PRIMER

OF THE

CLINICAL MICROSCOPE.

BOSTON OPTICAL WORKS.

BY

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THE PRIMER

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CLINICAL MICROSCOPE.

(Made at the Boston Optical Works.)

By EPHRAIM CUTTER, M. D., Boston, Mass.

Prelude.—Believing that micrographic (μικρός, small; γράφειν, to write) writers have aimed too high; that the use of this clinical microscope is as easy as a sewing machine; that in a short time instruction in person would suffice without any book; but that as this personal instruction is impossible in most instances, pupils should become as children, and learn from the simple printed form of instruction.

We ignore no good instrument, but confine the teachings to this clinical microscope because of its simplicity and sufficiency for physicians whose duties include travel to the bedside.

What is a Microscope? (μίκρός, small; σκοπεῖν, to view. A tool or instrument for viewing small things.

What is a Simple Microscope? A single lens or set of lenses (bi-convex or plano-convex).

What is a Compound Microscope? One that has two or more sets of lenses, of which one combination comes next to the eye, and is called an "*eye-piece*," and another set that comes next the object, and is called an "*objective.*"

What is this Clinical Microscope? A compound microscope designed for physicians' use at the bedside of the patient.

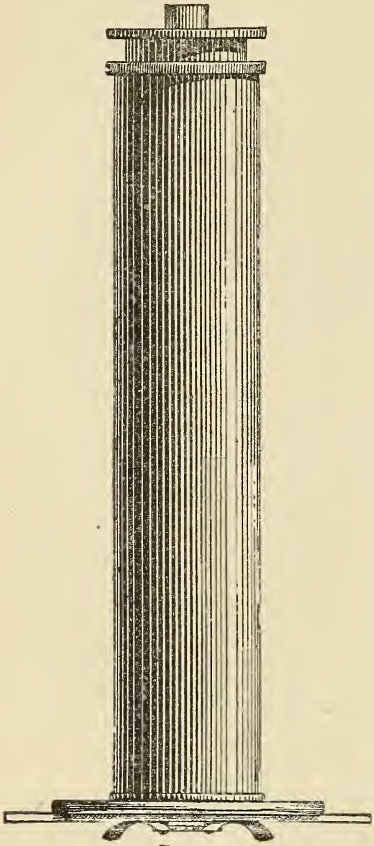


Fig. 1.

Of what parts does it consist? The following: 1. A $\frac{1}{5}$th objective. 2. 1-inch eye-piece. 3. Tube. 4. Cap to eye-piece. 5. Stand. 6. Stage. 7. Clips. 8. Stage screw. 9. Coarse adjustment. 10. Fine adjustment. 11. Cap of tube. Accessories, but essential: 12. Slide. 13. Cover.

What is a $\frac{1}{5}$th-inch Objective? The set of lenses next the object that magnifies as much at ten inches distance from its face as a bi-convex lens of $\frac{1}{5}$th inch focal distance, to wit, 50 diameters. Objectives are distinguished by nationalities, makers, systems and classes. Thus we speak of American, English, French and German objectives; also of Tolles, Spencer, Wales, Gundlach, Powell and Leland, Smith and Beck, Hartnach, Zeiss, &c., objectives. Also, we speak of two-system, three-system, four-system objectives, according as the compound lenses are two, three, four, &c.

What classes Objectives? Varies with different makers; with Mr. Robert B. Tolles (1) angular aperture. (2) Complexity of structure. (3) Definition and resolving power.

What is Angular Aperture? The angular breadth of the pencil of light entering the objective to form the image. A great controversy has been waged on this subject, and it is not settled yet. For us, it is only necessary to say that when all the pencil of light, so to speak, enters the objective and measures 180 degrees, the "180 degrees" would be called the angular aperture; so when the angular breadth of the pencil measures 90 degrees, the angular aperture of the objective would be called "90 degrees." A first-class objective should have over 160 degrees of angular aperture, and an adjustment for cover thickness—that is, arranged so that covers of varying thickness may be used, and the objective corrected for each thickness by moving the milled ring on the objective. A graduated circle renders it possible to make a registry of the different covers used, so that by the number the proper adjustment may at once be found; also, its resolving, penetrating and defining power must be in the highest degree of perfection. (*Note.*—This varies for different objects. A first-class objective may work splendidly on one class of objects, and quite poorly on another set of objects. A first-class ocean steamer cannot be a first-class river boat.)

What is an Immersion Objective? Where the face of the objective is wet with water, glycerine, oil of cloves, &c.

What is a Dry Objective? It is one where nothing but air comes between the cover glass and the objective.

What is Balsam Angle? The angle of light coming through an object mounted in Canada balsam. First-class objectives are usually wet and immersion.

What is the Working Distance? This means the distance of the objective in focus from the object cover; sometimes it is the $\frac{1}{250}$th of an inch.

What is a Second-Class Objective? One with cover adjustment, and less than 160 degrees of angular aperture, though it is possible to have a first-class objective of less angle.

A third-class objective has less than 100 degrees of angular aperture, three systems of lenses, and no cover adjustment. This class of objectives is now made with clearness, flat field, resolving power and definition amply sufficient for clinical work. Such an one is furnished with this clinical microscope. On monetary considerations, it is now unwise to refrain from buying a microscope when this instrument can be bought for $25.

This *Primer* is not written for the benefit of those to whom money for a microscope is of no account. On the contrary, it is intended for those who must make the most of the means they have at command.

How should you Rate this Objective? American, Tolles, 3-system, 3d-class, dry, not adjustable; working distance about $\frac{1}{50}$th inch.

What is a One-Inch Eye-Piece? It is the one found in this microscope, made of two plano-convex lenses—one next the eye, called the eye-glass, and the other is called the field-glass. When the plane surfaces are next the eye, it is called a Huygen's eye-piece. When the convex faces are towards each other, it is called a Ramsden eye-piece.

The terms "1-inch," "2-inch," $\frac{1}{2}$-inch," "$\frac{1}{4}$-inch," apply loosely to the length of the combination. A 2-inch eye-piece magnifies five diameters; a 1-inch magnifies 10 diameters. So that the amplification of the clinical microscope, 50 by 10 equals 500 diameters, when the standard length of ten inches is adopted. The clinical is seven inches in length, hence its power is 350 diameters. If so ordered, the clinical can be supplied with a draw-tube; *i. e.*, a tube to slip out and into the barrel, or it can be made ten inches long at the start.

Remarks.—Having an objective and an eye-piece, one has the necessary elements of a compound microscope. Were it possible to hold in the hands the objective, the eye-piece, and the object properly, observations could be made in microscopy. But a *tube* is necessary to hold the eye-piece at one end and the objective at the other, and to cut off cross-lights, as in a spy-glass. This tube is found in all varieties of the compound microscope. In this clinical microscope, it is $5\frac{1}{2}$ inches long, and $1\frac{1}{8}$ inches in diameter. The eye-piece fits into one end, and the objective screws into the other end. Thirty-six threads to the inch is the standard "society screw" for objectives adopted by the London Microscopical Society and most American societies; so that any objective may be used on any stand with this standard thread. In case of French and German objectives, adapters are made to fit them to the English pattern.

What is (4) *Cap to Eye-Piece?* A simple brass cap to cover the eye-glass of the eye-piece for protection.

What is (5) *the Stand?* A contrivance to hold or stand the tube on. In the present case, it consists of a thin tube surrounding the barrel of the microscope just described. It fits accurately, and should touch the collar on the eye-piece end of the barrel. At the other end it projects beyond the objective. Here is cut a female screw. Into this fits the stage screw, which is a ring slightly bevelled on the inside. Into this bevel fits a ring that projects from the under side of the stage.

