On the employment of the microscope in medical studies : a lecture introductory to a course of histiology [sic] / by John Hughes Bennett.

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THE EMPLOYMENT

OF

THE MICROSCOPE

IN

MEDICAL STUDIES.

A LECTURE

INTRODUCTORY TO A COURSE OF HISTIOLOGY.

BY

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EDINBURGH:

MACLACHLAN, STEWART, AND CO.

LONDON: HIGHLEY. DUBLIN: FANNIN & CO.

MDCCCXLI.

BALFOUR AND JACK,
PRINTERS,
NIDDRY ST., EDINBURGH.

Although the remarks contained in the following pages were thrown together hastily, it has been thought that they might be useful to many besides those for whom they were originally intended. I have therefore yielded to the request of several friends, and now offer them to the public. In so doing, however, I must regret that this production is not more worthy the important subject of which it treats.

J. H. BENNETT.

22, Picardy Place,
November 22, 1841.

LECTURE.

GENTLEMEN,

IN commencing a Course of Lectures on Histiology, or the microscopic structure of organized tissues, I must request not only your indulgence, but your co-operation. The immense difficulties which oppose every attempt to demonstrate minute structure to a class, has hitherto prevented a public course from being given on this subject. It has been tried, indeed, by M. Donné of Paris, and the efforts he has made to overcome all obstacles, are proofs alike of his perseverance and enthusiasm. He has, however, by no means succeeded, and he has never even attempted to give a comprehensive and systematic view of the subject, or to demonstrate numerous tissues. In this, therefore, the first effort which has ever been made to give a complete course on Histiology with microscopic demonstrations, let me hope you will excuse the numerous imperfections you will no doubt readily detect, and afford me that indulgence and encouragement a lecturer may expect from a scientific audience, in his attempt to treat a subject which is at the same time novel and interesting,—of the greatest importance and difficulty of execution.

The co-operation that I solicit, is the exercise of a little patience on your parts, and a willingness to coincide in certain rules, which, however new in this country, are absolutely essential to my fulfilling the object I have in view. The first of these is a refrainment from all applause, or

any thing which may induce vibration, or occasion dust. Instruments delicately adjusted for the proper examination of structure, are liable to become deranged by the least vibration; and dust, although invisible to the naked eye, if deposited on the object glasses, may not only considerably mislead those who view tissue for the first time, but even obscure the object altogether. I am sure, then, this appeal to your forbearance will be successful. At the close of this lecture, I shall indicate those rules which it is necessary should be observed, in order that every individual present may successfully view the object placed before him.

The great importance of microscopic investigations in the study of anatomy, physiology, and pathology, is now commencing to be generally understood. Manuals placed in the hands of the student give a description of the minute structure of every tissue; and it is at present evident that the morbid anatomist can no longer proceed with safety, unless he minutely investigate the lesions presented to him. In Germany, which has latterly been foremost in anatomical research, and to which country we are indebted for almost all the great discoveries in Histiology, this fact is universally acknowledged. There the microscope is so highly appreciated, that numerous private courses of lectures are given on Histiology, in which the use and management of the instrument are taught,—so that not only is a knowledge of the anatomy of texture very general in Germany even among students, and that to an extent which would surprise an Englishman, but a good acquaintance with it is demanded by examining boards, from all those who present themselves for medical diplomas. I myself went through a private course of lectures on this subject, under the tuition of Dr Gruby of Vienna, undoubtedly one of the first microscopic observers of the day. I have also attended the public instructions given by M. Donné of Paris, and possessed the advantage

of frequent intercourse with my friend M. Mandl, whose reputation must be well known to you. I have subsequently been diligently dissecting, investigating, and making myself acquainted with different animal structures, and the use of the microscope. I have also myself examined the different memoirs and publications which have appeared on this subject in Germany, France, and England, and hope that I shall be enabled to communicate, without the fear of inducing erroneous ideas, the present state of our knowledge of Histiological science.

I have thought it necessary to make this statement, Gentlemen, in order that you may exonerate me from presumption in coming forward to give lectures on a subject, which, however interesting, is avowedly one of immense difficulty. To such a charge I may appear liable, in a school which has long been celebrated for its anatomical teachers, and where I know some exist who are much more capable of fulfilling the task than I am. But why, I asked myself, should the medical school of Edinburgh be backward in the race of scientific improvement?—why should the graduates and pupils of this celebrated University be under the necessity of visiting foreign countries, in order to become acquainted with that knowledge which they might as easily acquire at home? It appeared to me that the reason is, because no systematic instruction was given on the subject. While, therefore, those who are better qualified refuse to come forward, or, by more important avocations, are prevented from doing so, I have ventured to fill up the chasm which exists in this medical school, and in doing so, have determined that no pains or trouble shall be wanting on my part, to render this course worthy the attention of those whose object is the investigation of truth.

