of infected animals which had the power to neutralize the effect of the bacterial poison in other animals infected with the same organism. Further investigation showed that an animal inoculated with the laboratory preparation of antitoxin was protected against the disease.

Furthermore, it was found that the blood serum of an animal inoculated with bacteria in a non-fatal and repeated dose contained an antitoxin. When the blood serum of the infected animal was injected into a healthy animal, the latter was protected against the original disease.

Antitoxin was, therefore, proved to be formed in artificial media of bacterial cultures and in the bodies of infected animals. When the antitoxin thus formed was injected into an animal it had the power to protect it against the particular bacterial infection or, if given subsequent to the infection of the animal, to mitigate the severity of the disease or to entirely check it.

Thus, by Koch and his students, was serum therapy established as a principle. Upon this principle there has been established and given to the world the antidiphtheritic serum of Behring and of Roux.

A curative or immunizing serum has been developed for Asiatic cholera, tetanus, erysipelas, plague, epidemic dysentery, streptococcus infection and other diseases. While the serum treatment has not proved successful in all the diseases in which it has been employed, it has been so successful in some—diphtheria, for instance, as to firmly establish the principle of serum therapy.

INFLUENCE OF BACTERIOLOGY UPON PRACTICAL MEDICINE AND SURGERY.

These practical results in specific prophylactic and curative therapy is but a part, however, of the influence which bacteriology has had upon medicine. The stimulus given by bacteriology to the study of pathologic anatomy, physiologic chemistry, clinical phenomena and of physical and chemical changes of the fluids and tissues of the body, has resulted in a knowledge so comprehensive that medical science has been revolutionized within the last twenty years. Speculative theories and hypotheses have given place to facts based upon sound principles proved by experiment and clinical observation.

Bacteriology made possible the comprehension of perfect cleanliness, and enables the surgeon to invade every part of the body without fear of infection, and has saved thousands of lives which twenty-five years ago perished miserably as the result of disease at that time inoperable, or the result of infection from contact with the surgeon. By means of cleanliness and skill, induced by a broader experience, the surgeon has been able to add to our knowledge information of great value which could have been obtained probably in no other way. He has been able to study disease in the living body and show the relation of a disease process to infection. He has thus been able to clear away many of the misconceptions of symptomatology and diagnosis, especially in disease of the abdominal organs.

Bacteriology has stimulated laboratory clinical diagnosis. Bacterial reaction to sera and blood cultural tests are of the greatest aid to diagnosis. Clinical research work has command of an armamentarium consisting of a knowledge of pathologic anatomy, of physiology, of bacteriology, of chemic physiology and of physics, which allows of a precision in diagnosis never before at the command of the physician.

From the foregoing it seems sufficiently demonstrated that today medical science possesses a knowledge so exact that we may answer definitely the question of our relation to the commercial affairs of the world. Infectious diseases which affect agricultural interests, like swine plague, rind pest, fowl cholera, glanders, tuberculosis, actinomycosis, trichinosis and many of the parasitic diseases of plants and of animals, have been studied by scientists with most definite results.

PREVENTION OF INFECTION.

Today no sane man believes in spontaneous generation. The presence of an infective disease, either bacterial, protozoic, parasitic or fungus, means the recognition of progenitors in the near environment of the infected organism. In practically every one of the diseases of animals above named the scientific investigator has already discovered the nature of the infecting agent, knows its life history, what conditions are most necessary for its propagation and multiplication, and what will remove and annihilate so dangerous an enemy.

Our Department of Agriculture, and especially the Department of Animal Industries, has done much to place comparative medicine on a scientific basis. Briefly stated, there is not a fungous-parasitic, animal-parasitic, protozoic or bacterial disease of the lower animals which can not, with our present knowledge, be stamped out for all time.

