The Value of the Microscope as an Aid to Diagnosis.
In looking for a something which should form a subject for a 'Thesis' one naturally comprehends that the surface of things is too often drowned. But can this ever be otherwise, in proofs as each and all of us are in preparing for that momentous examination. The goal of our anxious curriculum, unless that subject be long thought of original, or have the genius of a Brougham or the shrewdness of a Macaulay, to compose impromptu essays?
The subject of this paper, which has suggested itself as worthy of my attention, is: "The Value of the Microscope as an Aid to Diagnosis." The principal object I have in view, is in relation to the diagnosis of disease and localized morbid states, which may in their turn be due to certain constitutional or aesthetic changes—but I do not limit myself to this entirely.

The culmination of our studies as physicians or surgeons is the diagnosis and treatment of disease, and resulting from this, the "cure or relief." But how much importance can scarcely be assigned to the study of diagnosis by every means in our power; for the more accurate our observation and knowledge of a disease in all its detail, the more readily shall we be able to ward off and combat every source or threatening of danger that might complicate it. "Diagnosis" in medicine is employed to designate distinction of disease, and its "sources are derived from the history, symptoms, or changes of function, the effects of remedies, and the
morbid anatomy or changes in structure. It is to the latter that the microscope, by its aid to researches in that direction, has deservedly given it an importance unparalleled in the history of medicine.

Physiognomical diagnosis, doubtless, stands first as our guide, and calls for the deduction indicating perceptively certain modes of physical examination; and this instrument is one of its greatest auxiliary forces.

The examination of the changes in structure affords an invaluable confirmation or correction of our previous opinions. In attempting to make out the nature of a disease, every branch of medical knowledge should be brought to bear upon the inquiry; information should be sought from every source likely to afford aid. Various aids have constantly been adopted, and are continually being increased; and though fallacious perhaps for a time, have by the diligence and discrimination of the observers, and latterly by the advancement of science and correctness in our mechanical appliances, attained, by finity of purpose and continued observation, to
unmistakable signs and appearances, deductions from which and from primary knowledge of structures and tissues have indicated a more correct diagnosis. To mention only a few of the more important ones, we have the stethoscope for auscultation, which has rendered the diseases of the chest comparatively easy of diagnosis, and which has also been applied to many other parts besides the chest, as for instance the fetus in utero, to determine its position and condition, by auscultation of the fetal heart. Laruenz its discoverer for ever holds mankind his debtor, and particularly so the profession, for enabling them so clearly to diagnose chest diseases. Though, probably, to Robert Koolde is due the suggestion of the application of the ear to the investigation of thoracic diseases two centuries ago, so ably perfected by Laruenz in 1818.

Percussion, either by means of the fingers, or a pleximeter and hammer, is of great importance, and invaluable for mapping out the healthy or diseased organs, and also for limiting the extent of structural disease in a part, founded on a knowledge of sound. This was
first pointed out by Alex Brugger.

The Ophthalmoscope, invented by Dr. Helmholtz of Hindenburg, for exploring the interior of the eye ball in order to diagnose more especially the morbid states of the vitreous body, choroid, and retina.

The uterine sound, a round of metallic fipple in the invention of Professor Simpson, and first brought into notice in 1843, an invaluable instrument in diagnosing displacements, tumours, or enlargements of the uterus.

I might mention many others, each having an importance as bearing on the diagnosis of particular organs, but the ultimate use of the microscope, as a means of indicating abnormal conditions, does not single out any particular organ or part where it cannot be applied, to the exclusion of others, as do those above named, neither are its limits in the living but follow on after death, either confirming or correcting previously existing views, or still more widening our field of knowledge and adding further store of facts in that particular disease.

Whatever may be said or urged in favour of
other means or aids to diagnosis, cannot compare with the wide expansive range which the microscope possesses. By it the secreta and secretia, liquids and solids, as well as the cutaneous surface with its operations, may be examined, and that which before gone but a vague notion of its cause and constituents is now accurately determined. The eye, as it were, looks into upon the disease; observes its changes and transitions of structure; and our knowledge, which before was but indicated imperfectly is now directed of all doubt, demonstrated, and thoroughly understood.

