Episcopy with high efficiency LEDS

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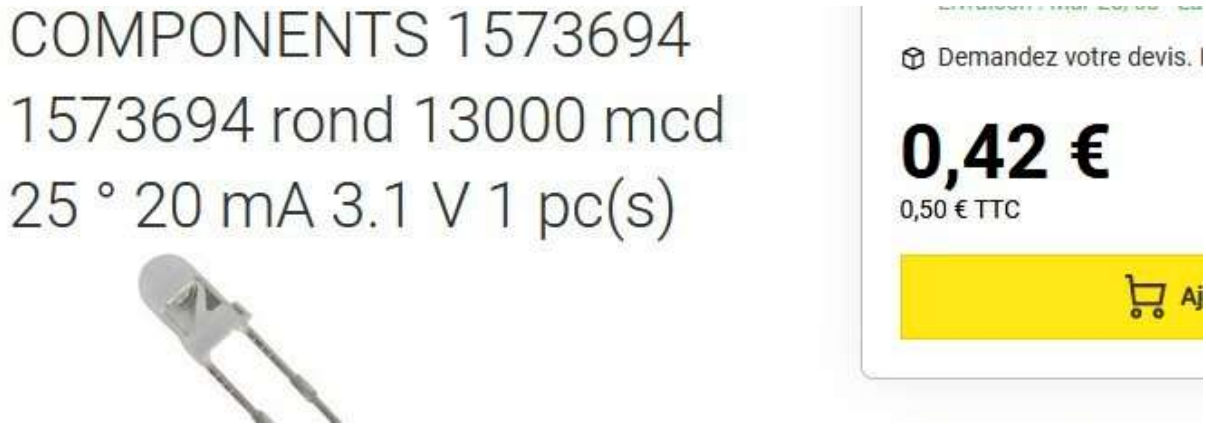
It is still Winter and not the best season to collect samples in the Nature. Why not take advantage of this to improve the performance of our microscopes, for example by adapting an incident light device ?

There are many articles on past issues of Micscape with LEDs lighting; but this project shows a device well integrated with objectives, a lighting very close to the object and allows to use other objectives than stereo microscopes.

There are small high-performance LEDs, 3mm diameter for example this model: 13000 milliCandela: light intensity - 25°: angle of the light beam - 20 mA: normal intensity of use - 3.1 V: voltage drop across the terminals of one LED



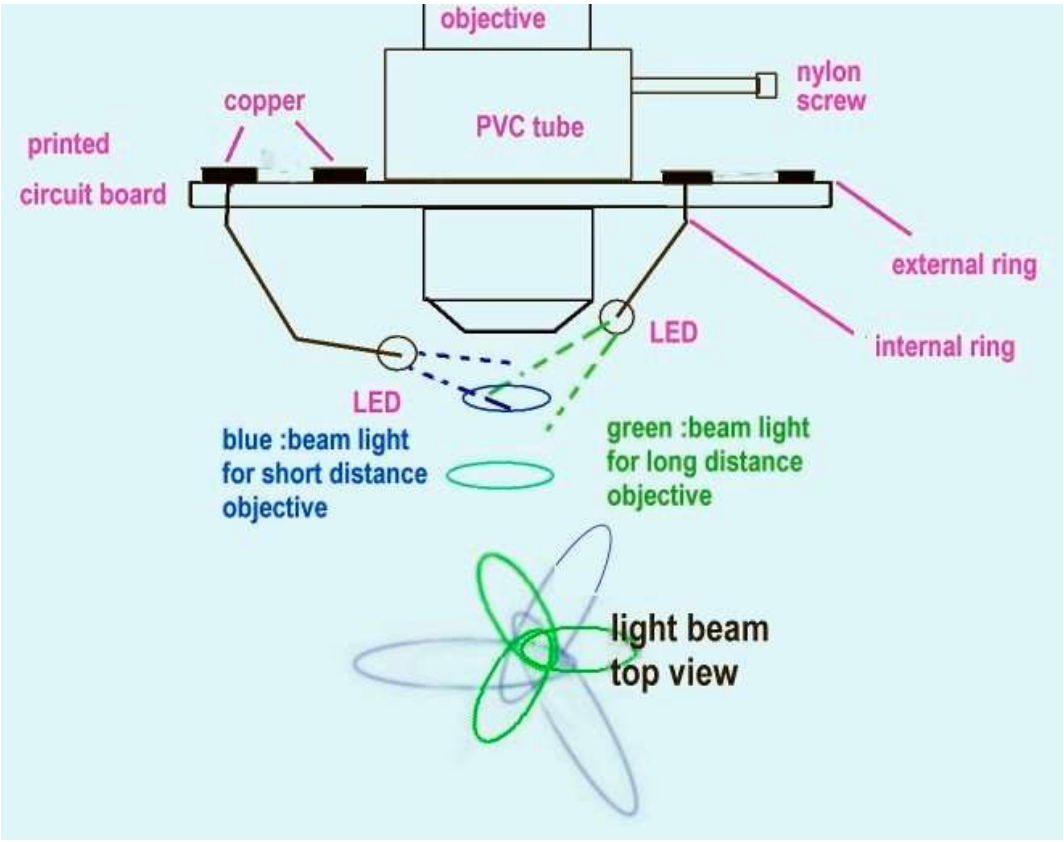
We know that each LED must have at least 3.1 volts across its terminals to illuminate normally. If we use a classic voltage source of 12 volts DC, and if we put 6 LEDs serial wired, this is not suitable because 6 x 3.1 = 18.6 volts ! So we'll use 2 groups of 3 (3 x 3.1 = 9.3 volts) and it works.

