Water drop photography with set **drop-timer²** + drop dispenser

01.2018

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Introduction

The Set **drop-timer²** and drop dispenser has been designed as a straightforward and low-cost entry into the world of drop photography.

In this guide, I would like to provide support for this entry, and show how drop collisions with tall and lean columns can be created and photographed using a specific system. I would mainly like to convey an understanding of the procedures and circumstances that lead to the creation of tall columns and ultimately to drop collisions. The artistic, photographic aspect is merely touched upon; there are certainly better people than me who can give advice on this. Here, I only show my own experience, but I also add many tips from users of our systems. I would like to take the opportunity at this point to say thank you!

As in many other areas also, there is no right or wrong here; it is the result that matters. But the way toward the result should be fun, and this guide is intended to be a small companion for this.

All drop images in this guide were created exclusively with the set **drop-timer²** + drop dispenser (exception *Figure 18* left).

Hans Gierlich

The equipment

Creating the drops

To create the drops, I use our set **drop-timer²** + drop dispenser, product no. 50088.

The timer **drop-timer²** is designed for controlling **one** drop dispenser, which is how crowns, columns and drop collisions are made. The drop size, the time lag between two drops and the flash lag can be set. In addition to the drop dispenser, it also triggers the flashes and the camera, which is fully automatic.

The drop dispenser doses the drop fluid, and its Mariotte's bottle design ensures constant water pressure on the solenoid valve and thus constant drops over time.

Details on the functioning and operation of the drop dispenser and **drop-timer²** are provided in the user manual.

Lighting

To light up the drop structures, I will use two Yongnuo YN560 II speedlites. These can be purchased at low cost and are sufficient for this purpose.

Other speedlites can also be used, providing they have the same shutter lag. This is extremely important, since different shutter lags cause the devices to flash in succession, thereby creating double contours. In the best case, only the total exposure time is longer, which can then lead to motion blur. If speedlites of the same manufacturer and type are used, there should be no problems at this point.

In this example, I take the picture with a backlight. For this, I use a 3 mm-thick Plexiglas plate XT (XT = extruded) with 45% transmission to act as a diffuser between the speedlites and the drops. This ensures a good light dispersion with acceptable losses.

To fix the speedlites, I use a carrier that I built from an aluminium rail 20x20x600 mm, product no. 50069, two small accessory brackets, product no. 50057 and a large accessory bracket, product no. 50059. This is placed on a small table tripod with swivel head, meaning I can adjust the light angle and need no additional ball head. Other mounting solutions are just as good here; we use what we have.

Each of the speedlites are connected to the **drop-timer²** via a set adapter for speedlites, product no. 50078 and a Y-plug, product no. 50048. Alternatively, the speedlites can also be controlled by radio, where the transmitter is connected to the **drop-timer²** via a set adapter for speedlites.

Device supports

Our carrier system for experimental photography, product no. 50050, is used to support the drop dispenser, which enables both stable and flexible assembly. Any other mounting system can also be used, provided these conditions are met.

Camera

I use my EOS 50D with a 100 mm macro lens. This is a good focal length since it creates a good distance to the action, meaning that the lens and camera do not become splashed. At the same time, due to the small angle of view, the Plexiglas plate in the background can remain quite small, whereby the area to be illuminated remains small. The smaller this area, the less flash output is needed, resulting in a shorter exposure time and ultimately sharper images.

Because the camera monitor is too small, I connect the camera to a notebook via USB to visualise the images, and use the remote control program from Canon Digital Photo Professional. For other camera systems, the relevant program can be used.

The camera is triggered by the **drop-timer²** via a connection set for Canon, product no. 50054.

Tray for the droplets

While shooting crowns, the droplets can either fall into water or onto a black Plexiglas plate. If a Plexiglas plate is used, effects such as reflections or colour changes can be created.

For drop collisions, the drops fall into a plastic bowl with a mixture of normal plain water and some drop fluid. This is filled to the brim, which gives rise to a meniscus (the water level is slightly above it), whereby the plastic edge disappears and only the “gentle” water edge remains visible.

Drop fluid

I fill plain water that has been thickened with “xanthan transparent” in the drop dispenser and colour it with some food colouring. Glycerine or guar gum, among other things, are used as thickening agents. Each agent fulfils its purpose in one way or another. Here too, there is no such thing as good or bad; everyone has to find what works for him. However, this guide intends to show that the choice of thickener plays a minor role.

A thickening agent changes the viscosity of the drop fluid. It becomes more viscous (“slippery”), thereby allowing the thin film of water, such as that of a cap, to stay intact longer.

