

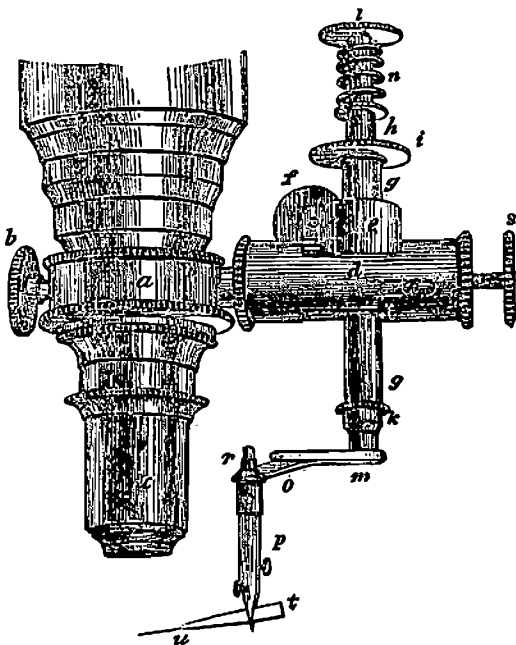
ART. XL.—*On a Mechanical Finger for use with the Microscope;*
by H. L. SMITH, Kenyon College.

IN order to make out satisfactorily the structure of the Diatomaceous frustule, viewed as an opaque object, I found it necessary to be able to change its position while still in view; and for this purpose, to mount it upon the end of a fine bristle, or hair. The bristle, having the diatom frustule adhering, may be placed in one of Mr. Beck's revolving slide holders for opaque objects, and examined with comparative ease on several sides. To pick up the diatom upon the end of the hair, or bristle, I contrived the little piece of apparatus which, perhaps, may not inappropriately be named "a mechanical finger," and which

is figured in the accompanying wood-cut. I find it answers most admirably to pick out diatoms and, of course, other minute objects, from a mass of accompanying dirt or debris, and transfer them to a clean slide. Thus from a sample of the "Bermuda deposit" the finer forms of *Heliopelta* may be rapidly picked up and placed together on one slide, the *Eupodiscus Rogersii* on another; *Craspedodiscus elegans* on another; and in like manner, the various species of *Coscinodiscus* and *Aulacodiscus*. These being all mounted after the method presently to be described, in the center of the usual glass slide, present great facilities for ready reference, and appear much more beautiful than when mixed with a lot of foreign material. The precision with which even very minute diatoms may be picked up and transferred constitutes the chief value of this little instrument. It is not, indeed, so very difficult for an experienced microscopist, who has become accustomed to the reversed motion of the hand when using the compound microscope, to pick out with tolerable ease the larger diatoms by means of a hair mounted in a suitable handle, but if the specimen is a very fine or rare one, he is exceedingly liable, through over nervousness, to injure or lose it; and, if very small, to fail entirely. The mechanical finger is entirely free from this nervous excitement, and the hair touches gently, and with the utmost precision, the indicated diatom or other object, and holds it until the receiving slide is made ready, then drops it just where it is desired. By far the greater number of those working with the microscope will, however, be found entirely unable to pick out and transfer specimens by the unaided hand, and to this class the present invention will, no doubt, be acceptable.

The cut represents the instrument attached to the lower or objective end of the microscope. An adapter, having the "Society screw" outside and inside, is screwed into the nose piece of the microscope, and upon this adapter the ring *a* moves freely between two collars and may be clamped, by means of the milled-head screw *b*, in such position as may be deemed best for use. Into the lower part of the adapter an objective (*c*) is screwed; the $\frac{3}{4}$ -inch will answer very well, using the B eyepiece. A tubular arm (*d*) is screwed to the ring, opposite to the clamping screw *b*, and inside of this arm moves another tube carrying the piece *e*, which is a circular clamp tightened by means of the milled head *f*; the whole is moved to or from the microscope body by means of the screw *s*, which pushes against a stout spiral spring. Within the clamp *e*, the smaller tube *g* moves up and down, parallel to the body of the microscope, and may be clamped in the proper position by means of the screw *f*. Inside of the tube *g* is fitted neatly another tube *h*, having the large milled flange *i* firmly attached above, and the smaller

one *k* screwed on to it below. This tube can be turned around freely in the tube *gg* by means of the milled flange *i*, but it has no motion up or down. Within the last mentioned tube the rod *nm* moves smoothly up and down a limited amount, determined by the slot and guide pin, as shown near *h*. A milled-head (*l*) receives the finger when it is desired to depress the rod, and, on releasing the pressure, the spiral spring *n* instantly elevates it. To the lower end of the rod the flat double-jointed arm *mo* is attached, having free lateral movement; the end of the arm carries the small spring forceps *p*, which turns freely in the socket *r*. The forceps grasp the triangular slip of card *t*, which has a bit of human hair *u*, gummed to it, and projecting about $\frac{1}{16}$ th of an inch.