It would be vain of me to try to set up the microscope as a means of diagnosis, to the exclusion of all others. I only wish to show that in it consists we have an instrument of whose paramount importance claims for it the highest notice in the art and science of medicine, and as Dr. Bennett observes, “you must not suppose that an additional method of gaining information implies abandonment of those, the utility of which has stood the test of experience.” An author has said of the picture he:
I forget to whose this extract belongs. "We suppose at the present day there are few properly educated medical men, who would deny the value of the stethoscope as a means of ascertaining the presence of disease. The man, who would be hardy enough to forego its use, would view the hazard of even popular neglect for his temerity." Might not this be urged with tenfold force with respect to the microscope in many cases, and as an instance of this in favor of its use, and willing treating the latter part of the sentence, I cannot pass over a circumstance which came to my notice, without relating it. A friend of mine (non-medical) was taken ill suddenly, with the following prominent symptoms: great pain in the lumbar region, bloody urine, painful and frequent micturition, feverishness. He called in a physician, whom he had long employed to attend upon his family, who asked various questions, curiously examined the urine, prescribed some medicine to be taken, and certain local applications. Unfortunately no improvement occurred after several days treatment, and not unreasonably getting anxious, desired that someone..."
else might be called in—a wish that was at once acceded to. An eminent physician of this city was fixed upon to consult with but said his attendants, you must save the urine for his inspection. The consultation took place, a microscopic examination of the urine was suggested the treatment altered; from which a gradual recovery took place.

The family attendant, although of long standing and holding a public office in this city, was discomfited from that time, the patient assigning the resultant treatment solely to the examination of the urine, which called forth a determination to have always a physician who kept up with the advancement of science.

This method of observation and diagnosis necessarily involves certain requirements.

1st The cultivation of the eye to minute observation, for it is not enough that we see with the microscope, but observe with it.

2nd The modus operandi in making preparations for examination. This is now taught and explained in many books.

3rd The knowledge of minute tissues
and structures, fluids and deposits, and solids that occur in the healthy or normal condition of the body, as well as those changes which take place in the unhealthy or diseased state. With the former, our knowledge of histology and chemistry comes into use, while the latter is being constantly brought before our notice by clinical teaching and pathology.

The kind of diseases which I have chosen as illustrative of this subject, are pulmonary, urinary, cutaneous, and blood diseases. These doubtless have excited great interest and called forth the most energetic exertion, with a view to a method of treatment both prophylactic and curative. The limits of this essay will confine me to a few examples, and as typical ones are always more striking, it will be exemplified by a few, a further knowledge of which has led to better results.

Commencing first with parasitic diseases attacking the skin. Among the acrual parasites attacking the human subject, we have the Acarus Scabiei, a striking instance of microscopic research. Although it was
Long thought to be an animalcule, even so far back as 350 years before the Christian era, and was known to the Greeks, Arabs, Romans, etc., to Hauynrannus of Dresden, in 1654, belong the credit of giving the first figure of the animal, no doubt examined by the microscope. Carol. Puerle and Weisemann also drew attention to it, but the Parisian student Gali's, in 1812, was the cause of particular attention being paid to it by his substituting the chesse-mite for it. Nasirai gave a good description of it in 1834. This scardus is an articulate animal, belonging to the class Brachicidae, subclass Acaridae, true itch mites. Aveynoar in the 12th century appears first to have recognized the mite as the cause of the itch, but it has ever been a vexed question until lately when continued observation has shown it to be the exciting cause of itch.

The mite is much smaller than the female, and has certain distinctive differences, but a minute description of these would occupy too much space in this paper. Therefore I shall describe as briefly as possible the general characteristics of this
animal. It is of a roundish form, having eight legs, four anterior and four posterior, united to the body, of which the dorsal surface is covered by tubercles, spines, and hair bearing tubercles remarkably disposed. The head is an oblong cylinder more or less obtusely pointed in front, flattened beneath, enlarging slightly laterally towards the body and is furnished with two maxillae with fixed lower lips. The head is capable of retraction beneath the dorsal plate. They burrow cuniculi in the soil, the hairs or spines from the cuticle serving most effectually to prevent their retrogression, while they are equally well organized for advance. The cuniculi have a whitish appearance, dotted correspondingly with the deposit of ovaries and the extremity of each canal an elevation, that of the acarina. (Female). After the death of the other insect the derma gives way, a depression is left, ragged along its edges, and dirty. The eggs are in various stages of development from the beginning of the cuniculi onwards to the female. The male is more often on the surface, and is one third the size of the female. The female lays the eggs at intervals of about
four days, and between each division makes
a small excursion, altering her position and
the direction of the canal, each time. The eggs
are hatched about the tenth day, and the larvae
grow rapidly and burst their shells. Each
gallery of eggs becomes the centre of radiation
of new acari, hence the opthalmia spread over
the body. It is only latterly that this animal
has become generally accepted as the sole exciting
cause of Scabies proper. Yet there may be simple
constipative or inflammatory cases, nothing more;
but generally there will be found a vesicular
or purpuric eruption, dependent on the presence of
the animal. Kuchenmeister says "The
diagnosis is possible in all cases with a lens
and the microscope, but without them com-
kpletely impossible in many cases, or a mere
piece of luck, which a conscientious surgeon
should never allow to have any dominion
over him, in cases where he has the means
of diagnosis".

