The present staff of the institute is composed of the following persons:

Department of Pathology and Bacteriology—Dr. Simon Flexner, Dr. E. L. Opie, Dr. H. Noguchi, Dr. J. E. Sweet, Dr. H. S. Houghton.

Department of Physiology—Dr. S. J. Meltzer, Dr. John Auer.

Department of Chemistry—Dr. P. A. Levene, Dr. W. Beatty.

Resident Fellows and Scholars—B. F. Terry, zoology; R. D. MacLaurin, chemistry; Chas. A. Rouiller, chemistry; E. H. Schorer, bacteriology; Bertha I. Barker, bacteriology.

L. Emmett Holt.

THE ENDOWMENT OF RESEARCH.

The support of hospitals has always made a strong appeal to the philanthropy of the state and of individual citizens, and the importance to the community of educated physicians has been appreciated, although in this country until recent years most inadequately, but the recognition of medical science as a rewarding object of public and private endowment is almost wholly the result of discoveries in this department of knowledge made during the last quarter of a century. An eloquent witness to the awakening of this enlightened and beneficent sentiment is the establishment, in 1901, of the Rockefeller Institute for Medical Research with its laboratories formally opened to-day.

While the scientific study of infectious diseases is, of course, not of recent origin and had been pursued as a part of the functions of health departments and of university laboratories of hygiene and of pathology, the first provision of a special laboratory for this purpose was made by the German government in 1880, in the Imperial Health Office in Berlin, and to the directorship of this laboratory was called from his country practise Robert Koch, who four years before had startled the scientific world by his memorable investigations of anthrax.

The supremacy of Germany in science is due above all to its laboratories, and no more fruitful record of scientific discoveries within the same space of time can be found than that afforded by this laboratory during Koch's connection with it, from 1880 to 1885. Thence issued in rapid succession, the description of those technical procedures which constitute the foundation of practical bacteriology and have been the chief instruments of all subsequent discoveries in this field, the determination of correct principles and methods of disinfection, and the announcement of such epochal discoveries as the causative germs of tuberculosis—doubtless the greatest discovery in this domain—of typhoid fever, diphtheria, cholera, with careful study of their properties.

The leading representative, however, of the independent laboratory devoted to medical science is the Pasteur Institute in Paris, founded in 1886, and opened in 1888. The circumstances which led to the foundation of this institute made probably a stronger appeal to popular sympathy and support than any others which have ever occurred in the history of medicine.

There stood in the first place, the personality and the work of that great genius, Louis Pasteur, of noble and lovable character, one of the greatest benefactors of his kind the world has known, who for forty years had been engaged, often under adverse conditions, in investigations which combined the highest scientific interest with important industrial and humanitarian applications. Pasteur's revelation of the world of microscopic organisms in our environment—the air, the water and the soil—and his demonstration of their relation to the processes of fermentation and putrefaction, had led Lister in the late sixties, even before anything was definitely known of the causative agency of bacteria in human diseases, to make the first and most

important application of bacteriology to the prevention of disease by the introduction of the principles of antiseptic surgery, whereby untold thousands of human lives have been saved.

In 1880, came the most momentous of Pasteur's contributions to medical science and art in the introduction of the method of active immunization by the use of the living parasites of the disease attenuated in virulence, a method which until this date had remained without further application since its employment by Edward Jenner in 1796 in vaccinating against smallpox. Pasteur's researches in this field of immunity, marvelous in their originality, ingenuity and fertility of resource, culminated in 1885 in the announcement of his successful method of protective inoculation against that dread disease, rabies, and most of those here present will recall the enthusiasm with which this great triumph of experimental medicine was hailed throughout the civilized world.

It was under the immediate impression and the incentive of this discovery, and as a mark of gratitude to Pasteur, that over two and one half million francs were raised within a short time by international subscription for the construction and endowment of an institute to bear his name, where the Pasteur treatment was to be carried out and ample facilities afforded for investigations of microorganisms and the problems of infectious diseases. This model institute, much enlarged since its foundation and after the death of Pasteur under the directorship, first of Duclaux, and now of Roux, and in one of its most important divisions, of Metchnikoff, has been a fruitful center of productive research and through its contributions to knowledge affords a signal illustration of the benefits to science and to humanity of the endowment of laboratories for the advancement of medical science.

It was under much the same influences that the important Imperial Institute for Experimental Medicine in St. Petersburg, with even wider scope than the Pasteur Institute, was founded and munificently endowed by Prince Alexander of Oldenburg in 1890.

In the following year the Prussian government established in Berlin, under the directorship of Professor Koch, the admirably organized and equipped Institute for Infectious Diseases, to which is attached, as to the Pasteur Institute, a hospital for infectious diseases. This and the excellent Institute for Experimental Therapeutics, in Frankfort, under Professor Ehrlich's direction, founded also by the Prussian government in 1896, are unsurpassed in their scientific activities and in the number and value of their contributions to our knowledge of infection and immunity.

