THE AMATEUR MICROSCOPIST DURING WARTIME.

By E. Kelly Maxwell, B.A.

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Figures 1 and 2 in Text.

It was my good fortune, during the war, to spend about a year at a very picturesque little town in Northern France. From the tall ramparts that completely surround the town, there is a lovely view over the peaceful rolling country all around, and one looks over the tops of the trees to see the river that flows along a winding valley, here and there giving a silver gleam back to the sky, while from the citadel that guards the northern gate one looks out along the widening marshy course of the river to a far distance, where two tall white lighthouses speak of passing ships and the ocean. The name of the town tells that once the sea was near, but that was long ago. During the eighteen months or so previous to my arrival here I had often cast a secret eye of longing at likely ponds and ditches in Flanders—and there are many around Bailleul and in the direction of Ypres—and at times I had inquired of priests, chemists, and other likely people whether there were any local pond-hunters, but without success. The quest was not entirely unfruitful, however, as it led to a very interesting hour in the private museum of an old doctor, who had a very fine specimen of young mammoth which he had obtained from the quarries of Arques. It was not until I came as sergeant-major to a company on duty near the little town on the hill that my enthusiasm was roused to action by meeting a kindred spirit. This was a tall sergeant of my company, a keen lover of nature, who, when a day off duty came, enjoyed nothing better than a long walk in the country, field glasses in his pocket, eye and ear ever on the alert to pick up, here a stone-chat perched on a stump, there a curlew skimming with plaintive note over a marsh, or a blue tit, as we came striding along, darting for cover. He was one of those rare people who can keep a diary going for

years; and many a delightful hour we spent over his notes of wild flowers and birds observed since we arrived in France. It was in one such hour we heard of a microscope given to him as a boy, and of some wonderful creature that darted across the field of view with something whirligigging in front like an aeroplane propeller. This was the beginning of many a talk of rotifers, and one of the first results was a set of little outlines in his notebook of the commoner forms, such as Melicerta, Limnias, Stephanoceros, Floscularia, Philodina, Brachionus, Euchlanis, and other well-marked varieties. After the sketches naturally the next thing was to find the living specimens, so after fitting up little cigarette tins with watch glasses, pocket magnifiers and bits of mirror after the fashion of dissecting stands, we applied ourselves to the quest. Our first rotifer was a bdelloid from a piece of moss picked off the wall of the Citadel, near the North Gate. The flat swampy fields just outside the low outer walls of the town yielded us very soon *Triarthra longiseta*, *Polyarthra platyptera*, Euchlanis and several small loricate forms such as Salpina and Diglena. A big marshy field not far from the ramparts, where we often saw curlew and other sea birds, gave us our first Hydatina. This was the first time I had ever taken this fine form. Always, however, I was longing to get one of the big tube builders to show my tall sergeant, and I shall never forget the day we got our first one. We had gone for a walk to the north of the town on the wide marshes of the river, and as luck would have it we had no collecting bottle with us. We came upon a number of low-lying gardens, separated by little drains leading into one of the big marsh pools. I was so struck by the likely-looking growth of Anacharis that we forthwith started to hunt for a bottle. Strange to say, old bottles of any sort seemed very absent on this particular day, and at last at a lonely railway crossing we found the Frenchwoman on duty had a lot of empty beer bottles. We persuaded her to part with one for fourpence, and set off again to the pool, looking back on our way to find her regarding us with a very puzzled, not to say comical, expression. I suppose she had never found empty bottles so much appreciated before! Our zeal was rewarded handsomely, however, when on turning out the contents into several shallow dishes, later in the day, we found two specimens of Stephanoceros and a fine big *Brachionus urceolaris*. All our finds were of course

seen by the hand glass simply, and I was delighted to find that the tall sergeant was getting quite able to distinguish a number of different types of rotifer by their movement and size. Many of my readers will perfectly understand that, on recalling to mind the appearance of, say, a Philodina swimming or crawling, Synchaeta, called the "swallow of the waters," Brachionus with tail anchored and wagging its body violently, Pterodina of dainty shape and almost disappearing edgewise, Anuraea with its everlasting somersaults, Polyarthra skipping with the speed of light, Triarthra with its long flashing sword blades and Euchlanis in its glorious crystal armour.

