## PRESENTATION OF THE MICROSCOPE

*Dr. Conklin, Dr. Novy, Friends, Ladies and Gentlemen:*

MY job is a comparatively small one, but there are some thoughts going through my mind of a rather reminiscent nature. I want to say a few words on my long connection with the association, being probably one of its oldest members. The first meeting of the association that I attended was in Nashville in 1877. The motive for my attendance at this meeting and those for many years to come was to become better acquainted with the people who were then outstanding in the field of science and to discover their needs and desires first hand so that we would be in a better position to serve and cooperate with them in the development of microscopes and other optical equipment which were so essential to their achievements.

And I am very happy to say this: In these contacts, not only at the association meetings, but also through the microscopical societies, which at that time sponsored a great deal of microscopical research, I met the outstanding members of the day, from the Atlantic Coast as far as St. Louis and Chicago, and I want to express now my deep appreciation, and that of my associates, for the help which we received, encouragement which we had, and suggestions which were made, all of which enabled us to do better work, build better and newer things and build to higher standards. The association was of the friendliest kind and most helpful. It was not only my traveling about that enabled me to meet these scientists, but many of them made it a point when passing through Rochester to visit us. Many of the outstanding men came to Rochester, spent a day visiting our then small plant, and it was my privilege sometimes to house them for a night or perhaps longer in our modest home. The encouragement then received and the contacts made at that time provided the foundation of what we are doing to-day.

Of course, in addition to this there was intense work and many discouragements, but all the while constant encouragement and cooperation enabled us to carry on. I am glad to say, further, that there has been a continuation of that same spirit to help along in the work being done by this company to aid the scientists. There are many of those old friends that I could name, but time will not permit it. However, there is one that I see looking at me, although I haven't had a chance to greet him—my old friend, Simon Gage. There are many of those, and I want to express here for myself and for our company that deep feeling of gratitude which we have, because, after all, while we originate and while we are doing our research (we are endeavoring to be ahead of the requirements all the time), nevertheless, many of the suggestions come from the outside, from you people. Many who are not here have enabled us to progress because of the encouragement which we have had from such sources. As an example, this particular microscope that I am to present to Dr. Novy was designed at the suggestion of Dr. Lester Sharp and Dr. L. F. Randolph, of Cornell University.

I haven't much more to say. It is a pleasure to have you here after such a long time—'92, I believe, is the last time we had you here. Rochester has grown in that time. There are representatives at our tables from concerns who are also identified outstandingly with progress made in various directions, and they, as well as we, will welcome your coming here again just as early as you can arrange to come.

Now, Dr. Novy, it becomes my great pleasure to present you with the 250,000th microscope which we have made. I remember well when we reached the 5,000 mark, the 10,000 mark, the 25,000 and the 50,000. Those were all big events in our career. It gives me great pleasure, Dr. Novy, to turn this microscope over to you. You have been a man of great achievement; you have accomplished much with very simple apparatus. I present you with our latest product, and I trust it may lead you to still further discoveries and be helpful to further improve the health and happiness of mankind.

EDWARD BAUSCH

## SOME RESULTS OF MICROSCOPICAL RESEARCH WHICH HAVE BEEN SIGNIFICANT FOR HUMAN WELFARE

*Dr. Conklin, Mr. Bausch, Mr. Eisenhart, Ladies and Gentlemen:*

IT is needless for me to say that I have a very deep sense of appreciation of the honor of having been selected by the association for this award; and of my indebtedness to Mr. Bausch for his very kind expressions and for the very splendid microscope which we have here before us. I do hope to make use of it in such time as there may be left. You know, these oculars are made so that they can be adjusted to your eyes, but my eyes are still pretty fair and a little turn of a screw or so does the work.