What is the Stage? A small platform with a central opening. In this case it is circular. Its use is to hold the object. Its diameter is $2\frac{1}{8}$th inches; $\frac{1}{8}$th inch of the periphery is $\frac{1}{12}$th inch thick. The inner table is $\frac{1}{16}$th inch thick—this allows of a space for the object.

What are the Clips? Two watch springs, free at one end and fastened at the other, with a bar having two pegs that go through holes in the stage, for the purpose of holding the slide. (Fig. 2.) These complete the clinical stand. Objectives 4-inch to $\frac{1}{50}$th-inch Tolles have been used with this stand successfully.

What is the Coarse Adjustment? It is the focussing apparatus that moves in great (comparative) distances. In this clinical microscope it is secured by simply drawing out and in the barrel of the microscope inside of the tube of the stand.

What is the Fine Adjustment? It is the focussing obtained by turning the stage on the screw-ring in the end of the stand tube.

What are the Caps? They are two brass covers—one to protect the eye-piece, and the other the objective, when out of use. The cap of the eye-piece fits on as a tube. The other cap has a beveled projection exactly like that of the stage. It replaces the stage for portability in the pocket.

How is the Stage Removed? By simply pulling off. Sometimes it sticks. It is then best to turn the stage screw, and bring the stage sharp against the end of the tube. The leverage of the screw will start it off. The cap is then inserted in its place. Sometimes it does not adhere, as owing to a fault of construction, the projection is not as long as that of the stage. This is the worst feature of the whole instrument.

In this case, I usually put the stage in (not too tight) and turn the screw out. Then the stage is pulled off, and the cap easily fits, and may be turned close to the tube. When the cap sticks, it is removed like the stage, by sharply turning against the tube.

Remarks.—A classmate lately purchased one of these instruments. I failed to communicate how it should be used. He removed the stage screw and cap, when he wished to use the instrument. He held the object in front of the objective, and said he obtained views. This is mentioned only as a warning to others, and as a work of supererogation.

The clinical microscope, with caps on and stage off, is best kept in a chamois bag. It can then be carried in a side pocket, and the stage in the vest pocket; or it may be carried in a satchel with stage on or off.

As the clinical microscope is intended for bed-side use, it has been the aim of the writer to reduce its features to the least possible number. But something more than the instrument is needed, as a microscope without illumination is like an engine without steam.

What is the Light? It is the illumination by which objects are viewed under the microscope.

How many kinds of Light are used? Natural and artificial.

What is meant by Natural Light as suitable for the Clinical Microscope? The following: (1) Ordinary diffused daylight in an apartment with one window (preferably). A room with more than one window may be used; but trouble comes from cross lights and too much light. (2) Sunlight reflected from a white object, as a house, a handkerchief, a garment, paper, &c. These make the best white cloud illumination I have used. (3) White cloud light.

What is Artificial Light? (1) A common coal oil or kerosine flame, such as is used all over the country. This flame, used direct, gives the best light for Tolles' $\frac{1}{75}$th inch objective (2) A wax or paraffine candle. (3) Gas light—the poorest of all illuminations.

Remarks.—The Perkins & House (of Cleveland, Ohio) lamp is the best I ever used with the clinical microscope.

Mr. Tolles commends the patent mechanical lamp with a naked flame.

What is Direct Light? A light unmodified by reflection or refraction.

How is the Clinical Microscope used with the Direct Light or Reflected Sunlight? By pointing it towards the source of light.

What are some of the reasons of its favor? (1) It was in common use 200 years ago. (2) It is effective; and (3) Less troublesome than reflected light. (4) It saves time. (5) It allows of the use of the clinical microscope when the observer is placed on a lounge, in bed, in railroad cars in motion, on ship board—indeed, anywhere that a lamp will burn, and the motions are not too violent. The microscope and the eye move together. The eye-piece, objective and object move together. (6) It does away with the reflecting mirror, and thus reduces expense and motions of adjustment.

Of the Object—What is it? Anything that can be seen with the microscope. We confine our remarks to the clinical microscope for brevity. There are two classes of objects: (1) Transparent, and (2) Opaque. Only class 1 can be used with the clinical microscope. In the case of opaque objects, sections are made so that the light can penetrate through the substance, or a minute portion of an object may be obtained in any other desirable way.

What are the Essentials of an Object? (1) To be thin enough, (2) spare enough, or (3) separated enough so as to let the light permeate or penetrate. Objects of observation with the clinical microscope are easy to mount.

What is Mounting? A preparation of an object for microscopic observation, either temporary or permanent, as for a collection of objects in a cabinet. The latter is a department by itself. It consists in preserving the specimen by media, that exclude the action of the air, and, as far as possible, interstitial changes of the object.

What is Staining? A coloring of the object or portion of the object by reagents, for diagnosis and differentiation. This art has made wonderful progress of late. (See the systemic works.)

What besides the Clinical Microscope and the Illumination are necessary for an Observation? (1) A slide. (2) A cover. (3) Pipette. (4) A piece of old cotton or linen, and (5) The object.

What is a Slide? According to the London Microscopical Society's standard, it is a piece of clear glass 3 x 1 x ($\frac{1}{14}$) inches, with rounded edges; but the dimensions vary.

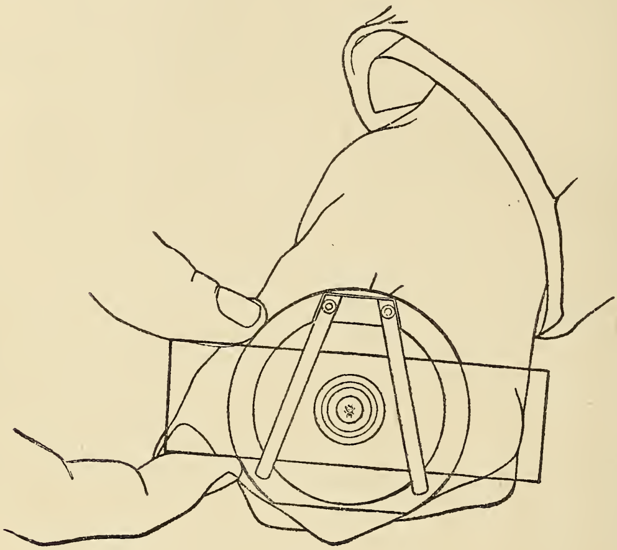


Fig. 2.

What is a Cover? Usually a square or circular piece of thin glass, less than one inch in diameter, and of a thickness varying from $\frac{1}{10}$th to $\frac{1}{250}$th inch. Thickness of covers for this microscope $\frac{1}{100}$th inch.

How are Slides cleaned? Ordinarily, by washing with water, and wiping dry with an old cotton or linen handkerchief.

Covers require much care, for fear of breaking. After soaking, I have found that by moistening with water a small surface of a handkerchief, taking the cover gently in the moistened fold, then rubbing to and fro with the thumb and forefinger, the object is best accomplished.

Dr. R. U. Piper, of Chicago, has invented a very simple device for this purpose. He takes a piece of glass plate 2 x 3 x $\frac{1}{10}$th inches, and secures on it two thinner plates of glass by balsam or cement, in such a manner that a space like the letter V is formed; the length of the largest plate is the length of the V.

It is easy to see how a cover may be cleaned and any amount of pressure brought to bear on it without breakage, as it is engaged in the V and held.

