

## HOW TO «RESCUE» FAILED MAGES

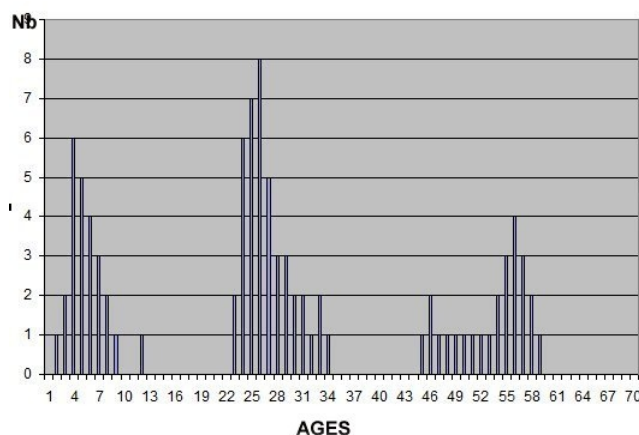
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One of my favorite subjects is the observation of plankton - living - which creates particular constraints for obtaining good images: the subjects move and you have to follow them by playing on the XY stage, focusing, open or close the condenser, take the photo... I think the best operator would be... an octopus with its 8 arms!

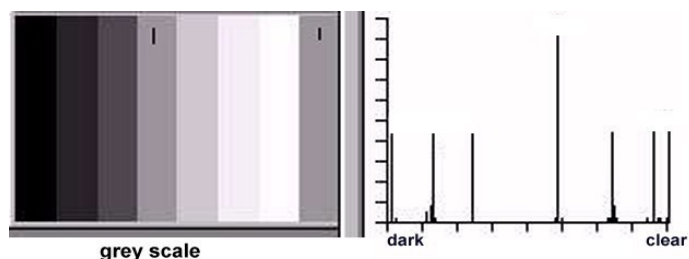
This explains why some images have a poor quality: for example too dark, or with a dominant color because the camera did not have time to do the white balance, etc., but these are sometimes images of a rare specimen that we want to preserve.

We will see that we can reduce some defects by using software functions that do NOT add pixels to the original image. In fact, certain functions resample the image by creating new pixels: a good tip is to always keep the original image and do the processing on a copy. We'll start with a very practical and quick function: one-click «histogram stretching». Histogram is a statistic tools giving distribution of a population

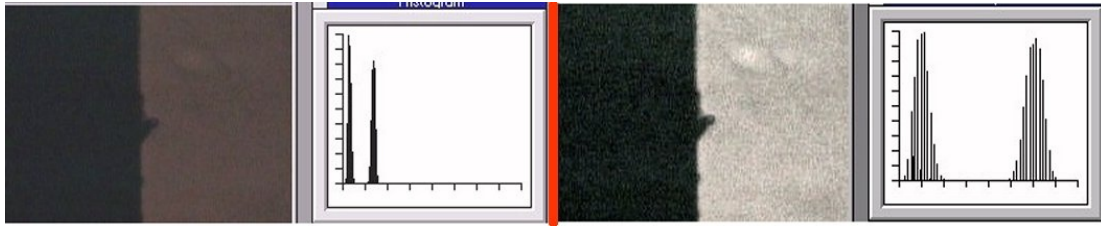
But first a little reminder to illustrate what a histogram is: let's take the example of the age of spectators during a family circus session: we take the age of each spectator and we assign a column to it in the graph above. If 8 spectators have the same age, for example 26 years old, the column will have a height of 8 elements. On the graph we see 3 peaks: the first on the left corresponds to the ages of children from 2 to 13 years old, the middle one to the age of the parents and the one on the right to the age of the accompanying grandparents: horizontally the age classes and vertically the number of people present in each class



Let's transpose this representation for the lighting levels of an image: we have the image of a gray scale and on the right the histogram corresponding to the lighting values. In the scale two (marked) columns have the same gray intensity which produces a bar twice as high in the histogram at the corresponding level:



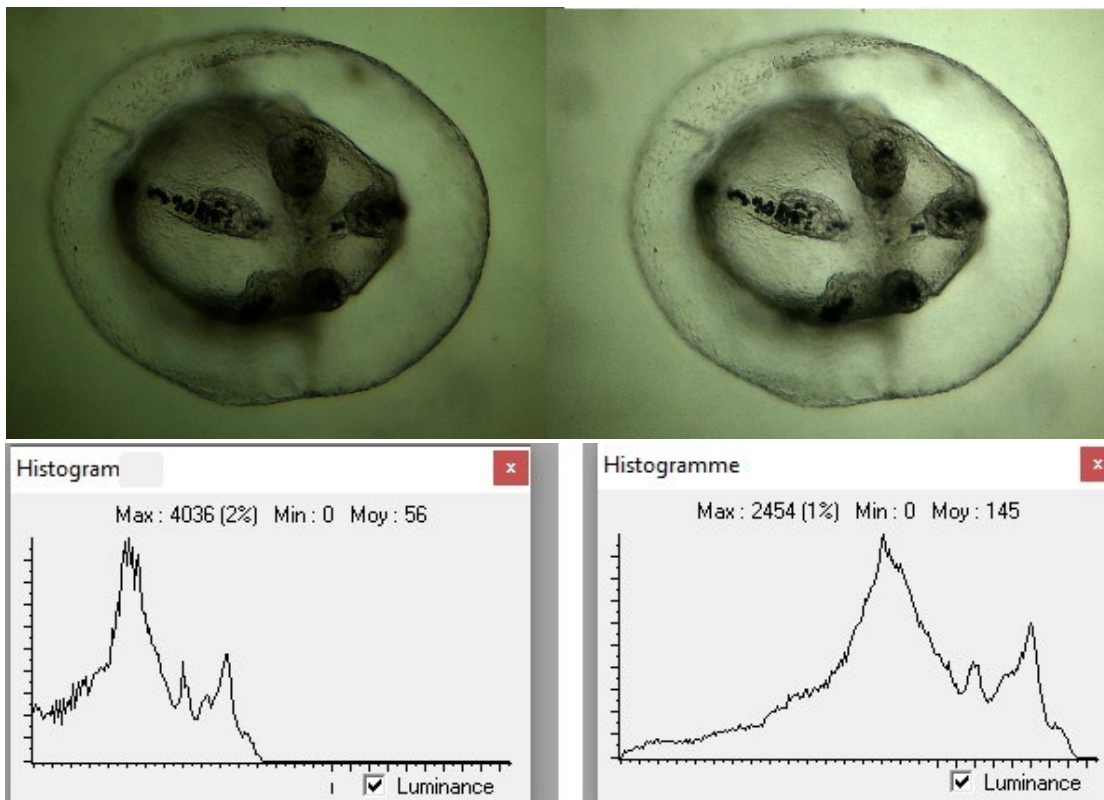
Let's see the result on an image which only has 2 areas: one very dark and the other a little lighter: (case of a photo which lacks light). The histogram shows 2 bars located more at dark levels. By applying the "stretch histogram" function the result on the right shows a more balanced image in brightness and we see that the histogram now occupies all the dynamics of the levels from dark to light.



We also see that the “bars” are thicker and the explanation can be seen in the improved image: the white is not uniform (the black too but this is less visible) because of the noise contained in the image.