A small calculation tells us that we must drop (12-9.3 = 2.7 volts) in a serial resistor which gives the value of this one: R = 2.7 V/0.02 Amp = 135 ohms rounded to the normalized value of 150 ohms for each group. 0.02 Amps or 20 mA is the nominal current which crosses all the LEDs serial wired.

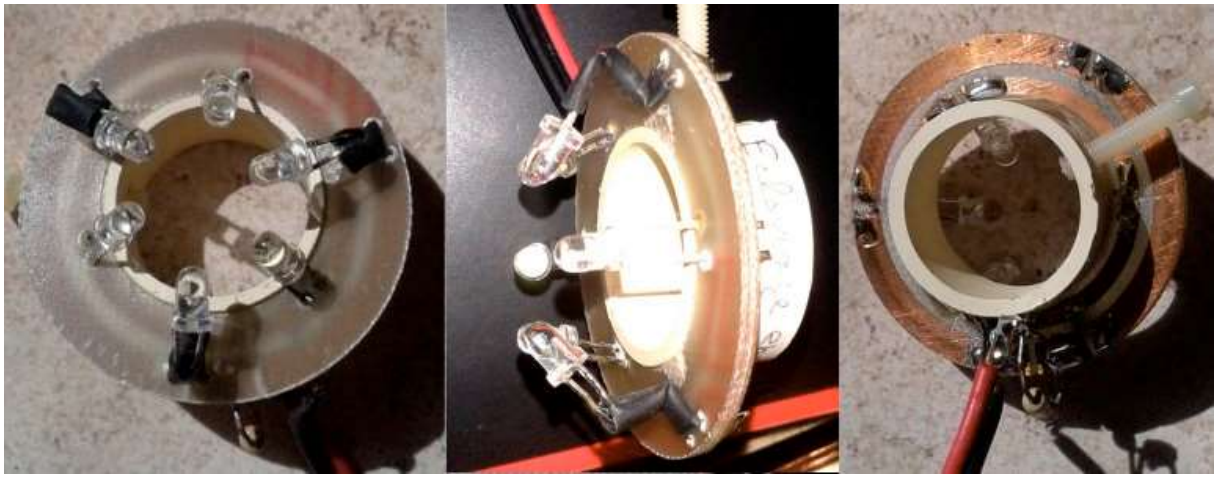
Principle:

The aim was to obtain intense omnidirectional lighting (without shadows) by placing the LEDs in a circle around the subject and close to it .We will therefore place the two groups of LEDs defined above on two concentric circles (Internal ring and external ring)
A PVC or plastic tube whose internal diameter is slightly greater than that of the objectives is glued (two-component glue) in the central hole drilled in the printed circuit board:

(Sorry for the poor quality of the drawing !)