As it is to the microscope we are indebted for all our knowledge of Histiology, it will be only paying a proper respect to that instrument if I say a few words regarding it at the commencement of the course.

The microscope, then, (from μικρος, small, and σκωπεω, to see,) may be defined, an instrument which is capable of making small objects appear larger than they do to the naked eye. In this sense it applies to any instrument, of whatever contrivance, capable of fulfilling this condition; and if we accept this definition, various reasons have been adduced to show that the microscope was known to the ancients. Spectacles, it is said, were in use among the Greeks and Romans; and as the glasses of these were made of different convexities, and, consequently, of different magnifying powers, it is natural to suppose that they must have been acquainted with the property possessed by the lens, of enlarging small objects. Various passages also occur in the works of Jamblichus, Pliny, Plutarch, Seneca, and others, which lead to a similar conclusion. Thus Seneca observes, (Nat. Quæst. lib. i. cap. 7.), " Literæ quamvis minutæ et obscuræ per vitream pilam aquâ plenam, majores clarioresque cernuntur." "Letters, though minute and obscure, appear larger and clearer through a glass bubble filled with water." Now, this glass bubble filled with water is sold, by pedlars and others, to the vulgar at the present time, in order to magnify objects. In going over the Pont Neuf in Paris one day, I was arrested by hearing a man cry, " Messieurs, microscopes à trois sous." I gave him three sous for one of his microscopes, which consisted of exactly the same instrument that Seneca has described.

The compound microscope appears to have been constructed in the early part of the seventeenth century. Both Holland and Italy have claimed the honour of producing its inventor. Borellus attributes its construction to one Zacharias Jansen of Middleburgh in the Low Countries, who, with his son John, according to this author, made his first compound microscope so early as 1590. It is stated that either he or his son presented one of his instruments to the Archduke Charles of Austria, who, in turn, gave it to Cornelius Drebbel, a Dutch alchemist,

who subsequently became astronomer to James I. of England. He it was who first brought the instrument to London in 1619, where it was seen by William Borelli and other scientific individuals. It is well known that Drebbel made microscopes in London in 1621, and generally passed for their inventor.

On the other hand, Francis Fontana, a Neapolitan, states, that he invented the instrument in 1618, and gave a description of it in his "Novæ terrestrium et cælestium observationes." It would appear, however, that although Drebbel and Fontana disputed concerning the origin of this instrument, the honour of inventing it, so far as our present knowledge extends, belongs to Jansen.

The microscope brought by Drebbel to London is thus described by Adams, who observes, "it is possible that this instrument of Drebbel's was not strictly what is now meant by a microscope, but was rather a kind of microscopic telescope, something similar in principle to that lately described by Mr Aepinus in a letter to the Academy of Sciences at Petersburgh. It was formed of a copper tube, six feet long and one inch in diameter, supported by three brass pillars in the shape of dolphins. These were fixed to a base of ebony, on which the objects to be viewed by the microscope were also placed."*

The improvement of the microscope made much less rapid progress than that of the telescope. The great utility of the latter, indeed, appears to have been early appreciated, while the microscope was for a long time only regarded as a means of satisfying curiosity. Thus it was merely looked upon as an expensive toy, and kept by the rich in their cabinets as a source of amusement. At a later period, however, it was found susceptible of adding much to our knowledge of the natural sciences; and, no sooner was this perceived, than the most celebrated artists, mechanics, geometricians, and natural philosophers paid great atten-

* Adams on the Microscope, p. 3.

tion to its improvement. For a long time, however, they were baffled by the difficulties of the undertaking, and during this period naturalists, for the most part, employed the simple microscope. Thus some of the most important discoveries in science have been made by means of a single biconvex lens, and the laborious and brilliant researches of Leuwenhoeck, Swammerdam, Lyonet, Ellis, and others were thus accomplished.

The inconveniences of the simple microscope, however, are very great. Thus, when capable of magnifying largely, the field of vision is very limited, and there is great difficulty in adjusting the focus. Leuwenhoeck had a separate lens especially adapted to one or two objects, and always had several hundreds at his disposal.