All the time it was becoming very obvious that we should have to bring more instrumental power to bear, and as it did not seem to be practical politics to get a valuable instrument out under our uncertain conditions, I determined to rig up some makeshift kind of microscope. With the object glasses of a pair of little Galilean telescopes I made an objective of about 2-in. power, and this tried with a brown-paper tube and wooden limb gave such promise that I fitted up a wooden tripod stand with a spot lens substage made from a 1-in. flash-lamp lens. On the large wooden stage a sliding bar held by a pair of rubber bands made a very efficient support for the slides, which were cut from broken window glass with a file, the cover-glasses being of the same material, and supported on the slip by three tiny pellets of cobbler's wax. And so our first microscope was launched, the beginning of what was known to those in the secret as the "Royal Society." Shortly after this we got a Melicerta, and the first séance with a candle and condenser in our little tent on the hill-side to see Melicerta is unforgettable. The optics of this extraordinary instrument would hardly pass the scrutiny of the brass and glass experts, but after an aching desire for magnification it was some solace to see a sizable picture. The dark-ground effect was there of course, but the details reminded me of some of Joblot's pictures, in which he got over these finicking minutiae by drawing a man's face on the object. My glowing description of the ciliary movement and the mastax, and the eagerness of such a promising pupil to see them, however, did not let us rest content; so after some tantalising delays I had sent out to me a body and draw tube, 2/3rd and 1/6th in. objectives, double nosepiece and eyepiece, with a few excavated slips and cover-glasses. I

had grave fears as to the searching demands of a 1/6th in. as regards stand and adjustments, but in the sacred cause of science I plucked up courage. The old wooden stand, good enough for a very doubtful 2 in., was rather shaky with the 2/3rd in. and impossible with the 1/6th in., and after some attempts to stiffen it I began to look about for suitable metal fittings. I spent hours and hours beguiling shopkeepers, all friendly, but some very inclined to be suspicious of a buyer who made excuses to get peeping into drawers and searching their stores for likely bits of brass. What I wanted was something to act as a guide or slide, and at the same time offer some hope of an adjustment by screw or otherwise for focusing. At last I found what I wanted. In the stoves one finds all over Flanders and Northern France there is very often a damper, *i.e.* a flat disk mounted on a spindle passing through the stovepipe, and moved to increase or shut off the draught by turning a key handle on the end of the spindle. The spindle I found was square with screw thread cuts on the edges to take the nuts which kept it in position. The square fitted in the damper and turned it. I got a blind-cord strainer of the kind in which a vertical bar carrying a pulley slides in holes in two projections from a base plate. I opened out these holes until they fitted as closely as possible, but easily, on the damper spindle. Using the spindle as a tap, I forced a thread in the vertical part of a furniture castor, after removing the pin, and a keyhole plate clamped between this and one of the nuts on the spindle formed the stage. The base plate of the cord strainer sliding on the damper spindle against a spiral spring placed round it, and pushed down adjustably against it by the remaining nut, formed a sliding carriage to which was attached by carpet tacks a wooden block carved out to take the sleeve in which the body tube of the microscope fitted. The jaws of the castor jammed on a wooden upright completed the model No. 2. A shaving glass propped up below served for mirror. With the 2/3rd in. we were able to see clearly ciliary movement and mastaxes now. With the 1/6th in. our first object was a desmid, *Closterium Lunula*, focused only with considerable care. But the 1/6th in. was not a success with this. The carriage, as it jumped briskly from point to point of the serrated edges of the guiding limb, did not recommend itself to the scientist at the eyepiece, chasing the elusive object at every jolt. At this time,

by great good fortune, there arrived from my old company as pioneer a man who was an excellent amateur mechanic. He was quite accustomed to the use of the microscope, and on seeing my efforts up to date he proposed to have some of his tools sent out from home. These arrived later, and comprised a good bench vice, taps and dies up to 1/4th in., hack-saw, files, brace and bits and soldering outfit. As model No. 2 was so unsatisfactory, the substage problem was deferred until a solution of the adjustment problem above the stage was reached.

