NOYES (H.D.)

PATHFINDING IN MEDICINE

BEING THE

ANNIVERSARY ADDRESS DELIVERED BEFORE THE NEW YORK ACADEMY OF MEDICINE, NOVEMBER 19th, 1885

BY

HENRY D. NOYES, M.D.

(*EXTRACTED FROM "THE MEDICAL RECORD."*)

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In assuming the position which I occupy on this occasion, I comply with the request of our President, who invited me to take it in place of our esteemed and distinguished colleague, Professor Janeway, to whom it had been assigned, but who has been prevented by severe illness from fulfilling the office. On behalf of the Academy, and also in expression of my own warm feeling, I beg to utter the most sincere congratulations to him and to ourselves that his health and activity have been restored, and that we may still admire and draw upon his shining abilities and his stores of knowledge, his untiring industry and his willing helpfulness.

During the year past, it has been permitted me to see many medical men and medical institutions in various parts of Europe. One gets a new impulse from such an opportunity, and one may also be lifted to a wider horizon in the field of medicine. The privilege of attending the great International Congress at Copenhagen, and also the smaller but no less interesting annual Ophthalmological Congress at Heidelberg, could scarcely fail to ennoble one's view of the science and practice of medicine. The impression which, to me, has come uppermost, is that the line of advance must hereafter be

through acute, exacting, and deep research. How little did the centuries contribute to correct knowledge of disease so long as only our unaided senses were employed! What an epoch arose when physical diagnosis began to be cultivated! How steady has been the advance, and how rich the treasure of facts, since means of physical study and examination have become more complete and numerous! We supplement the eye by the microscope, the ophthalmoscope, the laryngoscope, and the spectroscope; we augment the hearing by the stethoscope; we read the pulse by the tracing of the sphygmograph; we test muscularity by the dynamometer; we take the weight on the scales; we take the temperature by the thermometer and record it on charts; and we determine the quality of nervous and muscular reactions by the galvanic current.

Physiology has for many decades been a science founded on experiment; pathology has been rapidly pressing forward in the same direction. To read the account of how certain conclusions have been arrived at in the laboratory, by ingenious devices, and by skilful manipulations, is as fascinating as a tale of adventure. A modern laboratory for medical research is equipped with apparatus and means of experiment to a degree which creates a feeling akin to the awe inspired by a great astronomical observatory. Chemistry, mathematics, physics, applied optics, the deft hand, the keen eye, the quick ear, the delicate touch, all are taxed to solve these subtle problems. In such a place the ordinary medical practitioner may think that he sees nothing which has any special importance to him or to his daily calling.

What relation exists between laboratory experiments and the routine of measles and childbed and pneumonia, *et id genus omne*, is perhaps unintelligible to some solid practitioners; but many a shrewd physician will admit that he is sometimes greatly puzzled by the cases which he meets, and he would like to better understand the true nature of the morbid process whose phenomena he is watching. He has learned to rely on certain drugs and therapeutic methods, he would gladly know the true

affinities of these agents, and how they accomplish their work. If you tell him that a dose of iodide of potassium produces certain results according to the laws of molecular physics, he knows that he has heard that phrase; but to trace these laws demands the laboratory with an extensive equipment, and a man to work in it who has large attainments and commanding talent. The value of good clinical observation is not to be depreciated, it must always take high rank in practical medicine; but it cannot lead far in the path of scientific medicine. We may at this day almost say that clinical observation has wrought the consummation of its work. This may not be true in the department of therapeutics, as witness cocaine, jequirity, nitro-glycerin, convallaria, and so forth. But in knowledge of the essential nature of disease, of its causation, of its prevention, and of how medicines exert their effect, and, in some measure, by what rules they are to be chosen—for all this clinical observation must be supplemented by the laboratory. I must guard myself against being misunderstood. It must be noted that I do not speak of the instruction of students, or of young practitioners. Neither do I disparage the advance in knowledge which every good practitioner gets from long experience. Much valuable knowledge is locked up in the mental storehouses of shrewd practitioners, which dies with them. It sometimes happens that important discoveries are made several times, by different individuals, before they get into the current of common knowledge. A great clinical teacher contributes not a little to the sum of truth, from his own observations. The lectures of Trousseau and of Nélaton were a delight and a treasure to their listeners. But if I were to call upon our own eminent clinicians to tell us the sources whence they draw their deepest draughts of wisdom, we should hear them tell how they have sought explanation of morbid phenomena, their sequence, their mutual dependence, and their origin, in studies which have been made by the microscope, by analysis of the blood, of the urine, and of the tissues; they have called in the subtle aid of organic chemistry, they have resorted to the breed-

ing oven, and to cultures upon gelatin. In other words, they have been working in their private laboratories, and they pride themselves on their ability to supplement their own fine senses and perceptions by these additional methods of research.

