

sure in the cylinders is down to 60 or 70 pounds, I do not have such good results. In that condition they are generally sent to Detroit—only 40 miles distant—and filled to 200 pounds pressure.

With this simple outfit I illustrate my lectures on Histology. A transverse section of the spinal cord of a pig can be enlarged to ten feet in diameter on the screen. To show the nerve-cells a power of 500 diameters is easily obtained. The cells will show so clearly that their poles can be counted and their nuclei clearly discerned. Sections of injected kidney, liver, intestine, etc., show very clearly and beautifully as well. Sections of cancer will show the stroma and cells. Pneumonia lung will show air cells six inches in diameter more or less filled with the exudate.

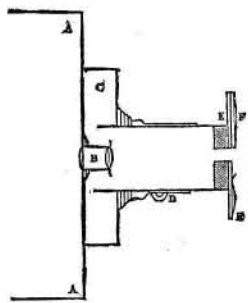
One of Dr. A. Y. Moore's double-stained blood slides will show the individual corpuscles and their nuclei at a distance of 20 feet from the screen very clearly. This is true with a disk six feet in diameter. The striæ and sarcolemma of muscle can be exhibited also. The circulation of the blood is simply no trick at all. I have exhibited this, using the tongue of the frog, on a disk 12 feet in diameter.

By a simple device opaque specimens are thrown upon the screen. In this way a frog is pithed, the thoracic walls removed, and the heart beating *in situ* exhibited. The heart will appear about a foot in length and will powerfully contract, stimulated by the heat of the light. The heart may be removed from the body, pinned to a card, and this thrown on the screen, still there is vigorous motion.

Again the heart may be halved and quartered, yet still the pieces will be seen to contract. No complex or wonderful apparatus required. Two hundred dollars and a little patience and ingenuity will go farther than some fifteen hundred dollar outfits.—*The Microscope*.

PHOTOMICROGRAPHY WITHOUT A MICROSCOPE OR MICROSCOPIC OBJECTIVE.

WE took a small Ross "postage stamp lens" we possess, and fitted it on to the front of a copying camera capable of extending to twenty-eight or thirty inches. This lens we may, in passing, explain is nothing more or less than a portrait combination in miniature. It is something under three-quarters of an inch in diameter, and about one and three-quarters of an inch equivalent focus. To use it for our present purpose we, of course, required something to support the object to be photographed, at the same time permitting its being adjusted in any position, and also capable of being used as a rough means of focusing or regulating the size of the image; in fact, to take the place of the stage of a microscope had one been employed. This is how it was accomplished. On the front of the camera we fitted a shallow box after the manner of an "elongating cone," and on this was screwed the mount of a quarter-plate portrait combination from which the glasses had been removed. In the place occupied by the front lens was fitted a plug of wood, on which was glued a flat piece of mahogany three inches by four, and a quarter of an inch or so thick. A hole, an inch in diameter, was then made with a center bit through the two pieces of wood corresponding with the axis of the small lens. A couple of flat brass springs screwed on to the mahogany served to hold the microscopic slide in position. This completed the arrangement. By this simple contrivance, which any one can make for himself, we had the rack and pinion of the portrait lens to focus with, which gave us a range of about one and a quarter inches—quite suf-



A A, camera front. B, miniature lens. C, elongating front. D, quarter-plate lens mount. E, stage. F F, springs to hold the object slide in position.

ficient for all purposes with the lens we were using. The annexed diagram, showing the arrangement in section, will make it better understood.

The light was condensed upon the object by an ordinary bull's eye condenser, the source being a single wick paraffine lamp. It may here be explained that in all cases where a photographic lens is employed, unless it be symmetrical in its construction, the posterior glass should be arranged next the object to be photographed. The class of objects we experimented with were familiar ones, such as the sting of a wasp, the tongue and the eye of a fly, tongue of drone fly, etc., and we found the definition given by this lens was as fine and crisp as anything that could be desired—quite equal in the center to that given by a very good inch objective in our possession, while at the margin of the image it was far more perfect. This was scarcely to be wondered at when we consider that it was longer in focus, and that a photographic lens is corrected to give an image on a flat surface, and not on another lens. With regard to the size of the image obtained, we may as well mention here that with the camera we employed, when fully extended, the tongue of the blow-fly measured about two inches and a quarter to two and a half inches—a very suitable size for the magic lantern.

We next proceeded to test some other lenses for the purpose, having modified our fittings to suit them. One of a pair of single lenses of French make, three and a quarter inches focus, which, when employed as a wide angle landscape lens for stereoscopic pictures gave capital definition, was next tried; but it proved useless for our present purpose, as it would not produce a crisp and well defined image, although stopped down equal to *f*. 45. At this we were somewhat disappointed, considering the exceedingly sharp pictures we had taken with it.