Why do the acute epidemic infections attack the swine, fowl and cattle of the agriculturist? Because the causative germ is allowed to live and multiply after a former epidemic, or it is transplanted from place to place by infected animals or by fomites. All of these acute diseases of the lower animals are preventable. One has but to read of the labors and investigations of Pasteur, in relation to charbon, to the silkworm disease and to fowl cholera to know what indifferent, careless methods may do to prolong and propagate an infection. On the other hand, proper precautions as to the destruction by fire of the infected bodies of animals and plants, the application of cleanliness through the use of abundant pure water, pure food, air and sunlight would extinguish an epidemic.

This may imply the loss of infected property by the individual, the municipality, the state or the national government, but fall the loss where it may, it is often necessary to destroy absolutely the infected organism that the greater commercial interests as well as the health of the people may be preserved. For example, actinomycosis of cattle, trichinosis of swine, tuberculosis of cattle, may be absolutely controlled and finally obliterated by proper sanitary measures. The expense of such an undertaking would be relatively great, but under the direction of scientists it can be done. Pasteur, with the aid of the government of France, abolished swine plague, charbon, silkworm disease and other conditions harmful to the agricultural interests, with the result that millions of francs were saved to individuals, to corporations and to the government.

The same happy result would occur here, and in addition the health of our people would be protected against the possible infection with tuberculosis, actinomycosis, trichinosis and intoxication from other infected animal foods.

SMALLPOX.

But what of the epidemic scourges of the earth, smallpox, yellow fever, cholera and the plague? No rational individual can for a moment doubt the protective influence of bovine vaccination against smallpox. Let one but look up the statistics of the mortality of this disease in the anti-vaccination period and he will become convinced of the utility of protective vaccination. In London the annual mortality from smallpox from 1660 to 1810 per million of the population was 2,040 to 5,020, while with vaccination, not adequate, however, the death-rate per million was from 1831 to 1835, 830; 1838 to 1853, 513; 1854 to 1871, 388; 1872 to 1882, 262; 1883 to 1892, only 73.

In Germany, where variola had decimated the population in the prevaccination period, thorough vaccination has practically stamped out the disease. Compulsory vaccination properly enforced would effectually eradicate the disease and would free commerce of the losses due to quarantine regulations. The question of individual rights, especially under a republican form of government, is debatable when one considers that science has proved the efficacy and utility of protective vaccination against variola; that with modern methods the process is free from the danger of inoculation with any other disease; vaccination is practically a harmless disease and, finally, that an individual right may become an evil when the practice of it subjects others to unnecessary risk of health, life and property.

Medical science, therefore, possesses the knowledge to rid the earth of variola. From a humanitarian point of view, this knowledge is priceless. Still, let one but compute the sum saved to the nations of the earth by vaccination, estimating each life saved at \$5,000, the usual valuation placed upon human life by statute. Great as would be this sum, it is many times less than that saved to the commercial interests of the world by the control of the disease which even inadequate vaccination has afforded. Think for a moment of the loss to commercial interests by quarantine and other restrictive measures, in the event of an epidemic of variola, without protection from vaccination.

THE PLAGUE.

The plague, the Black Death, which was first recognized in Europe in the year 543 as the *Peste Justinienne*,² became pandemic in the fourteenth century, and 24,000,000 people are said to have died of it. In 1655, London alone lost 70,000 people from the plague. It disappeared from Europe about 1720. It continued, however, in Egypt, Asia and other Eastern countries in small foci, occasionally occurring as severe local epidemics. In 1830, 60,000 people died of the pest in Bagdad. During the remainder of the nineteenth century it appeared sporadically in Asia, Turkey, Tripoli, Persia and other Asiatic countries. In 1891 it reappeared in epidemic form in middle China. From that date to the present time it spread over China, reaching Canton in 1894, Hong Kong in epidemic form in 1896, and in Bombay the same year. It appeared in Oporto, Spain, in 1899; in Glasgow in 1900, and in San Francisco in 1901, not to mention sporadic cases elsewhere in seaports of Europe and Central and South America.