The activity which at the present time pervades our profession in zealous pursuits of this description, displays itself in all our medical journals. Our American physicians may be justly proud of their forwardness and energy in such efforts. The wonder is, that they do so much with the meagre facilities which are at their command. I pay willing tribute to men who sacrifice ease and health to pursuits of pure science; who must snatch time from bread-getting, who give public instruction, whose is the heroism of steadfastness and unshrinking labor, that they may contribute to the advance of scientific medicine. You will acquit me of any thought of belittling the achievements and aspirations of my brethren, if I venture to bring before you the need there is among us for better and more perfect methods of pursuing scientific medical research.

The conviction of the inadequacy of simple individual efforts to carry us much farther forward in medical attainment has led to the establishment of *concerted* efforts in the study of disease. It is proposed to gather together multiplied observations in the same diseases, and to endeavor to elicit from the mass more accurate knowledge of their features and the effect of remedies upon them. Doubtless something, perhaps much, will be gained by collective investigations; but as the sum is merely the aggregate of all its parts, it is evident that by this method we shall only gain a better quality of simple clinical knowledge. We shall learn important facts in etiology, in the distribution and duration of disease, in climatic influence, etc. I repeat that I do not depreciate the indispensable need of making this clinical knowledge as perfect as possible; but can we continue to rest satisfied with it? Is it not imperative that we search deeper into the phenomena of living tissues and try to understand what really goes on within them?

The affirmative answer, which every one is ready to give,

may be illustrated by reference to chemistry, which analyzes the intimate character of every known substance, and creates new combinations of them, because it is not content to know only their outward qualities, their form, color, weight, consistence, etc. Chemistry is to a great degree the study of atoms and their behavior. Physics now busies itself with the affinities and repulsions of molecules, and finds in the infinitely small an ample field for its best powers.

In medicine, the aim has for a long time been in this direction. The great implement of search has been the microscope. And if the title of my paper may seem singular, perhaps it will be thought less grotesque if I suggest that the effort to penetrate the mysteries of the human organism is not a little like the attempts of explorers to make their way through a tropical jungle. They may hew ever so sturdily with axe and saw, but the mass of vine and twiners, of bush and tree, of grass and leaf, shuts out the light, hampers their labor, and keeps them in deep ignorance of what lies beyond.

When the microscope began its work, how discouraging was the vastness and complexity of the discoveries which it brought to light! How many years has it been diligently used, and how uncertain are we still about many of its revelations! But when a happy conjunction of a man and the proper environment takes place, we reach better results. Let me give an illustration.

Some thirty years ago, Virchow began his studies and lectures upon cellular pathology. The enthusiasm which they awakened spread over the whole medical world. The wonderful attention to detail, and the broad philosophy which signalized his observations, were alike remarkable. His class-room was packed with students from every country, who thought it no hardship to struggle for a seat at eight o'clock in the morning. A man of medium height and slender figure, and with quiet face, you felt the earnestness which burned within him by the tumultuousness and complexity of his sentences, as thoughts crowded thick upon him in the struggle for utterance.

With his blackboard behind him and specimens of pathology before him, and microscopes coursing upon railway tracks around the tables which filled the room, he was the embodiment of the teacher and the discoverer. Admired as a teacher, his highest honor is a discoverer. It was my privilege to see him once more at Copenhagen, and again later, when presiding over a meeting of the Medical Society in Berlin, and to note that much of the wonted energy remains. A nobly gifted man has been placed for more than thirty years in a position where he could command all needful appliances for his scientific work, and what bounteous results have followed! If some of his theories have had to be modified, much that he has done remains—for instance, regarding embolism, thrombosis, and metastasis, we shall be always in his debt. He taught us to regard the cell as the constructive element and essential factor in both normal and abnormal processes of nutrition. The life and importance of the cell, in both health and disease, it has been his work to discover and to teach. The point of view from which he has classified tumors is founded on this basis, and remains the accepted method. The light which he cast upon the nature of inflammations has not yet been obscured, and while other phenomena appear, the multiplication of cells and nuclei, and the formation of connective tissue in the process of inflammation, will always call to mind the labors of Virchow. The work which he did was within the pathological laboratory of the University of Berlin.

