tically certain that the ruminants represented in the sculpture are antelopes. They must, moreover, be antelopes of an African type, as there are no marsh-haunting species with spiral horns known from Syria, or Asia in general, and the presumption is that they represent an extinct member of the tragelaphine group allied to the nyala and situtunga, in which the females are hornless. The tragelaphine group is represented at the present day in India by the nilgai and chousingha, in which the horns of the bucks are small, but there is evidence that in the Pliocene India was the home of species akin to the kudu and bushbuck. And it is therefore quite reasonable to expect that in Assyrian times a member of the group may have inhabited the Euphrates Valley.

R. LYDEKKER.

Cavities in Stones.

IN the description of the Agglestone "on the old moor of Studland, near the north shore of the Island of Purbeck," given in Warne's "Ancient Dorset," allusion is made to superficial cavities or hollows in this stone, and in stones in Yorkshire and Lancashire. In some cases "the cavities consist of holes about an inch and a half broad and of the same depth drilled into the stone." Mitchell[1] gives illustrations of the stones with cup-shaped markings described by Sir James Simpson in his work on "Archaic Sculptures."

In all probability these examples of supposed archaic sculptures (and others) have long ago received the "more extended investigation by competent observers" that Warne thought they deserved. But it would be of interest to know if they have been examined by conchologists as well as archæologists. There is just a possibility that some may be burrows excavated by *Helix aspersa*, for the description and illustrations recall the helicidean cavities in Carboniferous Limestone that occur somewhat frequently in Ireland, but are uncommon in Britain. The rock-shelters of *Helix aspersa* at Great Orme's Head, Llandudno, and at Miller's Dale, Derbyshire, have been fully described and illustrated,[2] also others more recently observed by myself in the limestone on Brean Down, Weston-super-Mare.[3]

E. W. SWANTON.

Sir Jonathan Hutchinson's Educational Museum, Haslemere, March 10.

An Experiment for Showing Lines of Force in an Electrostatic Field.

A GILT cork ball, about 1 cm. in diameter, is attached by sulphur to a vertical straw about 28 cm. in length. The lower end of the straw is fastened by sulphur to the centre of a circular cardboard tray about 5 cm. in diameter, in which is a ring of lead. The tray is put on a watch glass which floats on the surface of mercury in a large flat dish. (A developing dish about 30 cm. by 26 cm. was used, but a shallow wooden trough made for the purpose would be better.) In this way the gilt ball is able to move fairly freely in a horizontal plane. This float arrangement is kept in a bell-jar desiccator when not in use.

Two conducting spheres, about 10 cm. in diameter, are mounted on vertical glass tubes (sealed off at each end), and coated for about 10 cm. with sulphur, which can be readily got into a good insulating condition when required by warming in a flame. The centres of these spheres and the gilt ball are at the same level. The spheres being arranged on opposite sides of the dish, and so that the ball can touch them.

The spheres are connected either to the same terminal or to the opposite terminals of a Wimshurst machine.

The gilt ball describes curves which, when it moves slowly, give the general directions of the lines of force between the spheres in the plane it is free to move in.

The experiment is effective for illustrating lines of force in an electrostatic field and for leading up to the mathematical definition of potential. It may be extended for different charges on the spheres.

R. F. D'ARCY.

Caius College, Cambridge.

Units of Pressure in Vacuum Work.

SURELY physicists do, or should, for convenience, always express wave-lengths in microns (μ) and molecular distances in millimicrons ($\mu\mu$). Why not follow the same practice in dealing with vacua? The millimetre is a convenient unit down to, say, 0·1 mm., but 1/1000 mm. and 1/10,000 mm. have frequently to be expressed. It is simpler to write and comprehend these in the form 1 μ or 0·1 μ. Again, in the pamphlet sent out by Dr. Gaede to describe his very successful pumps, we see unwieldy decimal expressions used. For instance, it is stated that it is possible to obtain a pressure of 0·000002 mm. of mercury after four minutes of pumping. Why not write this 2$\mu\mu$ of mercury?

