Australian Meteorological Association Inc.

# WELCOME

The *Australian Meteorological Association*, (AMETA Inc.) was established in 1969(*) to promote community understanding of, and involvement in,

**Meteorological Sciences and Services**.

(*) 2019 is the AMETA's semi-centennial (50 years)

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# Bureau of Meteorology Webinars

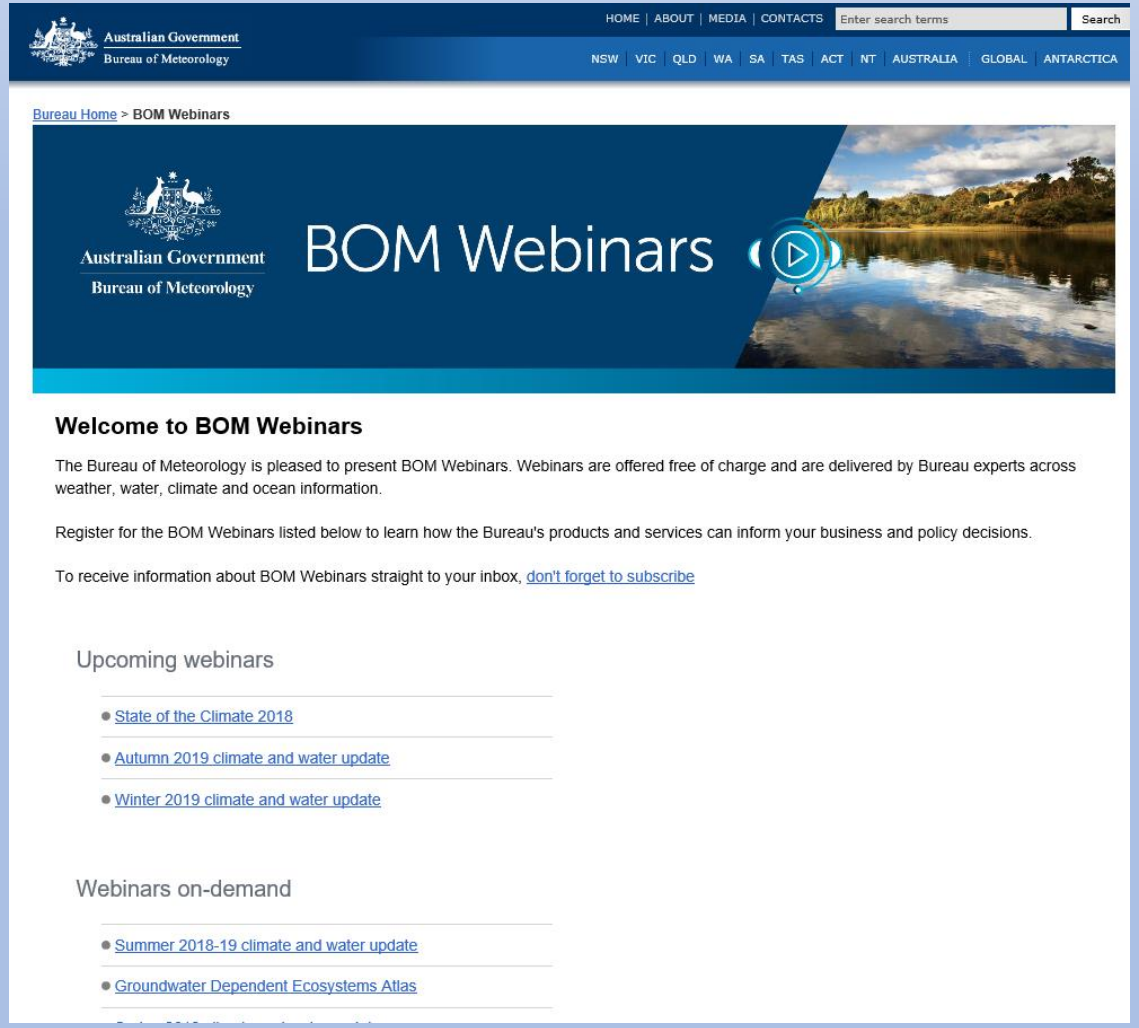


Image from BOM Website

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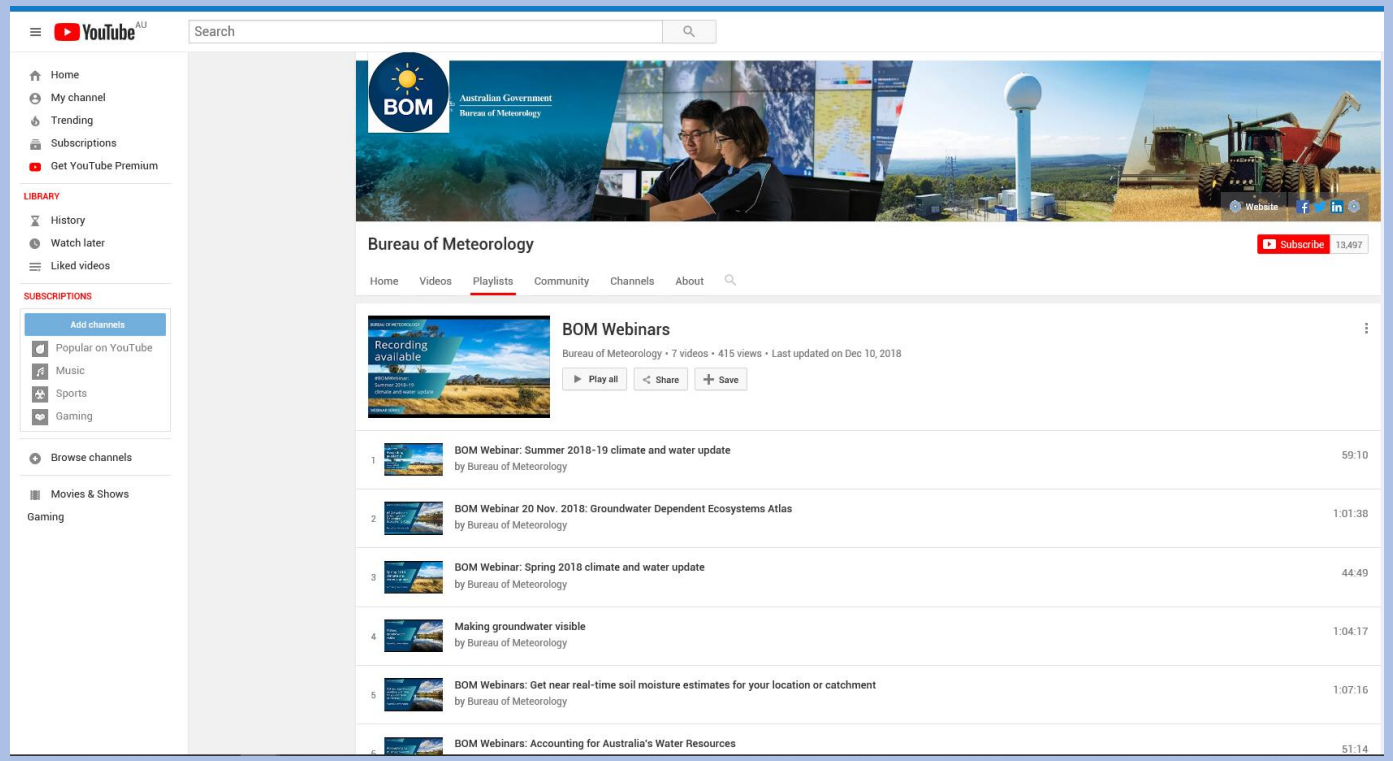


Image from You Tube

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# An Introduction to Rain Gauge Instruments

By Mark Little

Image from Townsville Bulletin

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# An Introduction to Rain Gauge Instruments

Along with temperature, rainfall is one of the most important meteorological measurements if you are involved with agriculture. So important, in fact, that the first known rainfall records date back **to 500BC in Greece**, and **400BC in India**.

This introduction deals with a number of rain measuring instruments from the common to the esoteric.

An instrument as important as the rain gauge is known by a number of names including:

- **Udometer**
- **Pluviometer**; and
- **Ombrometer**.

- A related instrument that measures drop size and distribution (and infer rainfall) is called a **Distrometer**.

By Mark Little

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# Interesting Rain Gauge Related Facts

- Your home weather station may measure the daily rainfall from midnight to midnight, but the BOM measures daily rainfall from 9am to 9am the following day.
- The largest recorded rainfall in 48 hours was 2,493mm recorded on June 15-16, 1995 in Cherrapunji, India. Cherrapunji also holds the record for the highest rainfall in a 12-month period of 26,470mm from August 1860 to July 1861.
- The Aswan Area in Egypt and the Attacama Desert in Chile have an average annual rainfall of less than 1 mm.
- The McMurdo Dry Valleys, Antarctica probably haven't had surface water for 14 million years.
- For South Australia, the highest daily recorded rainfall was 272.6mm (Motpena, 1989), highest monthly rainfall was 676.0mm (Balcanoona, 1989), and highest annual rainfall was 1852.6mm (Aldgate, 1917).

Sources: Accuweather and Bureau of Meteorology, Australia

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# Measuring Cylinder Rain Gauge

The Measuring Cylinder represents one of the earliest but still common types of rain gauge.

The concept is simple. Place the cylinder in a clear, exposed area and as the rain falls, it will be captured by the mouth of the cylinder. If the wall of the cylinder is graduated, the depth of the water will show the amount of water that has fallen.