In 1894 Dr. Yersin, director of the Pasteur Institute at Hong Kong, discovered the *bacillus pestis*. He elaborated a serum which has since been used with success as a prophylactic and curative agent. Haffkine prepared a protective vaccine which has also proved successful as a protective inoculation. It has been used in hundreds of thousands of cases in India with no harm-

ful results, and is said to reduce the susceptibility at least 75% and the mortality about 90%.³

The plague, the Black Death of the fourteenth century, still exists and rages with fearful mortality in communities which have no regard for hygienic surroundings. It is communicated to people through the abraided skin, or by flea bites, through the respiratory tract apparently by bacteria in dust-laden air and also through the alimentary tract by contaminated ingesta. Modern hygienic measures, which consist of perfect cleanliness, isolation, the destruction of vermin and the use of Haffkine's vaccine as a prophylactic and Yersin's curative serum, serve to control the disease. There can be no doubt that if sanitary authorities will take proper precautions to recognize the disease, proclaim its presence and then control it by the means which science has discovered, that the terrible scourge may be safely held in check and finally abolished from every civilized community.

The value to commerce of the discoveries of science in relation to the plague cannot be computed. While the knowledge of its cause and prevention is exact, the impossibility of controlling the unsanitary conditions of the countries of the East and even of our own western world makes it necessary to continue the quarantine regulations which so often restrict commercial ends.

YELLOW FEVER.

The mortality from yellow fever in the United States during the last one hundred years, 1798-1897, has been about 80,665.⁴ This gives an average annual mortality of 807. Several severe epidemics have occurred and it has prevailed extensively in smaller towns where the mortality records have not been kept. Hence the above figures do not represent the full annual death-rate from the disease. Yellow fever has been the scourge of the West Indies, Central and South America, Mexico and of our Gulf States.

Recognized as an infective disease, indefatigable search has been made for the bacterial cause by many earnest workers. Apparently up to the present time the specific infective germ has not been found. Indeed, from a recent paper⁵ by Reed and Carroll, it would seem that the bacterium must be infinitesimally small.

Although we do not know the specific bacterium of yellow fever, a most brilliant discovery has been made of the means of transmission of yellow fever by means of the mosquito (*stegomyia fasciata*) by two of our countrymen: ⁶ Walter Reed, surgeon, U. S. Army, and James Carroll, contract surgeon, U. S. Army. Twenty years ago Finley associated the transmission of yellow fever with the mosquito, but no proof of this was given until

³ Pacific Medical Journal, January, 1901.

⁴ Obtained from the records through the kindness of Surgeon-General Walter Wyman, U. S. M. H. S.

⁵ The Etiology of Yellow Fever, American Medicine, Feb. 22, 1902.

⁶ Experimental Yellow Fever, Transactions Association American Physicians, vol. xvi, 1901.

² Ph. Hauser: La Peste dan les temps anciens, etc., Paris, 1900.

the epoch-making and decisive experiments of Reed and Carroll. Furthermore, these experimenters proved that fomites contaminated with the vomitus and discharges of yellow fever patients do not transmit the disease to man.

In Havana, Cuba, the sanitary authorities of the United States have attempted during the last year or more to test the fact of yellow fever transmission by the mosquito. To this end the city was made clean; the breeding-places of mosquitoes in and about Havana were destroyed as far as possible and persons suffering from yellow fever were isolated and protected from the mosquito. Thus the number of mosquitoes were much diminished and care was taken that remaining mosquitoes did not become infected by biting yellow fever patients. As a result yellow fever disappeared from Havana and for the first time in years no case had occurred up to May 1 of this year. The usual marine quarantine regulations of the United States restricting the non-immune travel from Cuba was postponed. Furthermore, the Congress of the United States will probably modify the quarantine regulations in reference to yellow fever to meet the more hopeful conditions which the researches of Reed and Carroll have established in relation to the definite transmission and control of the disease.