To Professor Cohnheim, and also to one of Virchow's pupils, Professor Recklinghausen, we chiefly owe our knowledge of the phenomena of diapedesis as a part of the inflammatory activity. How incredible it seems that masses of living matter can make their way through the walls of blood-vessels which do not rupture and which have no visible apertures! Professor Recklinghausen is now the director of a nobly furnished pathological institute in Strasburg, whose great museum is almost wholly his own creation.

While Virchow fixed attention upon the forms and activities

of cells, their multiplication and degradation, and how they build up tissues both healthy and morbid, we have come now upon a new era in the study of their life and quality. Many observers have striven to unravel the mystery of the cell itself —to bring to light the nature of its contents. The declarations on this subject have been received with a degree of distrust; but now we seem to be approaching a clearer exposition of the matter. The work of the medical pathfinder has taught us that definite and remarkable formations and structure can be seen in cell nuclei when they undergo multiplication. Conspicuously is this set forth by Flemming in his book on "Cell Substance" (Leipsic, 1882); that he has made these discoveries is due to the use of immersion objectives aided by the Abbé illuminator and other similar devices. He speaks with much reserve about tracing organized form in the material of the cell. Although he asserts that in many cases a faint fibrillation can be discerned, he is far less positive about this than some observers. The interesting part of his book is that which describes the multiplication of the nuclei. In a few cases, he says, the division of cell and nucleus is *direct*, by which he means that no visible alteration in their interior structure can be seen while the division occurs. In leucocytes and in amœboid cells is this the fact, and in some other cells of both animals and plants; but in by far the larger number of cells, the division occurs in what he calls the *indirect* way. By this he means that during this act the nucleus elongates, and at each of its extremities appears a complex figure made of filaments, whose arrangement has a great variety of forms. Sometimes it is a mere mesh, sometimes there is a resemblance to a waving fringe of fibres, or they are coiled like a bunch of angle-worms. Innumerable varieties of arrangement appear, and with a certain symmetry of disposition, at the two extremities of the elongated nucleus; or the filaments may cluster around the expanded middle of the nucleus. The plates which he gives in illustration exhibit a wonderful variety. It is not for me to do more than to refer to this subject, I do not venture

even to attempt to give a clear account of it. My purpose is served in calling your attention to the opening of another path into the unknown, and that we have come so much nearer to acquaintance with the processes which transpire in the cell itself. To this metamorphosis Flemming gives the name of karyokinesis, and to certain modifications of it he attaches the name of metakinesis. With new phenomena he has been obliged to invent a new nomenclature. He is professor of anatomy in the University of Kiel, and most of these studies have been made within seven or eight years, in his laboratory.

To another matter with which, both literally and metaphorically, the air is full, I must also make allusion. The existence of micro-organisms in countless numbers is no new fact. What influence they exert over living tissues has only lately become the subject of earnest attention. So long as they were not known to have any practical bearing upon human welfare, they interested almost nobody. When, however, it was shown that putrefaction of meat is due to the agency of the *bacterium termo*, and the decomposition of albumen to *bacillus subtilis;* when anthrax in cattle and sheep was found to depend on the *bacillus anthracis*, and that in human beings it caused malignant pustule; when suppuration of wounds was found to be associated with the development of micrococci, and when Pasteur announced that by a process of inoculation, cattle could be protected against anthrax, and Lister declared that by carbolic spray and other well-known precautions the suppuration of wounds could be prevented, all the world lent its ear and investigation at once began. To what the germ-theory has developed, it is not within the scope of my remarks to narrate. It is the wonder of the age; nothing has ever arisen in medicine which has had such far-reaching results. We stand expectant, ready not to be surprised at any new announcement of strange and potential discoveries in bacteriology. Whence did all this commotion come? Chiefly from the work-room of an acute and thoughtful man, an experimenter of unrivalled

ability, who noted the cloudiness which came over his infusions of meat, and studied its meaning under the microscope, and by chemical methods and processes of culture. Nothing could have been more purely scientific than the labors of Pasteur during the years between 1857 and 1863. Happily, his investigations led to results of the utmost value to mankind, and so evident was the connection between study and result, that the world rings with the praises of the man of science.