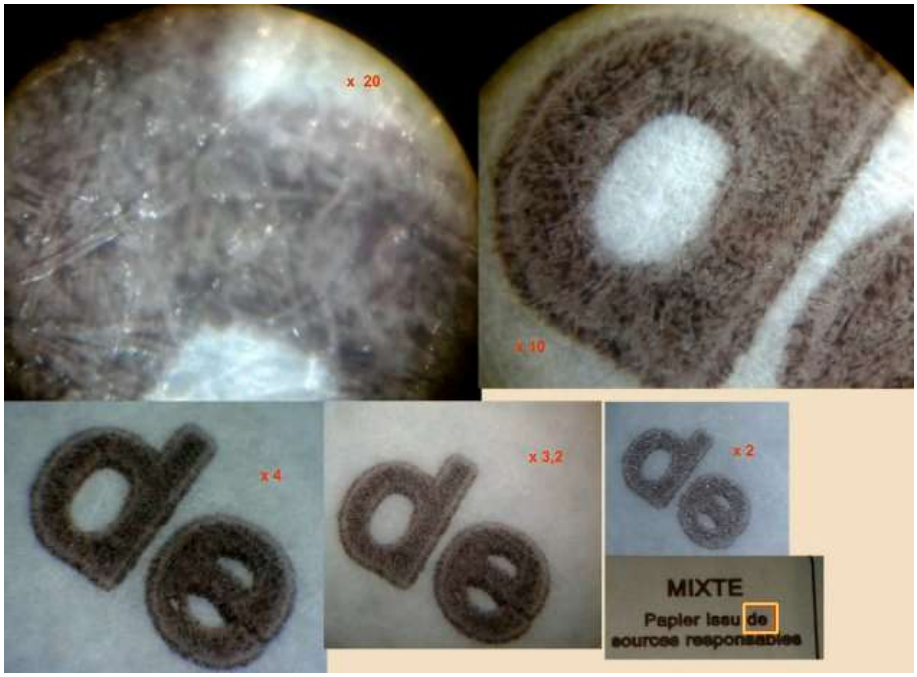
Realisation :
The LEDs are welded on a piece of circular printed circuit board: on the copper face are cut two rings (by means of a compass equipped with two points). Each ring is interrupted between the wires of the LEDs and drilled to weld them
Inner Ring: 3 LEDs angled at 45° and used for 2.5 to 4X objectives
Outer ring: 3 LEDs with an angle close to horizontal for 10 X to 20 X objectives, so that the light beam can pass under the front lens (wires covered by black insulation). You can to bend wires to obtain the desired angle.



I made a first test by lighting the 2 groups of LEDs simultaneously regardless of the objective used. With eyes seen there is not a problem but when shooting (with my phone with 5 mPx image and through a x 12 ocular) there is too much light! (Try with your own camera…may be better!)
So adding a switch (on the circuit) which allows to activate one or the other group and gives different results. The following images are made with the LEDs from the inner ring (those are tilted at 45°) or those of the outer ring.

The lighting is fixed on the objective (here X 15) with the nylon screw (don’t use metal screw!) tightening moderately. We can thus adjust the height so that the external LEDs do not touch the plate. (The light intensity has been reduced for the photo.)