In 1891, was founded in London the British, later the Jenner, and now the Lister, Institute of Preventive Medicine, designed to be a national institute similar in character and purpose to the Institut Pasteur, in Paris. The funds were contributed by the public, and subsequently increased by Lord Iveagh's generous gift of two hundred and fifty thousand pounds.

Within less than a year after the foundation of the Rockefeller Institute for Medical Research, the Memorial Institute for Infectious Diseases was founded in Chicago, by Mr. and Mrs. Harold F. McCormick, and placed under the capable direction of Professor Hektoen.

The Institute for the Study, Treatment and Prevention of Tuberculosis, which bears the name of its beneficent founder, Henry Phipps, was incorporated in Philadelphia in 1903, and, while devoted to a single disease, it must be ranked among those of wide scope, when we consider the magnitude and surpassing importance of

the problems pertaining to this disease.

It may also be noted that the Carnegie Institution in Washington, with its unequaled endowment of ten million dollars, includes within its scope the support of biological and chemical investigations of great importance to medical science, so that our country now stands in line with Germany, France and Great Britain in the opportunities afforded for research in medical and other sciences.

These various institutions have been mentioned as typifying the general aims and character of the Rockefeller Institute for Medical Research, rather than to afford any complete picture of the material aid now available for the advancement of scientific medicine. If the latter were the purpose, it would be necessary to travel far afield so as to include independent medical laboratories of more restricted scope, such as those for the study of cancer, the laboratories connected with departments of health, so well exemplified in our own country by those of the state board of health of Massachusetts, and of the department of health of the city of New York, hospitals and the laboratories connected with them, the medical laboratories of the universities and medical schools, such as the Thompson Yates and Johnston laboratories in Liverpool, and the splendid new laboratories of the Harvard Medical School, laboratories established in recent years for the study of tropical diseases, such as our government laboratories in Manila, and funds available for special grants to investigators.

Impressive and encouraging as is this remarkable growth within recent years of laboratories devoted to the medical sciences, no one who has any knowledge of the vast field to be covered, of the difficulty and complexity of the problems, of the expenditure of money required, and of the returns in increased knowledge and benefits to mankind which have been attained and which may be expected in increasing measure, can for a moment suppose that the existing opportunities, considerable as they are, are adequate to meet the present and the future needs of scientific medicine.

As I have already stated, the wider recognition of medical science as a rewarding object of endowment is a result of discoveries made during the last quarter of a century, and it is of interest to inquire why this increased knowledge should have borne such abundant fruit. The result is not due to any change in the ultimate aims of medicine, which have always been what they are to-day and will remain, the prevention and the cure of disease, nor to the application to the solution of medical problems of any higher intellectual ability and skill, than were possessed by physicians of past generations, nor to the growth of the scientific spirit, nor to the mere fact of a great scientific advance in medicine, for the most important contribution ever made to our understanding of the processes of disease was the discovery by Virchow, in the middle of the last century, of the principles and facts of cellular pathology, the foundation of modern pathology.

The awakening of this wider public interest in scientific medicine is attributable mainly to the opening of new paths of investigation which have led to a deeper and more helpful insight into the nature and the modes of prevention of a group of diseases—the infectious diseases—which stand in a more definite and intimate relation to the social, moral and physical well-being of mankind than any other class of diseases. The problems of infection which have been solved, and kindred ones which give promise of solution, are among the most important relating to human society. The dangers arising from the spread of contagious and other infectious diseases, threaten, not the individual only, but in-

dustrial life and the whole fabric of modern society. Not medicine only, but all the forces of society are needed to combat these dangers, and the agencies which furnish the knowledge and the weapons for this warfare, are among the most powerful for the improvement of human society.

Great as was the material, intellectual and social progress of the world during the past century, there is no advance which compares in its influence upon the happiness of mankind with the increased power to lessen physical suffering from disease and accident, and to control the spread of pestilential diseases. Were we to-day as helpless as the physicians of past centuries in the face of plague, smallpox, typhus fever, cholera, yellow fever and other epidemic diseases, even if the existence of our modern crowded cities were possible, which may be doubted, the people would sit continually in the shadow of death. Great industrial activities of modern times, efforts to colonize and to reclaim for civilization vast tropical regions, the immense undertaking to construct the Panama Canal, are all in the first instance dependent upon the successful application to sanitary problems of knowledge, much of it gained in recent years, concerning the causation and propagation of epidemic and endemic diseases.