The next lens we experimented with was a small portrait combination, about three and a quarter inches equivalent focus, and an inch in diameter—a "locket lens" of French manufacture. This, when stopped down to half an inch, gave very fair definition indeed; but by no means so crisp as that by the Ross lens with its full aperture.

We next took a double combination stereoscopic lens of English manufacture, of large aperture and about four and a quarter inches equivalent focus, such as are made for

"instantaneous" work. This gave admirable definition on all portions of the image; but, owing to its length of focus, it was not suitable for such small objects as we had tested the other lenses upon, as the image was too diminutive unless the camera be inconveniently long. But for objects of larger size, however, it answered perfectly.

We had now exhausted our stock of short focus lenses, but there is one other we should have liked to have tried for the benefit of our readers if we had had one, namely, the smallest size "portable symmetrical," which is about three inches equivalent focus; as we know these lenses are capable of yielding exceedingly fine definition, they would doubtless be found very suitable for photomicrography.

In our experiments we employed a camera, as in this instance it was more convenient to do so; but it is manifest that by fitting the apparatus shown in the diagram inside a box, as in Mr. White's arrangement, it may be dispensed with—indeed, in actual practice, we ourselves never use one. Although, as our experiments prove, many photographic lenses of short focus may with advantage be employed for the delineation of microscopic objects, it must not be taken for granted that all can simply because they are of short focus; for it is clear that, unless they are capable of yielding the very finest possible definition, they are worthless for the purpose.

The lenses of our best English opticians, as a rule, fulfill this condition; hence they can generally be relied upon. The so-called "gem lenses" would be very suitable indeed, so far as focal length is concerned, although we have not tried them for the purpose; we imagine, however, from the price at which they are sold, they cannot be very perfectly corrected instruments.

It must not be assumed that photographic lenses can ever be made to take the place of object glasses of high powers for the delineation of very minute objects, as their defining power will not be sufficient; and, even if it were, the distance at which the prepared plate must be from the object would be so great as to render it impracticable. But, for the more popular familiar objects, such as *acari*, parasites, tissues, etc., or for such objects as low powers of an inch or lower, they, if good, will answer quite well, and possess some advantages over the microscopic objective. They have no chemical focus, which most object glasses of low power have. They can easily be stopped down, so as to obtain depth of definition when the object is not a flat one, as in the case of photographing some of the larger objects. Indeed, for practical purposes a well corrected photographic lens of short focus will be found more convenient to use, and will often give a better result photographically than many microscopic objectives of low power.—*British Journal of Photography*.

A LABORATORY FILTER PRESS FOR RETAINING THE MOST FINELY DIVIDED PRECIPITATES.

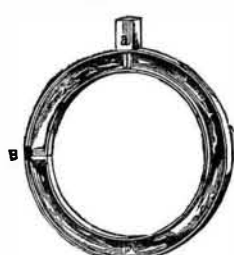
By JERVIS EYRE FOAKES.

It may be of some interest to those acquainted with the various apparatus for filtering, to learn the result of some experiments performed by a filter press, constructed on what appears to be an entirely new principle.

With several substances, whose nature has rendered them scarcely possible to filter by the ordinary process, have with the greatest ease been separated from the liquids in which they were suspended.

The apparatus consists of a solid flat glass ring (Fig. 1)

FIG. 1.

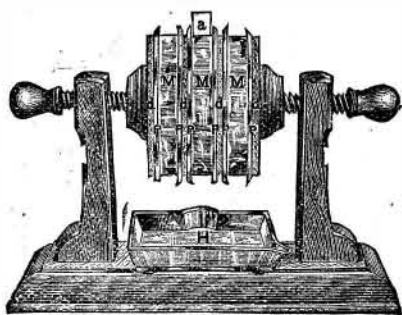


a, inlet. B, hole for the escape of air whilst the press is filling.

5 inches in its internal and 6 inches in its external diameter; thus leaving a surface or band of $\frac{1}{4}$ inch on each side, which is ground perfectly even, and parallel to the opposite side. The breadth of the ring is generally about 1 inch, but may be less, when the liquid contains little solid matter, and where the formation of a solid cake is not so much the object as quick filtration.

A diaphragm of plate glass 6 inches in diameter, whose surface is covered by a filter paper, or fine linen cloth, projecting about $\frac{1}{4}$ inch beyond the whole circumference, is placed on each side of the ring, the flat band of the ring pressing the paper or linen against the diaphragm.

FIG. 2.



M M, glass rings. d d, diaphragms. a, inlet for liquid to be filtered. P P, filter-papers.

The ring and diaphragms are then screwed tightly together in a wooden or iron stand by means of two screws having a flat-disk of wood at their end. A series of rings, with their corresponding diaphragms (Fig. 2) may be used instead of one; but in this case it is necessary that three or four holes be made through each diaphragm and its covering, to allow the liquid to pass into the adjacent ring, each hole being opposite to the one in the next diaphragm.