The one of the main disadvantages of this system revolves around the small area of the neck of the cylinder. Because there is a one for one correlation between the depth of the water in the tube and the amount of rainfall, it can be difficult to accurately measure small amounts of rain.

This problem can be reduced by adding a funnel to the top of the measuring cylinder. If the funnel is twice as wide as the measuring cylinder, then there will be four (4) times more water collected, meaning that the scale on the cylinder can be expanded, making it easier to accurately measure small amounts of rainfall.

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# Recording Pluviometer (Pluviograph)

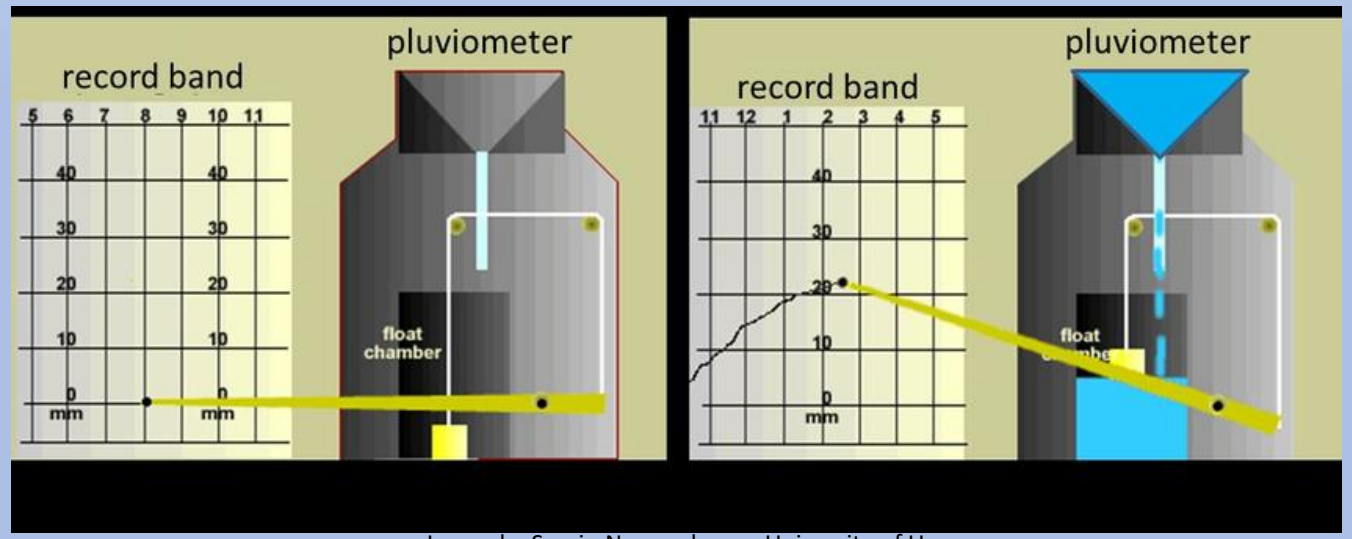


Image by Sergio Nesmachnow, University of Uruguay

The recording pluviometer uses the same collection principle as the measuring tube rain gauge to capture and store the rain, however, instead of the observer having to read the scale on the reservoir tube, a float is connected to the needle of a meter.

This needle draws a line on a calibrated piece of graph paper which turns on a drum. This graph shows the total rainfall, the rainfall rate and when the rain fell.

This instrument has the same problem with collection of rain as the measuring cylinder – it needs to be emptied. It also needs the paper cylinder changed so that the reading don't overwrite the readings from the previous rotation(s).

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# Weighing Bucket Rain Gauge