And yet probably a fair measure of the general realization of these facts is the provision by Congress that of the seven members of the Isthmian Canal Commission, four shall be engineers without a word concerning a sanitarian on the commission. There could hardly be a more impressive opportunity to demonstrate to the world the practical value of our new knowledge concerning the mode of conveyance of malaria and yellow fever, the two great scourges of Panama, than that afforded by the digging of the Isthmian Canal. The sanitary problem is not surpassed in difficulty by the engineering problem, but we may feel reasonable assurance that with the sanitary control in hands as trained and capable as those of Colonel Gorgas, the ghastly experiences of the old French Panama Canal Company and in the construction of the railway will not be repeated.

To comprehend fully the degree and the character of the progress of modern medicine requires a kind of knowledge and a breadth of vision not possessed by the average man. He is concerned mainly with the prompt relief of his own ailments or those of his family. Of the triumphs of preventive medicine he knows little or nothing. With such dull matters as the decline in the death rate by one half, and the increase in the expectation of life by ten or twelve years during the last century, he does not concern himself. He takes no account of the many perils which have been removed from his pathway since his birth, and indeed at the time of his birth, nor does he know that had he lived a little over a century ago and survived these perils, he would probably be marked with smallpox.

While it is true that in the relief of physical suffering and in the treatment of disease and accident the progress has been great and the physician and the surgeon can do more, far more to-day than was possible to his predecessors, and while improvement in this direction must always be a chief aim of medicine, still it is in the prevention of disease that the most brilliant advances have been made. The one line of progress, that with which the daily work of the physician is concerned, affects the individual, the unit; the other, like all the greater movements in evolution, affects the race. It has been argued, with a certain measure of plausibility, that the interference with the law of the survival of the fittest, assumed to be a result of the

success of preventive medicine, will bring about deterioration of the race. I believe the argument to be fallacious, and that we already have sufficient experience to show that there need be no serious apprehension of such a result.

Before some accurate knowledge of the causation of infectious diseases was secured, preventive medicine was a blundering science, not, however, without its one great victory of vaccination against smallpox, whereby one of the greatest scourges of mankind can be controlled and could be eradicated, if the measure were universally and efficiently applied. The establishment upon a firm foundation of the germ doctrine of infectious diseases, the discovery of the parasitic organisms of many of these diseases, the determination by experiment of the mode of spread of certain others, and the experimental studies of infection and immunity, have transformed the face of modern medicine. The recognition, the forecasting, the comprehension of the symptoms and lesions, the treatment of a large number of infectious diseases, have all been illuminated and furthered, but the boon of supreme import to the human race has been the lesson that these diseases are preventable.

Typhus fever, once wide-spread, and of all diseases the most dependent upon filth and overcrowding, has fled to obscure, unsanitary corners of the world before the face of modern sanitation.

In consequence of the knowledge gained by Robert Koch and his coworkers, Asiatic cholera, to the modern world the great representative of a devastating epidemic, will never again pursue its periodical, pandemic journey around the world, even should it make a start.

Of bubonic plague, the most dreaded of all pestilences, which disappeared mysteriously from the civilized world over two centuries ago, we know the germ and the manner of propagation, and, although it has ravaged India for the last ten years with appalling severity, it can be and has been arrested in its spread when suitable measures of prevention are promptly applied.

Typhoid fever, the most important index of the general sanitary conditions of towns and cities, has been made practically to disappear from a number of cities where it formerly prevailed. That this disease is still so prevalent in many rural and urban districts of this country, is due to a disgraceful neglect of well-known measures of sanitation.

To Major Walter Reed and his colleagues of the army commission, this country and our neighbors to the south owe an inestimable debt of gratitude for the discovery of the mode of conveyance of yellow fever by a species of mosquito. On the basis of this knowledge, the disease, which has been long such a menace to lives and commercial interests in our southern states, has been eradicated from Cuba, and can be controlled elsewhere.

Another army surgeon, Major Ross, acting upon the suggestion of Sir Patrick Manson, had previously demonstrated a similar mode of incubation and transportation of the parasite of malaria, discovered by Laveran, and it is now possible to attack intelligently and in many localities, as has already been proven, with good promise of success, the serious problem of checking or even eradicating a disease which renders many parts of the world almost uninhabitable by the Caucasian race and, even where less severe, hinders, as does no other disease, intellectual and industrial activities of the inhabitants. It is gratifying that one of our countrymen and a member of the board of directors of this institute, Dr. Theobald Smith, by his investigations of Texas cattle fever, led the way in

the discovery of the propagation of this class of disease through an insect host.

The deepest impress which has been made upon the average death rate of cities has been in the reduction of infant mortality through a better understanding of its causes. The Rockefeller Institute, by the investigations which it has supported of the questions of clean milk and of the causes of the summer diarrhœas of infants, has already made important contributions to this subject, which have borne good fruit in this city and elsewhere.