A tube is attached to the knob (a, Fig. 2) to admit the liquid to the interior of the rings, which is supplied continuously while the press is working by a pipe leading from

a sufficient height to produce the necessary pressure, the amount of this pressure varying with the elasticity and fluid state of the substance to be dealt with.

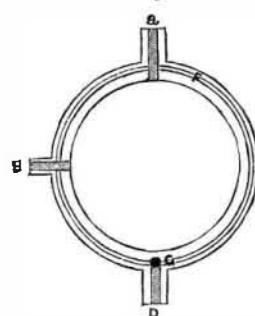
Directly pressure is applied filtration commences, all the insoluble matter being left in the hollow of the ring, or rings, while the soluble contained in the filtrate passes laterally, or radially, outward along the faces of the diaphragms, to the circumference, and finally escapes, running down the outside of the press into a vessel (H, Fig. 2) placed beneath to receive it.

The flow from the press depends on the number of rings, their diameter, the kind of covering placed on the diaphragm, the pressure at which the liquid is supplied, and the nature of the substance under treatment.

Filtration is produced not only along the flat band of the ring, as might be imagined, but is evenly distributed over the surface of the filtering material; for, upon examination of the paper or cloth after the press has been working for a short time, it will be noticed that there is a deposit of equal thickness over the whole surface of that part of the covering which is exposed to the liquid inside the press.

Where it is of importance that the liquid should not be exposed to the action of the air during filtration, a groove (F, Fig. 3), $\frac{1}{4}$ inch in depth, is made in the flat band, and a hole (G, Fig. 3) is drilled through the rings, diaphragms,

FIG. 3.



and the material with which they may be covered, connecting all the grooves in the series with a single outlet (D, Fig. 3) at the bottom of the press.

For general use, where presses of large diameter are required, the ring is dispensed with, and its place is supplied by a buffing, or band of cotton, sewed round the edges of the diaphragms; the whole surface, including the buffing, being covered by the linen cloth. In cases of this kind the diaphragms are made of metal, or whatever material is best suited for contact with the body to be filtered.

Where large quantities of a fluid have to be passed through the press at high pressure, it is preferable to employ the direct action of steam rather than that of a force pump; for ordinary purposes a pressure from 10 lb. to 60 lb. to the square inch is sufficient, but this may if necessary be increased to as much as 120 lb.

It is believed that this press has not till lately been applied to laboratory work, and it appears probable that by some slight alterations with regard to size and shape, it may become a great assistance in the collecting and washing of precipitates in quantitative analysis.

This press has been patented, and is known commercially as Bowing's filter press.

With a small laboratory press, the following results were obtained in the laboratory of King's College. The ordinary filter papers were used, and in none of the experiments had the liquid to be passed through more than once.

1. *Barium Sulphate*—precipitated from a cold neutral solution; filtered to a clear liquid.
2. *Precipitated Sulphur* (without boiling); filtered to a transparent liquid.
3. *Sulphide of Nickel*, prepared by precipitating nickel sulphide with excess of ammonium sulphide, producing a muddy brown liquid, which passes through an ordinary filter; filtered to a clear yellow.
4. *Guaiacum Resin*—dissolved in alcohol, and a few drops added to a large proportion of water, yielding a milk-white solution; also filtered to a clear liquid.
5. *Faraday's Gold*—preparing by dissolving 1 grain of gold in *aqua regia*, evaporating to dryness, and adding a quart of water to the chloride obtained. On adding phosphorus dissolved in ether, and gently heating, or leaving the solution to stand for several hours, a deep color is imparted to it. This color has been shown to be entirely due to the presence of finely divided gold suspended in the liquid.

If the flasks used in the preparation of this gold be carefully washed with distilled water to remove the last trace of saline matter, the liquid assumes a brilliant ruby-red color, which may be changed to a deep purple or blue by stirring with a glass rod which has been previously dipped in a solution of common salt.

Faraday, speaking of the ruby gold, says: "The state of division of the particles must be very extreme; they have not as yet been seen by any power of the microscope."

The following colored golds were filtered with the press to colorless liquids: Purple, blue, and ruby-red. A portion of the last was also passed through an ordinary filter-funnel and paper ten times with hardly any perceptible alteration.

It is a remarkable fact that even with these difficult substances, should the filter paper get torn while the press is in action, the filtering is in no way impaired unless the paper be damaged between the flat band of the ring and the diaphragm.—*Chemical News*.

ARTIFICIAL FUEL.

THE process of Mr. E. F. Loiseau for making artificial fuel from coal-dust is in successful operation in Philadelphia, where from 80 to 300 tons, according to size of the lumps, are made daily.

The process of manufacture may be briefly outlined as follows:

The coal-dust is fed into hoppers, together with about eight per cent. of bituminous slack, from which it passes through a series of four cylindrical revolving drums, in which it is thoroughly dried. From these it is carried to a receptacle situated near the press. The dust, still at a temperature of about 140° F., is then thrown into the mixing