There can be no doubt of the practical value of this important discovery to mankind. Proper sanitary measures in reference to cleanliness, the destruction of mosquitoes and their breeding-places and proper precautions against the infection of the few undestroyed mosquitoes by isolation of every imported case of yellow fever will eradicate the disease from every civilized country.

MALARIA.

Malaria has not borne as important a relation to commercial communications between peoples as yellow fever and the plague. Nevertheless, it has had an enormous influence upon the health and prosperity of the inhabitants of certain regions where it is endemic and at times epidemic in its prevalence. The principles which prevail to induce malaria in a certain region is the existence of human malaria and of the mosquito of the genus *anopheles*.

The mosquito is annoying but harmless until she becomes infected with malaria by biting a human being infected with the disease. Such an infected mosquito may inoculate all the people she subsequently stings. In this manner a region ordinarily free from malaria may become infected by the importation of a case of malaria from a distant point. It is also possible that a mosquito infected with malaria could be transported by railroad or ship in the luggage or clothing a considerable distance and then sting and infect individuals in its new environment.

We have many examples of infection of people in localities usually free from malaria, through its introduction by means of imported laborers employed in the construction of railroads, canals, etc. Malaria was rarely found in Chicago until

1891, when the construction of the World's Fair buildings was commenced. Then it was attributed to the excavations and to the turning of virgin soil. The construction of the Chicago Drainage Canal began at the same time and continued until 1900. During that period malaria was constantly present in Chicago and in 1898-1899 was augmented by importation of infected soldiers from Cuba and other malarious regions. No one can doubt that malaria was imported in the persons of some of the foreign laborers employed in the above-named enterprises, and that the previously innocent *anopheles* became infected and afterward inoculated many people who suffered from malaria at the period named.

The mortality of malaria in malarious districts with a considerable population is large. Thus Professor Celli⁷ says that the mean mortality from malaria in Italy is about 15,000 victims annually, and that about 2,000,000 cases occur in Italy each year. As the mean duration of malaria is generally long, sometimes infecting the individual for years, the loss of labor and of production and the expense entailed in dealing with the disease, amounts to several millions of francs. Furthermore, Celli says that owing to malaria about 5,000,000 acres of land remain uncultivated with a resulting large economic loss. According to the very accurate calculations of Ricchi, the Adriatic Railway Company, with 1,400 kilometres of road and employing 6,416 men, spend on account of malaria alone 1,050,000 francs a year. In the Italian Army, in the twenty years from 1877 to 1897, there occurred more than 300,000 cases of malaria. Finally, Celli⁷ says malaria annually costs Italy incalculable treasure.

Malaria is so widely disseminated over the world and the opportunity for continued infection of the mosquito so great that it seems almost hopeless to try to eradicate the disease. The principle upon which malaria may be fought has been suggested by science and has proved of value. This consists of the destruction of the mosquito and its breeding-places. The prevention of the infection of the remaining mosquitoes by isolation of the malarious individual from the mosquito and the diminution of malarial material in man by an attempt to cure him with quinin and other antimalarial remedies.

Experiment has already demonstrated that non-immune individuals may live safely in the most malarious districts, with adequate yet simple protection from the sting of the mosquito infected with malaria. Man thus protected against malaria may now explore, settle in and develop regions of the earth hitherto inaccessible because of the danger from the deadly tropical malaria.

This address would become too long were one to take up other infectious diseases, although in some of them the science of medicine has made such successful investigations that the knowledge of the cause, means of propagation and dissemination is exact.

⁷ Malaria According to New Researches, 1900.

TYPHOID FEVER.

I cannot close without saying that if in typhoid fever we could employ, unembarrassed by the great cost of the necessary measures, the precautions which science affords to prevent water and food contamination, that the disease would be effectually abolished. The great cost of the measures necessary to stamp out typhoid fever would, however, be an economic measure, inasmuch as the immense value to the state of the conservation of the labor of the thousands sick and the lives saved each year would more than compensate for the treasure spent.