To free slides from covers cemented by blood dried on, simply soak over night in cold water. A better plan is to clean the slide immediately after use.

Remarks.—For transportation and years of wear, a zinc plate box, just sufficient to receive 8 to 10 slides, I have found satisfactory. A moist cloth or paper laid in the box will keep specimens from drying. Covers mav be carried in between the slides. An India rubber band will keep the box closed.

What is a Pipette? A little tube of glass (usually) 6 to 10 inches in length, and one-eighth inch inside diameter. (Fig. 3—Pipettes.) A No. 5 catheter serves well, and does not easily break. The pipette is used to collect deposits from urine, &c.

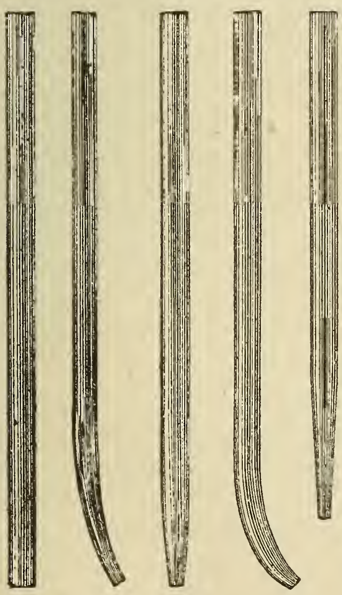
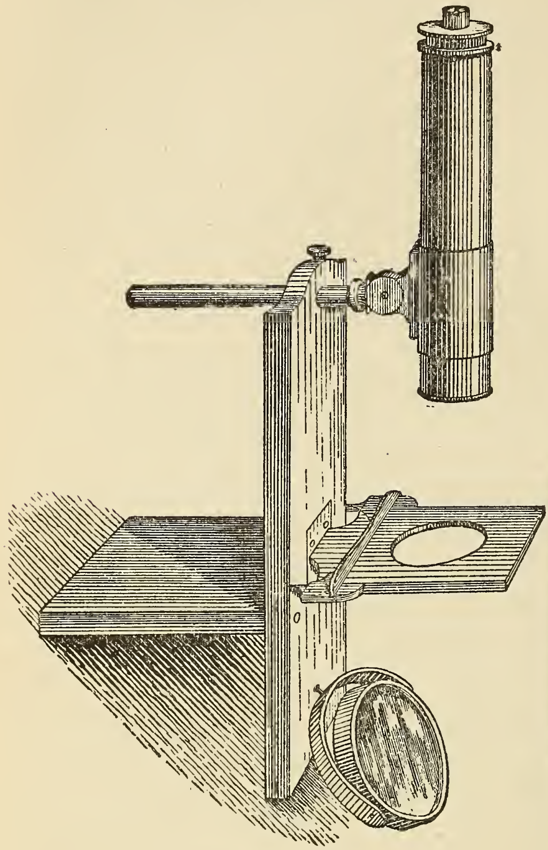


FIG. 3.

Office Stand of the Clinical Microscope.—An upright post of wood ten inches long by two inches square may be set in a base, and bored transversely or obliquely, so that the opening is just large enough to receive the tube of the stand, not the microscope. It may be lined with velvet. For use, the barrel with the eye-piece and objective should be removed; the tube then placed in the foramen in the post; the barrel is replaced, and the illumination set against the objective. Fifty cents would cover the cost. Figure 4 is another device for the same purpose. Figure 5 is another form for viewing opaque objects.



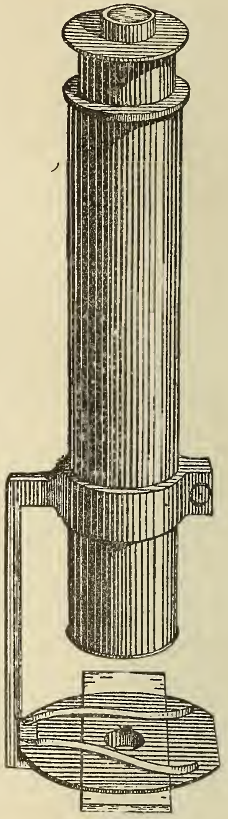


FIG. 5.

FIG. 4.—WADDINGTON STAND.

Having thus given a brief account of the clinical microscope, it is proposed next to give examples of its use, so plain that it is hoped the average intelligence can repeat them.

EXAMPLE I.—*Hair.*—This is a coarse object for the clinical microscope; still its marked characters are so striking, that the novice would do well to practise with it. Its size and color make it visible long before it comes into focus. An easy mode of mounting a specimen of hair, for examination, is as follows: Put a small drop of clear water on the centre of the slide; then take a small pencil of hair (removed from the beard or head) between the left thumb and forefinger. Cut the free end off, square, with scissors. Then holding the hair over the drop of water, cut a section $\frac{1}{4}$-inch in length, transversely. Enough pieces of hair will fall into the drop to make an object for practice, when they are covered with a covering glass, and the excess of water removed by a bibulant, such as a blotter or cotton cloth touched to the edge of the superfluous drop. When this is done, the slide can be put in any position, and the cover will not move, as the capillarity will hold it close and fixed. The removal of the excess of liquid from the object is a necessary procedure in the use of this clinical microscope, for obvious reasons.

The next step is to place the slide, *cover* towards the objective, under the clips of the stage. A hair can then be readily brought over the centre of the objective, by observation with the naked eye. The facility with which objects can be found by this manipulation and holding is a recommendation of the clinical microscope. It saves time which otherwise might be lost.

Of course, the next thing is to turn the microscope towards the illumination—be it diffuse daylight, a white cloud, reflected sunlight, lamp or gas light. The observer gazes through the microscope as he would through a telescope—holding the barrel with the right hand and the stage with the left hand.

(It is well to have the clipped part of the stage uppermost. The left forefinger may be above and the thumb below.)

It is probable that a faint outline of the hair will be perceived. Holding the stage still (as above), turn the barrel with the right hand. If the object becomes more distinct, keep on turning till it becomes clearly in focus If, however, the object becomes more dim, turn in the opposite direction until the image is clearly seen. This turning backwards and forwards is termed the "fine adjustment." Look for the cortical portion of the hair, its imbrications like shingles, its medullary portion. Note the coloring matter, and get a general idea of the physical features as one on picket scrutinizes a new comer in war times. Move the slide about on the stage, and bring successive hairs into the field of vision. Focus off and on if each hair is not perfectly clear and distinct.

Pluck out a hair by the root, cut it off over water as above directed, and then the physical features of the bulb can be studied. Study comparatively the hairs of different parts of the body, of different races, ages and sexes, of animals and insects. Also study the hairs and connected glands of plants. These may be obtained by sections of leaves and stems, or by wetting leaves in water and then gently scraping off the cuticle with a lancet or delicate knife-blade. A portion of the pulp is placed on the slide, gently teased out with needles or pins, and covered with a cover. Water is added or removed as may be necessary to make the cover stick; and then proceed as with the first case. Many hours and days could be profitably occupied in the study of *hairs*.

II.—*Urinology.*—Things needed: microscope, urine (put in a clear wineglass or bottle or tumbler), pipette or catheter, slide, cover, light, bibulant.