The Acarus Autumnalis, though not of
much importance, I may mention en passant,
having had an opportunity of observing it.
I feel sure this animal is the source of con-


Buchemuster. Seite 66.
Siderable irritation to the skin of various parts of the body from what I have myself suffered and seen in others.

Its distinguishing characteristic is its redness. It belongs to the same order and family as the acarus species, subfamily liceae, has six feeler-hexapod, a harelip and soft body; red colour; mandibles and labii with large palpi. You liebold thinks that the hexapod mite is only the young state of one which becomes octopod, after changing its skin, and which is parasitic during its young state, the mature condition of which we do not exactly know.
and the animals so numerous, that on one occasion I discovered them on the dinner-room table. A popular notion exists among the country people that it is the bite of a bug, which they allege comes with the Irish deer, and goes away with them. My brother first pointed them out to me as a parasite affecting the skin in autumn, and two years ago I had the opportunity of seeing them very frequently. They appear to have a predilection for the skin, upon which they seem to bore their way in for a short distance, and there rest and probably deposit their eggs.

This gives rise to yellowish red elevations easily detected by the intolerable itching produced. This irritation causes scratching and rubbing of the part, which produces a white swelling around exactly like that produced by the common bug. Towards evening the exacerbation of itching is irresistible; sores are formed, which most frequently occur on the lower part of the legs about the ankles, and arms just within the sleeves. They are very small, and require a high power of the microscope to see them. I have taken them from the arm with a needle, but if taken out uninjured and placed on any hard
substance as a glass slide, they suddenly became very active, and it is difficult to con-
tact them again on account of their smallness and colour. I have always noticed that the
same spot rarely itches more than two or three
days.

Amongst Vegetable Parasites we have the
Sarcid Ventriculi, so familiar to us from its
able discoverer Professor Gooden, in vomiting
matters. Its occurrence gives rise to a form
of dyspepsia characterized by copious vomiting
of a faint acid smell, and after standing a
few hours, becoming covered with a thick
brownish yeast-like froth, and brown flaky
deposit. According to Dr Watson vomiting
of this kind is usually, if not always, indicative
of some structural disease of the stomach.
Numerous instances have been presented in the Infirmary this session, that have always been
connected with certain morbid conditions of
that organ. It consists according to Lachmann's
of cubic or prismatic, roundish or irregular
masses of cells, which are square at one
side and round at the other, and of which
the largest are 0.055-30 m.m. long, and 0.055-30
on m. breed. Under high powers the edges are serpentine. They stand in the middle of the surface a slight depression. From this there proceed four linear depressions or furrows, from which originate four woundish projections, which have been named 'frustula' by Prof. Goodsir.

The cells are generally a multiple of four, twelve, sixteen or together. Every cell according to Robin is either composed of an homogeneous mass, free from nuclei, or more frequently of the same mass with four or two or three nuclei; both kinds of cells are to be seen near one another according to the observations of Hasse, Hollick, Müller, Simon, Robin, and Lebert.

The nuclei are from 2 to 4000 times the 600th of a millimetre in diameter, are cubical, elongated, prismatic, with rounded corners or oval almost spherical, reflect the light strongly, and seldom contain nucleoli. Robin observes that in the representations of Bennett and O. Tindal, the nuclei are not given, and accounts for this by their using magnifying powers under 600 diameters.

The fluid in which these algae flourish generally gives an acid reaction, and less
frequently alkaline; but found by Röschow in ammoniacal pus. By their nature and character, Schlesinger maintained that they were nothing more than decomposed muscular fibres; but Virchow shewed that the cubical portions of sarcina were much larger than any that could result from the decomposition of muscular fibres; and that muscular fibre disappeared in acetic acid, whilst sarcina were distended, also that the former disappeared in water whilst the latter remained; and hence he deduced it to be no product of decomposition, but any relation to fermentation or other morbid symptoms.

Among the Fungi we have several very interesting forms of epiphytic diseases attacking the cutaneous surfaces of various parts of the body, and localizing themselves to certain parts as the epidermis, sebaceous ducts, hair follicles, and the hair itself; and causing by impaired nutrition multiplication and spread of the disease. There is generally congestion and an increased production of epithelial scales of a jejunate character and spreading by marginal
Huckeumaister (page 141).

McCall Anderson on Vegetable Parasites (page 147).
Trychophyton Tonsurans, Tinea Tonsurans, Herpes Tonsurans, Yeast Ringworm, is due to the presence of the Trychophyton, first noticed and discovered by Nornsten, and aforementioned by that name. According to Backermeister “the filaments, placed in rows in which the spores originate, have undulated edges, and show in their interior, at small intervals, the round spores, rarely so long as to simulate the filaments, and peculiar to the Cryptogamia. These spores are round, transparent, half as large as blood-corpuses, 0.0037-0.0010 in in length, and 0.003-4 broad. Many have in their interior a distinct spot or vaguely defined nucleus; many, when they are long in shape, appear to have a constriction in the middle. There are no partition walls, although it appears as if they existed, when the spores are very close together.”