I am rather in a difficult position as to what one should say here in regard to the achievements, that is, the practical results that have come to mankind from the use of the microscope. I presume that it is somewhat trite to say that without the microscope mankind to-day would be in the dark ages—that period which was defined once upon a time as being "Egyptian darkness." Just imagine, if you will, what would be the position or condition of mankind in so far as science is concerned if it were not for this instrument.

which has been perfected and developed from the very simple outfits of Galileo and Leeuwenhoek to this magnificent instrument here beside me. Without the microscope it is safe to say that we would have absolutely no knowledge of the cell structure of animals and plants; we would have no knowledge of fertilization and cell division; we would have no knowledge of fermentation or infectious diseases. There would be a lack of knowledge of cytology, of embryology, bacteriology and of protozoology; in short, the whole subject of microbiology would be non-existent—and I dare say, Mr. Bausch, that you would not have a very large audience here to-day if those who made use of the microscope or optical instruments in some form or another were thus excluded.

It took centuries, as a matter of fact, we will say two and a half centuries and more, before the microscope was actually brought into use for the benefit of mankind. It had been used in a general way to uncover this and that type of organism that was present in nature, but the great mysteries of fermentation and infectious diseases could not be touched until the right man and the right age and period arrived. That period in a way began to show itself on the horizon a hundred years ago when Schwann came out with his cellular theory, when the cause of scabies was rediscovered, when this and that organism of the larger size was recognized, but bacteria and disease were as yet not touched upon.

It was practically eighty years ago when the first step in the unveiling of the mystery of fermentation came with the entrance of Pasteur into that field. It is apparently a strange phenomenon not so much that a chemist should enter the field of fermentation, because that is largely chemical, but that a chemist should make use of the microscope in trying to solve this age-long mystery, for the chemist had never dreamed of using a microscope to aid him in his work. Pasteur, however, had the vision, which came to him from his previous studies of polarized light, that substances which rotated light were produced by living things, and since in fermentation there were products that rotated light it was but natural to look for a living cause. Therein we find the explanation of why a chemist made use of the microscope at that time; and, he was promptly rewarded by the detection of minute organisms. Others had seen bacteria, but they never connected them with any process in nature. It was reserved, therefore, for Pasteur to point out that these things which he collectively called yeasts, because he was not a botanist or a zoologist, were the causes of fermentation. But, as a chemist, he went further; he proceeded to cultivate these organisms, and he went still further inoculating batches of sterile material with his seedings and thus reproducing the phenomenon. He thus was able to establish an iron-clad demonstration of the relation of these organisms to this particular change. The same steps which he used in the study of fermentation eventually led to the uncovering of that mysterious phenomenon which had been known to man from the beginning of time, the diseases of man and animals. Twenty years passed before the first real disease was studied from the modern standpoint. But I might say in passing that the first fruit of Pasteur's work on fermentation was the application of the idea that ferment organisms caused similar changes in wounds; that they were responsible for suppuration in surgical operations, in accidents and the like. Pasteur's work stimulated Joseph Lister to apply means to destroy those organisms that might enter wounds, with the result that antiseptic surgery came into being, even before a single disease germ had been actually proven to be the cause of disease. As year followed year, the original crude methods of Lister gradually changed and evolved into the aseptic surgery of to-day. Every one, I am sure, must realize that without this modern method it would be absolutely impossible or at least it would be most unsafe to make the surgical operations which at present are everyday occurrences in every hospital in the world. Organisms in the past could destroy life if introduced into wounds or by incisions and operations. Then man did not know anything about the invisible enemy we had in the form of these organisms. But shortly after Lister came the real advance.

In 1876—a matter of sixty years ago—an obscure physician in an east Prussian small town, Robert Koch, with the use of a microscope of simple construction studied anthrax. Others had studied anthrax and they had seen the rod which Koch had seen, but they could not draw any valid conclusion as to its relation to the disease. But Koch, who, consciously or unconsciously, was actuated by the steps of Pasteur, proceeded to study it under the microscope. He was able to follow the growth, the multiplication, the formation of spores, the germination of spores, and so on. And then he applied those two cardinal subsidiary principles, that is to say, cultivation in the test-tube or in a container of some kind, and inoculation of animals, and when that trio of evidence was produced, then for the first time was unveiled the cause of this disease, primarily one of animals and incidentally of man.

That marked the beginning of an era. That was the beginning, we might say, of modern bacteriology. During the next two decades, utilizing the methods that were developed in the laboratories of Koch and of Pasteur, one disease after another was shorn of its secrecy. In rapid succession the microscope revealed this germ and that germ down the line. In that period of say two decades, which may be properly spoken of as the "heroic age in bacteriology," the causes of some twoscore diseases were revealed, and that search has been carried on ever since with the result of a continuous increase in our knowledge through the help of the microscope.