I began to look out for a sliding fitting with less play in movement. In this wearisome quest for something suitable, I made friends with a kindly old man in a shop near the South Gate, who allowed me to search drawer after drawer in his shop until at last in a guide for a sliding plate-glass show-case front I found what I wanted, a substantial brass block with a steel strip dovetailed into it. It took the leisure of three days to get the working of the dovetail sweet and without shake, working at it with razor paste. I spent weeks trying to find a piece of rack and pinion in vain, and finally recollected the motion of the "Argus" stand. Getting a number of little grooved brass rollers from window blind fittings, I cut them two at a time into worm wheels with a tap, and made a dozen before I could get two to work smoothly enough on the best screwed bar I could produce. The screwed bar is an ordinary six-inch nail. The attachment of this rod to the slide was no small difficulty. To recall the items of construction, and their innumerable variations in the progress to a final efficiency, would be too tedious; but in the figures it will not be difficult to recognise the large and small castor jaws forming the knuckle joint, the large castor wheel cut in two to make coarse adjustment heads, the small wheel, the fine-adjustment head; the heavy scutcheon of a keyhole forms the stage, the little dovetail attachment underneath it carrying a substage bracket, made from window-blind fittings, a substage ring cut from a shaving-soap box, tailpiece of fishing-rod joint, and gimbal (very effective, after hours of work and making and remaking) holding a mirror made from a shaving-soap box lid and a penny shaving-glass cut down. The feet are detachable, and comprise a blacksmith's dividers held by a dummy cartridge screwed on to the pin of the small castor. To get the original rivet out of the blacksmith's dividers was no small job, effected at

last by heating in a shoeing forge with horses champing and stamping around. The condenser originally used was quite satisfactory, and was made of a large flash-lamp lens, about 1 in. diameter, with its tin cone, into which was stuck with