The slips of paper and the size and length of the hair may be varied to suit the different objects which are to be picked up. To use the instrument the following adjustments are necessary. We will suppose the $\frac{3}{8}$ -inch objective is employed. The ring *a* is first firmly clamped, and the slip of card bearing the hair is put in the forceps *p*, inclined downward as represented in the cut, but not too much; the tube *g* is elevated in the clamp *e*, and, by means of the milled head *i*, the arm with forceps and hair turned one side. For my own use I prefer to clamp the ring *a* in such position as to place the tube *d* at the left hand of the microscope, using one of the fingers of the left hand to depress the head *l*, the right hand being free to use with the mechanical stage, and for focussing. Place on the stage a slide with a bit of thin paper pasted near its centre, and having a small cross marked on it, or a simple black dot. Next, bring this dot into focus, and, while thus remaining, turn back the

tubes *g* and *h* by means of the head *i*, and so adjust by slipping the tube *g* up and down, and by moving the arm *m o*, or the forceps *p*, in the socket *r*, that the end of the hair shall stand just over and a *trifle above* the dot; now clamp *g* by means of the screw *f*; and bring the point of the hair so that it may be seen, slightly out of focus, when looking into the microscope, just over the intersection of the cross, or the dot, by means of the screw *s*. The whole may now be elevated by means of the rack of the microscope and the adjusting slide replaced by another containing the material from which it is desired to pick up certain objects. If the material is dried upon mica from a suspension in alcohol, the object may be picked up easily; if dried upon glass, from suspension in water, it sometimes adheres strongly, but with a little care is easily detached. If the illumination from below is too strong, the hair, which is, of course, a little within the proper focus, is not so readily seen at the same time with the object as it is with a feebler illumination. Upon depressing the tube of the microscope the forceps and hair are likewise depressed, and when the desired objects are in focus the hair will be dimly seen, projecting into the field of view. The object being now brought under the point of the hair, by means of the stage movement, the hair is pushed down gently by means of the finger applied at *l*, its tip just touching the object. If the hair is too much within the focus it may first be slightly depressed, yet not so as to touch the object, and then, by means of the stage movement, the object can be placed distinctly under the point. Sometimes the first touch will lift the object, but generally it will take two or three touches to dislodge it. When it rises with the hair upon releasing the pressure, the whole is to be gently elevated by means of the rack of the microscope, so that the slide can be removed without disturbing the hair. In doing this care must be taken to avoid a current of air, made by the breath, or quick movement of the hand, as this might dislodge the object. In order to place the objects quickly at just the right place on a clean slide, I cut a small hole in the center of a gummed label and stick it on to the slide, so that the hole is exactly in the center. This may be done rapidly, by previously marking the outline of the slide on a paper and placing a dot at the center. The perforated label is supposed to be on the under part of the glass slide. Upon breathing heavily upon the upper surface of the slide, a copious deposit of moisture is effected, and the slide is then to be immediately placed on the stage, and its central portion, indicated by the hole in the gummed label, brought to the center. If an achromatic condenser is used this is easily done, as the spot of light will show itself shining through the paper. The tube of the microscope is now depressed, of course carrying the hair and the object

with it, until the moisture is in focus; a slight touch of the finger now causes the hair to descend, and instantly the moisture takes the object off and causes it to lie flat on the glass. Of course the slide, having the objects thus placed upon it, must be handled gently; but there is no danger of disturbing or losing the objects if it is first gently breathed upon, but not obliquely unless with great care. The next step is to mount the objects, of which we will suppose there are several, say of *Stauroneis acuta*, in the center of the slide, without displacing them and altogether making but a slight white spot when viewed without a magnifier, or by a lens of one or two inches focus. Cut a small circular disc or square of thin glass of about a quarter of an inch in diameter or breadth, and warming it gently, after cleansing it, place at one edge a minute drop of Canada balsam, not too old, nor yet too fluid. Warm the slide gently to drive off all moisture, but not hot enough to cause the balsam to flow when the little cover is put on, yet sufficiently warm to make it stick. The cover being lodged over the objects, but not touching them, as it is held off by the little drop of balsam, the next step is to warm the slide at one end very gently; the heat conducted along the slide soon causes the drop of balsam to spread and move forward under the slide. Care must be taken not to do this too rapidly. If heated slowly the balsam will move forward and the cover settle down without disturbing at all the positions of the objects, and seldom requiring any reheating. The balsam should be hard enough to fix the cover firmly, and all pressure upon it carefully avoided when the slide is entirely cooled.