At the close of the first public dinner of the Congress at Copenhagen, the guests were strolling in the open court of the hotel. Among other dignitaries the Turkish ambassador, in full costume, was present. He sought an introduction to Pasteur, and on being presented, saluted him by kissing his hand, an act of homage which he emphasized by words expressing his profound respect. The world owes a debt to Pasteur like that which it owes to Jenner, and to the discoverers of anæsthesia. For men like Virchow, it has scant praise, because it does not understand their work nor their merit. To both alike the reward of honor is due, because each has wrought to the full measure in his own way.

Because labors in bacteriology promise to be fruitful in practical results, the workers in it are innumerable, and we are accumulating a wondrous store of facts. How long is now the list of diseases in which germs make their appearance!—in pneumonia, in endocarditis, in erysipelas, in pyæmia, in tuberculosis, and so on, and so on. One of the most striking illustrations is in the gonococcus of gonorrhœa, whose presence in and around them, gives to the pus cells their virulent properties, and, when transferred to the eye, works such lamentable mischief. Without their existence, the inoculation of pus in the healthy eye is harmless; pus bearing the gonococci excites the most intense inflammation. Similarly suppurative action in the cornea is often caused by infection by cocci. The proof of causation may be found in the fact that the most effective cure now practised for such suppurations is to sterilize

them by the actual cautery. The value of chlorine and of corrosive sublimate was known empirically long ago, but the true reason for their efficacy was not known, until the germs were discovered. Now the hot platinum kills at once the organisms which other agents can only less perfectly destroy.

Rosenbach (Wiesbaden, 1884), page 63, says that he knows six distinct microbes which are capable of exciting suppuration in man. Some of them grow without oxygen, others require it. Their activity may be by the production of a poison, such as sepsin or ptomaine, or a putrefactive alkaloid, which is absorbed. The secretions of the lachrymal sac, when it is inflamed, exhibit, according to Sattler, at least three different microbes, which possess pernicious properties to a greater or less degree. Founded upon exact and laborious investigations of germs and their antidotes, is the whole practice of asepsis and antisepsis. As to its importance or its value, it is not necessary for me to speak. But long unfamiliarity with general surgery, and the vivid recollection of the sacredness which was held to belong to the large joints at the time when I was passing my pupilage in the old New York Hospital, under Buck and Watson and Cheeseman and Parker, qualified me to regard with amazement, both the operation which Sir Joseph Lister did for a fracture of the patella, and the lack of special interest on the part of the spectators. Freely he laid open the joint, and with much force dragged down the comminuted upper fragment by a stout hook, and wired the pieces together. Meanwhile the carbolic spray was in active operation.

Again, in Heidelberg, I was witness to a still bolder act of surgery, which I may perhaps be allowed to partially describe. Professor Czerny excised the pyloric extremity of the stomach for cancer. The piece removed was not less than one-third of the organ. It measured twelve and one-half centimetres upon the greater curvature, and nine centimetres upon the upper or lesser curvature. The rigid attention to detail in this operation was most noteworthy. The temperature of the theatre

was above 80° F.; for two hours previous to the operation the air was charged with carbolic spray, and the apparatus was kept at work during all the proceeding. The assistants and nurses removed their coats and wore long white gowns, many bared their arms to the shoulders, all washed their hands and arms vigorously with soap and brushes, and gave special heed to their nails in the scouring process. Two nurses took charge of the sponges; large porcelain trays, filled with solutions of carbolic acid, held the instruments. Alongside of the operator were two bowls of a weak carbolic solution, in which to rinse his bloody hands and the instruments, and at short intervals this water was changed. Before the cut upon the linea alba was made, the skin was shaved, soaped, scrubbed, and carbolized, and clothes wrung out of a carbolic solution laid close to the wound, and as they became soiled, fresh layers were put over them. The half-dozen spectators were not allowed to approach within ten feet of the patient, because they were not, in the surgical sense, clean. I need not refer to the steps of the operation. It was elaborate and difficult, especially in controlling the blood-vessels and in putting in the sutures to unite the pylorus to the cut end of the stomach. Two hours were consumed. It was the sixth case in which Professor Czerny had operated. He wrote to me, two months later, that the man had made a perfect recovery, and that his temperature had not risen above 100° F. No greater triumph of antiseptic surgery, it seems to me, can be adduced.