List of components used

Components	**Prod. no.**	**Number**	**Purpose**
Set **drop-timer^2** + drop dispenser	50088	1	Creates the drops
Carrier system for experimental photography	50050	1	Support for light barrier and drop dispenser
Mounting rail 20x20x600	50069	1	Carrier for the speedlites
Small accessory bracket, set	50057	2	
Large accessory bracket	50059	1	
Berlebach mini tripod	---	1	
Yongnuo YN560II flash gun		2	Light source
Adapter for speedlites, set	50078	2	Flash gun connection
Y-plug	50048	1	Signal distributor for the speedlites
Plexiglas plate, 3 mm, 45% transmission		1	Diffuser
Spring clamp		X	Clamping the diffuser, cable duct
Small salad bowl, plastic		1	Drip tray
Reflex camera		1	Recording device
Connection set for Canon N3	50054	1	Camera adapter
Notebook		1	Visualisation of results
Xanthan transparent		1	Thickening agent for water droplets
Food colouring			Colouring the water droplets

The assembly

Setting up the devices

I assemble the devices on a tabletop, where possible, see *Carrier system*.

Carrier system

The carrier system, *Carrier system-1*, is assembled according to the assembly instructions. The frame for the drop dispenser, *Carrier system-2*, is positioned where the outlet nozzle of the drop dispenser is around 45 cm higher than the water level of the drip tray, the frame for the light barrier *Carrier system-3* remains empty and is mounted to provide stability to the carrier system. I put two strips of kitchen roll over the table and the feet of the carrier system to prevent them from becoming splashed with paint.

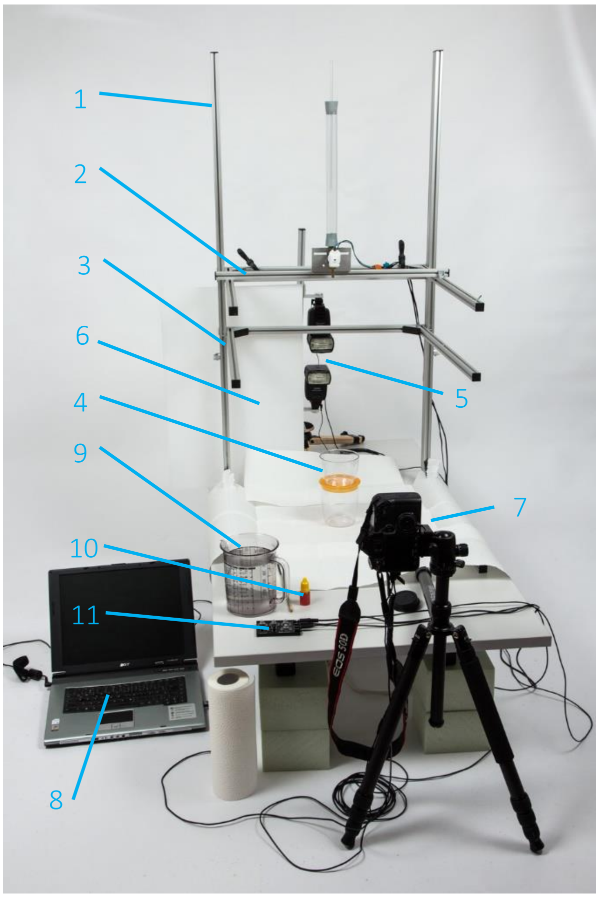

Figure 1: Assembly before starting

Drip tray

The drip tray, a storage jar from the kitchen, *Carrier system-4*, stands on a slightly higher version of the same, in whose lid I have drilled holes so that the excess water does not flow onto the table, but into the tray below.

Speedlites

Each of the two speedlites, *Carrier system-5*, are mounted on an aluminium profile bar with a small accessory bracket. The whole setup is placed on a Berlebach mini tripod, see *Figure 2*. The arrangement makes it possible to position the speedlites vertically to each other, and to adjust their heights. The Y-plug distributes the signal from the **drop-timer²**, red arrow, to the speedlites, blue arrows.

The speedlites are controlled by the **drop-timer²** by means of a cable running over the “flash” jack, *Procedure* green arrow.

The Plexiglas plate, *Carrier system-6*, is intended as a diffuser and is positioned between the speedlites and the drip tray (moved to the side in the image to make the speedlites visible).

Figure 2: Flash stands

Camera

I place the camera, *Carrier system-7* on a tripod with the optical axis slightly oblique to the table surface and around 8 to 10 cm above the water surface. I select a large frame in order to capture the action as completely as possible.