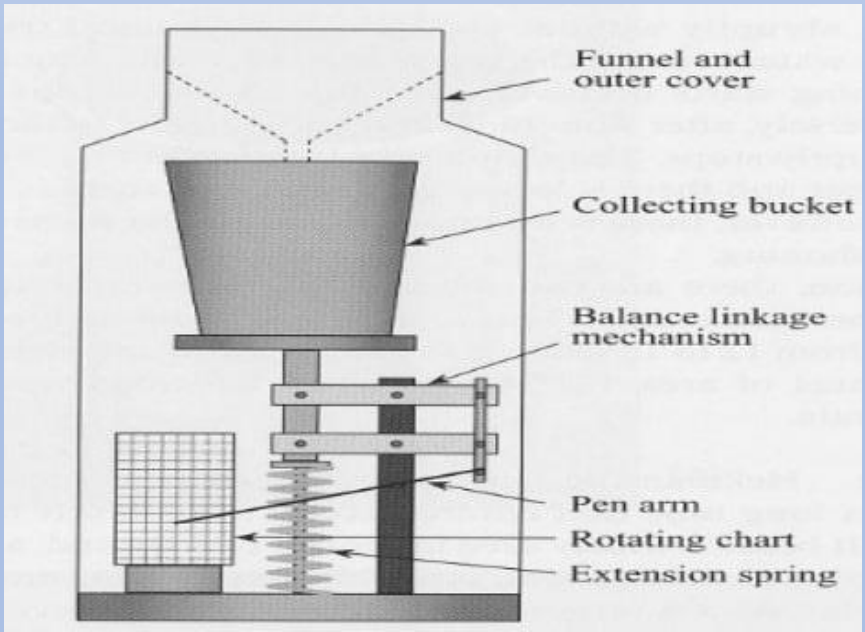


Image from theconstructor.org

The weighing bucket is sort of the opposite of the previous rain gauge in that the bucket moves down as the water is captured for measurement. It is actually measuring the weight of the water.

Because the density of water is known, the movement of the pointer can be calibrated to translate the weight into the amount of water than has fallen.

This instrument has the same problems as the previous pluviograph in that needs the paper cylinder changed so that the reading don't overwrite the readings from the previous rotation(s) and the bucket needs to be emptied to prevent overflows.

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# Tipping Bucket Rain Gauge

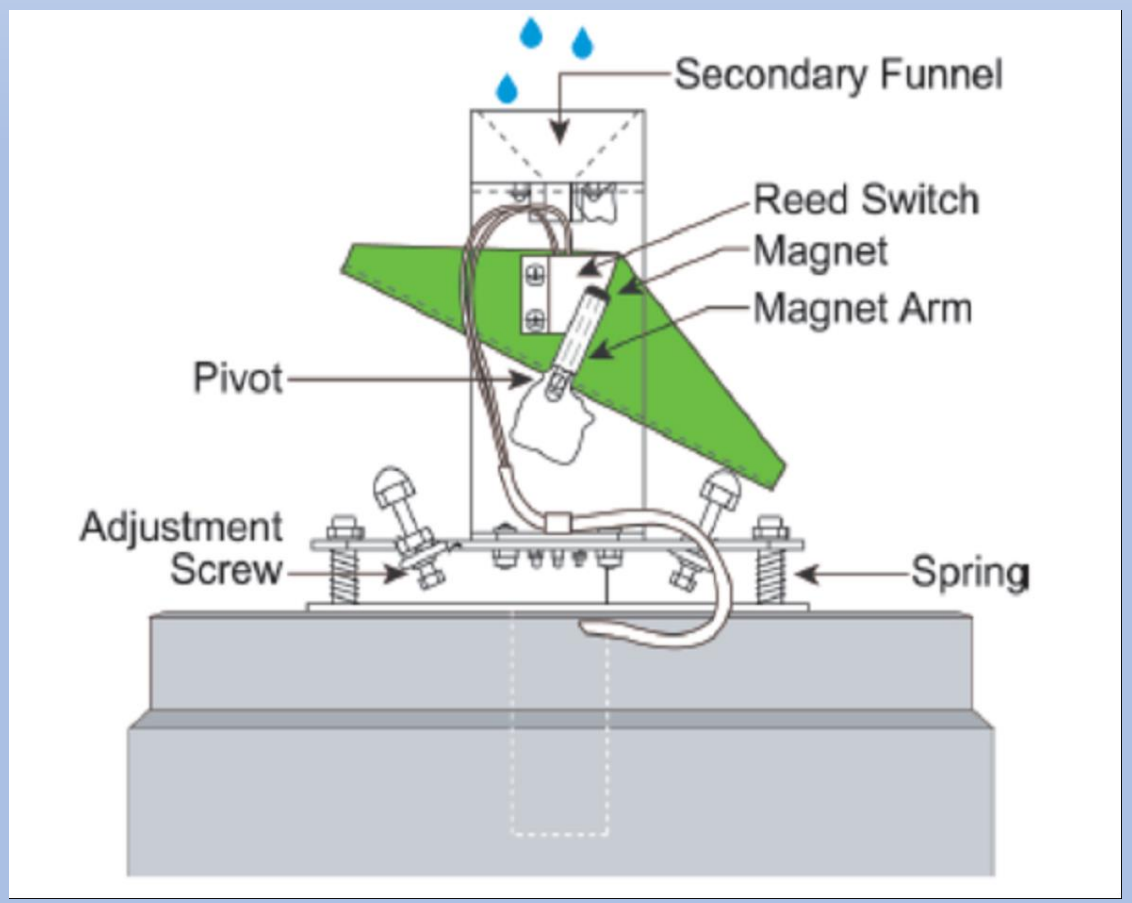


Image from SUNJRAY

The tipping bucket rain gauge provides a means of measuring rain remotely and it does not suffer from the overflowing issues of the measuring cylinder as it continually empties as the rain is captured and measured.