Let me briefly refer to what experimental physiology has lately done in acquainting us better with the functions of the several parts of the brain. In this field we can claim some good workers in our own country and in our own academy. But the most painstaking labor and skill, aided by suitable conveniences, have been needed to achieve what has been done. No physician counts these endeavors superfluous—we all wait for further results. I call to mind a room, not less than fifty feet long, the laboratory of the hospital for the insane, in the outskirts of Munich, where Professor Gudden, with three assist-

ants, was carrying on his studies in brain structure, making sections in thin slices of the entire organ under fluid. He was also pushing through the press a book giving the results of his own experiments, and he showed me some of the specimens from animals which he had utilized. A well-appointed establishment and a man suited to the place were there combined. What he did a few years ago, in settling the question of the partial decussation of the fibres of the optic nerves, will guarantee the thoroughness of his work.

If he be called one of the pathfinders in medicine, you will admit that the *iter a tertio ad quartum ventriculum* is a road not too large for comfortable travelling, and that some difficulties hang about the locality to which it leads.

Let me now call to your notice a man of great ability, who has done valuable work in medicine, but who, by ungenial influences around him, was not permitted to labor in his profession as he might have done, and whose talents have therefore been little appreciated among medical men. Dr. Thomas Young practised in London during the early part of the present century, and was a physician of Middlesex Hospital. In his youth he was precocious, and showed his scientific bent by constructing a microscope from a written description; to do it he learned the principles of optics, and the use of a lathe. At the age of fourteen, he had some proficiency in Greek, Latin, French, Italian, Hebrew, Persian, and Arabic. At nineteen he began his medical studies, and while pursuing them he presented to the Royal Society a paper entitled "Observations on Vision;" he was next year elected to membership in the society. After taking his degree in medicine he went to Göttingen, in Germany, to continue his studies. The breadth of his aim is quaintly and truly stated in a letter to his mother in which he says, "I by no means wish to confine the cultivation of my mind to what is absolutely necessary for a trading physician." In 1797 he began practice in London. In 1801 he published in the "Philosophical Transactions" the results of further studies upon the eye, in which he anticipated what was

more fully set forth fifty years later. He described the existence of astigmatism in his own eye, and proved by immersing it in water that the erroneous curve was not in the cornea but in the crystalline. He also calculated the difference between the foci in the vertical and horizontal meridians, and indicated the power of the cylindric glass which would correct it. In 1802 he was made Professor of Natural and Experimental Philosophy at the Royal Institution. Two years later, when he married, he gave up his professorship by the advice of his friends, who considered it likely to interfere with his success in his profession. The comment of Arago upon this act was, that "in England a physician must not addict himself to any kind of scientific or literary research which seems foreign to the art of healing, if he would not lose the confidence of the public." He had, however, written his great paper on the "Interference of Light;" and his after-career was brilliant with researches in physical science and literature. He it was who fully deciphered the tri lingual inscription on the famous Rosetta stone in the British Museum, and laid the foundation of the science of Egyptian hieroglyphics.

I call this famous man to your memory, not only that one who was little honored may be somewhat better known, but chiefly to bring out the fact that to succeed in medical practice his noble powers must be warped from their natural bent, and his eager mind was driven to investigations in physics, in tables of life insurance, in literary and linguistic studies, because scientific medicine was far inferior to other branches of science, and the prevailing spirit was hostile to efforts in this direction if a physician would gain popular favor. Dr. Young never was popular as a physician, but he happily inherited from an uncle a sufficient fortune. In optics, both physical and physiological, he did achieve great things, but what might he not have done in other fields of medicine, had his environment been more auspicious.

In his time nothing was esteemed in medicine which was

not practical, and very narrow was the definition of the word. In this country and in our time we make the same demand with a somewhat broader meaning to the word. We admit that the strictly scientific man is a respectable but rather unintelligible person. How most men would stare to hear Agassiz say that "he had no time for making money."

A man lately passed away who was rector of Lincoln College at Oxford, Dr. Mark Pattison. An English reviewer says of him: "A life devoted to learning in a country given over to practice, and in a university consecrated to cram, was original to the verge of eccentricity." "He believed in knowledge as a physician believes in ozone." "His paramount love and faith in knowledge dictated and governed all his mental affinities and sympathies." "He was a true liberal, because he knew what ruin a despotic government could bring upon all independent thought and study. He was no democrat, because he was aware how democracy, in its present stage at least, from no ill-will, perhaps, but out of sheer ignorance, is apt to scorn and destroy a science of which it cannot see the use and meaning."