The imperfections of the compound microscope on the other hand, were, at that time, very great, and must have have appeared insurmountable. Thus, from its peculiar construction, the rays of light were readily decomposed, and circles of different colours surrounded or tinged the object, constituting the aberration of refrangibility. The form of the object was also distorted on account of the aberration of sphericity. Opaque objects could not be seen from the absence of light, and very transparent ones could not be examined from its excess.

But gradually all these different obstacles were overcome by patience and labour. The details connected with these, however, would detain us too long to enter into. Suffice it to say, that to Liberkuhn we are indebted for the means of examining opaque objects by means of a reflector; to the diaphragm of Le Baillif, for a convenient mode of modifying an excess of light. Achromatic instruments were constructed principally through the ingenuity and labours of Euler, Dolland, Frauenhofer, Selligue, Amici, and Vincent, and Charles Chevalier,—while the aberration of sphericity was got rid of by the same mechanicians.

The object of the optician at present engaged in per-

fecting this instrument, is to construct a microscope which will admit of an easy and universal application, and possess the power of magnifying largely, combined with clearness and distinctness of the image. The instruments now constructed by Ploesel in Vienna, Frauenhofer in Munich, Schiek of Berlin, Vincent and Charles Chevalier in Paris, and Powell, Ross, and Smith in London, if they have not reached perfection, certainly approach very near it, and permit the most minute details of structure to be examined with ease, even when magnified largely.

But it is not enough to have good instruments; we must know how to use them. The knife of the surgeon is of great service when properly employed, but if guided by the hand of a man ignorant of anatomy, it is more likely to be injurious than beneficial. In the same manner, the contradictory statements of former microscopic observers arose more from their want of knowledge, than from any fault in the instrument.

Here let me remark how necessary it is for individuals to examine for themselves. Descriptions and figures, however they may assist instruction, wholly fail in communicating just ideas of structure. To arrive at this, every one must look for himself. You will have an opportunity of proving this fact to-night. I have here displayed under the microscope, most of the elementary structures of the body; for instance, the red blood globule, cartilage, bone, tendon, cellular tissue, muscle, brain, nerve, &c. Now I am sure, that those of you who have not yet examined these structures under the microscope, would be unable to recognise any one of them, if asked to name it. In fact, individuals who are merely taught the ordinary descriptive and surgical anatomy of the day, are profoundly ignorant of the structure of tissue. To know this, it is necessary to be seen; and this cannot be done without employing the microscope.

A gentleman who had been for some time a member of the profession, and made physiology an especial study,

once asked me to show him the globules of the blood. I complied with his wish, placed some fresh blood under the microscope, and adjusted the focus. Now he was perfectly well acquainted with what had been written concerning the blood globules, the different opinions regarding their structure, size, form, and so on; and he had even seen figures of them in different works. Well, he looked long, and appeared to examine them very attentively. After having observed them sufficiently, he praised my instrument, and said that the definition was remarkably clear. I asked him if he had seen the central nucleus distinctly. He replied that in two out of the three globules, this was very distinct. I was somewhat puzzled with this observation, as I knew there must be at least 3000 globules in the field of the instrument. On looking through the microscope, however, I saw three large bubbles of air in the centre of the field, which he had evidently mistaken for blood globules. Two of these were in focus, and he saw them distinctly; the other was not, and it appeared confused. On drawing his attention to the real structure, he for the first time in his life saw a blood globule.

Thus it often happens that persons for the first time looking through the microscope, are really unable to see what is placed before them,—a circumstance which in a great measure arises from the real structure being so very different from the conceptions they had formed regarding it. Or, on the other hand, their attention is directed to globules of air, pieces of dust, shreds of cloth, &c., which appear prominent in the field of the microscope, but which he who is accustomed to them entirely overlooks. It was in ignorance of these circumstances perhaps, rather than from the badness of the instruments employed, imperfect as these undoubtedly were, that the numerous errors on the subject of structure originated among the early observers. "Hence," says Burdach, "it may be affirmed that Monro would have come to the same conclusion that

he did, even though he had had a microscope of Frauenhofer; and that, on the other hand, Ehrenberg, even with Della Torre's imperfect lenses, would have made out the structure of the nervous substance as he has now done."* In short, the sense of sight as applied to the microscope, must undergo a new education, and our ideas of organized structure be completely changed, before it is possible to arrive at satisfactory results. In no case can this be accomplished without practice and industry; but here, as in other branches of knowledge, proper instruction may do much. Some few gifted individuals, indeed, have succeeded by their own unaided efforts, in making themselves masters of the subject; but by far the greater proportion soon grow wearied with vain attempts to overcome difficulties, and give up the pursuit in disgust.