Dr. McCall Anderson classes as rare varieties of this form “Herpes Tonsurans,” “Herpes Lenticularis,” and “Yecosis,” and he says “In all three affections, in placing the excelled debris under the field of the microscope, after adding caustic potash to separate the epithelial scales, innumerable
little rounded oval globules or spores are distinguished about the 700th of an inch in diameter. Many of these are isolated; others are united together into chains. Comparatively few cryptogamic tubes are to be seen. The sparing development, then, of tubes, and the enormous number of spores are characteristic of all three affections, and distinguish them from the vegetable structures formed in other parasitic diseases. These statements are confirmed by investigations of Robin, Bazin, Hardy, Deffin and others.”

Alopecia Areata, due to the microsporion Andouinii, detected by Grubh in 1843. It consists of spores and filaments, the former very small and not very numerous, the latter in great abundance. These are found on the skin mixed with epithelial scales in the early stage of the disease, and they are also to be met with in the downy hairs at a later period. In the interior of the hairs they are also met with being collected into little bundles, and causing remarkable swellings of the hairs. These bulbs are also distinctly atrophied, a peculiarity which is
so marbled as to be seen almost without the aid of a lens. — McColl Anderson.

"The distinctive character of Trycosphyton tunsurans consists in its numerous curved undulated branches having generally smaller spores, in the constant absence of granules in the interior, in the spores adhering to the filaments and branches, and in its habit, for whilst Trycosphyton tunsurans is developed in the root of the hair, Microsporon Audomini forms a tube around each hair, of the thickness of 0.015 mm., and surrounds the hair outside the follicle." With respect to these distinctions Mr. J. Hogg says: "I have not been able to verify these distinctions; on the contrary, on comparing many specimens of these diseases with each other, I have always found filaments springing up around or along the hair, sometimes longitudinally in bifurcating branches nearly straight, sometimes in tortuous or spiral forms, with or without spores; as the drawings here exhibited will show. In both diseases the bulbs of the hairs and the hairs themselves were variously decayed and deformed."
Psorasis Viricicolor is due to the presence of the microsporon furfur discovered by Eckelstadt in 1846. The parasite consists partly of elongated and branched cells, partly of spores which are piled up in groups or in heaps, some of these being 100 in an in diameter. Dr. McTavish Anderson says, "By putting a little of the diseased matter under the field of the microscope, and adding a drop of Liquor Vitriol to render the epithelium more transparent, numerous epithelial scales are detected, mingled with the spores, and tubes of the parasite. The spores are oval or roundish, of considerable size, and usually collected into large clusters like bunches of grapes. They are so characteristic, that I think I could undertake to form a diagnosis of the disease from the microscopical appearances alone. In addition to them, there are tubes, some of them jointed, others not. These, though often very short, are branching and others appear like small bronchial branches of trees. The spores and tubes are formed also on the hairs and in them, though not to the same extent as in "Psorasis tenuis." I feel certain that all who have seen one..."
Preparation of this parasite under the microscope, will not fail to recognize the disease again, as it is quite unique in its characters.

Porrogs appear under numerous external forms, to which special names have been assigned by many authors, and which have in fact been distributed in different classes, as if they had no mutual connection. They all, however, have one common characteristic, by which, as respects their origin, they are distinguished as a group, from other cutaneous diseases; this characteristic is the existence in them of fungi, which were discovered by Schonlein in Porrogs lupicosa, and thereafter subsequently confirmed by all observers. (Gudde).

McCall Anderson says, "There is no cutaneous disease the consideration of which I enter upon with greater pleasure than that of Faus. It affords one of those instances, alas, so rare in medicine of a highly successful mode of treatment, formed upon a correct knowledge of the nature of the affection. It is one of the best examples which could possibly be adduced of the great usefulness of the microscope in the investigation of pathol-
logical structure, and of the practical benefit resulting therefrom, and one of the best reputations to the detractors of this most invaluable instrument.

It is not very long since favous was looked upon as a fungicular disease, and regarded as incurable; or if its true nature has sometimes been suspected, the appropriate treatment has been only partially or not at all, put into practice. There are few dermatologists, if any, who now deny the presence of a vegetable parasite in favus exists, although there are many who look upon its existence as altogether secondary, ascribing the origin of the affection to deranged nutrition, a view altogether untenable in the present state of our knowledge.