Like virtue, like beauty, like art, knowledge has no need of apology or of justification. Up to a certain point society will admit this. Our age is more liberal in this regard than its predecessors. The meetings of scientific bodies are reported in the newspapers, and the discovery of comets is chronicled, and Tyndall's lectures are thronged. But do we in medicine hold the purely scientific studies in sufficient esteem? Medicine is, indeed, chiefly an art, but what would the art be were there no science? As practitioners we, to some degree, separate into the cultivation of specialties. If a new book has more of recent knowledge than a reviewer thinks is easy to take in one meal, he makes the sapient remark that it is not meant for the general practitioner, but for the specialist. Why should not every medical man demand the last results of science in the books which he reads, and who shall assume to say, like the physician at the table of Sancho Panza, that this or that dish is

too heavy or too dainty for his digestion? The thing which is to-day the property of the few will next year be common to all. What men call abstract or transcendental science will not long remain in the higher regions of study; soon it asserts its affinities with the already known, and in some way touches the ordinary needs of life.

Let me adduce an illustration in the life of one who recently met a heroic death. Edward Henry Palmer was born in Cambridge in 1840. He was not remarkable for talent in his youth, but he showed a curiosity respecting the life and manners of gypsies, and learned their language by mingling with them. He made a dictionary of Romany for his own convenience, and he learned it with all the vagabond slang. He could always pass as one of the fraternity, and delighted to frequent their camps. After leaving school he became a clerk with a London merchant, and while employed about the docks he picked up Italian, both in its purity and in several dialects, and also French, and bits of other languages from sailors. Chance threw him in the way of a teacher of Arabic, who took kindly to him, and he essayed to learn the language. This and the growing spirit of acquisition of knowledge moved him to give up business and enter Cambridge University. With comparative ease he gained a fair knowledge of Greek and Latin, but his craving desire was for oriental languages. To these he devoted himself intensely, and especially by intercourse with natives. He cared far less for grammars and dictionaries than for the spoken tongue; but his appetite embraced every modern language, and his facility in them was marvellous. He had a quaint humor, and he would don the dress of a dealer in oriental wares, and with the utmost gravity imitate the bearing and gestures, the protestations and unblushing falsehoods, of the most practised merchant in the Turkish bazaars. He travelled in the East, and mastered Turkish, Arabic, Persian, and Hindoostanee—not as scholars know them, but as the natives speak the languages—and he knew them in their dialects and variations. He was made Professor of Sanskrit and Ori-

ental languages at Cambridge. Once a burglary was committed in the town, and a scrap of paper was found in the room bearing strange characters. The police brought it to him. He told them it was Yeddish, which is Polish Hebrew, and indicated that the thieves were to "crack" another house the next night. They were waylaid and caught. Such was his omnivorous appetite for languages of all kinds. Such a man might never have been known beyond a small circle, and his gifts might not have conferred any great benefit upon mankind, or upon his country, save that he was a bright ornament of its cultured classes. But England found herself at war with Arabi, in Egypt, in 1882. The safety of the Suez Canal made the pacification of the desert tribes of the highest importance. Whom to send among them was a difficult question to settle. What man could go knowing their languages, able to command their confidence, possessed of courage and address and discretion? That man was Palmer. The Arabs knew him of old; he had lived among them—they call him Sheikh Abdallah. He won their friendship to England, he secured the safety of the canal. As he was leaving their country, his little party were cruelly murdered by robbers bent on plunder, and, at the age of forty-two, a brilliant life was quenched. Would one be likely to think that such a scholar could ever become anything more than a mere wonder and a man apart from his fellows? Such achievements as his are in themselves a triumph, the manifestations of a noble mind, something for pride and gratulation. But when these high talents and attainments found fit scope for play in the enterprise on which he entered, knowing well its peril, we see how indispensable they were to its success, and in the crowning sacrifice of patriotism, we bow in homage to the lofty genius of the scholar.

Let me come back to the sphere of medicine, and I will bring before you a man, still living, who has nobly fulfilled the task of combing the highest scientific studies with results which have been of far-reaching utility. In 1850, Professor Helm-

holz occupied the chair of physiology in Heidelberg. He was a mathematician of rare attainments, he had a special aptitude for physics, he was a close observer and good experimenter. Like Thomas Young, he was attracted to the problems of sight. A question had been raised why the pupil of the eye is always black, save under some exceptional conditions. To this subject he addressed himself.