But let me hasten to say a few words on the importance of microscopic investigations in the study of anatomy, physiology, pathology, and the practice of the profession.

You have doubtless, Gentlemen, been told, and correctly so, that anatomy is the basis of medicine. We need not therefore feel surprise at the inefficiency of the medical art, when we take into consideration the general ignorance which prevails regarding the real structure of every organ in the body. Many structures cannot be seen without employing a magnifying power of 200 diameters, and to examine all, the microscope is absolutely essential. It may therefore be laid down as a general rule, that those individuals who have never seen the tissues properly displayed under this instrument, must necessarily be profoundly ignorant of the structure of tissues.

To the naked eye, the brain and nerves appear to be composed of fibres. These have been demonstrated to you by your teachers. Whole volumes have been written

* See Brit. and For. Med. Rev. vol. v.

in describing them, and numerous theories have been built upon the assumption of their presence. The microscope however tells us, as was first pointed out by Ehrenberg, that these supposed fibres do not exist, or rather that they all consist of numerous tubes, the walls of which are distinct, and contain a fluid which may be seen to flow from their broken extremities on pressure.

In looking at a muscle, the strongest sight can only detect fine longitudinal fibres, of which it appears to be made up. The microscope tells us that each of these fine fibres is composed of numerous smaller ones, and that these are crossed by other lines, which have received the name of transverse striæ. Formerly it was supposed that muscular contraction, the cause of motion in animals, was produced by the fibres being thrown into zig-zag rugæ. It has been shown from the microscopic researches of Bowman, that this appearance is owing rather to relaxation than contraction, which latter depends upon the approximation of the transverse striæ.

What disputes have taken place regarding the termination of the arteries, and the nature and supposed properties of capillary vessels! The microscope has shown us that a distinct net-work of vessels lies between the arteries and veins, partaking of the properties of neither, and possessed of others peculiar to themselves. These have been denominated intermediary vessels by Berres, and serve to connect the arterial with the venous system. What on the other hand was understood by capillary vessels has been shown to have no existence.

On regarding with the naked eye the different glands, in which the secretions are formed, how complex they appear, how various in conformation, and how opposed to one another in structure. The microscopic researches of Malphigi, Weber, Müller, and others, have shown that they are all formed on one type; that the ultimate element of every gland is a simple sacculated membrane to

which the blood-vessels have access, and that all glands are formed from the greater or less number, or different arrangement only of the primary structure.

The notion of most men respecting the skin is, that it is composed of epidermis, rete mucosum, and cutis vera. But it was by means of the microscope that Breschet, Vauzème, Gurlt, Simon, and others, discovered its real anatomy, and showed us the existence and relations of the papillæ, of the sudorific organs and their ducts, the inhalent and mucific apparatuses, and so on. All our knowledge of epidermic structures also, such as hair, horn, feather, &c., may be said to have originated in the use of the microscope.

In the same manner the real structure of cartilage, bone, tooth, tendon, cellular tissue, and, in a word, of all the solid textures, has been revealed to us,—so that it may be truly said, that all our real knowledge of structural anatomy, and all our acquaintance with the true composition of every organ in the body, has been arrived at by means of the microscope, and would never have been known without it.

Although men who keep pace with the advance of science are well acquainted with all these circumstances, many even of these have no farther notion of such structures than that which descriptions and drawings convey, while by far the greater number of practitioners and anatomists in Britain, and the whole mass of students, have no idea of them at all. One of the great objects of these lectures therefore, Gentlemen, will be to demonstrate each structure of the body to you in turn, and make you acquainted not only with the opinions held regarding them, but with the things themselves.

With the textures which I have hitherto mentioned, you are all familiar, although their intimate structure be unknown, and they are described, however coarsely, in the ordinary descriptive and surgical anatomy of the day. But there are some parts of the body highly organized, of

which your anatomical teachers never speak either in lectures or in books, and which even the physiologist, however well he may be acquainted with their details, never thinks of exhibiting. Who, for instance, is in the habit of demonstrating the different globules found in the blood? and yet these are very complex and highly organized structures. The red globule, for instance, is composed of three distinct layers, the existence of each of which is capable of being made evident to the mere tyro in anatomy, on using proper means.

Again, the semen in its normal state is found to contain millions of animalcules, which vary in the different tribes of animals, and possess peculiar properties by which they may readily be distinguished. In the same manner, what anatomist or lecturer ever demonstrates the structure of the milk, chyle, lymph, bile, saliva, &c., all of which perform most important parts in the functions of the economy?