It is estimated that tipping bucket rain gauge is the most popular rain gauge, accounting for over 60% of the rain gauges in use.

The tipping bucket rain gauge was first developed by Christopher Wren in Britain in 1622, so it has been around a long time!!

By Mark Little

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# Variation of Tipping Bucket Rain Gauge

This tipping bucket rain gauge only provides one bucket, but the principle is the same. When the bucket fills, it tips over and empties.

However, in the model, the magnet provides a counterbalance that causes the bucket to tip back immediately the water was run out of the bucket. The shape of the bucket ensure that this will occur quickly.


This model of tipping bucket mechanism is known to be used in the HP-1000 Weather Station shown to the left.

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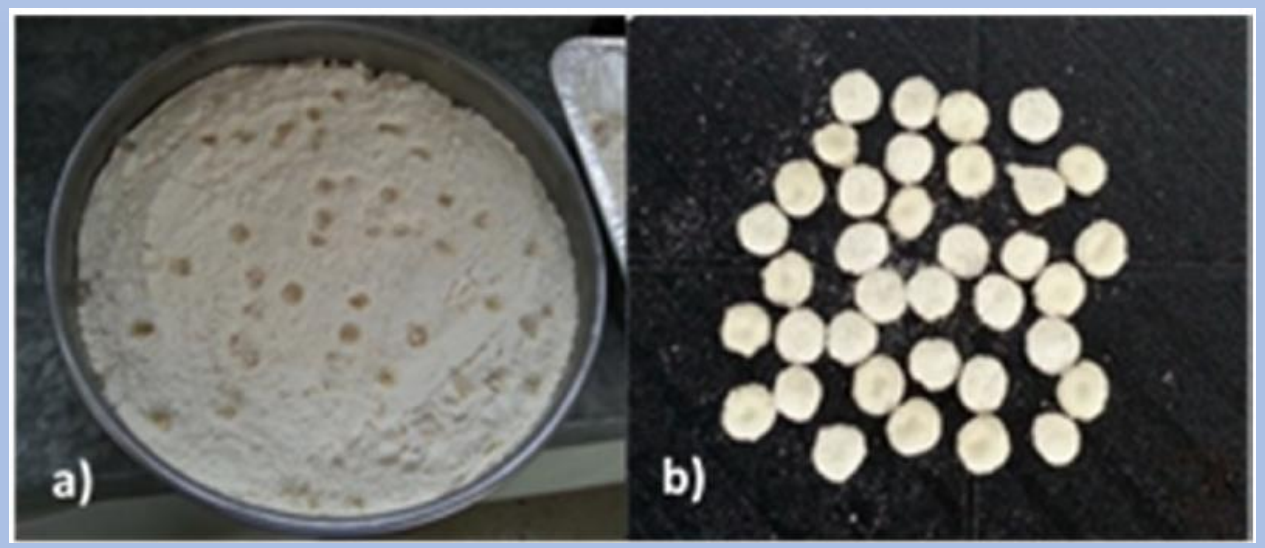
# Unusual Rain Instruments

**THE FLOUR PELLET METHOD**




First developed in 1904 to study rain drop size distributions. The flour caught the water droplets and then the pan was later baked to make a record of where the rain fell and how big the drops were.

This method of measuring rain drop size and distribution has been overtaken by advances in technology such as high speed video camera and other optical measurement techniques.

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# Unusual Rain Instruments

**IMPACT DISDROMETER(*)**

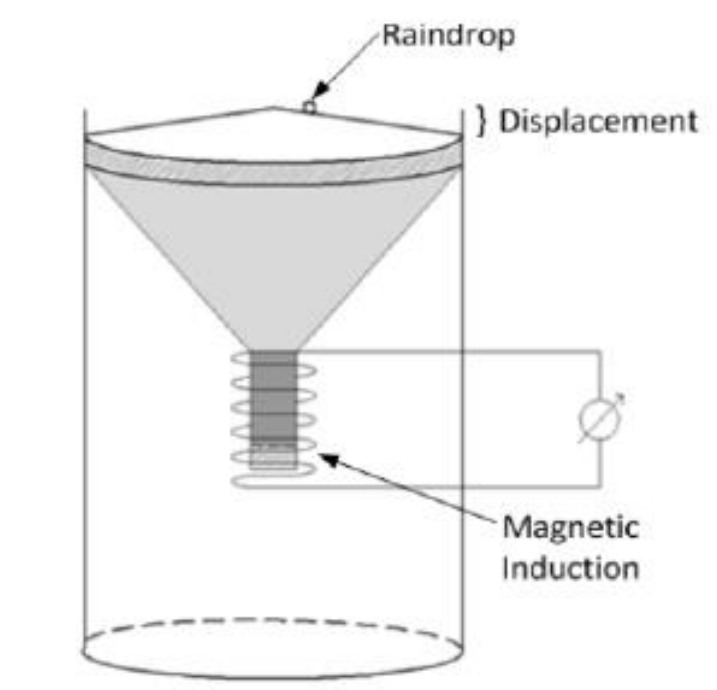



Image from Distromet Ltd.