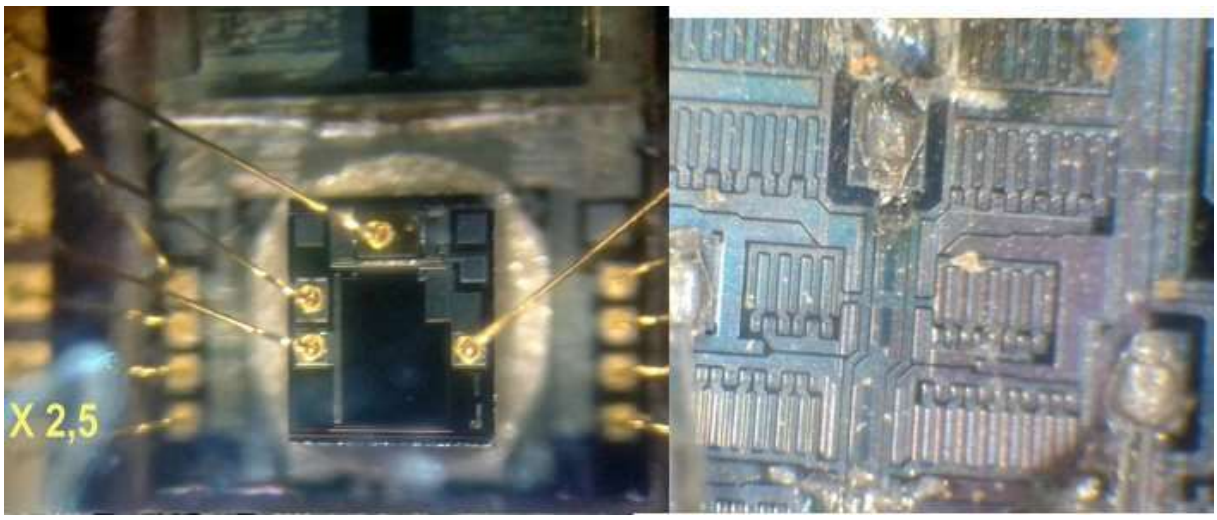
First attempts on an easy (flat!) subject: a small group of letters: NB: the transmitted light of the microscope is switched off in all that follows and an opaque disc is placed on the condenser to avoid reflections



Difficult subject (thick and large volume) fly - eye: image on the left side in light diffused by the external LEDs (not provided for this magnification) and on the right side by internal LEDs; below trunk and detail of the tip this one at x 10.

Fly wing X 2,5 objective and butterfly wings scales X 4 objective

"Technical" subject: On the right photosensitive cell of a laser disc player, on the right image of an integrated circuit. (LM 338 regulator: we see the power transistors with the shape of combs.)