The Favus parasite attaches itself to the bottom of the hair follicle, to the simple layer of the cells of the epidermis. The spores and articulated filaments met with here closely adhere to the hair, and form a sheath for it. Sometimes the spores are close together, forming single, double, or triple rows. The spores and tubes sometimes penetrate into the root of the hair, and from thence into the hair itself, after having filled up the hair follicle causing atrophy to take place both to the bulb of the hair and also to the follicle. The Favus...
To Bennett: Principles of Medicine. Page 800.
consists of the mycelium, the spores, and the receptacles of the abortive, together with a finely granular amorphous mass, which forms the external coat of the fungus, representing a membrane or capsule of epidermic scales, which cannot be isolated, and is the representation of the amorphous "stroma" which often accompanies the mycelium of algae and fungi, and is therefore not the result of drying up of the amorphous albuminous exuded mass, nor of an accelerated formation of the epidermis, nor of the drying up of any, nor any of these substances together.

Dr. Bennetts says: "In order to examine the natural position of these vegetations microscopically, it is necessary to make a thin section of the capsule, completely through, embracing the outer layer of epidermis, amorphous mass, and light friable matter found in the centre.

It will then be found, on Median this slightly between glasses, and examining it with a magnifying power of 300 diameters, that cylindrical tube (Helle) springing from the sides of the capsule, proceed inwards, give off branches dichotomously, which when fully developed, contain, at their extremities termination (mycelia), a greater or
less number of round or oval globules (sporidia). These tubes are from the \( \frac{1}{400} \) to \( \frac{1}{1000} \) of a millimetre in thickness, jointed at irregular intervals, and often contain molecules varying from \( \frac{1}{10000} \) to \( \frac{1}{1000} \) of a millimetre in diameter. The longitudinal diameter of the sporules is generally from \( \frac{1}{500} \) to \( \frac{1}{100} \), and the transverse from \( \frac{1}{500} \) to \( \frac{1}{150} \) of a millimetre in diameter (Gruby). In concluding these examples of parasitic diseases I must remark that I have purposely given a little minuet of description, to show how successful the microscope has been in this particular field of observation, but really it is but a generalisation of the observations which have been made on these diseases, and but briefly portrayed. There are many other forms of parasitic disease affecting the human subject, not forgetting those of the animal kingdom, which might be mentioned, but these being more common and not less interesting and characteristic, are probably the best examples I could notice on account of their frequent occurrence. Doubtless there are many cutaneous diseases not necessarily dependent on parasitic causes, yet, on account of their sordid condition, offer a sufficient substratum and nidus.
for the development and maturation of these epiphyses, whenever an opportunity occurs, and
probably by this means complicated pulmonary disease.

The expectoration affords ample opportunity for observation, and though not ordinarily examined by the microscope in these diseases, has been regarded by many distinguished physicians as valuable confirmation of those obscure forms of disease, where physical examination has not proved sufficiently distinctive. It is in these nice points of diagnosis that the microscope has proved valuable, enabling the physician either to give a favorable prognosis or to enforce such precautions, regimen, and treatment as may arrest the onward progress of the disease. The expectoration offers to us an opportunity for examining and ascertaining the conditions of the respiratory tract, and ultimate cells of the lung by its secretion, and though in its passage it must necessarily come to be mixed with secretions from the buccal cavity and particles of food which may encumber the investigator, yet these difficulties
Leitsonian Lectures by Theophilus Thompson

M.D. F.R.S.

On Pulmonary Consumption with

remarks on some indications afforded by the

microscope and on the comparative virtues of

Cocoa nut and other oils.
will be easily overcome.

"Pulmonary Consumption.

Firstly, expectoration characterizes irritation, which may be produced from various causes. It contains stringy mucus, epithelium, and cilia in a smaller or greater quantity, besides the presence of tubercular deposit in the cells.

Dr. Thompson (from whom I derive the most of my information on this part of my subject) says: "A gentleman whom I visited a few weeks since with Dr. Brosse, was affected with obstinate cough. There was hereditary tendency to consumption; this aspect was rather un-promising, and there was dull percussion in the right subcostal region. It was doubtful whether this dull percussion depended on tubercular consolidation; but the absence of any tubercular element in the purely bronchial frothy sputum, when microscopically examined, encouraged us to give a favorable prognosis, which has hap-

Gelatinous expectoration consists of a transparent and very tenacious semi-fibrillated matrix, almost stringy, and resists pressure between the glass.
Dr. L. C. Hall. On Pulmonary Consumption.
for examination. It contains granules, molecules, not aggregated, cells partly devoid of granules and oil globules. It is indicative of a chronic form of irritation, unlike that from bronchitis or pneumonia, and is usually tubercular. This kind of expectoration may be seen in various forms of pulmonary congestion, and according to Dr. J. C. Hall is a diagnostic guide of very great practical importance, for he says: "where there is no special tubercular tendency, the corpuscles are of one uniform kind, but when the deposit of tubercle has taken place or is impending, the corpuscles are of various forms and sizes, some ovoidal, some spherical, and exist the action of acetic acid; others are abruptly defined, obscurely granular or nebulous, requiring the application of reagents to render their nuclei apparent. Others again are compressed and elongated; another set may be seen of a spherical form, which are filled with granules of fat or pigment, and these are often in process of disintegration, and, lastly, corpuscles may be seen with depressions from which nuclei have been extended."