Suppose we have a case of *oxaluria.* Having previously decanted the clear urine and poured that portion containing the deposit into the urine glass, tumbler or bottle, note the situation of the deposit. Then holding the pipette between the right thumb and middle finger, close the upper end tightly with the forefinger. Bring the free end of the pipette near to the deposit in the urine, and then remove the forefinger. The hydrostatic pressure forces the deposit into the tube; next re-apply the forefinger. Withdraw the tube, and deposit on the middle of the slide *one* drop containing the sediment. Apply the cover to the drop. If the amount of liquid is rightly gauged, the capillary attraction will cause the cover to adhere, so that the slide can be turned in any direction, and the cover will not slip. If the cover does slip, absorb the excess of fluid by touching the edge of the cover with a blotter or dry cloth. The specimen is then ready for examination. Proceed, as in the case of the hairs, after bringing the deposit over the centre of the object, as near as possible.

Remarks.—Be sure the barrel of the microscope is pushed home against the tube of the stand. In the case of a delicate object like this, it is a good plan to turn the stage quite near to the objective; and then in focussing, it is only necessary to turn the stage off.

On having mastered the hair demonstration, the novice had better take off the specimen, when in focus, and prepare the urinary deposit, with the same slide and cover. Having accomplished this, the object comes into focus almost at once. There is, then, an advantage in the use of the same slide and cover for many examinations.

If *oxalate of lime* is present, beautiful and characteristic octahedral crystals will plainly appear. Once seen, they will not afterwards need identification.

Note.—It sometimes happens with such transparent objects as oxalate of lime, that the focussing is difficult. If so, move the slide so that the edge of the cover comes in the centre of the field. Focus it clear, and then move the deposit to the centre of the objective's face, and it will be readily focussed. Also, there is usually too much light with the clinical microscope. If so, the observer may retreat away from it, or darken the room by day time, so as to cut off cross lights.

Triple Phosphates (ammonia and magnesia).—These appear in large white and transparent crystals—common and harmless. Bright's disease—Urine coagulated by heat and nitric acid, large cylindrical bodies (casts), fattily degenerated epithelium, granular detritus, etc.

Ague plants.—These float in flocks half way down the column of liquid. Under the microscope, they appear as circular bodies with double periphery enclosing a clear interspace, with a central granular of green or red contents. (Species of Palmellae, described by Salisbury, see *American Journal Med. Sciences*, 1866; *Revue Scientifique*, Nov. 1869.)

(For other pathological bodies, see the systemic works.)

Remarks.—The following foreign substances, to be classed as *dirt*, are found in urine: Cotton, silk, linen and other fibres of textile fabrics, feathers, silica, woody fibres, bast, pitted cells, etc., yeast plants, and often fungi, etc.

Bacteria and Vibriones.—Keep urine for a few days until it stinks. Put a drop under the cover, removing the excess with a bibulant. Examined under the microscope, numberless minute swarming threads or rods, combined with dots, all in protoplasmic motion, will be clearly seen. If it is desired to amplify them more, attach to the stand a tube of 10 inches length, of pasteboard or of brass, whose diameter is sufficient to receive the eye-piece at one end, and at the other end to fit the barrel or tube of the microscope. Thus a greater distance of the eye-piece from the object is obtained, and consequently an enlargement of the object, on the principle of shadows lengthening as their course is removed from the source of light.

Note.—Bacteria are often confounded with the spores of entophytal (εντοσ within; φυτον, life or being) algæ and fungi. This department needs study more than any other, as there is so much difference of opinion amongst authorities. It is probably true that bacteria are mixed with the spores of the vegetation—for example, of a yeast in the case of the fetid putrefactive fermentative vegetation. In place of exhaling carbonic acid gas, they give off sulpho-hydric acid gas and other gases, possibly phospho-hydric; so that bacteria do not form all the bodies found in fetid urine. They are mingled with the spores of other vegetations in the same way as in a phanerogamous forest all the trees are not of the same species.

Urinological evidence must always be taken in connection with the rational and physical signs accompanying. At present, the urine receives more attention than any other excretion or tissue. There are others equally and more important.

To give anything like a complete idea of *urinoscopy* is out of the question. (See Beale's *Microscope in Medicine;* also, Richardson & Wyeth on the *Microscope.*) The following list of substances to be found in urine is taken from Beale, in addition to those already named: 1. Starches of different grains. 2. Fragments of tea leaves, spiral tissue and parenchyma. 3. Oil from catheter, milk or butter. 4. Mustard, cheese, potato skin, fruits. (These the student should study and know away from urine.) 5. Uric acid. 6. Cystine. 7. Carbonate of lime. 8. Sarcinæ (found at Fresh Pond and a lagoon at Oak Bluffs, Mass.). 9. Spermatozoa. 10. Casts of the seminal tubes. 11. Dumb-bell crystals of the oxalate of lime. 12. Casts of uriniferous tubes—epithelial, waxy, fatty, granular. 13. Chyle. 14. Urates. 15. Phosphate of lime. 16. Cancer cells, exudation corpuscles. 17. Small organic globules (Golding-Bird). 18. Granular matter, &c.

III. *Mouth.* This is a handy site for microscopic investigation. Take a clean slide and cover; gently scrape the upper surface of the tongue with the cover itself or with a knife blade, collecting only a small drop of not more than ¼ inch longest diameter; place the cover with the drop on the slide, or deposit a drop from the blade on the slide, covering as before. If properly managed, the cover will adhere to the slide, and it can be put in any position. Place this prepared slide on the stage and focus as described before. The following objects should be seen if the observation is made before or sometime after a meal, which scours off the tongue rapidly. 1. *Epithelial Cells.*—These are flat, wrinkled, irregularly squared bodies, with a nucleus or spot within. Sometimes there are two. They line the mouth, cover the tongue, and are found on all the mucous surfaces of the body (see systemic works). 2. Globes filled with granules actively moving with protoplasmic motions; also containing nuclei. These are *mucous corpuscles* with the famous Brunonian movements. They are a good test for an objective. To bring out well the dancing movements of the minute points is also a good test of the observer's powers. It would be well to lengthen out the tube as just described. 3. *Filaments of an Alga.*—Some call it a fungus vegetation that grows harmlessly with its host. The filaments are very delicate and subtile. It is known as the leptothrix buccalis. 4. *Masses of Spores* which may or may not belong to the leptothrix. 5. Some of the *papillæ* of the tongue. 6. Vegetations about the teeth from *decaying particles* of retained food. 7. *Foreign substances*, etc.

Mouth in Disease.—*Aphthæ* are examined by scraping off some portion of the white pellicle and depositing on a slide. It is then covered. If there is not enough moisture to hold on the cover, a small drop of water placed on the periphery will penetrate underneath the cover and hold it by attraction. If the specimen does not show filaments, spores and sporangia (spore cases), it may be from the fact that it is not teased apart enough. A layer of too great thickness can be thinned by tearing into small shreds by pins or needles. So, also, can the membrane in croup, or diphtheria, etc., be studied.

Sputa embrace not only the discharges from the mouth, but also from the pharynx, larynx, trachea and bronchial tubes. The productions of so large a territory with thousands of glandular structures, furnish a collection motley in disease. We name some: 1. Clear, structureless mucus, in which the form elements float. 2. Epithelial cells—pavement, cylindrical and ciliated. 3. Mucous cells, protoplasmic, and usually undergoing the amœboid (amœba means changing) movements. They appear in all sorts of weird, bizarre shapes, found best in acute bronchitis and catarrh. 4. Blood in pneumonitis and hæmoptysis. 5. Curling spiral pulmonary tissue (phthisis). 6. Fungi—vegetative mycelial (*μυκος*, mushroom) filaments, spores, sporangia. 7. Foreign substances inhaled in the air. 8. Calculi of the lung (Salisbury). 9. Asthmatos ciliaris in contagious colds. (See *Va. Med. Monthly*, Nov., 1878, and April, 1879.)