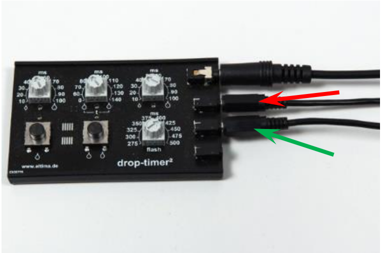

Figure 3: Connection drop-timer²

I connect the camera to a notebook to visualise the results, *Carrier system-8*.

The camera is triggered by the **drop-timer²**, *Carrier system-11*, and connected to the **drop-timer²** camera jack via a connection set for Canon N3, Procedure, red arrow.

I set the camera’s shutter speed to ½ second, and the aperture to 16.

Drop dispenser

I mount the drop dispenser on the large accessory bracket from the top frame, around 20 cm from the stands, see *Start-up*. I then align the outlet nozzle vertically. The drop dispenser is ready for operation after connecting it to the power supply and the **drop-timer²**.

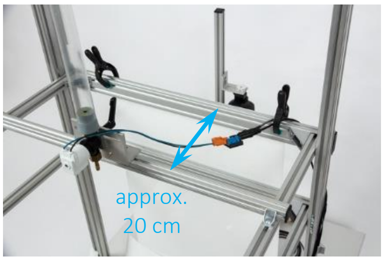

Figure 4: Assembling the drop dispenser

Procedure

After pressing the button for double drops, for example, the solenoid valve opens for the time set for the first drop and then releases it. The camera is triggered at the same time.

After the first drop, the time between the two drops passes, after which the solenoid valve opens for the second drop and releases it.

As the drops fall, the camera shutter opens. Depending on the shutter lag, and due to the set drop height, the first drop will be more or less far from the water surface as soon as the shutter is open. This makes it possible to detect the drops even before they hit the water surface.

Once the flash lag has expired, the speedlites are triggered and the image is created. Once the ½ second for the shutter speed has expired, the camera shutter closes and the image is saved.

Around 250 to 350 ms pass from the moment the first drop hits the water surface until the drop sculptures collapse. The set shutter speed of ½ second (500 ms) allows each phase of the drop sculpture to be photographed, from the moment it hits the water until it collapses, without changing the camera setting.

Start-up

Drop fluid

As a drop fluid, I like to use plain water thickened with xanthan. This solution can be produced easily and quickly, and it provides presentable results. For this, I dissolve an espresso spoon tip of xanthan powder in a litre of water: see *Setting the* camera.

Figure 5: Espresso spoon with xanthan

First, I add the strong-clumping xanthan to a quarter litre of hot water. Then I vigorously stir the mixture with a hand blender and add cold water until there is one litre. After cooling to room temperature, the liquid is clear and ready to use. If it is left for one day, the columns become smoother and slimmer (as I have seen).

I use this to fill the drop dispenser and add a small amount of transparent, liquid food colouring. For stirring, I use a stirrer made of a chopstick with an attached straw, which I have cut open and fanned out at the end. I move it up and down in the drop dispenser until the colour is mixed evenly, see *Figure 8*.

Figure 6: Stir

Figure 7: finished solution

To work as long as possible with a filling of the drop dispenser, I fill it up to the top with liquid. After plugging, the remaining air chamber should be as small as possible.

I fill the collecting basin with water so that the water level is above the edge of the vessel and forms a meniscus. This is the reason why you can only see the water in the picture, and not the edge of the vessel. I then move the basin until the drops fall into the middle of the water surface.

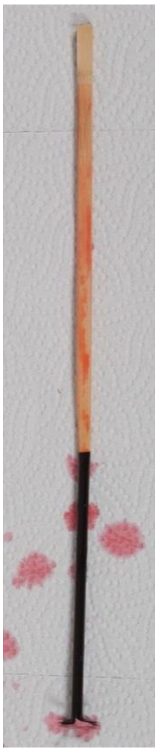

Figure 8: Stirrer

Adjusting the focus

A wood screw, for example, can be used to adjust the sharpness. This is placed in water and moved until the droplet sits exactly on the tip of the screw. The focus can then be set to the screw.

Figure 9 shows a droplet that just meets the screw. For this picture, I already determined the required delay time of the light barrier by means of trial and error. However, this step is not necessary for adjusting the sharpness itself since this can be seen with the naked eye if the drop falls on the screw.

Personally, I do not use a setting aid. I place the focus roughly on the spot where I suspect the drop will fall, and only focus later on, to the desired drop sculpture through repeated triggering and trying.