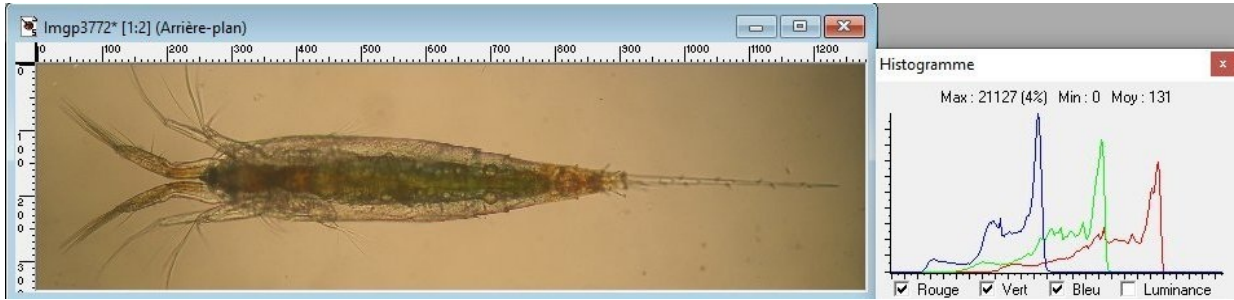
*This is the electronic noise of the CCD or CMOS sensor, noise which has a constant level but when the useful signal (light) decreases, the sensor compensates by increasing its amplification (Gain) and also increases the noise contribution: the ratio signal/noise (S/N ratio) deteriorates. This noise is due to the quantum nature of the electrons which move in bunches, and their agitation increases with temperature which also increases the noise. High sensitivity cameras used in astronomy are cooled by Peltier effect device.*

First try of a histogram stretching on this image of a micro jellyfish which lacks light: with one click the image is better. Below the luminance histograms of the two images: on the right one we see that it occupies all the levels from darkest to lightest

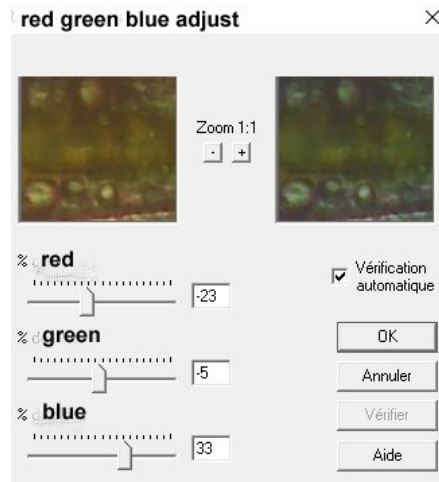


For color images we will have 3 peaks in the histogram corresponding to the 3 colors used by the filters of the sensor matrix. The following treatments are done with PaintShopPro 5 but exist in Photoshop and other softwares...

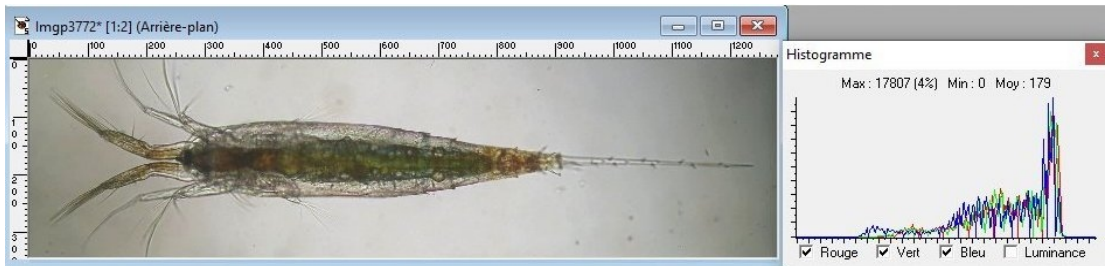
Example with a colorful image: here is a living specimen of a copepod of the *Pontellina* genus: this is a rare subject because there are no images on the Web! The lighting was reduced so as not to excite him and we see a dominant red color. We will make the red and blue peaks coincide with the green peak which is best centered on the histogram.