Nasal excretion contains mucous cells, concretions of more or less solidity, pus, blood, ciliated and non-ciliated epithelium, dirt, asthmatos ciliaris, vegetative filaments, pollen (hay-asthma), etc. The *tears* are remarkably free from any form elements; but in the contagious colds, the asthmatos ciliaris is found in the thick, ocular excretion by Salisbury. Epithelium, pus and blood are found in ophthalmiæ. Cataract is a good object on which to study fatty degeneration. I have found the fibres a darkly outlined, rough substance, granular, very much different from the clear hyaline fibres seen in health.

Ears.—Place the cerumen on a slide, with or without water or glycerine. In the amorphous substance, crystals of cholesterine, fungi, pus and blood are found. A drop of *milk* placed on the slide and treated as described above, shows a field full of globules of fat, all molecularly dancing and tumbling about in ceaseless motions. These are physical, not protoplasmic, movements. If the specimen be taken in the first flow of milk, the colostrum corpuscles will be seen as large, aggregated, compound globules.

Milk should present no foreign bodies. Swill milk presents such (Piper). Vegetations are readily developed in milk by keeping. It is an instructive study to examine milk often until it is soured. A few comparative examinations of milk of known purity will serve as a standard by which to judge the morphology of diseased or suspected milk. A microscopical should always go with a chemical analysis of milk. We are much indebted to the labors of Dr. Piper, of Chicago, for light in this direction.

Vaginal discharges furnish a field for the microscope. A drop is deposited as described. Cancer may be thus at times determined.

The detection of parasites, the establishment of virility of the husband in sterile marriages, the detection of syphilitic and gonorrhœal vegetations, the presence of spermatozoa in a case of rape, would be of value.

Fæces.—This is an extensive but not well-cultivated field. Macroscopic should precede the microscopic examination. A small piece of wood (toothpick) serves to deposit a minute portion on the slide; the cover holds usually without aid. Among the things to be seen are the eggs of intestinal worms—fermentative vegetations—epithelial cells in various stages of development (cholera). The best dissections of the spiral tissues of plants are obtained from the fæces by stirring up with water. Dr. Salisbury has cultivated this repulsive field, and is the best expert in this department that the writer knows of.

The *Skin* is a fruitful field of study. It may be wet with water and then rubbed with a knife blade, for example, and the collected drop may be mounted on the slide; or the scum of a bath-tub, after a bath without soap, may be studied. The following may be looked for: 1. Epithelium without nucleus. 2. Itch insects. 3. Fungi of skin diseases. 4. Foreign substances from the clothing, sweat and atmosphere, cryptogamic spores and filaments, cotton, silk, linen, woolen

2

and woody fibres, hairs, salts from sweat, starch grains, cystine, fat and fat acids from the sebaceous glands, sand, smoke products, coal dust, harvest bugs, ticks and other insects, vegetations of boils and carbuncles, bloody sweat, comedones, etc.

The study of histology belongs rather to the anatomist and the dissecting room. Still the clinician may study the characters of tumors, outgrowths, the contents of cysts, abscesses, etc., which are relieved by aspiration. It is easy to see the form elements of ovarian and fibro-cystic tumors. A drop, treated as before directed, will furnish a field. Though time has not verified Drysdale's ovarian corpuscle and Gluge's compound cells as diagnostic, still their characters are well worth studying. For making thin sections of tissues, they may be set in wax, paraffine or tallow, and cut with a well-sharpened razor—Seiler's cutter recommended.

The clinician should know the morphology of the air of respiration found in crowded rooms, ill-ventilated apartments, shops, hospitals, of districts infected with disease (contagious or not), of court rooms, of ague districts, of ships, prisons, of school rooms, of sewers, etc.

Methods.—1. Simple exposure of slides smeared with glycerine in the apartments named. 2. Arrange a funnel on a vane, so that the wind will always blow through the nose on to the slide placed against it. 3. Aspiration by air sucked or blown over or against the prepared slide. 4. Fill a glass bottle or other vessel with a mixture of salt and ice. An examination of the drops of water that collect on the outside will furnish some of the forms of matter that float in the atmosphere. 5. Blow air through cotton fibre, which remarkably arrests foreign aerial bodies; examine the cotton directly, or wash it with water that is known to be free from forms of life or mineral matter, or with which the observer is familiar. It should never be forgotten that air is food, and should be pure.

VEGETABLE FOOD.—*Starch.*—Scrape a small portion of the pulp of a *common potato.* Place it on a slide; add a minute drop of water; cover, and treat as before described. The beautiful grains of starch will clearly appear. Once seen, their form cannot be forgotten by the careful observer.

Wheat.—Place a drop of water on a slide; stir in a minute portion of flour; rub with the flat surface of a common case knife into a uniform mixture; then examine with the microscope. The forms of the starch grains will be seen to vary much from those found in the potato. The same processes applied to rye, oat, corn (maize), barley, sago, tapioca, etc., will give a clear idea of starch and amyloid bodies. In case the cellulose coverings of wheat are examined as found in real Graham flour, dark cells, set like bricks in mortar, are the so-called "gluten cells," on which so much stress is rightly laid as being true nerve food. The changes that occur in cooking is strikingly shown in beans. One has only to make a section of the bean before cooking and compare it with a portion of the same after baking, for example, to satisfy himself on this point. This list might be extended indefinitely; but it is believed that enough has been indicated to show how much work can be done with this simple clinical microscope by the practical man.

With a brief allusion to the examination of the *blood* we close. The clinical examination of blood is a matter of great importance. The profession is indebted to Dr. J. H. Salisbury for opening up a new physical means of diagnosis by the inspection of the blood under the microscope. The field is so new that some find it easier to ignore it rather than to study it in detail. I am not prepared to say that everything that Dr. Salisbury has pointed out (some 67 states, conditions and products) are just as he describes; but I can say that in everything he has attempted to point out to me, personally, in the course of 12 years, he has succeeded in doing. I think I am doing no wrong to ask the profession to attend to what I have to say and to show, especially as I state nothing but what I believe to be the truth, and have demonstrated, to my own satisfaction if not to others. (*Vide* "Blood Examinations," by Dr. Salisbury; published by Moorhead, Bond & Co., New York, 1868. Also, a paper on the Morphology of Diseased Blood. *Southern Clinic*, March, 1879.)

Preliminaries.—It is necessary to have the patient, the microscope, the light, the means of withdrawal of the blood (a lancet—spring lancet—the scarificator of the writer, a needle, which is not the best thing) all together. There is no such thing as taking the blood home to examine. The changes are so rapid that most of the important ones disappear in ten minutes time. Still, after these are gone, many valuable points remain to be looked for.

Kind of Blood.—The capillary—not the venous nor arterial.

Site of Withdrawal.—On the radial edge of the forearm between the wrist and elbow. The skin should be clean and free from hair. If dirty, wash with soap suds or ammonia water.

Note.—It is well that the beginners should study the skin surface, dirt and epithelium, before looking at the blood. Take the patient's forearm in the hand and make the skin tense in the interval between the thumb and forefinger. A quick puncture is then made about one-eighth of an inch deep. The tension of the grip will squeeze out a drop of blood. The size of the drop should bear a direct relation to the size of the cover. If of the right size, the blood will diffuse itself uniformly between the cover and slide. The cover will not slip. If there is too little blood, the corpuscles will become crenated—that is, wrinkled from a sort of protoplasmic action induced by too much dryness in the space about the blood. If there is too much, the superfluity will float the cover about; there will be too much thickness of the film, and it will crowd the red corpuscles so much as to render them indistinguishable. The excess must be removed by a bibulant. Very much depends on handling the drop of blood rightly. When the drop evenly diffuses itself, it is presumed that the film is about uniform in thickness, so that one can judge somewhat as to the comparative number of corpuscles in each specimen. The process of transferring the blood should not take but a few seconds of time; a fraction should be sufficient.