The structural composition of these fluids, then, it will be also my task to describe, and demonstrate to you.

I think, Gentlemen, I have sufficiently shown the great service which the microscope has rendered to anatomy, and now let me show its importance in the study of physiology.

In reviewing the labours of physiologists for the last six or eight years, we cannot fail to be struck with the rapid improvement which has taken place in this study, and the comparative exactitude which has been thrown upon its different details. Although this may in a great measure, certainly, be attributed to the improved method of conducting experiments, the advance which has taken place in healthy and morbid anatomy, and to other causes; yet there can be no doubt, that the employment of the microscope, by enabling the physiologist to follow out those changes in corpuscular bodies, which were previously hid from his view, has exercised immense influence on the progress of this science. Thus he has been enabled to follow the

traces of development, not only from an early period of embryonal existence in entire animals, but in each of the organs constituting the complex structures of which they are composed. By its means the phenomenon of the circulation, and the connection of arteries and veins are no longer matters of inference, but are susceptible of demonstration. By the aid of the microscope, also, he has become acquainted with thousands of animals which were formerly unknown, with whose habits and minute organization, even, it has made him familiar.

To point out in detail the discoveries made through the employment of this instrument, as regards physiology, would be to give a history of modern biological science; for there is no department in this study which is not more or less grounded upon the facts the microscope has revealed.

To illustrate the great importance of a knowledge of structure in physiology, and the inferences it gives rise to, it is only necessary to allude to the beautiful doctrine which the labours of Schleiden, Schwann, Valentin, and Barry have lately established, regarding the development from cells of all tissues, animal as well as vegetable.

By microscopic researches Schleiden pointed out, that in vegetables, the earliest traces of organization in the embryonal sac of the unimpregnated ovule, was the appearance of minute granules, which augment in size, originate cells, and constitute the structural basis of every plant. From the different transformations these undergo all the different tissues in vegetables are formed; for instance, the spiral and dotted ducts, woody fibre, and so on. Schwann shewed that the formation of tissues in animals went through exactly the same progress, a fact that has been confirmed by the microscopic observations of Valentin and Barry. Thus vessels, glands, the brain, nerves, muscles, even bones and teeth, are all formed from metamorphosed cells. The details connected with this subject will be given in my next lecture; in the mean

time, let me say a few words on the physiological deductions to be drawn from this brilliant discovery.

If true, and of this there can be little doubt, it obliges us to modify entirely our notions of organization and life. It compels us to confess that vegetables and animals are not simple beings, but composed of a greater or less number of individuals, of which thousands may exist in a mass not larger than a grain of sand, each having a vital centre and separate life, independent of those around it. Each of these individuals or organised cells, should be regarded as a living being, which has its particular vital centre of absorption, assimilation, and growth, and which continues to vegetate, to increase, and undergo transformations, as if it were an isolated individual. These remarks demonstrate to us, that the vital properties and ultimate structure of vegetables and animals are identically the same, and the uselessness of the ideas at present attached to one as distinguished from the other. To certain stages of their development, viz. in the simple state to which I have alluded, this distinction is absolutely impossible; and in this case, as M. Turpin has well remarked, the denomination of animal or vegetable ought absolutely to be abandoned. These terms ought only to be applied to the assemblage, combination, and particular disposition of the elementary organs constituting the different tissues of which they are composed. In the same manner, our ideas of life ought to undergo modification, and we should learn to separate the life of association, found in the compound structure of man or a tree, from the individual life attached to each of the organic corpuscles of which one or the other is composed.

You now see, Gentlemen, the vast influence microscopic researches are destined to exercise over physiology, and the evident necessity which arises, as we advance in minute observation, to banish the antiquated doctrines of the schools, and to reform the first elements of our scientific education.

But in pathology how vastly important, nay, how absolutely necessary, is an appeal to the microscope. How often are men, who have passed their lives in the examination of morbid structure, deceived in determining with precision the presence of inflammation or softening. Indeed, how can it be otherwise, when we consider the deceptive nature of the modes in which the investigation is determined? Thus, an intense degree of redness in a tissue is by some called congestion, by others inflammation. How vague are the ideas attached to the consistence of organs;—what appears healthy to one, seems to another somewhat indurated, and to a third softened. Again, it is impossible for such morbid anatomists to decide definitely, on the exact limits of any peculiar morbid structure. Who, for instance, can affirm, that in the brain, because the substance looks white and healthy, and neither softening nor induration be apparent, that it is in a normal state?