Purulent expectoration, so characteristic of
In this, (a) Simple purulent usually contains curled elastic tissue as well as other characteristic manifestations of tubercular formation; flocculent, a variety of it characteristic of secretion from a poison, modified by absorption of the thinner constituents; very rarely occurring from any other cause. (b) Non-coherent, is thick, sticky, rather firmer than common pus, often accompanied with hemoptysis, and contains shrivelled cells and angular earthy deposits, sometimes, also cholesterol. It is indicative of a chronic form of tubercular affection in which the diseased action is checked. The flocculent may be mixed with pus corpuscles, of the admittable shrivelled cells, granules, molecules, and oil globules and not infrequently curled elastic tissue.

In the examination of the exploration it is not merely pus and mucous that you see, but cells which should have formed healthy epithelium, hastily developed, overgrown, irregularly formed, jagged, and losing their vitality, shrivelling or bursting and starting with their granules; the rapidity of the disease bearing a proportion to the amount of fat globules and of bursting cells.
Dr. J. H. Bennett, Principles of Medicine, pages 84 & 698.
The diagnosis as well as diagnosis derives considerable importance from these facts.

Acinar and elastic tissue, which not uncommonly are found in the sputum, are considered to be an indication of sloughing and ulceration of the lung, generally seen in the purulent exudation of Phthisis. Thoeber van der Helden found fragments of this before the physical signs of ulceration were well characterized by auscultation. Dr. Brunk says "This fact Thoeber confirmed and believe it to be one of great diagnostic value"; and again referring to this subject says "I must point to the great occasional diagnostic value of a microscopic examination of the sputum, previously alluded to p 82. Thoeber was in this way not only recognized Phthisis pulmonalis before the occurrence of marked physical signs, but have been enabled to determine the existence of ulceration, by finding fragments of lung tissue in the sputum, under circumstances where otherwise this could not have been determined."

Dr. Theophilus Thoeber records four cases where his diagnosis was entirely dependent on microscopical examination, where the negative
Signs of no shrivelled cells in one case, and no elastic tissue and very few misshapen cells or loose granules in the other had time to give a favorable prognosis, which ultimately proved the correctness of the diagnosis.

Sir C. Radcliffe Hall has drawn attention to the appearances in the spueta of uncoiled blood corpuscles, at the commencement of thoracic consumption, where to the naked eye there has been no trace of blood, and he thinks it is rarely absent in cases of this disease. In acute pneumothorax, fibrous casts are frequently found in the spueta.

Urinary diseases.

The pathology of urinary deposits as a diagnostic of disease of the kidney has received much attention, and probably no investigation has been pregnant with such results as the researches in urinary pathology. Chemistry, Anatomy, Physiology, Histology, and Microscopy have each lent their aid in contributing some quota of deductions. To further our knowledge in the different diseased states of the kidney, and the gland-urinary passages. This wonderful organ with its complex secretion has afforded immense
people for observation, and modern investigators have not been wanting in emulation to solve the technicalities of its various operations, and probably no branch of research has ever rewarded observers with such ample results, and gained for them more memorable names than those engaged in this undertaking.

Dr. Beale speaking of the microscope says: "There is no class of diseases in which its powers have been more advantageously brought to bear by the practical physician, than in those of the kidney. By microscopical examination of the urine, we are frequently enabled to ascertain the nature of certain morbid conditions, changes which are going on in the kidney, and even to distinguish, during life, the existence of certain well defined pathological conditions of that organ. The laborious researches of Dr. Johnson have shown us how, by the peculiarity character of the casts of the urinary tubes which are found in the urine, we can ascertain whether the epithelium is desquamating, or on the other hand, whether it presents no such tendency,
but remains firmly attached to the basement membrane of the tube.
If the epithelium be undergoing that peculiar change termed fatty degeneration, we shall often be able to ascertain the fact by examining a specimen of the deposit from the urine by the microscope. So again by the presence of certain other deposits, as we shall be guided.
The case may be to the existence of local changes, affecting some part of the genital urinary mucous membrane, or to more general disturbance in the changes which take place in primary or secondary dilatation.