Of course, the slide and cover should be previously cleaned, and also the microscope should be free from dirt and in focus, as after a previous use. If the blood specimen is quickly placed on the stage, it will be in focus at once, and the rapid movements, changes, and morphological elements will be visible.

The novice had better scrutinize carefully everything he sees—not caring whether he knows the name of the object or not. The following is the Salisbury plan :

For our purpose, we will divide the field into three divisions. (1.) The colored corpuscles. (2.) The colorless corpuscles. (3.) Serum.

Note the following about the *red corpuscles:* (1.) In normal proportion. (2.) In excess. (3.) In diminished quantity. (4.) Normal consistence. (5.) Too soft, plastic, and sticky; adhering together and being drawn out in thread-like prolongations. (6.) Nummulated, like rolls of coin. (7.) Not nummulated. (8.) Evenly and loosely scattered over the field. (9.) Slightly grouped. (10.) In irregular, compact masses. (11.) In ridges. (12.) Holding firmly the coloring matter, yet soft and plastic. (13.) High-colored, smooth and even in outline, hard and rigid. (14.) Allowing the coloring matter to escape freely, obscuring their outlines. (15.) Mammilated.

As to *colorless corpuscles*, note if they are (1) In normal proportion. (2) In too small quantity. (3) In excess. (4) Normal in quantity, sticky and plastic, endangering the formation of thrombi and emboli. (5) Ragged and broken down. (6) In excess ragged and broken. (7) In excess, smooth and even. (8) Containing vacuoles. (9) Containing vegetations that distend them to an enormous size.

As to *serum*, note (1) Too little. (2) Too much. (3) Normal. Also, the following foreign matters: 1. Minute grains and ragged masses of black, blue, brown or yellow pigment. 2. Fat. 3. Amyloid matter. 4. Broken-down parent cells. 5. Thrombi of fibrin, filled or not with granular or crystalline matters. 6. Thrombi of algæ spores. 7. Thrombi of algæ filaments. 8. Algæ filaments and spores without aggregation. 9. Fungi spores. 10. Fungi filaments. 11. Oxalate of lime. 12. Crystine. 13. Phosphates. 14. Stelline. 15. Stellurine. 16. Granules and crystals of a miscellaneous character. 17. Conchoidine. 18. Pigmentine. 19.

Eucine. 20. Creatine. 21. Uric acid and urates. 22. Inosite. 23. Zymotosis regularis spores. 24. Zymotosis regularis mycelial filaments. 25. Entophyticus hæmaticus spores. 26. Spores of mycelial filaments. 27. Penicillum quadrifidum spores and mycelial filaments. 28. Penicillum botrytis infestans.

To cite a specific example, take *syphilis* (see *American Journal Medical Sciences*, April, 1867): If the novice takes a well-marked case in the later stages, and collects the blood as designated, he will find that the white corpuscles are enlarged and distended with the entophytal growths; also, some cylindrical, smooth, uniform, clubbed at the ends, mycelial filaments of crypta syphilitica, which are copper-colored when slightly turned off from the focus; also, if the light is good, small spots will appear in profusion, which must be distinguished from globules of fat, that are copper-colored, and have the protoplasmic movements of ordinary spores, to wit.: they dance about in the serum spaces; and besides, their lateral movements, which might be taken for physical motions, they locomote often, moving by each other in opposite directions. Also, they may be seen to dissipate under the eye and be lost to the vision. Moreover, they are seen inside the white corpuscles to be of a red color. I have found the copper-colored spores and enlarged white corpuscles in all cases that I have examined. The filaments are not so readily found. Whatever else may be said of this diagnosis, I can say for myself that I have found it invaluable in my own practical experience. I have been able thus to treat cases that otherwise would have baffled me. I don't think that the value of this physical exploration can be too highly estimated.

The Pre-Embolic State.—(See *Chicago Medical Journal*, Feb., 1879.) If the blood of a rheumatic is examined often, there are found, according to Dr. Salisbury (*American Journal Medical Sciences*, October, 1867, page 350), microscopic thrombi (Figure 5, page 376, *ut supra*). The nucleus of these is a collection of white corpuscles, a collection of crystals, &c. They form skeins like a sailor's fancy coil of rope, or masses irregularly rounded and pointed, like a boy's **A** kite. Now these thrombi, of a microscopic character, are found in the blood long before there are any signs of embolism. They are quite large and easily distinguished. The attention of the novice is directed to this as an important point in all respects.

Rheumatism.—(See *American Journal Medical Sciences*, October, 1867.)

Ague.—(See *American Journal Medical Sciences*, October, 1866.) To collect the ague plants in the natural habitat, I have found an easy task. During the month of August, visit an ague locality; examine the surface of earth that has been spaded up within a month; note the fine white dust, as if the earth had been sprinkled with fine salt. Take a minute portion of this dust; place it in a slide; add a drop of water; rub up with a knife-blade, cover, absorb the excess with a bibulant, and then place under the microscope. The field will be found swarming with millions of spores. These are small, minute dots, that dance with ceaseless motions to and fro, here and there, yet never jostling each other. If this motion is compared with that found in milk, the difference will be seen between the molecular motions and the protoplasmic. Scattered here and there, will be seen round bodies like a coin, twice the size of a red blood corpuscle, with an outer wall next a clear space, then another wall and next the protoplasmic contents. These are fully described in the *American Journal Medical Sciences* (*loco citato*). If the observer will scrape a very minute portion of the soft, spongy, sometimes greenish, surface of the banks of some streams in the ague districts, he will secure some fine specimens of the plants Dr. Salisbury has so well described. Be not discouraged if you don't get them at first.

Allow me to relate a bit of my own experience. Soon after Dr. Salisbury's paper appeared, I wrote to him to send me some earth. He did so. I labored on it for some time, but without getting a single specimen. I inferred that I was wrong—not the author. So I went 700 miles and carried a box of the earth, to have the discoverer show me, in person, just how he collected the plants. He took my box and, in a few seconds, displayed the forms under the microscope just as he had described. My trouble was that I took too large a quantity of material.

In thus confessing my own incompetency, and its speedy disappearance under the eye of the master, the writer would like to suggest to those who should follow the procedures that I have laid down in this primer, and should not succeed, that the trouble must not be laid to the writer too strongly, as the printed page is but a poor substitute for the kindergarten mode of instruction. As long as the writer cannot be favored with the personal presence of the pupils, he has done the best he could.

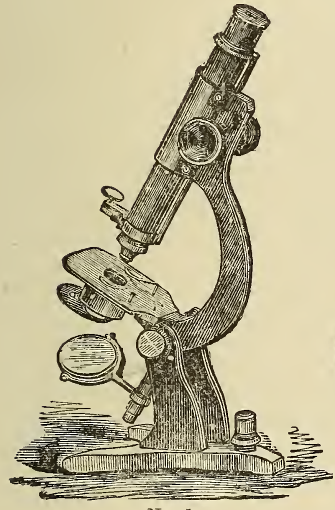
In closing, allow me to say that Dr. Salisbury, after demonstrating the presence of the plants in the soil, showed to me afterwards the plants in the blood of a patient (the blood was drawn in my presence), in the urine, and in the sputa.