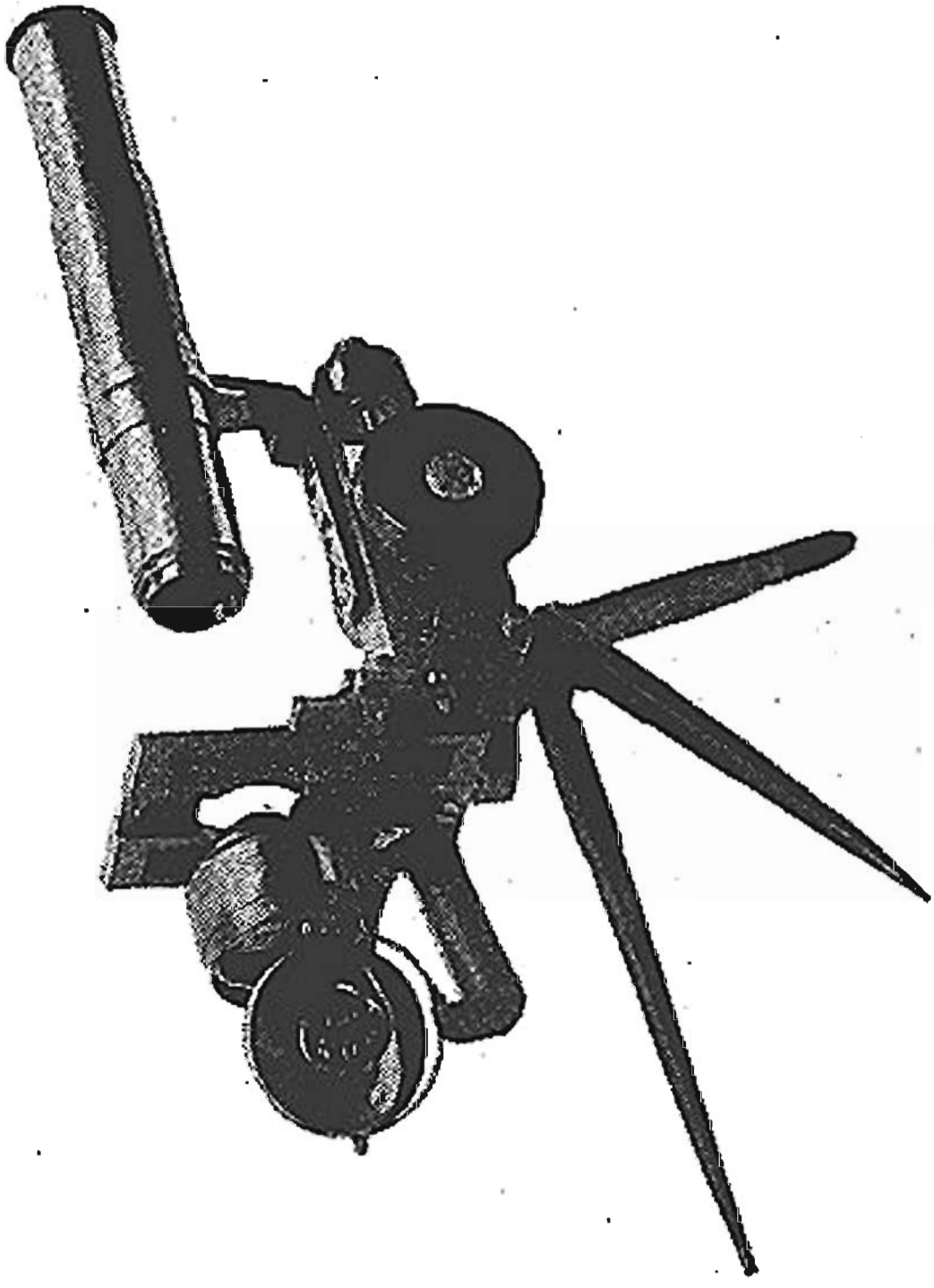

FIG. 1.—SIDE VIEW.

cobbler's wax a small lens of the same sort, the combination mounted in a blind-roller end cap. (The condenser shown in the figure was brought out later from home.) The block attached to the dovetail slide which carries the sleeve fitting of the body is half a butt hinge, a piece of the remainder of which appears

in the pretentious clamp for locking the body at the right inclination. Last of all the sliding bar, all odds and ends, but its velvety