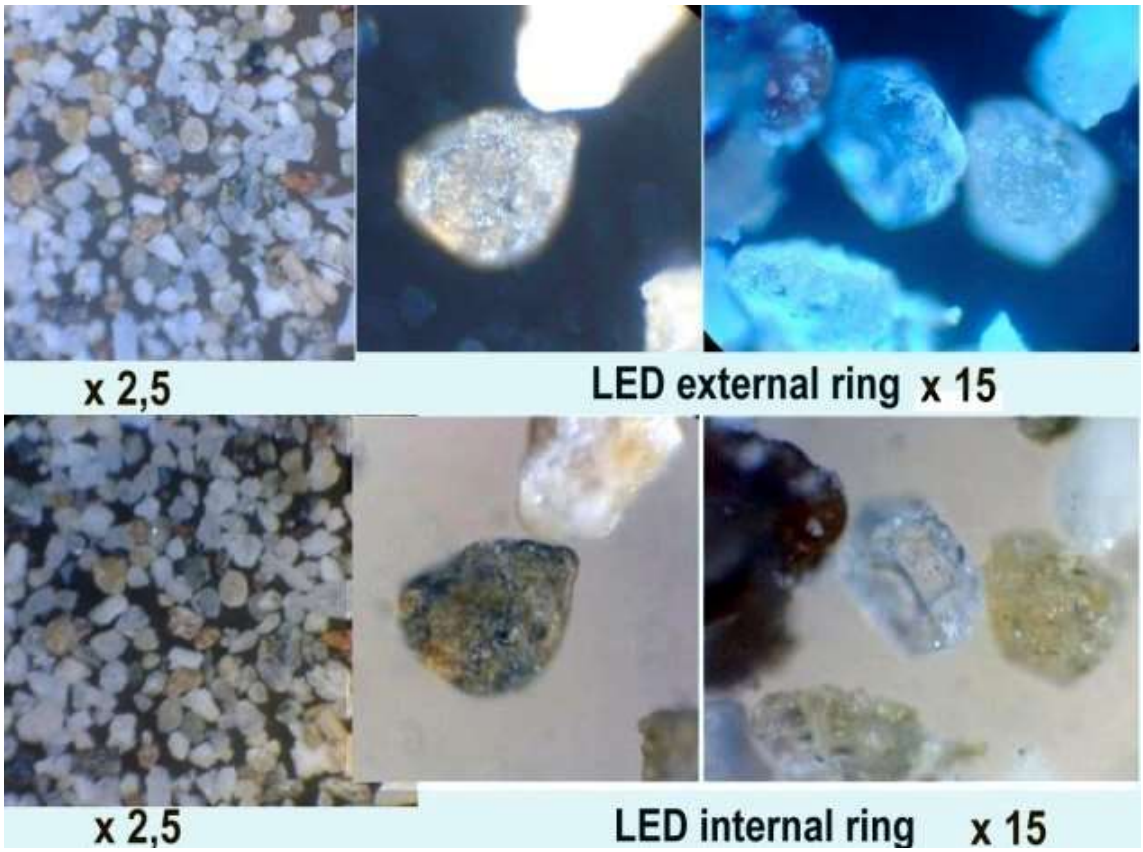


Foraminifera under cover slip: The light reflected by the glass causes loss of contrast.

Two tests with X 10 objective to test the effectiveness of the lighting:

- 1 This test is done by varying the supply voltage of the LEDs: The image taken for 7.5 volts is so dark that it is almost invisible to the eye! (one pound coin at 2,5 X).

- 2 Another test on sand using external LEDs with 10 X objective and below with internal LEDs (which are not provided for this objective) and which produce diffused light = less saturated image and "softer" colors.



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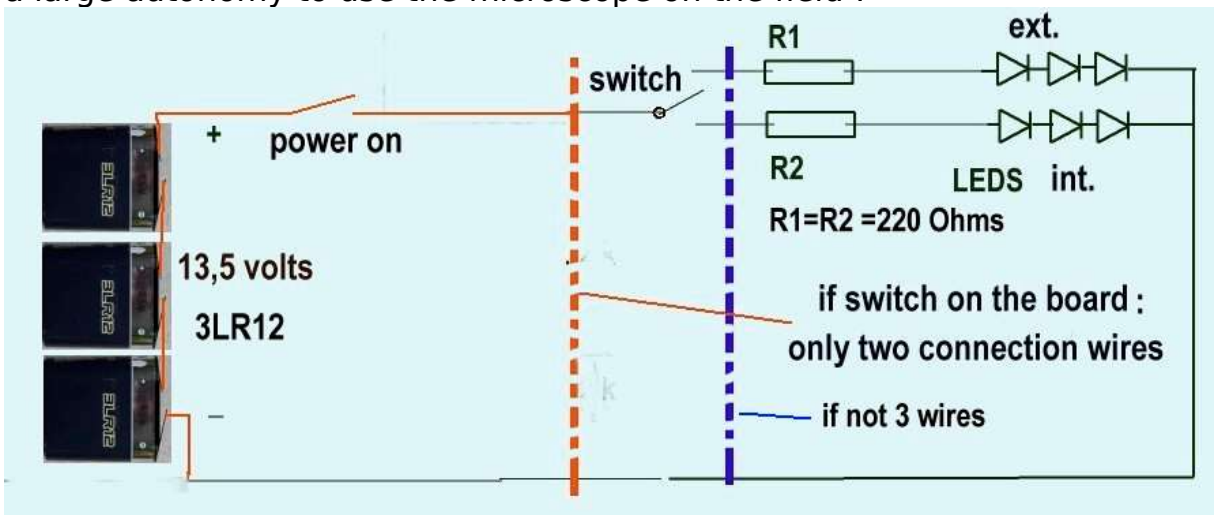
NB: some images in direct lighting have a blue cast due to LEDs with a color temperature of 6000°K. "White warm" LEDS would be a better choice.

Example of a simple electrical diagram with 3 batteries of 4.5 Volts, which also gives a large autonomy to use the microscope on the field !



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