Having much exceeded the limits of my primer, I must close by saying that the presentation has been, of necessity, very laconic and brief. Perhaps it may answer as a fit step for some mind in the profession who is in earnest in his battles with disease. I hope that the microscope may not be relegated to the younger members of our profession alone. It is an instrument for old age. Ehrenburg worked with his microscope up to a few days of his death. The focussing accommodates the defects of vision. Moreover, it is a comfort and a solace to an aged physician to quietly explore the mysteries of the unseen world he has been dealing with macroscopically during a long and laborious life. May it be a good preparation for that endless life where we shall no longer see through a glass darkly!

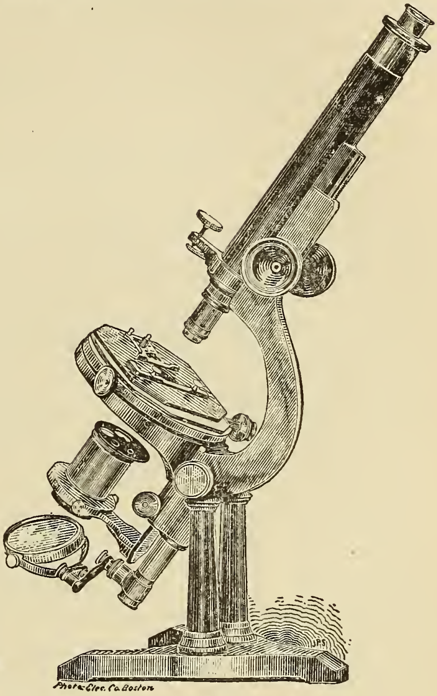
Tremont Temple, 1879.

POSTSCRIPT.

This primer is merely a prelude to the systematic works. So is the Clinical Microscope. When this has been mastered the student may essay either the student's stand (see cut No. 1) or the magnificent B stand of Tolles (see cut No. 2).



No. 1.



No. 2.

The following works are recommended and for sale by CHARLES STODDER:—

Micrographic Dictionary	$21 00
Carpenter on the Microscope	5 00
Hogg	3 00
Frey, Microscopical Technology	4 00
Newcomb, Popular Astronomy	4 00

Subscriptions received for the following Periodicals:—

Journal Royal Microscopical Society, London, bimonthly	6 00
Quarterly Journal Microscopical Science	5 00
Journal Quekett Microscopical Club (irregular), per number	40
Science Gossip, London, monthly, contains articles on Microscopy	1 50
Cincinnati Medical News, monthly, has a Microscopical Department	2 00
American Monthly Microscopical Journal	1 00

TO THE FOLLOWING GENTLEMEN

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MY ASSOCIATES IN THE

AMERICAN INSTITUTE OF MICROLOGY.

WHICH HAS BEEN ORGANIZED
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A NEW SCHOOL OF THE MICROSCOPE.

Lists of the Works of these Authors to July, 1878.

Published Works and Papers

—OF—

J. H. SALISBURY, A. M., M. D.

1. Analysis of Fruits, Vegetables and Grains. N. Y. State Geological Reports. 1847-48-49.
2. PRIZE ESSAY.—Chemical Investigations of the Maize Plant in its various stages of growth, with the temperature of the soil at various depths, and that of trees in different seasons of the year. 206 pages. State Agricultural Reports of N. Y. and Ohio. 1849.
3. Chemical Analysis of Five Varieties of the Cabbage. 1850.
4. Rheum rhaponticum. Chemical examination of the various parts of the Plant. 1850.
5. Chemical Examination of Rumex crispus. 1855.
6. Experiments and Observation on the Influence of Poisons and Medicinal Agents upon Plants. 1851.
7. Chemical Examination of the Fruit of five (5) varieties of Apples. 1850.
8. Chemical Investigations connected with the Tomato, the Fruit of the Egg Plant, and Pods of the Okra. 1851.
9. History, Culture and Composition of Apium graveolens and Cichorium intibus. 1851.
10. Some Facts and Remarks on the Indigestibility of Food. 1852.
11. Compositions of Grains, Vegetables and Fruits. Ohio State Agricultural Reports. 1861.
12. Microscopic Researches, resulting in the discovery of what appears to be the cause of the so-called "Blight" in Apple, Pear, and Quince Trees, and the decay in their fruit; and the discovery of the cause of the so-called "*Blister and Curl*" in the leaves of Peach Trees; with some observations on the development of the Peach Fungus. Illustrated with 6 plates. Ohio State Agricultural Reports. 1863.
13. Chronic Diarrhœa and its Complications, or the diseases arising in Armies from a too exclusive use of Amylaceous Food, with interesting matter relating to the Diet and Treatment of these abnormal conditions, and a new Army Ration proposed with which this large class of diseases may be avoided. The Ohio Surgeon General's Report for 1864.
14. Something about Cryptogams, Fermentation and Disease. St. Louis Medical Reporter. February, 1869.
15. Probable Source of the Steatorzoon folliculorum. St. Louis Med. Reporter. January, 1869.
16. Investigations, Chemical and Microscopical, resulting in what appears to be the Discovery of a New Function of the Spleen and Mesenteric and Lymphatic Glands. Do., Aug., 1867. 29 pages.
17. Defective Alimentation a Primary Cause of Disease. Do. March and April 1 & 15, 1868. 70 pages and two plates of illustrations.
18. On the Cause of Intermittent and Remittent Fevers, with Investigations which tend to prove that these affections are caused by certain species of Palmellæ. Am. Jour. Med. Sciencs, 1866. Also in Revue Scientifique. Nov., 1869.
19. Some Experiments on Poisoning with the Vegetable Alkaloids. Am. Journal Medical Sciences. Oct., 1862. 28 pages.
20. Discovery of Cholesterine and Seroline as secretions in health of the Salivary, Tear, Mammary, and Sudorific Glands; of the Testis and Ovary; of the Kidneys in Hepatic Derangements; of Mucous Membranes when congested and inflamed, and the fluids of Ascites and that of Spina Bifida. Do., April, 1863. 2 plates. 17 pages.
21. Remarks on Fungi, with an account of Experiments showing the influence of the Fungi of Wheat and Rye Straw on the Human System, and some observations which point to them as the probable source of Camp Measles, and perhaps of Measles generally. Do., July, 1862. 1 plate. 20 pages.
22. Inoculating the Human System with Straw Fungi to protect it against the contagion of Measles, with some additional observations relating to the influence of Fungoid growths in producing disease, and in the Fermentation and Putrefaction of Organic Bodies. Do., October, 1862. 8 pages.
23. Parasitic Forms Developed in Parent Epithelial Cells of the Urinary and Genital Organs, and in the Secretions. With 34 illustrations. Do., April, 1868.
24. Remarks on the Structure, Functions and Classification of the Parent Gland Cells, with Microscopic Investigations relative to the causes of the several varieties of Rheumatism, and directions for their treatment. 1 plate of illustrations. Do., Oct., 1867. 19 pages.
25. Microscopic Researches relating to the Histology and Minute Anatomy of the Spleen and Lacteal and Lymphatic Glands, showing their ultimate structure and their organic elements, of their highly interesting and important functions, with some remarks on the cause of ropiness of Mucus and the tendency of all healthy and many diseased cells to be metamorphosed into filaments. 1 plate. 34 pages. Do., April, 1866.
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30. A New Carbonic Acid Apparatus. Do. 1853.
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34. Microscopic Examinations of Blood and the Vegetations found in Variola, Vaccine and Typhoid Fever. 66 pages and 62 illustrations. Published by Moorhead, Bond & Co.: New York. 1868.
35. Vegetations found in the Blood of Patients suffering from Erysipelas. Halliers Zeitschrift fur Parasitenkunde. 1873. 8 illustrations.
36. Infusorial Catarrh and Asthma. 18 illustrations. Do., 1873.
37. Analysis, Organic and Inorganic, of the White Sugar Beet. The Albany Cultivator. Oct., 1851.
38. Analysis, Organic and Inorganic, of the Parsnip. N. Y. State Ag. Report. 1851.
39. Ancient Rock and Earth writing and inscriptions of the Mound-builders, with a description of their fortifications, enclosures, mounds and other earth and rock works. 49 plates In the hands of the American Antiquarian Society, and only partially published in their transactions and in the Ohio Centennial Report. 1863.
40. Influence of the position of the body upon the Heart's action. Am. Jour. Med. Scien. 1865.
41. Material Application of Chemistry to Agriculture. Albany Cultivator. 1851.
42. Analysis, Organic and Inorganic, of the several kinds of Grains and Vegetables. The Albany Cultivator. Aug., 1849.