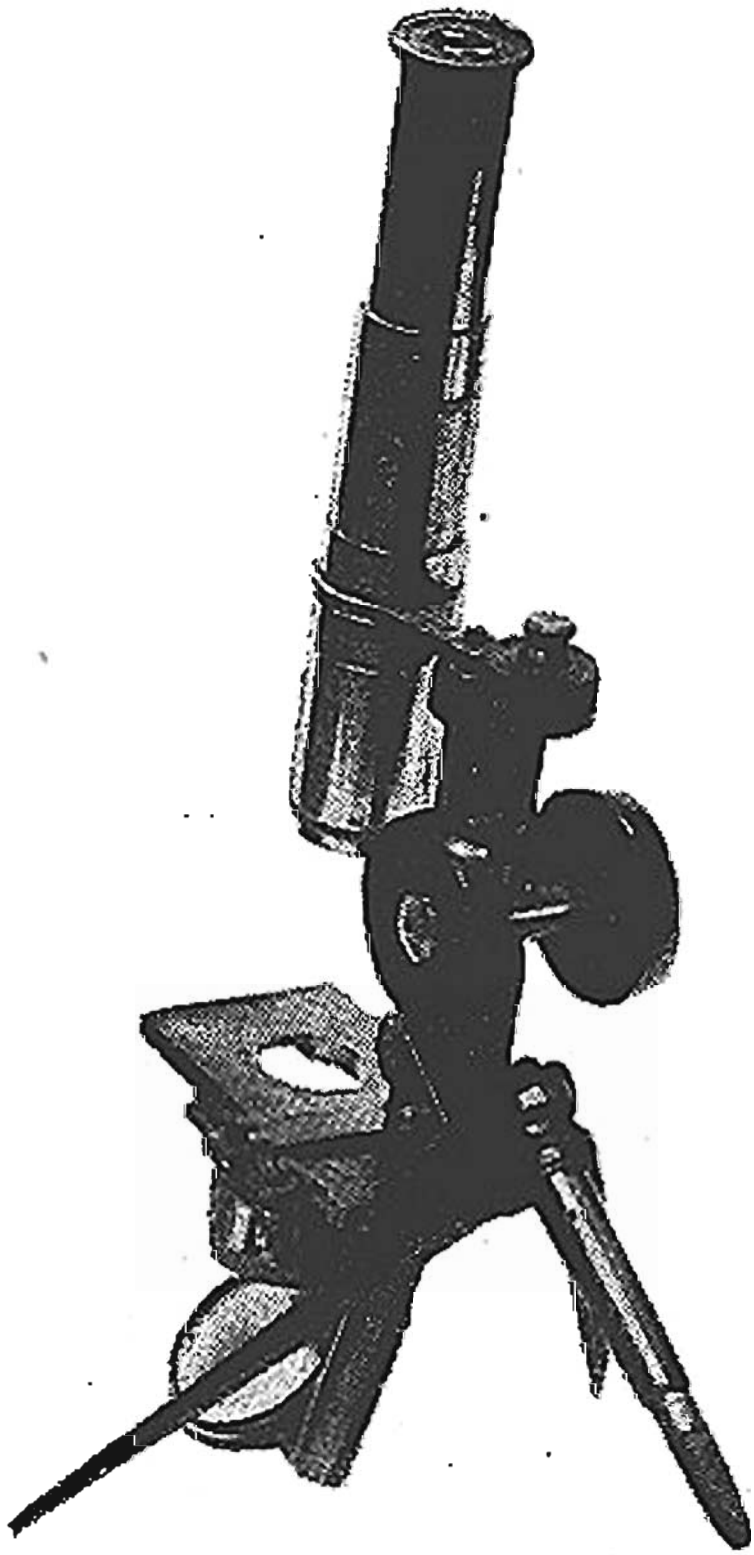

FIG. 2.—BACK VIEW.

motion and its stop-dead action had quite the feel of the professional article in use. And so at last we had a microscope with which it was possible to find and focus an object with the 1/6th

in, and leave it so that another could see it. Thus equipped we essayed some of the regions till then denied to us. Diatoms were a source of great interest, and rotifers now showed their cilia and mastaxes on demand. The first sight of a flame cell in a rotifer marked the new advance. Now that the mechanical difficulties were settled, the "Society" acquired a new popularity. One lucky dip taken direct from the little stream in the village on to the slip, contained half a dozen lusty Hydatinae, and hosts of Euglenae and slipper animalcules. Such sights as these were very popular, and Madame, our excellent hostess, became an interested visitor of the Society. I have a charming recollection of the visit of her two little children to a séance: the wee girl, after a lot of coaxing, took an eager hurried peep at the wriggly things down the tube, and clung with frightened pleasure to her mother's skirt. Melicerta we found again away towards the Estuary.