There is a small unit sometimes found in researches, viz. one-millionth of an atmosphere, denoted by the letter M, but for this unit to have a definite numerical meaning it is necessary to quote the barometric reading at the time. If the barometric reading is normal 1 M=0·76 μ. But, of course, 0·76 μ alone needs no qualifying as to the barometric pressure, and therefore is simpler and more direct.

P. E. SHAW.

University College, Nottingham, March 2.

NEW MICROSCOPE EYEPIECES.

Eyepiece Micrometer.

DR. METZ, one of the researchers employed in the Leitz optical factory at Wetzlar, has recently described[1] a micrometer for use with the microscope which, if we are not mistaken, will rapidly replace all others, including the expensive filar micrometer where a mechanical stage is available. The root idea is that the scale used is such that microns can at once be read off without greatly changing the tube-length, or considering the micrometer value of the objective employed, and therefore dispensing with the arithmetic for which this is a necessary datum.

To bring this about, the intervals of the new scale, instead of being 1/10 or 1/20 mm. wide, as is usually the case in eyepiece micrometers, have a definite value of 0·06 mm.

With an objective of 2 mm ($\frac{1}{12}$) focus when a stage micrometer with ten $\frac{1}{100}$ mm. divisions is viewed, each of these divisions falls on the larger

1 "The Past in the Present," p. 86.

2 John Taylor, "Monograph of the Land and Freshwater Mollusca of the British Isles," vol. i., p. 311, fig. 601, and vol. iii., pp. 244–246.

3 E. W. Swanton, "The Mollusca of Somerset" (Somerset Arch. and Nat. Hist. Soc., 1912), pp. 26, 27, pl. iii.

1 *Zeit. für wissenschaftliche Mikroskopie*, xxix., p. 72.

divisions of the eyepiece micrometer indicated by the steps (see Fig. 1). Each of the smaller divisions therefore represents a micron.

If exact coincidence between the eyepiece and stage scales does not occur with the proper tube-length, it should be varied—a slight variation is all that is necessary—and the new tube-length recorded for micrometer purposes.

It is obvious that as a 4 mm. ($\frac{1}{6}$) objective has half the magnification of one with a focus of 2 mm., such an objective treated the same way will give us the ten divisions of the stage micrometer covering five of the large divisions of the eyepiece micrometer; hence to obtain microns we must multiply by 2, and this is all the arithmetic needed.

It also follows that with an 8 mm. ($\frac{1}{3}$) we must multiply by 4, and with a 16 mm. ($\frac{2}{3}$) by 8, to obtain the number of microns subtended by each of the smallest divisions of the eyepiece micrometer.

It will be seen then that one of the results of the new departure is to obtain for each objective and for a given tube-length convenient, and in the majority of cases integral, micrometer values, which greatly facilitate the use of the instrument. The actual tube-length differs in most cases but little from the standard length.

Dr. Metz in his paper gives the value of the unit of the scale and the proper tube-length to be used with each of the twenty-four of the achromatic, fluorite and apochromatic objectives produced by the Leitz firm.

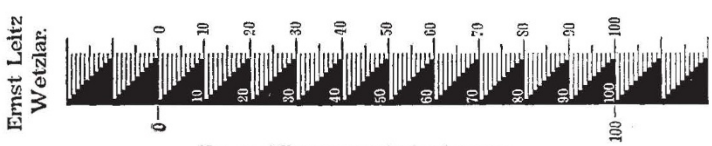

Fig. 1.—Micrometer scale showing steps.

But, of course, the new micrometer can be used with any objective, and for general purposes it will be employed with objectives having foci of 2, 4, 8, or 16 mm. focus. These we have already considered.

The following table gives the tube-length results obtained in a trial of the new micrometer with objectives of different makers; it will also show the wonderful simplicity brought about:—

Focal length mm.	Focal length in.	Maker	Tube length for best definition	Tube length for scale coincidences	Scale divisions equivalent to $\frac{1}{10}$ mm.	Multiplier to obtain microns (μ)	One division of the scale $=\mu$
2	$\frac{1}{12}$	... Crouch...	... 170	... 170			
,,	,,	... Reichert (dry)	170	... 190	100	... 1	... 1
,,	,,	... Watson	.. 200	... *172			
4	$\frac{1}{6}$	... Bausch & Lomb	160	... 188			
,,	,,	... Watson	... 200	... 210	50	... 2	... 2
8	$\frac{1}{3}$	... Winkel	... 170	... *192	25	... 4	... 4
16	$\frac{2}{3}$	... Watson	... 200	... 193	12·5 ...	8	... 8

* The variation from the normal tube length in these cases arises from the fact that the $\frac{1}{12}$th is really a $\frac{1}{14}$th, though listed as $\frac{1}{12}$th, and the focus of the 8 mm. examined is really 8·5.