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1. Diphtheria, its Cause and Treatment. 3 plates of illustrations. 1862.
2. Asthma, the various forms of, and their causes and treatment. 3 plates of illustrations. Ready for press since 1866.
3. Consumption, its causes and treatment. 4 plates. Ready for press in 1867.
4. Hog Cholera, its Cause and Prevention. 1858.
5. Ultimate Structure and Functions of the Liver. 1865 3 plates.
6. Ultimate Structure and Functions of the Kidneys. 1864. 2 plates.
7. Geological Report of the Coal Fields of Virginia and Kentucky. 1857. With maps and many illustrations.
8. Histology of Plants. Prize Essay. 65 illustrations. 1848.
9. Causes and Treatment of "Bright's Disease." 1865.
10. Causes and Treatment of Diabetes. 1864.
11. Causes and Treatment of Goitre, Cretinism, Ovarian Tumors, and other Colloid Diseases. 1863.
12. Causes and Treatment of Progressive Locomotor Ataxy. 1867.
13. Cause and Treatment of Fatty Diseases of the Heart, Liver and Spleen. 1864.
14. Cause and Treatment of Paresis. 1865.
15. One of the most Common Causes of Paralysis, with Treatment. 1867.
16 Microscopic Examinations connected with Spermatozoa and Ova, with contents of pollen Grains and modes of development of Zoosporoid Cells. 1860.
17. Cryptogamic Spores in the Tissues of the Living Animal. Their development in food one source of disease, and a cause of fermentation, gangrene or death and decay in organized bodies. 7 plates and 102 illustrations.
18. Microscopic Investigations connected with the Exudation and Expectoration of Angina membranacæ and Gangrenosa and Scarlatina Anginosa, resulting in the discovery of the true source of and the pathological process by which the exudations are produced; and the further discovery of a peculiar fungus belonging to the Genus Peronospora, developing in the sloughs and membranes, the spores of which are infectious and produce the disease; also some general conclusions on the Ætiology of Fevers, the peculiar functions of the Epithelial cell envelope, and the probable way in which the system receives a more or less permanent protecive immunity by one attack of certain contagious diseases against a second invasion of the same. 3 plates. 160 illustrations. 1862.
19. Description of several new species of Ascaridæ found on and in the human body, and a brief account of several new Entozoa. 2 plates and 30 figures. 1865.
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List of Writings Published by

Dr. GEO. B. HARRIMAN.

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1. Free Mercury in Vulcanite. Dental Cosmos. March, 1870.
2. The Discovery of Cells with Fibres in the Dentine at the Junction of the Enamel and Cementum. American Journal of Dental Science. May, 1870. Illustrated.
3. The Effects of Animalcules on the Teeth. Do. Nov., 1870. Do.
4. The Discovery of Nerve Fibres in the Soft Solids of the Dentine. Dental Cosmos. Jan., 1870.
5. Bone Fibrous. American Journal Dental Science. Illustrated. June, 1871.
6. The Structure and Development of the Teeth. Dental Register. July, 1872. Illustrated.
7. The Period when the Teeth Begin to Form. Do. August, 1872.

8. Is the Dentine Tubular? Do. September, 1872. Illustrated.
9. The Dentine Cellular and Fibrous. Do. 1872. Illustrated
10. What Will Make Good Teeth? Do. Nov., 1872.
11. What Makes Teeth Decay? Do. 1874.
12. Anæsthetics—Three Deaths from Chloroform and Ether. Do Dec., 1874.
13. The Microscope in Analysis. New Bedford Mercury. January, 1872.
14. The Microscope. Dental Register. March, 1874.
15. Anæsthetics. Do. January, 1875.

UNPUBLISHED.

16. The Use of 1-75 Objective in Micro-Chemical Examinations of Blood Stains.
17. Professional Success.
18. The Fifth Pair of Nerves.

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1. Case of Thoracentesis. Boston Med. and Surg. Journal. 1857.
2. Dr. N. R. Smith's Anterior Splint. Mass. Med. Society. Com. 1858.
3. Report on the Zymoses of 1857 as they occurred in the Middlesex East District Medical Society. Do.. 1858.
4. Report on the Veratrum Viride, in connection with Truman Rickard, M. D., and W. Ingalls, M. D. American Journal Med. Sciences. Jan., 1858.
5. Do., do., 1860. Second Report.
6. Experiments with Animal Vaccination. B. M. and S. J. 1860.
7. On Kerosolene as an Anaesthetic. Do. 1860.
8. On the Laryngoscope and Rhinoscope. Do. Vol. LXIX., No. 20, page 389.
9. Veratrum Viride. London Lancet. 1862.
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11. Veratrum Viride. London Medical Sciences and Gazette. 1862.
12. Emploi Therapeutique du Veratrum Viride. Gazette hebdomadire de Med. et de Chemique· Paris, 1862. Also in Pamphlet form
13. Veratrum Viride. Rankins' Abstract. London, 1862.
13. Practical Uses of the Laryngoscope and Rhinoscope in Diagnosis. B. M. and S. Journal. Several papers. 1866-7.
15. Case of Aphonia cured by extirpation of a neoplasm on the vocal cords by laryngotomy. A. J. M. S. Oct., 1866. Remains so. 1878.
16. Apparatus for Bedridden Patients. Do. Jan., 1867.
17. On the Apparatus for the Nebulization of Medicinal Substances. M. and S. Reporter. Phila. Vol. XV., No. 3, page 60. Also Com. Connecticut Med. Society. 1866.
18. On the Contemporaneous Investigation of Therapeutical Substances. B. M. and S. J. 1863.
19. Case of Nephritic Calculus Complicating Labor. B. Jour. Chemistry. 1867.
20. On the Attachment of Sponge to Metallic Bougies. Do. 1868.
21. Reports of the Midd. East District Med. Society. Several published. B. M. and S. J. 1857-68
22. On the Normal Condition of the Eustachian Tube. Do. Feb., 1867
23. Veratrum Viride as a Therapeutical Agent. Pamphlet. Riverside Press, H. O. Houghton & Co. Cambridge. 1862.
24. Modes of Administration of Systemic Anaesthetics. B. M. & S. Jour. Vol. LXXVI. p. 117.
25. Contribution to the Treatment of Retroversion of the Uterus. Do. Nov. 26, 1868.
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27. How to Vaccinate with the Crust from Kine. B. Jour. Chemistry. Sept., 1868.
28· Carbolic Acid. Do. Oct., 1868.
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