The floscules found in the days of model No. 1 we never found again; but the finest haul of diatoms and desmids I've ever had we found under two feet of water in a delta-shaped patch where one clear stream met another at right angles. In surface water lying on a field for several weeks I found *Pterodina valvata*, considered rare by Hudson and Gosse. Its delicate lorica folded at each side was very transparent, almost invisible. In the marshes we found Volvox and the purple Stentor. Along the river bank, a mile or two from the sea, we once found a hoof mark filled with water faintly milky-looking; this was due to countless hosts of Synchaeta, a form rather smaller than *S. pectinata*, of which, however, there were a fair number. A rotifer talked of for long before we found it was Dinocharis, but at last we captured this dainty form. We paid a considerable amount of attention to moss, because there was plenty about the district. The roofs of several places in the village yielded *Philodina citrina* and *P. roseola*, fine big forms, as well as more ordinary forms like *Rotifer vulgaris;* an Adineta with curious sudden movement in crawling. Some rather unusual infusorians we took in the moss, among which I remember most clearly a species of Folliculina. We kept Hydatina under observation, and managed to get the fourth generation of one individual by the cobbler's wax and thick cover-glass method. The "Society" was generally fortunate in its expeditions. A little knob of moss, about the size of half a

golf ball, collected from an old wall contained an extraordinary number of bdelloid rotifers and water-bears.

Opportunities arose at times for bathing in the sea, and our first "find" in a little pool in the sand consisted practically entirely of the polyparies of polyzoa and zoophytes; of which I made out at least six different species. These of course were all dead, but the empty tubes contained many fine diatoms, polycistina and foraminifera. Another marine expedition gave us some fine specimens of medusa buds, of a kind of Obelia, with sixteen tentacles to the bell. We got several alive under the microscope; but still more pleasing was the fairy beauty of the adult polype like an exquisite flower in its crystal cup. This lost nothing by being seen on a glorious summer afternoon with a jocular nightingale, a familiar friend of ours, singing exuberantly a few yards off. At night in our little tent we were able to see the tiny flashes of light on tapping the bottles containing the polype.

A call to sterner duty came one day, and dissolved the "Society."

When next I had opportunity to turn my attention to the old pursuit, it was strangely enough not far from the same district. I had no instrument but a pocket lens, but the "microscopic" specimen was not difficult to see, being nothing less than a huge patch of plasmodium of a mycetozoon crawling on an old fungus-covered log in the garden of the little farm-house where I was billeted. The daily change was readily seen as it threw out a front line and communication lines in a bright orange network, until it was quite 30 inches long and about half as wide. This was in December 1917. I watched it until a few days' dry frost seemed to dispel it, and presently there appeared in the more shady and obscure parts of the log the purple berry-shaped masses of sporangia. It was about five or six years previously that I had been first initiated into the fascinating mysteries of the mycetozoa, and I had often searched for them, but without success. It was with no small delight, then, that I detached and sent home some of the magnificent first haul of "myxics." I lost no time in searching in a little wood near for more, and, after diligent investigation of a number of old rotten tree stumps, managed to secure three further different species.

So! I have shown you this little cameo, clean cut to me at

least, standing out from all the tangled experiences of the dire years of war. The horses stamping and champing in the gloomy forge while I toiled like Vulcan to get the rivet out of the dividers—the first glimpse of my friend at the beautiful flower-like polype, outside our tent on the hill-side, with the most wonderful nightingale in France in full song a few yards away—the shy little French girl clutching at her mother's skirt after peeping into the magic tube—the gallant men from London and Peru, Panama and Bonnie Scotland, who formed the delightful "Royal Society" on the little French hill-side.

Note.—The specimens exhibited at the reading of the paper were some of the polyparies mentioned, viz.:

Hydrallmania falcata (Lin.).
Abietinaria abietina (Lin.)
Idmonea serpens (Lin.).
Sertularia operculata.
Obelia (? species).

and the mycetozoa collected in the little wood, viz.:

Badhamia utricularis (from the log at my billet).
Arcyria denudata.
Trichia inconspicua (var. *contorta*) (possibly also *affinis*).
Physarum pocillum.

I gladly take this opportunity of expressing my indebtedness to the President, Dr. Rendle, F.R.S., for getting the zoophytes named for me at very short notice, and to Mr. Hilton for revising the nomenclature of my specimens of mycetozoa.