The Impact Disdrometer is equivalent to tapping a microphone with your finger. When the drop hits the top of the instrument, it displaces the sensor cone causing the coil to pick up the movement of the magnet. The information about the rain drop size and frequency are recovered by using digital signal processing.

(*) A **disdrometer** is an instrument used to measure the drop size distribution and velocity of falling hydrometeors (rain, hail, etc).

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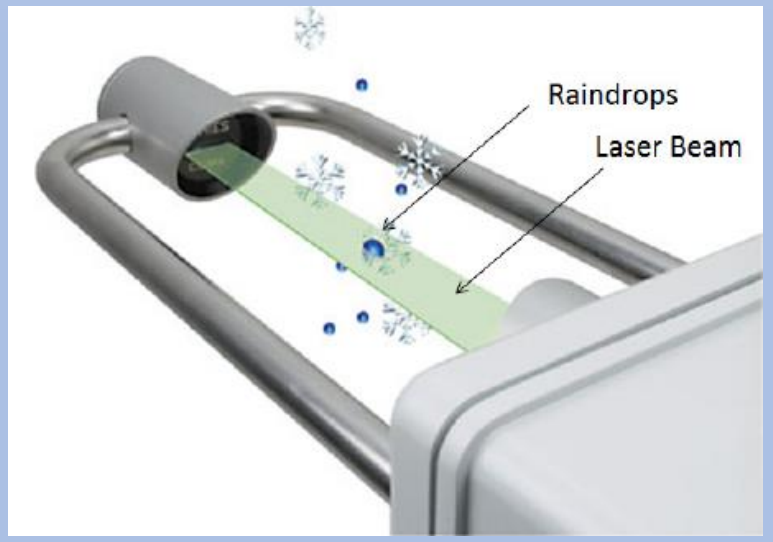
# Unusual Rain Instruments

**OPTICAL DISDROMETER**

Image from Eigenbrodt




The Optical Disdrometer emits a broad beam of light to an array of detectors. As the droplets fall through the beam, they refract the light and alter the light being received by the detectors.

By using digital signal processing, it is possible to determine count and determine the size of individual rain drops.

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# Unusual Rain Instruments

**LEAF WETNESS DETECTOR**

As most home weather station owners who closely follow their stations will attest, their rain gauge does not measure the first light rain that falls after a dry period.

This is because a standard tipping bucket rain gauge may take about 0.25mm of rain to wet the surface of the rain gathering cone before water flows into the tipping bucket. To see the effect of “wetting” try to empty a bottle and water will continue to drip before some time because water tends to stick to the inside of the bottle.

The Leaf Wetness sensor can detect just a single drop of rain (or condensation from mist and fog). This can be important for agriculture where the crops may be susceptible to mildew caused by water on the crop. This sort of detector can be used to turn on fans used to control fungus.

By Mark Little

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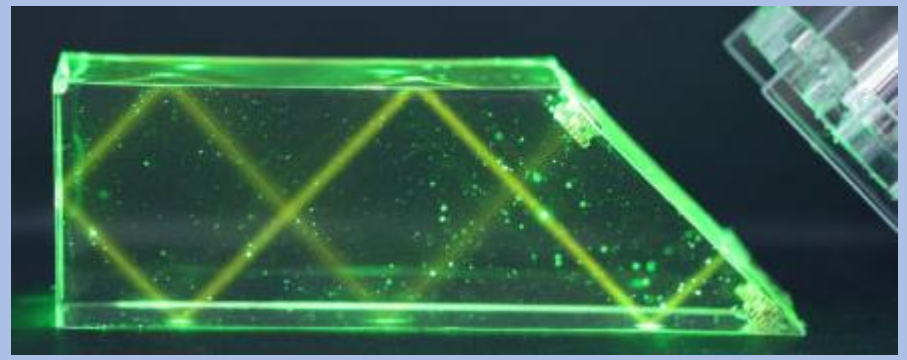
# Automotive Rain/Water Detector

Optical Rain Sensor Image from ElectroSchematics

Image from 5 Star Autoglass

Meteorological instruments (left image) aren't confined to the weathers station and some have moved into cars (right image) to provide automatic windscreen wipers, but how does this type of instrument work?

The images below shows what happens to the light when a rain drop falls on the surface of the sensor.