Not long ago, I saw a case which will illustrate this point. A man entered the Royal Infirmary, labouring under apoplexy. There was profound coma, stertorous breathing, full pulse, and all the signs of active hemorrhagic apoplexy. The whole right side of the body was completely paralyzed, in a state of resolution, the limbs, when raised, falling down, like inert masses. The whole of the left side, on the other hand, was intensely rigid, so much so, that it was impossible to flex either of the limbs. Dr Spittal, who had charge of the case, diagnosed hemorrhage in the left, and inflammation in the right cerebral hemisphere. Notwithstanding the most judicious treatment the man died. On inspection, a large hemorrhagic effusion was found in the left hemisphere, so far confirming the diagnosis, and explaining the resolution and paralysis of the right side. In the right hemisphere, on the other hand, neither Dr Spittal, nor myself, nor any of the assistants, could detect traces of inflammation. There existed, indeed, several small excavations, and the appearance which Dr Sims has described as resulting from the

cure of ramollissement; but nothing could be detected capable of explaining the severity of the symptoms. On examining it microscopically, however, I found the most evident traces of inflammatory action, and a new product formed in great abundance, to which Glüge of Brussels has given the name of globule of inflammation.

In several other cases, I have convinced myself by means of the microscope, that inflammation existed in textures where nothing abnormal could be seen with the naked eye, and in this manner have been enabled to explain many symptoms which otherwise would have remained inexplicable. A man died a short time since in the Infirmary, who had for several days been affected with loss of consciousness, and rigidity of the right arm. Besides a tumour in the brain, which had been previously diagnosed, I detected, by means of the microscope, inflammatory softening of the left corpus striatum, a lesion which, by unassisted vision, none present at the examination could positively assert to be present.

On the other hand, I have determined, in several cases, that lesions supposed to be inflammatory arose solely from hemorrhage, or simple congestion—that what has been considered tubercle was in fact infiltrated pus—that tumours imagined to be malignant, were really innocuous, and so on. Regarding all these points, we are enabled to get rid of the vagueness and looseness which at present prevail in connexion with them, and by means of the microscope, to arrive at positive information, on which the morbid anatomist may safely rely.

The microscope explains to us also why certain diseases are so intractable to treatment. It shews us, that several morbid lesions are composed of cells, each of which, as I have before stated, possesses an independent vitality. Thus, warts, melanosis, cancer, fungus hematodes, &c., defy the efforts of the practitioner, because he is unable to attack them through the organism of the individual in whom they exist. In fact, they are distinct beings, en-

dowed with a vitality of their own, true parasites, which it is impossible to consider either as animal or vegetable, which feed upon the tissue they are found in, and can only, by its destruction or excision, be removed from the economy.

I have before pointed out, that it is not possible to become acquainted, by means of naked vision, even with the *healthy* structure of organs. How therefore can we expect, by its aid alone, to arrive at the knowledge of *diseased* tissues? Need we wonder that so many affections and morbid growths are considered incurable, when we remain ignorant of their very nature? The surgeon who only regards cancer with the naked eye, is like an individual ignorant of plants, who from some eminence beholds an extensive forest. He sees, indeed, a mass of substance before him, which appears more or less uniform in colour, a little undulated on the surface, and so on—characters which merely enable him to distinguish it from the other known features of the physical world, such as plains, mountains, or rivers, in the same manner that the surgeon distinguishes cancer from fat, muscle, and bone. But how could he tell that this mass before him was composed of individual beings, each endowed with a separate vitality, and each obeying certain laws in the grand system of development, unless he examined those things nearer which he had seen at a distance. In the same way pathologists, without minutely examining tubercle, cancer, and other morbid growths, must remain profoundly ignorant of their real structure, and can consequently form no definite or proper idea of the mode of their origin. So long as these circumstances, Gentlemen, remain unknown, so long will these diseases remain incurable.