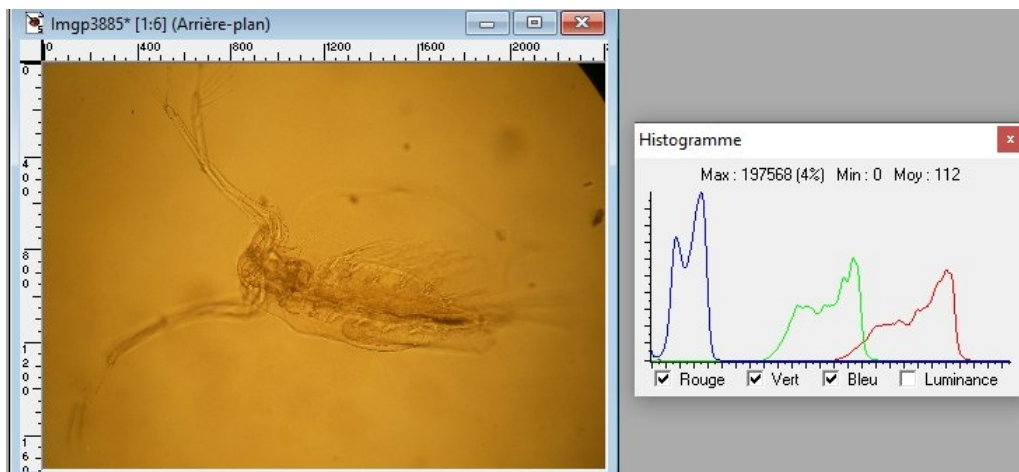
Using the RGB adjust menu sliders:



by superimposing the 3 peaks, the background color becomes closer to white: the more the peaks go towards the right of the histogram, the clearer the image will be. We further improve by applying histogram stretching which moves the three peaks to the right



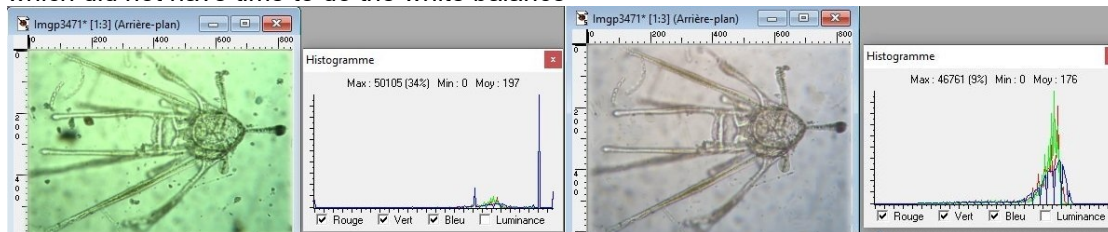
Another example with *Penilia Avirostris* seen in profile but in a photo that is difficult to use: same lighting problem as above:



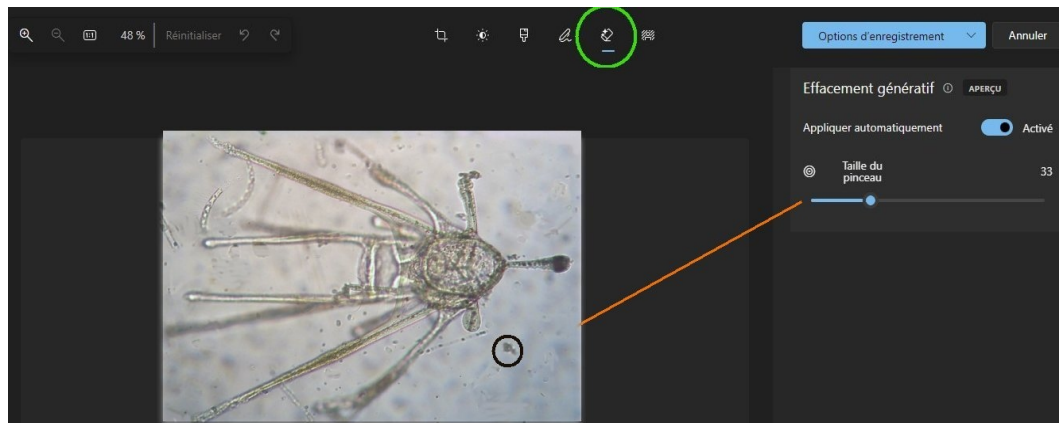


If the contrast is low the “correct gamma” function significantly improves the result