To finish the slide, all that is necessary is to paste another label, with a small hole in its center, directly over the glass cover, and coinciding with the hole below; or if preferred the under label may be removed, leaving only the small round disc on top to cover the object. I prefer the perforated paper above and not below, as it indicates readily the exact spot occupied by the objects, and protects the covering glass from accidental dislodgement, and the slides thus finished appear quite neat if the gummed labels are properly selected.

The instrument as described above was made for me by Wales & Co., Fort Lee, New Jersey, and is a very fine specimen of their skill in the nicer forms of mechanical work. It is but justice to them to attribute much of the success of this contrivance, to the very careful manner in which they have made it.

The hair should move nicely up and down when magnified by the microscope, and touch the desired object with precision; for this purpose the rod *n* must move very smoothly, and all lateral motion of it prevented by the careful arrangement of the pin and slot, as shown near *h*. If, after the object is mounted

on the clean side, it is desirable to examine it with a higher power, say a $\frac{1}{8}$ th- or $\frac{1}{4}$ th-inch objective, it is not necessary to remove the hair from the forceps; the whole may be turned one side without disturbing the arrangements, by means of the milled collar *i*; and the lower objective being removed, a higher may be substituted; upon again replacing the first objective, and turning back the head *i*, the hair will again appear in the right place for use.

It will frequently happen that the hair will gather up considerable dirt and must be cleansed; this is readily done by slightly scraping it, without removing from the forceps, by the edge of a sharp, clean knife. The little spring of the hair as the knife edge slips off the end, will readily throw off all the loosened dirt. If too much dirt is picked up with the diatom, or other object, it may first be deposited upon a cleaner place of the slide, and again picked up freed from most if not all the foreign material.

One great advantage of this little instrument is, that it enables us to turn over a diatom, or deposit it on end, and thus obtain views very difficult to be had from balsam mounted specimens; and again, the frustules viewed dry often present particulars with great distinctness that can only be glimpsed, or guessed at, when mounted in balsam, and for this purpose it is very necessary to have them mounted on a clean slide, and themselves free from dirt. If the diatoms stick too firmly to be raised by the hair, they can generally be loosened by strongly heating the slide, and on this account I prefer mica to receive the material from which the selections are to be made.

I have been more particular in describing this instrument, as some who have procured the reflector for opaque illumination,¹ did not succeed well in using it until after many trials and disappointments. I have, however, received testimony from many of the most experienced workers with the microscope in this country as to its complete success, and trust the "mechanical finger" will be duly appreciated, and prove fully capable of doing all I have claimed for it.

Since the preceding article was written a further experience in using the mechanical finger enables me to add a few useful suggestions. It will happen frequently that specimens having considerable thickness, e. g. *Triceratium favus*, or some very fine specimen of *Actinoptychus* may be picked out; these, if mounted under a small bit of thin glass, will probably be crushed, and entirely ruined; and especially if the label punctured with a small hole is pasted over the glass cover, to indicate the exact locality of the object. In a case of this kind, the injury may be

¹ See this Journal, Sept. 1865.

prevented by inserting a small bit of tissue paper under the glass cover, to keep it from pressing the object, when the balsam runs under. If the alcoholic solution containing the diatoms should deposit any resinous or gummy matter, on drying, the diatoms will stick fast to the glass; excessive heating will be of no avail to dislodge them, and may be injurious. To meet this difficulty breathe gently, but sufficiently long to deposit considerable moisture, on the slide, without removing it from the stage, and immediately bring the hair in contact with the object; it will now be loosened, and if kept moving, by pushing it on the slide until the moisture has evaporated it can be picked up. I have found that the outside bristle of an ordinary clothes brush has generally a nice point worn upon it, if the brush has been long used; it is somewhat stiffer than the hair and may therefore project farther beyond the paper to which it is gummed. With care the diatoms may be so located that they will be in the exact center of the slide, and thus, when the microscope is adjusted for one, the others, although on different slips of glass, will be in the field with a high power, and this even when the ends of the slide are reversed. It is best to thoroughly explore the slide before picking up the objects, and to register those desired to be preserved. In this way the choicer specimens can be selected, and the whole slide completely examined.