But I shall be asked by the practitioner, how will your minute knowledge of structure, and your employment of microscopes, enable me to cure disease? Will the time I throw away upon acquiring the information you speak of,

teach me how to benefit my patients, and increase my practice? To this I answer, most undoubtedly. No man can proceed to treat a malady, without forming some ideas of its nature. The merest practical man, as he styles himself, is insensibly guided by some theory or doctrine; and the more he boasts of his practical information, the more likely is his theory or doctrine incorrect, and far behind the existing state of science. To illustrate the application of the microscope to diagnosis, however, permit me shortly to relate the history of a case:—

Mr D——, an English gentleman, whose acquaintance I formed in Heidelberg, asked my advice for a complaint, consisting principally, as he stated, of headache, vertigo, and a disposition to faint, under which he had laboured for some weeks. He was thirty-five years of age, of a peculiarly sallow countenance; and though once robust and stout, was exceedingly weak, and greatly emaciated. He could not stand erect for any time, or stoop, without feeling faint. He had constant headach in the occipital region, sometimes extending to the forehead. He was very excitable; and the pulse, although generally slow and soft, would, on the slightest alarm, become rapid and thready. I learnt that he had been very dissipated, had suffered under several forms of syphilis, and had even then a stricture of the urethra, for which he had lately been treated by Professor Chelius. In addition to this affection of the urinary apparatus, he had for the last sixteen months laboured under what appeared to be an affection of the bladder. His urine was often cloudy, contained at different times more or less mucous flocculi, deposited a sediment which varied in amount, and exhaled a peculiarly fetid and disagreeable odour. He had consulted most of the celebrated physicians and surgeons in London. The former had told him that he laboured under disease of the kidney, and the latter, that he had chronic inflammation of the bladder. He even went to Leamington, to consult a celebrated physician of that

town. He presented to me a mass of prescriptions, from which I learnt, that he had taken in turn mercury, arsenic, copper, opium, and all the heroic, as well as minor remedies. He had also been frequently leeched, and cupped in the loins; and even when I saw him, had an open issue in the lumbar region. He had always been kept on low diet, and was on his way to Carlsbad, to drink the purgative waters of that celebrated spring. I really did not know what to advise, and merely ordered him some emollient drinks, until I had further observed the case. One day I took home some of his urine, and examined it with the microscope. Much to my surprise, I found in it the spermatic animalcules in great abundance, some destroyed and broken down, but others entire, so that no doubt could exist regarding their presence. It was now apparent that the semen had found its way into the bladder, and the real nature of the case dawned upon me. On questioning him, I found that some time previously he had been conscious of involuntary seminal emissions. This had been increased by the antiphlogistic treatment pursued; and latterly there had appeared headache, fainting, and the other signs of irregular distribution of blood within the cranium. I immediately ordered the seton to be taken out of his back. Instead of his usual low diet, I ordered beef-steaks and good beer. At the same time, I administered vegetable and chalybeate tonics. Instead of keeping him confined to the room, I ordered him to take short walks, which were to be gradually increased in length, according to his improving strength. Instead of going to Carlsbad to drink purgative waters, I advised him to visit Wildbad, and use the stimulating and tonic carbonic acid baths of that spring. The cold douche to the back was also occasionally to be employed. The gentleman was intelligent, saw the force of my arguments, and followed the treatment proposed; and in six months I heard from him, that he was perfectly restored to health.

Here, then, was a diagnosis established, and a cure completed, entirely through the agency of the microscope; and in looking over the elegant and highly practical work of M. Lallemand on involuntary seminal emissions, you will at once be struck with the vast importance of attending to this class of maladies.

The practical application of the microscope is also occasionally evident in some diseases of children. An infant about nine months old, was brought by the mother to Professor Barrez's clinical hospital for children in Berlin. It had within the three weeks preceding wasted rapidly. The bowels were irregular, and, notwithstanding various remedies had been employed, it was getting worse. The milk of the mother, according to her own statement, was good, and abundant. A tonic treatment, with slight alterations, was persisted in for two weeks, but still without effect, and the infant appeared to be falling rapidly into a state of marasmus. Another nurse was now ordered to suckle the infant, and from that moment the child improved in health, and got well. Here, then, the cause of the disease was a morbid state of the milk. Now, this may be detected by the microscope, as I shall show you when we treat of this subject. It was reported in Paris, that M. Donné had, by examining the nurse's milk microscopically, detected the cause of ill-health in the infant Count of Paris, the grandson of Louis Philippe, and heir to the French throne. The practical importance of this subject must be evident. How often is the physician called upon to determine the state of health possessed by a nurse. In aristocratic or wealthy families, where the preservation of an infant heir to noble titles or great wealth is at stake, the possession by the practitioner of another means of distinguishing the source of disease, cannot be too highly appreciated.

Again, how often you observe the physician examine spit-boxes, with a view of determining by the appearance of the sputa, the nature of the disease affecting the lungs.