He not only developed the true explanation of the mysterious fact, but he also contrived the mirror which makes it possible to see the interior of the eye, and he evolved in masterly completeness the whole theory of the ophthalmoscope. Since 1851, improvements in the mechanism of the instrument have been made, but it can scarcely be said that its mathematical theory has been improved. What a boon that has been to the world, directly and indirectly, it is impossible to compute. Pursuing his studies, Professor Helmholz attacked the perplexing question of how the focusing of the eye is effected. To discover it a way must be found to measure the curves of its several refracting surfaces, viz., of the anterior surface of the cornea and of the two surfaces of the crystalline in the living subject. These elements and the distance of these surfaces from each other, and their exact position, must be determined to the fourth decimal. Taking a hint from astronomy, he contrived an instrument which permitted the needed exactness despite the involuntary movements of the most steadfast eye. His ophthalmometer was afterward improved in certain details—his measurements were slightly modified by his pupils working under his directions; but he settled these questions. He pursued the subject of physiological optics until he made a treatise which is the most perfect work on this topic in existence. It is profound and lucid; it is condensed, but it is complete; it demands close study and a mathematical training, but it satisfies the pursuit of the reader. In the ear, and in developing the theory of sound and the mathematics of tones, Helmholz did work scarcely less brilliant. To-day he holds the chair of physics in the University of Berlin, in a labora-

tory of magnificent equipment. He long since left physiology for his more congenial subject. That he achieved such shining success in physiology was made possible by his exceptional talents, coupled with his mastery of mathematics and physics. To him the world owes the great strides of the present day in dealing with diseases of the eye, because he gave us the ophthalmoscope.

With this instrument in his hands Graefe began his masterly studies in clinical ophthalmology. The world has never known so brilliant a clinician, and no physician of this century lives again in so many devoted disciples. Under the same stimulus Donders turned from the general subject of physiology to the morbid conditions of refraction and accommodation of the eye, and supplemented the labors of Helmholz by systematizing and elucidating these errors of vision. The correct and scientific employment of spectacles may almost be said to have had its real birth in the labors of Donders. His laboratory, at Utrecht, is, as you might expect, replete with all that can contribute to his department.

To touch upon the labors of those who, by the influence of these men, have enriched the world with knowledge and practical achievements, would occupy the entire evening. I may not even mention any names. I may, however, show how the work of Helmholz in measuring, by an exact yet complicated instrument, the curves of the media of the eye, has borne fruit in the production by Javal, of Paris, of an ophthalmometer of more simple construction which becomes an instrument of daily practical utility. It measures the radius of the cornea with the least possible trouble, and reveals with ample exactness the degree of astigmatism which it may possess. By it, what is often a tedious and annoying examination, is done in two minutes, and the whole is an objective investigation, which does not turn upon the intelligence or visual ability of the patient.

This instrument which is before you, and which was invented some five years ago, is an outgrowth of the studies of Helmholz in 1850.

Why do I present to you facts and illustrations which are more or less familiar to you all? You cannot fail to note that they have been drawn from sources foreign to our own country. You know well how our ambitious young physicians betake themselves to European capitals, and often to obscure small cities, for the knowledge which they crave. I am far from saying or feeling that American physicians are not among the best and most skilful. In surgery, especially, and I may instance gynecological surgery, we have commanded the admiration of the world. In these achievements we have excelled mainly by the exceptional talent of certain individuals. Their successes were often a tale of perseverance under crushing obstacles and hindrances, as witness the early labors of Sims. But the advance of scientific study demands proper facilities in addition to the possession of talents. Even men of only average ability can accomplish useful work when they are placed in positions which facilitate it. I do not forget that the discovery of vaccination, of anæsthetics, of the ligation of arteries, was the work of individuals who were not surrounded by elaborate apparatus. But such men as Pasteur and Koch and Helmholz can do their best only when they are placed amid fitting surroundings. Because he did not have them Thomas Young was kept below the height of achievement which he might have reached in medicine. What are the surroundings fitted to bring out the powers of men of this type? They must have leisure and encouragement to work. They must have suitable pecuniary support. They must have apparatus, equipment, and laboratories adapted to the nature of their investigations.