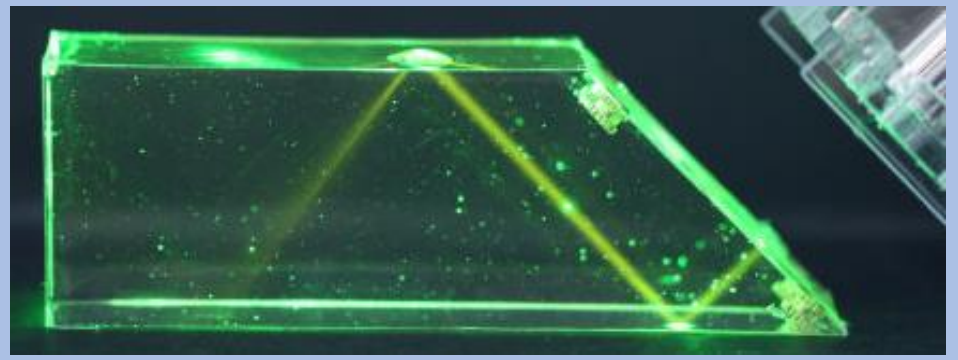


Image from Yocotopuce

The light escapes reducing the light reflected back to the receiver, indicating that the surface of the sensor, often the windscreen, is wet and it is time for the wipers.

By Mark Little

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# Generic Problems with Rain Gauges

Image from Amikazzo, Amazon UK

While this bird sculpture looks quite nifty. It highlights two problems that can occur with rain gauges.

The first is that the sculpture will block rain falling from the direction behind the bird, causing the rain to read low. Not only that, but the comb and the beak may catch rain and let it drip into the mouth of the rain gauge when the wind is coming from the side.

The lesson from this is that, where possible, the rain gauge should be away from obstructions that can block the rain from , or channelling rain into, the rain gauge as it will affect the accuracy of the readings.

The second problem is if that was a real bird roosting on your rain gauge. Especially if its tail is hanging over the rain gauge catchment and the bird does what birds do. This can as easily block the drain hole as a leaf or a seed falling from a tree.

By Mark Little

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# Generic Problems with Rain Gauges

Image from Amikazzo, Amazon UK

YES!!! It really DOES happen!

And it doesn't do much for the Wind Direction measurement either. 😕

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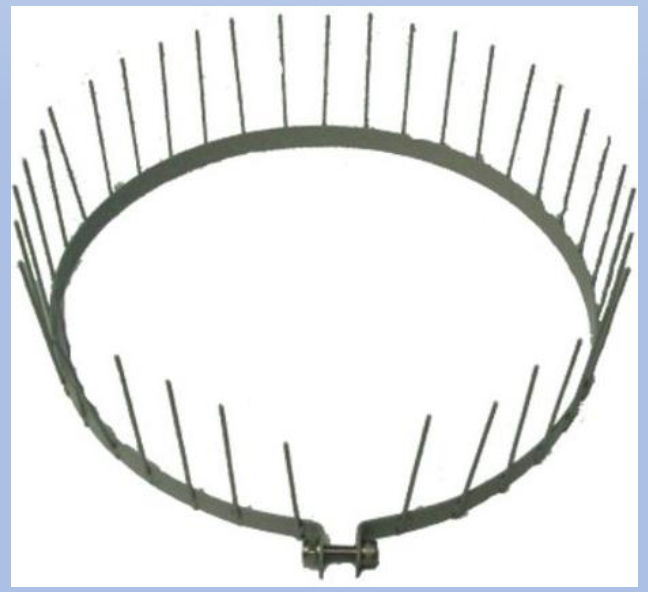
# Generic Problems with Rain Gauges


Image from Amikazzo, Amazon UK



Bird spikes are either available as an option for your rain gauge, or as an after market fitting, although, they tend to be expensive.

Personally, I tend to occasionally clean out the throat of the rain gauge with a cotton bud to make sure that it is not blocked with Pidgeon droppings, leaves or seeds.

This can be an issue if it is difficult to get to the rain gauge for cleaning.