Now, in very few cases do the sputa present to the eye, such characters as will enable him to speak positively regarding the morbid lesion. But I shall show you, Gentlemen, that by means of the microscope, certain appearances may exist, which, when present, will invariably enable you to decide on the nature of the affections in the lungs.

Indeed, I might readily multiply instances, where the employment of this instrument will enable the practitioner to obtain positive knowledge of the disease he has to treat, and enable him to practise with more certainty and confidence.

In some instances, long practice, and the accumulated experience of centuries, have conducted the profession to the proper mode of treating certain morbid lesions, although it is to the microscope we are indebted for having since shown not only in what manner the treatment is effectual, but the real nature of the morbid lesions themselves. Thus, although the cause of inflammation and suppuration is to the mass of practitioners unknown,—although they may never have heard of the inflammatory and pus globules,—they yet apply the very treatment which those who have studied them would propose should be followed.

In the same manner, practitioners have successfully treated the porrigo lupinosa, or favosa,—one of the forms of scalled head, with caustic and detergent applications, without knowing anything of its real nature. Some considered the disease to reside in the bulbs of the hair, others in the follicles of the skin. Microscopic observations, on the other hand, have demonstrated that it consists of minute plants or fungi growing on the human scalp; in short, that it is a species of mildew which covers the skin. Now, we know that caustic and detergent applications are fatal to vegetable life, and these are exactly what medical men have long employed to cure the disease.

A little reflection, Gentlemen, must convince you that the novel facts to which I have alluded, as well as others

which are continually being made, must exercise an all-important influence over the science of medicine; and if we pay attention to the improved views which daily take place in our knowledge of the structure of organs, and compositions of the fluids,—the modified physiological doctrines resulting from these,—the new discoveries daily unfolded in the formation and mode of development of morbid growths and diseased processes,—and the certitude which this information communicates to the diagnosis of maladies,—we need not feel surprised if the whole science of medicine, as it is at present taught, should be greatly revolutionized in a period not far distant. This statement will not appear exaggerated, when we take into consideration the unprecedented discoveries which have been made within the last few years, in our knowledge of the pathology of the fluids, and this entirely by means of the microscope and organic chemistry,—a science which, as regards pathology, must be studied in conjunction with Histiology. These things tend to show the great importance that must necessarily be attached to the fluids, in founding a true system of medicine.

I need not refer you to the prominent part attributed in ancient times to the humours, and to the long period during which the Hippocratic and Galenic doctrines governed the minds of scientific men. It is curious to know, however, that after this doctrine had been overthrown, first by the chemical views of Basil Valentin, Paracelsus, and Van Helmont, and, secondly, by the mechanical views of Descartes, Bellini, Pitcairn, and others, it was again revived in a modified form, principally by the reputation and genius of Boerhaave, supported by the microscopic observations of Leuwenhoeck, and again swayed even in a more despotic manner than before, the opinions of the physiologist and pathologist. It was again attacked by Baglivi, Hoffman, Gaubius, and others, who considered the solids the *primum mobile* in disease. It was, however, principally through the influence of Cullen and his disciples, that solidism was

made to reign in the ascendant, while the importance of the fluids was entirely lost sight of. This celebrated hypothesis is now in turn crumbling away before the more enlightened doctrines of modern research. The microscopic labours of Hewson, Treviranus, Müller, Schultz, Mandl, Gruby, Donné, Gulliver, Lane, &c., and the chemical and experimental observations of Magendie, Denis, Lecanu, Prevost, Dumas, Andral, Davy, Babington, Stevens, Prout, O'Shaughnessy, and a host of others, have again placed the humoral pathology in the prominent position to which it is entitled.

The great merit of modern investigators, however, is their freedom from exclusiveness,—that rock on which all previous opinions and doctrines have been wrecked. These have all contained to a certain extent the elements of truth, which it is the object of the present cultivator of science to distinguish and separate from what is false, then to unite them with the result of his own labours, and thus from the whole build up a system of pathology, which may command the respect, and deserve the confidence of the scientific world.

Thus every thing connected with our science sufficiently manifests, that we are now in a much better train than those who preceded us. The wisdom of Gaubius, Boerhaave, and Cullen, though highly useful in its day, is fast retiring before the chaster knowledge of the present age, as that which we ourselves may be inclined to boast of, may be eclipsed by the labours of the next. Yet, Gentlemen, science must advance. The axiom that knowledge is power, is universally received, and however men nursed in error may smile at our enthusiasm, and look coldly on our endeavours, nothing can deter or check the labours of that earnest and united band, whose watchword is the search after, and discovery of truth.