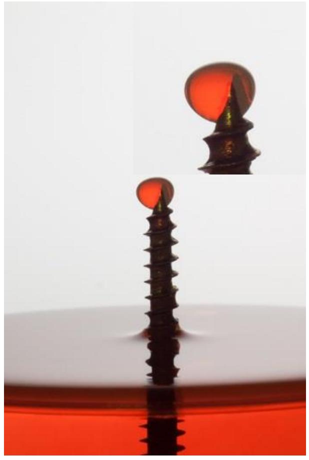

Figure 9: Adjust the sharpness with a screw

Setting the speedlites

As already mentioned, I use two speedlites in this guide. I prefer to set both to 1/128 of the flash output and the zoom to 24 mm, thereby achieving the shortest exposure time and thus also the least motion blur.

Setting the camera

Generally speaking, the type of camera that is used is not important; the basic principle remains the same. Since I myself use the Canon EOS 50D, the settings first apply to this. For other models, they are probably the same or at least similar.

I set the shutter speed to ½ second. As described in section *Procedure*, this makes it possible to capture all phases of the “drop life” without changing the camera setting. I set the aperture to 16 to achieve a good depth of field. I now adjust the image exposure via the camera sensitivity. My setup and the values I have set for the flash and aperture result in an ISO of 250 for the pictures shown here.

Since no drops are visible in the image at this stage, the exposure setting is initially approximate and is guided by the background or the drip tray. The settings can be optimised later on, if necessary.

Setting the drop-timer²

The exact settings on the **drop-timer²** are described step-by-step in the following chapters.

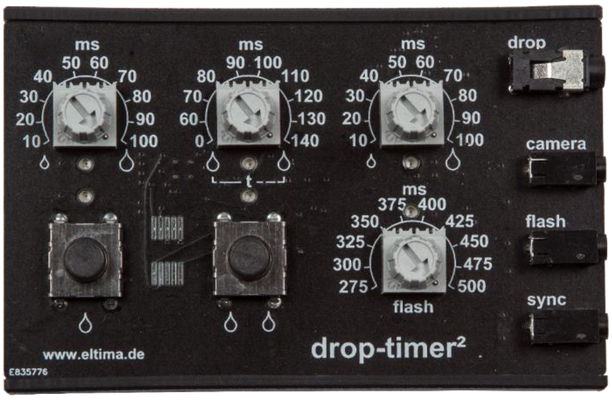

Figure 10: drop-timer²

Generally speaking, the setting of the top three potentiometers is responsible for the type and shape of the droplet sculpture. The left potentiometer is used for the size of the first drop, which determines the shape and height of the column. The centre and right potentiometer determine the form of the cap.

The flash delay potentiometer determines when the picture is taken.

For the starting point in this guide, the left potentiometer should be set to approx. 45 ms, and the potentiometers for the time lag and the second drop should be set to the left limit stop, i.e. zero.

Up to chapter *Cap*, the left button for single drops is pressed in each case.

Water drop photography

Figure 11: Airing tube ventilated

Before starting the water drop photography, make sure that the airing tube is completely filled with air and that it contains no more water *Figure 11*. Once a drop is released, an air bubble must rise! If this does not happen, there will be no constant drop size with the same setting, which leads to results that are random and not very reproducible! If the air in the airing tube is displaced by water over time, the plug is not airtight and needs to be turned into the outer tube more tightly.

As a newcomer to water drop photography, it may be difficult to find a time orientation at first since you do not really know where you are with the set values.

This is especially true with the flash lag. It is not always clear if the lag is too short or too long, especially if the highly anticipated drop sculpture is not visible. The following pictures can help somewhat.

Figure 12: Flash lag too short

Figure 13: Flash lag too long

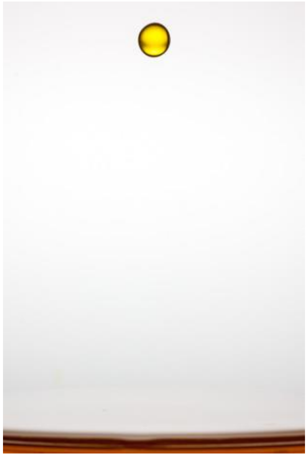

Figure 14: Flash lag OK

In *Figure 12* no droplet or figure can be seen; the water surface is even. This suggests that the selected flash lag was too short hence the image was taken too soon. The drop is still above the picture section.

Figure 13 shows an image with a very long lag. There is a drop and the water surface is wavy, suggesting that the drop has already touched the water surface. Here we see the moment just before the column rises from the water.

What you are possibly looking for in the beginning is the situation in *Figure 14*. Here, the drop is in the picture but not in the water. From there you can approach the desired result by increasing the flash lag bit by bit.

Crowns

Starting from the situation similar to that in *Figure 14*, move forward while carefully increasing the flash lag. If a step was too large, it helps to return to a known position and continue from there on. At some point, with a bit of feeling, you will obtain the situation as in *Figure 15* right, where the drop hovers just above the water surface. After that, the drop starts to collide with the water surface.