To demonstrate the simplicity of the method and the degree of accuracy to which the step micrometer lends itself, the following examples may be given:—

The object selected was a valve of *Surirella gemma*; its length was measured first by an eyepiece micrometer of the usual type and then by the step micrometer.

(1) Leitz objective $\frac{1}{6}$ in., possessing micrometer value 0·00349 mm., length of valve 30·9 intervals of the scale; therefore $30{\cdot}9 \times 0{\cdot}00349 = 0{\cdot}1078$ mm. $= 107{\cdot}8\ \mu$.

With the step micrometer the value of the same objective is 2 μ at a mechanical tube-length of 178 mm., the valve covers 53·8 intervals of the scale; therefore $53{\cdot}8 \times 2 = 107{\cdot}6\ \mu$.

(2) Leitz objective $\frac{1}{12}$ in. oil immersion, micrometer value $=0{\cdot}00164$, length of valve 65·5 intervals of the scale; therefore $65{\cdot}5 \times 0{\cdot}00164 = 0{\cdot}1074$ mm. $= 107{\cdot}4\ \mu$.

With the step micrometer the same objective possesses a micrometer value of 1 μ at a mechanical tube-length of 168 mm., the valve covers 107·5 intervals of the scale; therefore $107{\cdot}5 \times 1 = 107{\cdot}5\ \mu$.

In certain cases of frequent occurrence the use of the eyepiece micrometer involves difficulties. The usual eyepiece micrometer has very fine lines, and with some objects it is difficult to see them under unfavourable conditions of lighting. During prolonged observations with an eyepiece micrometer this is very fatiguing and apt to strain the eye. This defect is particularly pronounced when an object and a micrometer scale are seen by dark-ground illumination, a method which is now largely employed. Indeed, in a dark-ground field the micrometer scale may refuse to come into view.

In the new micrometer the intervals are arranged in groups or steps of ten, each group being indicated in an unmistakable manner by a black echelon rising from the first to the tenth interval. This arrangement possesses the great advantage that the divisions can always be seen distinctly whether the objects be light or comparatively dark.

The micrometer is mounted on the diaphragm of the eyepiece, and can be sharply focussed with the eye-lens, which is mounted in a sliding sleeve. The device is made by E. Leitz, and its cost with eyepiece is fifteen shillings.

Double Demonstrating Eyepiece.

Next in importance to the new micrometer comes a form of eyepiece, introduced also by the firm of Leitz, which enables two observers to use the same objective, and therefore to view the same object. It is called a double demonstrating eyepiece, as no doubt its chief, though not its only, use will be to serve a demonstrator to instruct a student.

The new eyepiece slips into the draw-tube of the microscope like an ordinary eyepiece. The field of view is common to both eyepieces, and contains a pointer which either observer can direct upon any feature to which he wishes to direct attention.

The arrangement of the device is shown in the subjoined figure:—

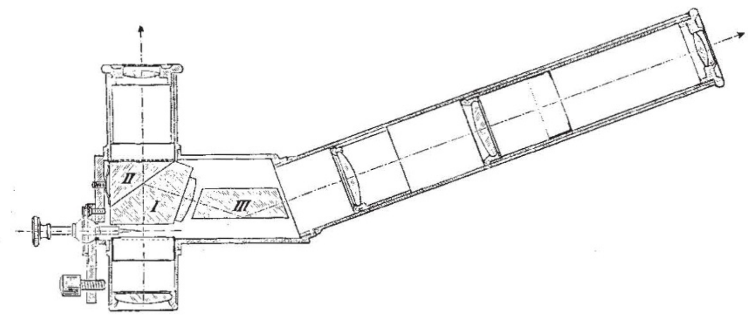

FIG. 2.—Demonstrating eyepiece.