In the early stages of an acute attack of xanamatic nephritis there will be abundant sediment in the urine, and when it is examined, blood corpuscles in sufficient quantity will be recognised and will give the urine a pink or reddish colour, according to the quantity. There will also be granulated albumin, crystals of uric acid and cells having for the most part the character of renal epithelium. Fibres in irregular manner, having no definite form indicate the rapid and abundant hemorrhage, much of the
blood escaping from the kidney before it had time to coagulate. There are also numerous cylinders of fibrous cast, coagulated mouths of the tubes in which are entangled blood corpuscles and epithelial cells which have been shed by a process of desquamation. The diameter of these epithelial casts is about 3/16 of an inch. All the constituents of a cast may be free. Epithelial casts with scattered epithelial cells indicate of a recent attack and in acute forms of dropsy following toxic causes. Pas and granular casts may be found; the former may be from some irritation of the mucous canal; the latter are mixed with epithelial casts and blood corpuscles.

According to Dr. Johnson, after a period of two or three weeks oil globules may appear in the casts and cells and in proportion to their increase or decrease to those which do not contain oil, a bad or good prognosis will be given, guided by the causes of the attack, previous history, diathesis and habits of the patient.

The chronic form of desquamative nephritis may be rather a transition from the acute or
chronic from the beginning. Intravenous granular casts, with scattered amorphous epithelial cells, a degenerated condition of the epithelium of the urinary tubes, and a copious sediment continued for a longer period after the cessation of the acute desquamative process and the disappearance of the epithelial casts, than could be explained by the clearing of the tubes from the epithelium and blood which accumulated in the acute stage, and which subsequently becomes disintegrated and washed out.

It will be seen that granular casts, unmixed with entire epithelium, or epithelial casts, are constantly present, but that the granular appearance varies considerably in different specimens, depending on the progressive degeneration of the cells. There is absence of blood, and the condition of the urine varies little from day to day.

The presence of abundant fat cells, fatty casts, and free oil, with albumen in large quantity, in the urine, would indicate fatty kidney, although for a time such appearances may exist. They are most frequently a sequel of non-desquamative disease. In the contracted.
Kidney. Fat cells or fatty casts are either not present in the urine, or exist in but small number, and only occasionally. In many enlargement there are faint traces of granular fibrous casts of large size (Hyaline casts) in small number, and consisting of two forms: one smaller in diameter indicative of the acute stage; the other large and complete moulds of the tubes after desquamation of the epithelium indicating the chronic stage. The number of casts is sometimes remarkable.

Blood in the urine may have some light thrown on its origin by the microscope. If it comes from the bladder, there will be more or less vesical epithelium mixed with it, which is scaly and sufficiently distinguishable from the spheroidal epithelium of the kidney which is frequently accompanied by, and entangled in, small casts of the tubularous tubes, as well as blood casts, formed of coagulated blood.

Pelvic casts indicate pyelitis of the pelvis and tubes of the kidney and also abscess of the kidney will be denoted by pus following hematuria.
Symptoms will afford sufficient guide to its situation, although the condition of the blood, hand, may be of some diagnostic value.

Carcinomatous deposits and tuberculars of the bladder may be diagnosed in this way. In fact, to name the innumerable diseases of the blood, kidney, and genital urinary organs, which may be indicated in this way, would lead me too far, and in concluding this imperfect description of this part of my subject, it must be evident that a microscopical examination of the urine is most valuable for attaining to a correct diagnosis.

In Leucocystemia, gout, and other marked conditions in relation to the blood, its employment has proved of great aid. Tumours have also been diagnosed in this way, but has not proved of such value as could be desired, on account of certain discrepancies in the differentiation of cells in connection with malignant disease.

To conclude this paper, I shall give a slight glance at the history of the instrument. It would be vain to inquire into the history of the single microscope for the magnifying
power of globes was known to the ancients. Probably water was the first observed magnifying medium, if we must have a primary suggestion; as the pivot of the plow might probably be that of the plow, as suggested by Mr. Gladstone; for all our most valued pieces of mechanism seem to have been suggested, in their most simple form, from animate or inanimate nature. Magnifying glasses were known as far back as before the Christian era. But by Roger Bacon, our own countryman, the simple microscope was thought to have been invented along with its sister instrument the telescope, in the beginning of the third century. Some hundreds of years elapsed before it was again heard of, and then it was in a compound form. Many claimants came forth as its discoverers, but the credit of the discovery of the compound microscope is generally given to Zacharias Janssen in 1590. Afterwards to Galileo the invention was attributed by many in 1610; but may not he be said to have reenacted, or improved the microscope, as he did that of the telescope, which is so nearly allied to it?
The real inventor of the compound microscope is as little known as that of the telescope. The invention of the telescope attributed to Galileo, was not of higher importance to the astronomer than was that of the microscope to the physiological naturalist. The one saw in every star a system, the other a world in every atom. In 1621 Comenius Drebell, mathematician to King James the first, made microscopes, probably after the plan of Jansenius, for the archduke Albert of Austria received one as a present from Jansenius, which he afterwards gave to Drebell.