In medicine there are two lines of study and effort. The one deals directly with the sick person, and may be called the bedside study, or, if you please, the clinical study of disease. It is founded largely upon empirical experience. It is intelligent and rational. It strives to connect symptoms with lesions, and with the use of remedies. It is the practice of medicine which will be wise and sagacious according to how much a physician knows, and according to his consciousness of his ig-

norance. The second line is that which studies the secretions and tissues by the microscope and by chemical methods; which attempts to study the processes of disease as they may be imitated in the lower animals; which patiently inspects the lifeless body, where alas! only the results, and too often not the sequence, of morbid action are to be found. It attempts to give an accurate account of how remedies produce their effect, and sometimes the laboratory, as in the case of chloral, constructs a new remedy and forecasts what its application must be. The second may, perhaps, be called the philosophical study of disease. Between these two lines there is a wide gulf. How to bring them into closer connection is the problem. My plea to-night is on behalf of the laboratory. That we may have among us the same sense of its need, and the same provision which exists in Europe. Germany has taken the lead; France, Holland, Russia, Sweden, Denmark, Switzerland, and Italy are thus equipped. They do it in virtue of their centralized forms of government and education.

In republican America the case is different. We must act through the general sentiment of the community, and it is our part to awaken in it the conviction that our need in this regard is urgent. In this city we are proud of two recent noble acts of private munificence coming to aid medical teaching, and incidentally medical investigation: we boast the Carnegie laboratory, and the great gift of Mr. Vanderbilt to the College of Physicians and Surgeons. Most timely and most helpful are these generous bestowments. It will not, I hope, be thought invidious if I say that there is a still higher reach for similar philanthropy—above mere teaching, above the training of pupils beginning their course of study, above provisions for communicating what is already known; above these is the need of providing for the teaching of the teachers, of giving scope to well-trained men, already possessed of large attainments, to push their searchings into the unknown, and for study and experiment which shall lay bare new fields of scientific wealth. One such example has already been set in this country in the Johns

Hopkins University in Baltimore. Can we, in New York, not hope for something similar? Will not this Academy set before itself the high ideal of seeking to realize such an establishment? Is it not an aim within its sphere, and fully appropriate to its purposes? Ought we as a profession and organized in a corporate capacity as the Academy of Medicine —ought we to be content with an inferior aim?

This is not the first time that this suggestion has been brought before you. Most forcibly was it presented by Dr. Barker in his late valedictory address. Without plot or conspiracy between us, my thought has run in the same direction. I have brought before you some illustrations of what the higher medical research has accomplished, and I have referred to the difficulties which beset it.

In our country we have a high degree of average knowledge, we also have men of exceptional talent, who are peers among the highest; but we are just beginning to realize that, to make the most of these men, and to procure for ourselves the benefits which they can bestow, we must give them a suitable equipment, a place to work in, means to work with, and encouragement to pursue their researches into the farthest reaches. A wealthy Californian devotes a fortune to the founding of an unrivalled astronomical observatory. Honor to the man who lays this tribute at the feet of science. Will not men of wealth see that in medicine there is an opportunity and a need for wise liberality, which will not only shed lustre upon themselves and upon our country, but which is certain to bring forth fruit to bless mankind. Here, under the influence, and why not under the auspices, of this Academy of Medicine, why may we not have a laboratory which shall emulate the activities of Berlin and Strasburg, of Kiel and Heidelberg, of Cambridge and Leipsic? It is for us to proclaim our need. We show our zeal by the multitude of isolated observers, who are struggling by individual effort to do this kind of work; but we may justly ask for large and adequate appointments to fitly organize and prosecute scientific medical research. With the abun-

dant wealth of this country, with its self-reliant and ambitious spirit, with its determination to hold a rank inferior to none, with the readiness which has been shown to provide for general education and to encourage certain departments of science, it cannot be long ere the necessity of large endowments for pursuing scientific medical research, will be appreciated by those who with intelligence have also wealth.

Great gifts are obtained with little difficulty for hospitals, retreats, and dispensaries, where the wretched and sick may take advantage of medical skill; but the time is yet to come when donors shall see that their charity fails of its full purpose until a portion of it is applied to aiding the medical man to acquire a better knowledge of disease, and how to meet it. No hospital is complete which does not have its scientific appliances and conveniences for the study of the true nature of the diseases which it treats. A larger development of these arrangements is part of the topic to which I have asked your attention, and for which we may justly appeal to the liberality of an intelligent community. Give us endowment, organization, and equipment, and the fit men to utilize them will not be wanting, who shall bring out of them precious fruit, which shall ultimately go into every home with sound knowledge and skilful healing.