I and *II* are two prisms in contact and mounted above the diaphragm between the field-lens and the eye-lens of the eyepiece. The prism *I* has an isosceles cross-section, and its angles are 35°, 35°, and 110° respectively. The prism *II* is rectangular, and its angles are 35°, 55°, and 90°. The prisms are placed with those faces in contact which subtend the angles of 90° and 110° in such a manner as to leave between them a very thin film of air. This film is inclined at an angle of 30° to the axis of the eyepiece and partially reflects the emerging pencil of rays; about two-thirds of the rays pass through the prisms, and one-third is reflected.

The image formed along the axis of the microscope is accordingly brighter than that produced by partial reflection. The centre line of the reflected pencil is inclined at an angle of 70° to the axis of the microscope. *III* is a prism the lower surface of which reflects the pencil upwards at a convenient angle for observation. In order that the two observers may not be in each other's way, the branch tube is fitted with a system of lenses which resembles a terrestrial eyepiece. The image as seen in the side tube is reversed with respect to that which appears in the axial eyepiece; but this scarcely affects the observer, since the oblique attachment of the side eyepiece changes the orientation of the field which is focussed through the principal eyepiece, as the image seen through it is brighter. The adjustment for one eyepiece furnishes a clearly defined image in the subsidiary eyepiece, provided the eyes of both observers can accommodate in a similar manner. The objective in conjunction with the field-lens below the double prism of the two eyepieces forms an image in the plane of the diaphragm below the double prism. This image and the pointer, being both in the plane of the diaphragm, are seen simultaneously in both eyepieces. The pointer can be moved backwards and forwards and turns on a pivot so that its extreme end can be set to any point in the field.

The new eyepiece is well adapted for the instantaneous photography of living bacteria and other moving organisms illuminated by means of a dark-ground condenser; it enables one to observe the object through the side eyepiece and to defer the exposure until a favourable moment presents itself.

This eyepiece makes the instrument to which it is attached into a binocular microscope in a new sense. Its use will certainly not be confined to laboratories; it will equally be a delightful acquisition to tyros discussing pond-life or other subjects in which amateurs take an interest. The 6-diameter power is to be preferred, and as the branch tube is not counterpoised, if the eyepiece tubes do not fit tight it is better to use the microscope in a vertical position.

STANDARDS AND TESTS FOR SEWAGE AND SEWAGE EFFLUENTS.

THE eighth report of the Royal Commission on Sewage Disposal deals with the important question of standards and tests for sewage and sewage effluents discharging into rivers and streams. In their fifth report the Commissioners indicated the desirability of fixing a legal standard for sewage effluents, and suggested that such a standard should be based on (i) suspended solids and (ii) absorption of dissolved oxygen. Their contention then was that the two tests should be taken separately, and they suggested three parts per 100,000 as the limit of suspended solids, and that the effluent after removal of its suspended solids should not absorb more than 0·5, 1, and 1·5 parts dissolved oxygen per 100,000 after one day's, two days', and five days' incubation at 65° F. respectively.

In their present report the Commissioners recognise the difficulty of the separation of the suspended solids, and finally recommend the following as the normal legal standard, viz.: 3 parts per 100,000 of suspended solids, and, including its suspended solids, the effluent shall not absorb more than 2 parts dissolved oxygen per 100,000 after five days' incubation at 65° F.

The importance of this report lies in the fact that not only is a definite legal standard recommended, but that in the opinion of the Commissioners this standard should be a variable one, dependent on the conditions at the outfall, *i.e.* condition of river or stream receiving the effluent and relation of volume of sewage effluent to river water.

The Commissioners state that their experience leads them to think that if the dilution while not falling below 150 volumes does not exceed 300 volumes, the dissolved oxygen test may be omitted and the standard for suspended solids fixed at 6 parts per 100,000, and if the dilution while not falling below 300 volumes does not exceed 500, the standard for suspended solids may be further relaxed to 15 parts per 100,000, and with a dilution of more than 500 volumes all