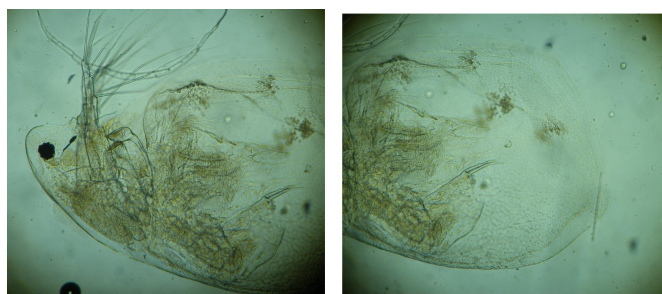
Another example with a larva of *Echinocardium cordatum* (common heart urchin or the sea potato) metamorphosing into an adult. The dominant green color comes from the sensor which did not have time to do the white balance



We notice that in the image on the right the spots in the background have disappeared! This has nothing to do with the histogram but with a function (green circle) of the Windows 10 image viewer illustrated below: we move the brush (= the circle centered on the defect) and the software replaces the spot by the average of surrounding pixels



Finally, another function which allows you to obtain an acceptable image from two (or more) poorly exposed images. Here it is a *Simocephalus* cladoceran of which I wanted to take a detailed image with a higher magnification objective but the subject does not entirely fit into the field. Here are the two partial images



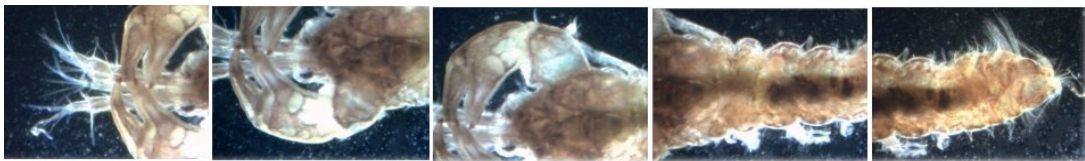


Using the Windows 10 application “Image Composite Editor” which produces panoramas, we will process these 2 partial images:

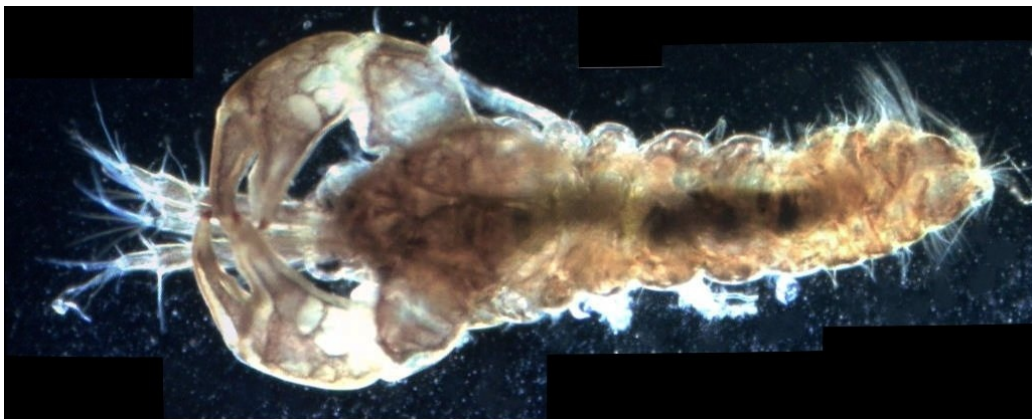


we obtain this “stitched” image which was corrected with *RGB/histogram stretch/correct gamma*. Warning: this software add pixels into image!

Another more complex example with this *tanaïdae*: 5 basic photos taken with 2,5 X objective; Pictures must overlap 30% of each other for stitching.



Result with ICE but without optimization of the background:



So here are some techniques for “rescuing” images but of course this does not exempt you from applying yourself to making the best images when shooting. Image processing cannot provide information where it is absent.

***Don't forget the limitations of softwares: Garbage in, garbage out***

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