I might add also in this connection that when Koch was doing this work in '76 and '78 the Bausch and Lomb Company brought out its first microscope, and is thus coexistent with the era of bacteriology. A couple of years later, with the introduction of the oil immersion objective and the Abbe condenser, the microscope became fully equipped for the work that was ahead. I have indicated briefly that a very large number of organisms have been found to be the cause of disease. The microscope perhaps can be credited with something else. It is not enough to see a germ in the disease process. You do not know much about it, however, until it has been cultivated and its effect tested upon the animal. Incidental to this study came the discovery of how the organisms enter and how they leave the body, and out of this came some of the great practical benefits to man. By way of example we may first mention typhoid fever, which formerly was common, claiming in every large city thousands of subjects each year. In the past year there have been only about 1,400 deaths from typhoid fever throughout the length and breadth of the land. Formerly, Chicago or Pittsburgh or Philadelphia had almost as many cases in a year as the whole United States has to-day. But since that time the way in which infection occurred became recognized and hence means could be taken to prevent the disease.

Not so many years ago—I remember it and I am sure Mr. Bausch remembers it also—we had cholera in this country. Its last appearance was in the 70's. Previous to that time cholera made its epidemic appearance from one end of the world to the other. Man was absolutely powerless to stop it, or seemed to be powerless. But, when Koch discovered the germ of cholera, studied it in detail with the help of the microscope and found the disease to be primarily water-borne, it became a rather simple matter to stop the further invasion of that organism. Its home is India and it followed the trade routes. Since then, in spite of a vastly greater commerce, cholera no longer travels from country to country as it once did. Here again the microscope has been responsible for the success in overcoming that scourge.

We might illustrate that by another example: In '82 Koch discovered the tubercle bacillus. One of the most deadly diseases of mankind was tuberculosis. It still is, but with the knowledge that has been acquired came the successive steps which led to the improvement of mankind, and while it is not likely that tuberculosis is going to be wiped out in any short time, there certainly has been a phenomenal decrease in incidence and mortality. The chances of recovery are vastly better to-day than thirty or forty years ago. I might go down the line in this way, showing how other disease organisms have been discovered and isolated and what precautions have been taken to prevent their spread, thus ensuring an effective control.

But there is one thing that I want to especially emphasize, and that is that the microscope aided directly in the discovery of what we call "carriers." I won't speak of the human carrier or the animal carrier, but of the insect carriers. We listened this morning to a beautiful address by Dr. Simon Gage on the life of Theobald Smith, in which he brought out the fact that Smith was the first to show that the carrier of Texas fever was an insect (a tick may not be, strictly speaking, zoologically, an insect, but the term answers the purpose. I fear that if we were to use the scientific name, some people would not know what we were talking about, so we will call the tick an insect). This was the first demonstration that an insect or tick was responsible for a disease. Dr. Gage remarked that at the time of the discovery it was commonly spoken of as a romance. I could supplement that by saying that in Europe it was looked upon as a case of American humbug. That was the first discovery that an insect could transmit disease, and yet in a few years after Smith's fundamental work came the demonstration that the mosquito was responsible for the spread of malaria. Ronald Ross, working in India, and later Grassi in Italy and scores of others, followed the road thus opened and solved the mystery of malaria. Here was an insect which fed upon the blood of a sick individual, the causative protozoan multiplied in the body of the insect, underwent development, passed into the salivary glands of the mosquito and then was injected into a new subject. All those steps the microscope had to unveil. Without it nothing could have been done.

To-day, in Italy, the Campagna is being made habitable for man, whereas for two thousand years it had been a proscribed place, the people not knowing exactly why death lurked in those regions. It is possible to control the scourge of malaria in many places when conditions in general are fair.