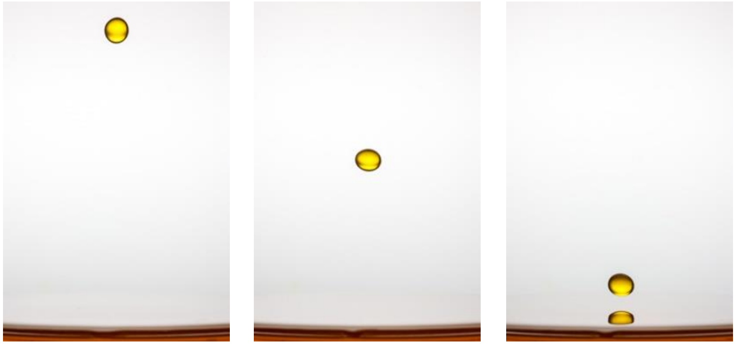

Figure 15: Approaching the water surface

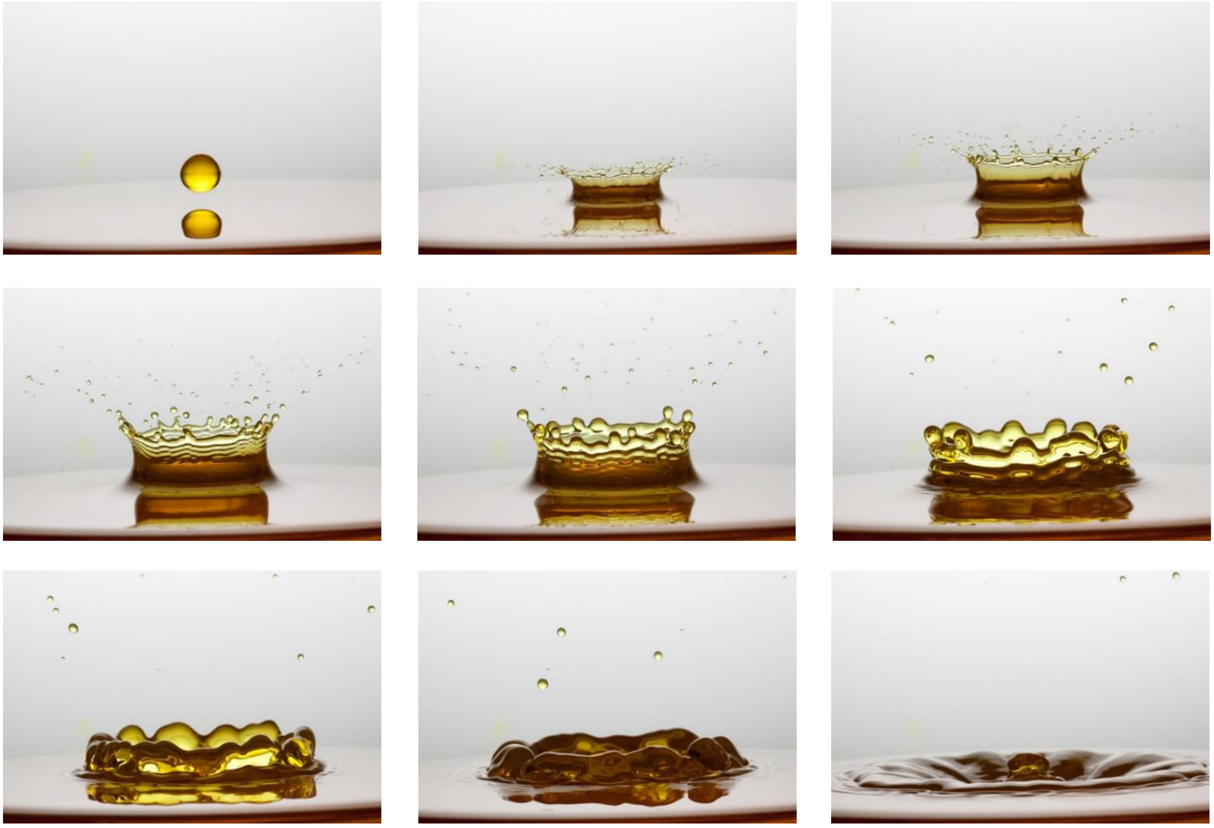

Figure 16: different stages of a crown

First, the drop penetrates the surface and displaces the water around. The crown then begins to form and develops a filigree spike formation at the top. In the left and centre of the middle row, it fully develops; on the right, the structures gradually fuse and begin to dissolve. The pictures below show different phases of the collapsing crown. The last picture shows the depression in the middle, from which a column is already emerging.