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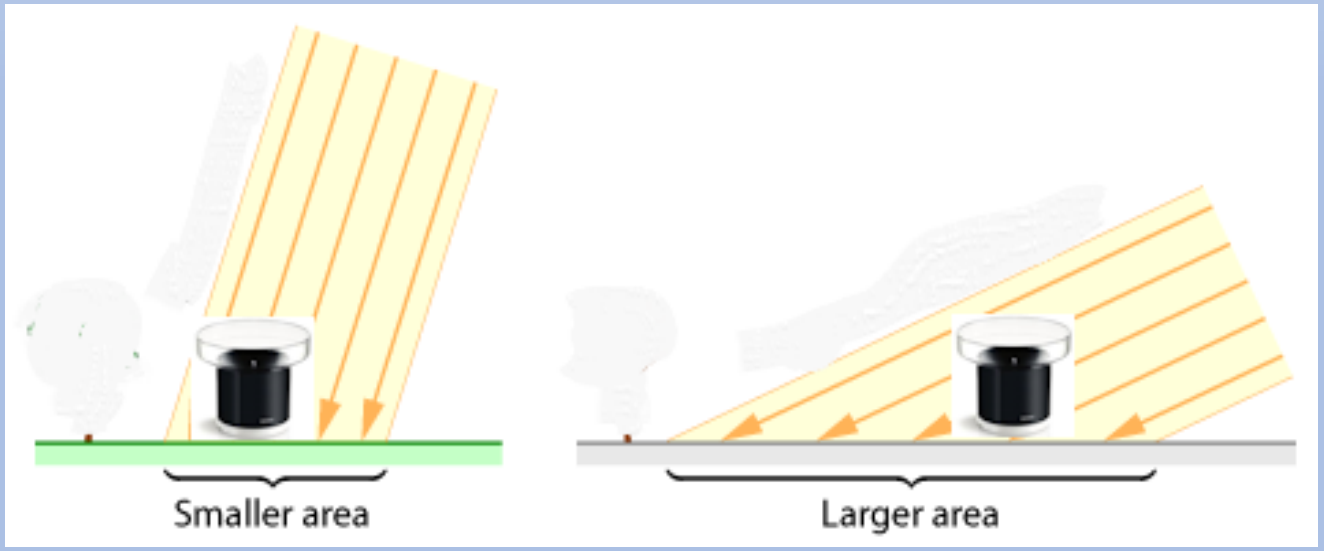
# Generic Problems with Rain Gauges

**WIND DEFLECTION**




Strong winds can reduce the accuracy of a rain gauge. As the diagram to the left shows, when the wind slants the rain, less of the rain may hit the mouth of the rain gauge, reducing the rain measured.

Heavy rain can also bounce off the upper edge of the rain gauge and the splash falls outside of the mouth of the rain gauge, reducing the rain measurement from what is actually falling.

Image from Looking Glass Photo & Camera

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# Generic Problems with Rain Gauges

**MITIGATING WIND DEFLECTION**

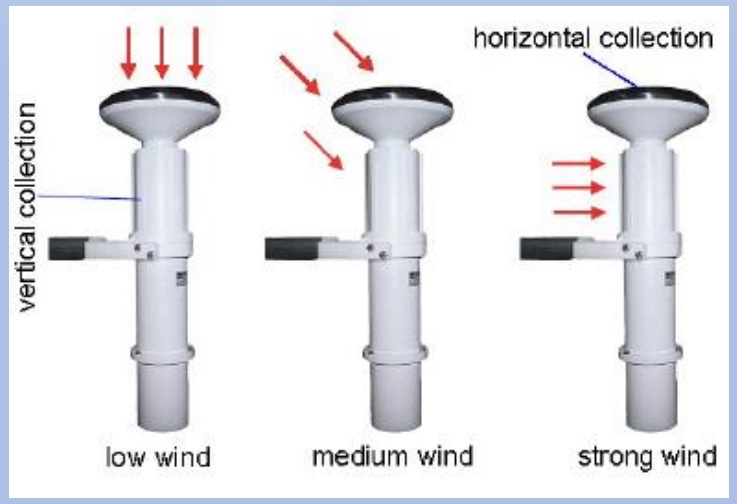


Image from Eigenbrodt

The effects of strong winds deflecting rain away from the rain gauge mouth can be mitigated in a few ways. A really neat (but expensive) is a ship's rain gauge that can capture rain vertically and horizontally.

Another way of addressing the issue is to set up a baffle around the rain gauge that breaks up and slows the wind over the rain gauge, reducing the amount of rain that is deflected away from the measuring mouth. Some systems use two large rings of baffles to reduce the reduction in measured rain.

By Mark Little


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# SELECTING A RAIN GAUGE

The following questions are important if you are wanting to select a rain gauge.
**WHY** do you want the rain gauge? Just general interest, or part of an official program with measurement guidelines?
**WHO** do you expect to be recording the readings? Yourself, your family or automatically to the Internet?
**WHEN** will you have time to look at your rain gauge? Taking readings and doing maintenance, for example.
**WHERE** are going to mount it? If part of an official program, does the location meet the guidelines? Maintenance?
**WHAT** are you prepared to pay? This is an important thing to consider as there is a wide range of units available.

# LOOKING FOR A RAIN GAUGE

- If the rain gauge can be part of a home weather station, starting searching on the Internet for "**weather station Australia**" and/or look on eBay or similar sites. Visit hardware suppliers like *Bunnings* and electronic stockists like *Jaycar* as these types of business stock a range of weather stations.
- For a standalone rain gauge, search on the Internet for "**rain gauge Australia**". Again, visit the hardware stores and electronic suppliers for a range of rain gauges.

By Mark Little

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# Thank You for your Attention!
# Any Questions?

*After a short break, the program will continue with a presentation about a Working Citizen Science Rain Monitoring Station.*