VALUE OF MEDICAL SCIENCE RECOGNIZED.

However much medical science has done for humanity, and great as the value of the knowledge of infectious disease is to the commercial interests of the world, scientists have not, especially in our own country, received the recognition and financial aid from the state, from corporations or from wealthy individuals which they deserved.

MEDICAL SCIENCE SHOULD RECEIVE FINANCIAL SUPPORT.

Medical science should receive the moral and financial support of states and municipalities in the employment of the measures which science has proved to be efficacious in modifying, restricting and abolishing infectious disease. Wealthy corporations and individuals should establish institutes of original research in properly constructed and equipped hospitals and laboratories. There the many earnest, indefatigable and conscientious medical investigators could make more perfect the knowledge we already possess of many of the infectious diseases and, unembarrassed by financial needs, could search for the cause, the means of transmission and the prevention and cure of the diseases of which we know but little.

Funds, too, should be created to support the cost of committees of scientific investigators in regions now dangerous to the white man. By such means the many plagues of the tropics would be investigated and conquered. Regions uninhabitable or dangerous to the Caucasian would become accessible to settlement and commercial intercourse. Civilization, humanity and commerce would be advanced and multiplied.

It is right, therefore, that medical science should demand of the moneyed interests of the world the recognition which, though long withheld, is her just due. This she asks, not that individuals may profit in either fame or fortune, but that she may the more readily rid the world of infectious diseases for the sake of humanity.

LAW AND MEDICINE.—Princeton graduated this year a class of 258 men. Of this number 69 have asserted their intention of pursuing the law as a profession, while only 23, or exactly one-third as many, will choose the more arduous study of medicine.—*Medical News*.

SUTURE OF HEART WOUNDS.¹

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THE RECORDED SUTURES OF THE HEART.

IN 1896 three operations for the suture of wounds of the heart muscle were done. Two are recorded as having been done in 1897. Four are credited to 1898. In 1899 the heart was sutured eleven times, in 1900 three times, and in 1901 nine times, three of this last set being done in this country. This year two operations have thus far been reported. This makes a total of thirty-four operations in the six years following the first attempt to treat, by a simple surgical procedure, an organ usually supposed to be particularly vulnerable,—in fact, so vulnerable that any interference, even for surgical purposes, might be followed by immediate fatal results.

There is more than enough material here for our consideration at this time, and I beg you to follow me in the necessarily brief discussion which I offer you. In order to start with some knowledge of the results of these operations, before any discussion, in general or in detail, is attempted, a short review of them will be necessary.

REVIEW OF THESE CASES.

As regards the manner of wounding, all these cases, except two, were due to punctured or incised wounds, the two exceptions being bullet wounds. The particular injury to the heart was inflicted on the ventricles thirty-two times, the left ventricle being implicated seventeen times and the right thirteen times. In two cases only were auricles opened, once the right and once the left, and there are three cases in which my information is incomplete. In most of the cases where details are given the pleura is reported wounded, and usually there was a hemothorax, the collection representing, in large part, the overflow from the pericardium.

The practical questions which usually come to the mind of a surgeon in planning an operation to meet these conditions relate to the method of exposure of the heart, the detail of the treatment of its particular condition, and the method of closing and dressing the wound of the operation.

In the cases reported the heart was reached variously, depending on the location of the original wound in the skin and the choice of the operator, but either a flap of all of the tissues of the thoracic wall was turned up or a resection of two or more ribs was practised. The particular detail is of no great moment provided that the heart is properly exposed. The special method of treating the heart wound is of interest, for it involves the choice of suture material for a novel situation, the time at which the suture is introduced and tied with reference to the heart beat, and the

¹ Oration on Surgery delivered before the Fifty-third Annual Meeting of the American Medical Association at Saratoga Springs, N. Y., June 10-13, 1902.