Columns

Following the collapse of the crown, a column emerges from the depression. *Figure 17* shows different phases of the formation and collapse of the column - quite shapeless at first and then becoming slimmer and finally collapsing.

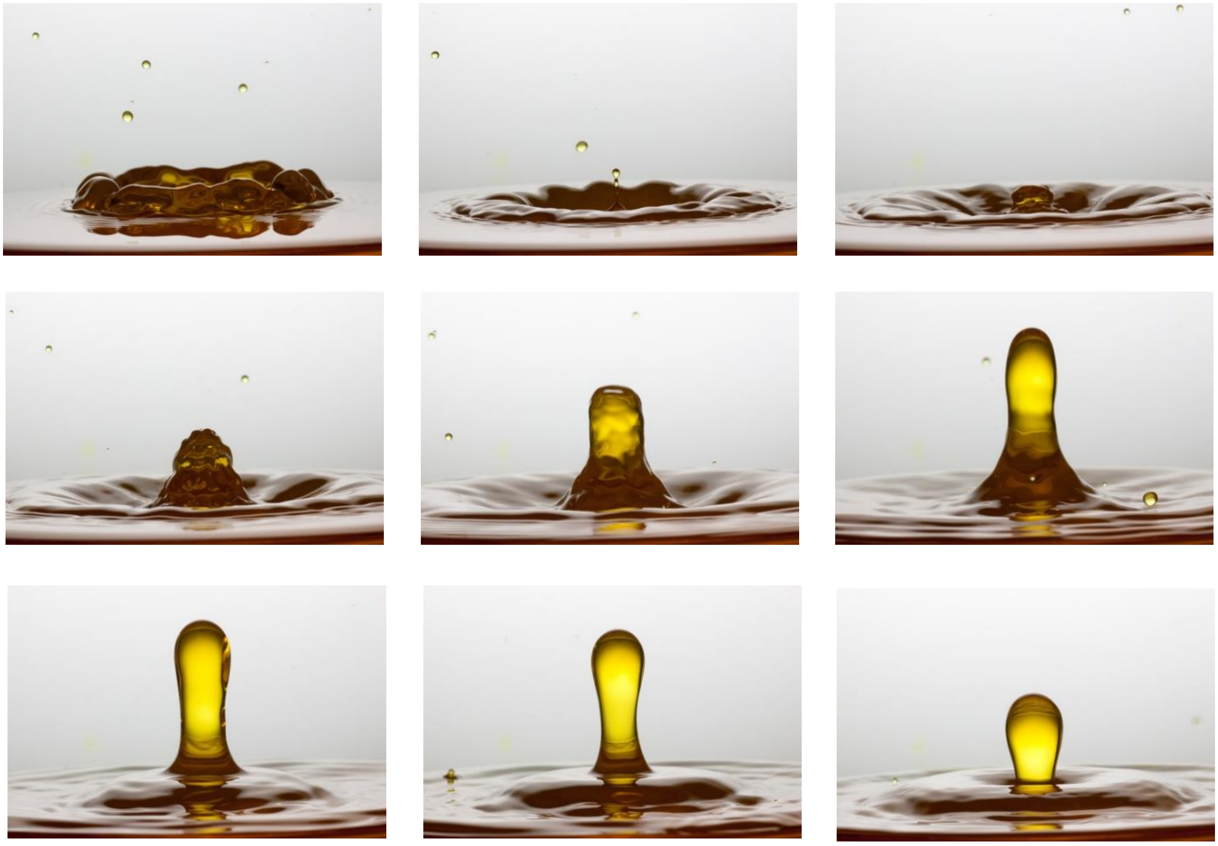

Figure 17: Different phases of a column

The condition of the water surface is important for orientation over time. This is initially smooth around the crown. After that, the waves spread and cover the entire surface. In large basins, the wave diameter is already very large in this phase.

Unfortunately, the energy of a single drop is too low for tall columns. A different technique is needed for XL columns.

XL columns

A large drop would contain more energy (momentum), form a deeper depression and probably result in a taller column. Unfortunately, the drop size is physically limited to a level that is too small for tall columns. A larger volume of water would split into small, single drops due to various factors such as the surface tension.

Because of this, we need to use a trick. We let two drops fall into the water in quick succession. As we have seen, the first falls into the water and forms a depression in the surface. The second one then needs to fall into the depression just when this is about to be displaced by the water and then rise as a column. The second drop then forms another depression in the existing one, and a tall column emerges out of these. Therefore, timing plays a crucial role here.