No outcome of the modern science of bacteriology has made a more profound impression upon the medical profession and the public, or comes into closer relation to medical practise than Behring's discovery of the treatment of diphtheria by antitoxic serum, whereby in the last twelve years the mortality from this disease has been reduced to nearly one fifth of the former rate.

The most stupendous task to which the medical profession has ever put its hands is the crusade against tuberculosis, whose preeminence as the leading cause of death in all communities is already threatened. Sufficient knowledge of the causation and mode of spread of this disease has been gained within the last quarter of a century, to bring within the possible bounds of realization the hopes of even the most enthusiastic, but it will require a long time, much patience and a combination of all the forces of society, medical, legislative, educational, philanthropic, sociological, to attain this goal.

Time forbids further rehearsal, even in this meager and fragmentary fashion, of the victories of preventive medicine. Enough has been said to make clear that man's power over disease has been greatly increased in these latter days. But great and rapid as the progress has been, it is small in comparison with what remains to be done. The new fields which have been opened have been explored only in relatively small part. There still remain important infectious diseases whose secrets have not been unlocked. Even with some whose causative agents are known, notably pneumonia and other acute respiratory affections, and epidemic meningitis, very little has yet been achieved by way of prevention. The domain of artificial immunity and of the treatment of infections by specific sera and vaccines, so auspiciously opened by Pasteur and by Behring, is still full of difficult problems, the solution of which may be of immense service in the warfare against disease. Of the cause of cancer and other malignant tumors nothing is known, although many workers with considerable resources at their disposal are engaged in its study. With the change in the incidence of disease, due at least in large part to the repression of the infections of early life, increased importance attaches to the study of the circulatory, renal and nervous diseases of later life, of whose underlying causes we are very imperfectly informed. There are and will arise medical problems enough of supreme importance to inspire workers for generations to come and to make demands upon all available resources.

In directing attention, as I have done, to some of the practical results of scientific discovery in medicine, and in indicating certain of the important problems awaiting solution, there is always the danger of giving to those unfamiliar with the methods and history of such discovery a false impression of the way in which progress in scientific knowledge has been secured and is to be expected. The final victory is rarely the result of an immediate and direct onslaught upon the position ultimately secured. The advance has been by many and devious and gradual steps, leading often, it might appear, in quite different

directions, and mounted more frequently than not to secure a wider prospect, but without any thought of the final goal. The army contains a multitude of recruits drawn from the most various fields, the biologist, the chemist, the physiologist contributing their share to medical triumphs just as truly as the pathologist, the bacteriologist, the hygienist, the clinician. The inspiration has been the search for truth and joy in the search far more than any utilitarian motive. In the fullness of time comes the great achievement; the leader is hailed, but he stands upon the shoulders of a multitude of predecessors whose contributions to the result are often lost from view.

In full recognition of the dependence of success in the warfare with disease upon increase of knowledge, the Rockefeller Institute for Medical Research was founded by the enlightened munificence of Mr. John D. Rockefeller, to whom we make grateful acknowledgment. Likewise to the broad sympathies and active interest of his son, Mr. John D. Rockefeller, Jr., the origin and development of this institution are largely indebted.

What has already been accomplished, as well as the general scope and aims of the institute, have just been concisely indicated to you by Dr. Holt. My purpose has been to show, although of necessity most inadequately, that these aims relate to matters of the highest significance to human society, that the present state of medical science and art requires large resources for its advancement, and that the returns in benefits to mankind have been and will continue to be great out of all proportion to the money expended.

May the hopes of the founder and of those who have planned this institute be abundantly fulfilled! May it contribute largely to the advancement of knowledge, and may the streams of knowledge which flow from it be 'for the healing of the nations.'

William H. Welch.

It seems to me significant that this home of scientific research is placed amid the teeming population of a great city. Science has for its end service, and there will be no quicker or more useful application of the discoveries made here than among the tens of thousands who live just outside these walls.

In no way has knowledge more completely revealed its power than in the triumphs of modern engineering and of modern medicine. Engineering and medicine have conspired together to make human life pleasanter and happier, and to relieve it from a large amount of suffering and pain. The transmission of energy over long distances and in new forms and the discoveries of the modern pathologists have changed the conditions and even the aspect of life more than we realize.

These buildings are dedicated to the relief of human disease and human suffering by the application of scientific method to the study of a concrete body of facts. They will exert their influence in three ways: they will add to the sum total of human knowledge in respect to medicine; they will aid in developing a company of trained scientific observers; and they will help spread abroad in the public mind a respect for science and for scientific method. Each of these services is a public service, but the last named is perhaps the greatest.

Pasteur, whose name will often be spoken here and always with reverence, understood this. In 1870, when his country was crushed under overwhelming disaster and staggering under blow upon blow, he found voice to say that neglect of science and of scientific research was a powerful cause of