I might add that in the case of yellow fever we have again a mosquito carrier. We may not see the germ with the microscope, but we know that a particular mosquito is responsible for the spread of that disease. The result of this knowledge is that to-day yellow fever is practically non-existent. It does not cause the epidemics that it did in former years. There were times in the history of our country when yellow fever came as far north as Philadelphia, St. Louis and even up to Illinois, then retired for a season or for some years, only to recur again. That is now impossible. I am confident in making this assertion, because it is inconceivable that anybody, official or otherwise, would be so negligent as to allow this invasion by disregarding the fact that yellow fever is carried from individual to individual by a certain mosquito. Yellow fever is now an unknown disease in this country. If you want to study yellow fever, you will have to go to Western Africa or to one or two places in South America.

When the United States went into Panama to dig the canal, it took hold of a job which France had had to give up because of her inability to control malaria and yellow fever. In the interval—the few years that had passed—came the new knowledge of these diseases, and our men went down to Panama and encountered relatively little malaria and no yellow fever. Actually not a single case of yellow fever has originated on the Isthmus of Panama since 1904, the first year of the work on the canal. This great service to humanity was the direct result of microscopic research, supplemented by experimental methods.

In speaking of carriers, I want to refer to one or two additional examples. Thirty-five years ago, an English scientist, Dutton, in west Africa, in conversation with a local doctor was told that the latter had found peculiar worm-like bodies in the blood of a river captain. The scientist promptly got hold of the captain, examined his blood and discovered a trypanosome, a flagellate protozoan. For a time that organism was supposed to be localized on the west coast of Africa, but within a year this same organism was found in Central Africa in cases of sleeping sickness. This was the African sleeping sickness, not the one commonly known to us. The cause of sleeping sickness was thus revealed and shortly thereafter came the further observation that the carrier of that disease was an insect, the tsetse fly. The microscope made it possible to follow that germ through the body of the fly, and the mystery of that disease was cleared up.

I will refer to another instance of this kind, and that concerns an insect which we ordinarily do not name in polite society, the body louse, which is capable of transmitting two diseases. One is relapsing fever (due to a spirochete) which at one time extended throughout Europe and at times was present even in the eastern United States. The other disease is typhus fever, where an exceedingly minute rod-shaped organism is present. Recognizing that this insect was the carrier of this disease, during the world war, special efforts were made on the western front against the importation of the disease by troops from Africa, and from the Orient. As a result not a single case of typhus fever developed on the western front, whereas on the eastern front, the disease became wide-spread. It has been estimated that thirty millions of cases of typhus fever occurred in Russia during and after the war. We can not conceive of those figures, but certainly western Europe and the United States have benefited by the use of the microscope in the study of this disease.

Time does not permit my taking up any more examples of this kind. In fact, I believe I have already gone beyond the limit set, but I want to leave with you this conclusion—that the microscope has enabled man to gain the mastery over his ancient enemies, the enemies that have afflicted the race from the beginning of time. If it accomplished nothing else, it would be a wonderful result, but it has done more. Optical studies in general have enlarged the boundaries of science in all directions.

And now, in closing, I wish to thank you again, my dear friends, Mr. Bausch, Mr. Eisenhart, ladies and gentlemen.

FREDERICK G. NOVY
UNIVERSITY OF MICHIGAN

# OBITUARY

## HENRY SEWALL

HENRY SEWALL, born at Winchester, Virginia, on May 25, 1855, physician and pioneer physiologist of America, passed on suddenly from a heart attack, in a measure as he would have chosen had it been in his power, on the morning of July 8, 1936, at Denver, as he was preparing for his breakfast with his wife, Isabel Josephine Vickers Sewall, who had been his close companion since their marriage in 1887.

Dr. Sewall at heart was always first a physiologist. He cherished the memories of his training under Professor Henry Newell Martin while teaching physiology in the newly founded Johns Hopkins University at Baltimore and following his graduation from Wesleyan University in 1876. He also cherished his associations with Carl Ludwig and Michael Foster during his European training. In 1881, he founded the new department of physiology at the University of Michigan, serving as professor and head under Dean Victor C. Vaughan, who later noted that "as a physiologist Sewall has had but few equals." At Ann Arbor, Sewall demonstrated that pigeons could be immunized to the venom of rattlesnakes,[1] an obser-

[1] Henry Sewall, *Jour. Physiol.*, 8: 203, 1887.