Figure 18: Drop pair for tall columns

Figure 18 shows how the small splash of water splits into two parts immediately after the outlet nozzle (note: the pictures with the red drops come from another guide). A drop has already formed and is almost round. The upper part initially assumes quite idiosyncratic forms, ultimately forming a round drop. The increasing distance between the two drops can be clearly observed, which indicates the varying rate of fall. Before the second drop is released from the nozzle, a thin thread is formed. This can either disappear completely inside the drop or part of it forms another very small drop that is seen in the pictures again and again.

In *Figure 19*, the developments under water become clear. The depression is formed after the impact of the first drop. In the middle picture above, you can see the second drop, inside the crown, which will soon strike. The following pictures show how the second depression forms and how deep the complete hole becomes through the second drop when it hits at the right moment. The depression is then displaced by the water in the basin and a column emerges.

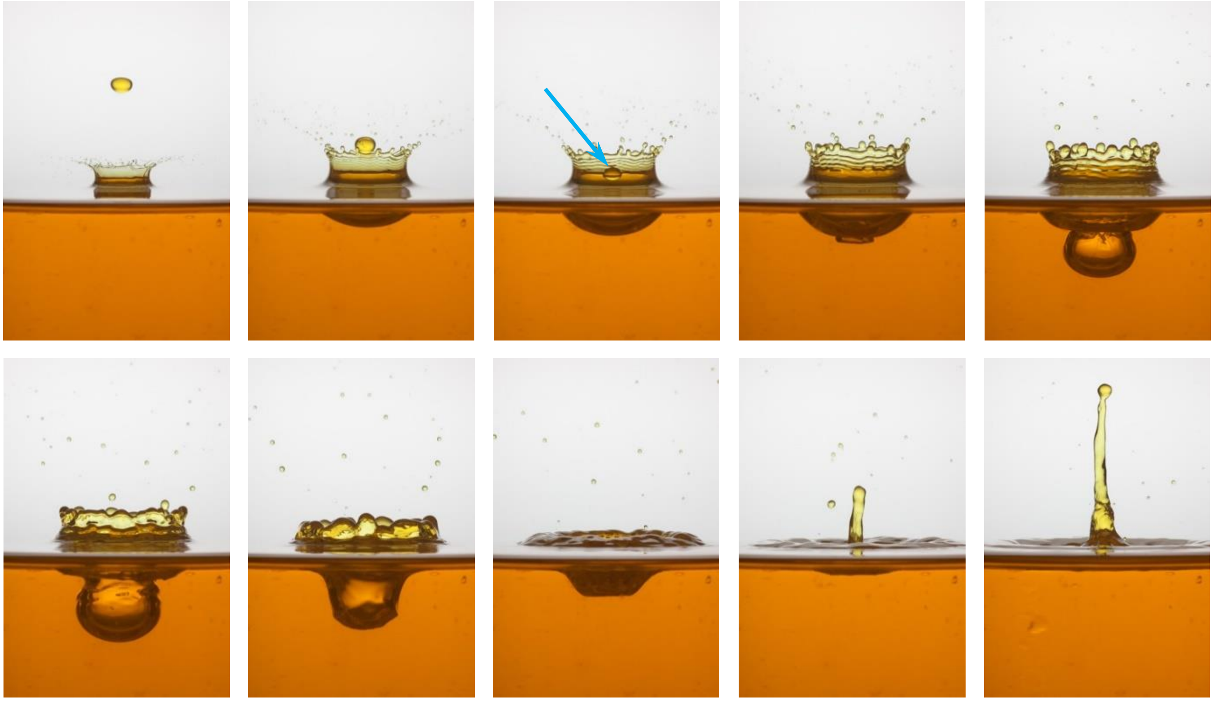

Figure 19: Effect of the second drop

To create these two drops, the amount of water that leaves the valve has to be more than that which fits in a drop. As already shown, this splits this amount of water into two drops. These fall into the water at slightly different speeds, hit the water surface in quick succession and cause the effect described above.

It sounds complicated but it is not. To create a tall column, it is only necessary to follow a strict procedure. Information or specifications of valve opening times are not helpful since they heavily depend on the properties of the drop fluid.

Generally speaking, it is very important to change only **one** parameter at a time and see what happens. For better assessment of the intended effect, it is equally important to take several pictures after a change is made.

To get a tall column, I first turn off the camera and the flash; what we see can be seen with the naked eye. For the beginning, I set the drop size on the left potentiometer of the **drop-timer²** to app. 45 milliseconds. For the time being, it is very likely that only one drop will fall, which leads to a small column. I then increase the drop sizes in very small steps, and trigger the drop dispenser 2-3 times after each increase and observe what happens. The potentiometer must be operated very sensitively.