In 1660 the discovery of the blood corpuscles by Malpighi was one of the first fruits of microscopic study, although Kircher and Swammerdam have also received from different writers the honour. Swammerdam was the first to inject preparations. Structural anatomy was not thought much of till the time of Malpighi, who perceived the forerunners of Harvey's theory by his discoveries of corpuscles in the blood, and of capillary circulation. He also showed the main facts of the cellular structure of the lungs, and the principles of formation
of secreting glands; the more important parts of the anatomy of the kidney; the threefold constituents of the teeth; mode of growth of hair; and many other things were established by him. He also made researches in the vegetable structure of plants, at the same time Gray was prosecuting the same study. In 1667 Stolte published his Micrographia, a physiological description of minute bodies, magnified by magnifying glasses, and many other treatises were published about this time of improvements in the instrument, in the transactions of the Royal Society.

Stolte was the first to apply the compound microscope to the structure of muscle about a year before Leuwenhoek published his discoveries. Coeval with Stolte are Eustachio Divini of Rome and S. Campana of Bologna. In 1670 Philip Bonnani describes an improvement, and in 1672 Sir I. Newton discovered the first reflecting microscope; after this Gray made a simple reflecting one, and the simple pocket microscope of Wilson was afterwards in great demand. In 1673 Leuwenhoek appears in the Philosophical Transactions as a discoverer of numerous wonders.
his instruments as well as Maltzigh's were composed of single lenses. The mysteries revealed by the glasses of Leuenhoek were at first regarded as beyond belief. The uncertainty of microscopic investigations, in consequence of which so much was supposed to depend on the imagination of the beholder, was alleged against them, and even after men of noted judgement and the most industrious application had confirmed the experience of the indefatigable Buffetman, Voltaire, cutting sarcasm did not spare him. Leuenhoek may be considered the founder of microscopic anatomy. His discoveries in connection with bone, cartilage-corpuse, sphagmatic animal cula, fiber of urnament, scales of cuticle and of the coraeus epithelial, chyle and sylve, corpuscular, muscularus fibulla, transverse, thrio of their fasciculi, tendon, and nerve fiber, and the fibrous and membranous structure of the eye and cornea. He made more recent discoveries only of their announcement, without previously consulting his world.

In 1729 the compound microscope was found inferior to the single, owing to chromatic and
spherical aberration, occasioned by the great distance, the light had to pass, and achromation is said to have been discovered by Christopher Hall, a private gentleman in London, about this time, and applied to the telescope. Euler in 1734 proposed its application to the microscope, and Dollond by a series of experiments accomplished it in 1757, but its use was principally directed to the telescope. In 1738 Lebertchen's solar microscope improved by Cuff, and his achromatic objectives were applied, by which he made so many discoveries in the alimentary canal. In 1748 George Adams published a work entitled Micrographica illustrata, and greatly improved both single and compound forms. It was now in the hands of all the most eminent men in Europe, including Muller, Ehrenberg and Scheden, and their discoveries were being constantly made known to the world. Many experiments were made to apply achromation to the microscope, and in 1812 Sir David Brewster succeeded in rendering both single and compound microscopes achromatic by a very simple process. This subject seems now to have engaged the most profound mathematicians in Europe, and the first to
contribute to contribute on this subject was Sir David Brewster, afterwards Sir J. Herschell and Professors Airy and Barlow. In 1824 the Achromatic Jolmie came into use. Pellégrin and Chevalier of Paris made the first successful attempt, then we have Talley of London from suggestions of Sir Gröning. Then Sir David Brewster proposed the Arendt stones for the single lens, afterwards carried out by Britchart. Amici's triple object glass was very successful. Then came Sir Wallaston doublet, and Holland's triple, the former consisting of two plano convex lenses, whose focal lengths are in the proportion of 1:0:3, with the convexity towards the eye. Then the Coddington lens suggested by Wallaston and improved by Sir David Brewster. But to J.J. d'Arsonval is due the honour of raising the compound microscope from its almost useless condition to the most important instrument ever yet bestowed by art upon the investigation of nature, and has gained for the discoverer a lasting reputation, by a combination of lenses to form an achromatic instrument. From these investigations all our principal instruments are made. Then follow Ross, Powell, Smithson
Beck, the most eminent of English makers, and Chevalier, Oberhaeuser, Brummer, Jachet among continental makers.

Well may this instrument stand forth as the idol of this age and the acme of scientific research, for it ranks amongst its designers the most learned in the sciences, and among modern investigators, who have sought its aid, both here and abroad, counts among the number the most astute and penetrating minds of modern times. Their discoveries have come upon us like an avalanche in every science where it could be applied, and have not failed to advance our knowledge in each, but very few will comprehend the whole.

Apologizing for the imperfection, which doubtless this crude sketch must necessarily bear with.

"Errors, like straws, upon the surface flow.* My only wish is that the import of the writer may be understood.

[Signature]