From a certain opening time/drop size, the amount of water flowing out will be high enough for the two drops to fall into the water at the right times, as described above. A tall column will rise out of the water. The column itself is not quite visible to the naked eye since it moves too quickly and its duration is too short. However, individual drops of water that jump strikingly high arise from it.

After further gradual increases of the drop size, the drops will no longer jump so tall and small columns will form again. In addition, a distinct “plop” can be heard upon impact of the second drop.

It is noteworthy that the time range in which tall columns form, lies within a few milliseconds - about 5 - 7 ms. For this reason, the steps for increasing the drop size need to be very small so as to not miss this range. With the current drop height of around 45 cm and my drop fluid with xanthan, this time range for the drop size is around 65 - 70 ms.

After finding the setting for the tallest column, I turn the camera and speedlites on again and try to capture the column that has formed. For the flash lag, I select a time that is roughly the same as that of an “old” crown, see *Figure 16*. In this way, I am certain that the column will emerge over time. I then gradually increase the flash lag until I get a tall and intact column.

The following images provide a brief guide to finding the optimal column. *Figure 20* shows very “young” columns on the left; they were photographed with a shutter delay lag that was too short. From the third image, the columns are already quite old; they are starting to dissolve into individual drops.

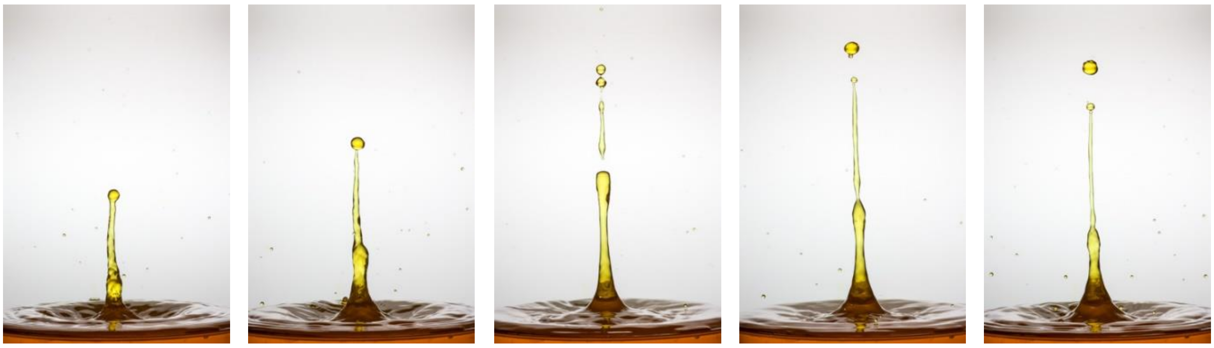

Figure 20: young columns, shutter lag too short

The leading drop at the very top is already quite far away from the column.

The two right columns are at the limit of usability. A few milliseconds later, they dissolve into drops. Although interesting pictures can be made with them, this guide is about intact columns.

Figure 21: Exposure time too long

Figure 21 shows columns where the drop size is too big. Typical of this is the column dissolving into many small drops with a leading drop front of it. In the two images on the right, the drop size is much too big, no column is formed and a splash or a dull “plop” is heard, as in the situation in the image on the outer right.

Figure 22: Drop size too small

If the drop size is too small, columns such as those in *Figure 22* are formed. Only the slightly thicker stem is visible, while the upper slender part cannot develop.

Cap

Usable columns can be seen in *Figure 23*. They are slim and (almost) intact. With some, the leading drop is already dissolving from the tip, but this creates a nice cap during the collision with the drop falling on it. As we already saw above, the column on the outer right is at the limit of usability.

Figure 23: usable columns

Once the optimal column is formed, I first set the potentiometer for the time lag between the drops to the right stop limit and that for the second drop to about 40 ms, thereby forming a single drop.

By pressing the button for double drops, the previously set column forms, as does a second drop which falls afterwards. The latter will either already be seen in the picture or not, depending on the picture frame. Now I turn the potentiometer for the time lag bit by bit to the left towards smaller times. The drop will appear in the picture and approach the column.

I shorten the time lag until the second drop is just above the column's leading drop, or until it is just touching it, as shown in the right picture in *Figure 24*.

Figure 24: Approach and collision

I then carefully increase the flash lag. First, a small disc is formed out of the collision, which grows into a small cap with increasing flash lag, see *Figure 25*.

Figure 25: Cap

High-Speed for Photography

eltima electronic
Hans Gierlich
Staufenstraße 10
73230 Kirchheim unter Teck

Tel: +49 (0)7021 863444
mail@eltima.de
www.eltima.de