



## Day 8- Fact Sheet 22

### Tales of the Todd- Read all about it!

# Measuring devices

Source: Australian Bureau of Meteorology

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## The Barometer measures Atmospheric pressure

Differences in air pressure (that is the weight of air pressing down on us) cause the wind to blow, so the measurement of air is very important to weather observation. It's measured using a device called a barometer. The Barometer was invented in 1643 by an Italian called Evangelista Torricelli. He invented a long glass tube filled with liquid, sealed at one end, into a bath of the same liquid, and found out that changes in the length of the column of liquid were the result of changes in air temperature.

Cheaper, more convenient but generally less accurate are aneroid barometers (aneroid meaning not wet). These barometers have a thin metal chamber from which most of the air has been taken, a spring inside prevents the walls of the chamber from collapsing and these walls move in response to variations in atmospheric pressure and these readings show the changes in air pressure.

## The Thermometer measures air temperature

The first thermometer was invented by Galileo Galilei around 1592. He also was an Italian and his basic design which was hollow glass bulb attached to a narrow stem with a tread like bore is still used.

The bulb is filled with liquid (usually mercury or alcohol) that expands and contracts as the temperature rises and falls. Some thermometers now record temperatures using electrical principles.

There are two types of thermometers a maximum thermometer and a minimum thermometer used to record the weather. The maximum thermometer usually contains mercury, and the tube is constricted near the bulb. Increasing temperature expands the Mercury past the constriction, and when the temperature falls, the Mercury breaks there. The remaining Mercury indicates the maximum temperature. This is reset every morning by the weather observers at exactly 9.00 am. Medical thermometers used to measure body temperatures are maximum thermometers. The minimum thermometer uses alcohol, which has a lower freezing point than Mercury, to indicate the minimum temperature for the day. Again this is reset at 9.00 am every day.

The thermograph continuously records air temperature on a chart mounted on a slowly rotating drum. The drum is linked to a temperature sensitive element consisting of two strips of different metals welded together in a spiral. The different expansion rates of these metals cause the spiral to wind or unwind with the changing temperature, so moving the pen arm. Temperature is generally measured in degrees Celsius or degrees Centigrade. In some countries such as the USA the Fahrenheit scale is still used.

What is the conversion from Fahrenheit to celcius?

A:  $(F-32) \times 5/9 = C$



## A Hydrograph measures Humidity

It was discovered centuries ago that the length of human hair varies with humidity and hair hydrographs are still used in some circumstances to measure variations in humidity, however more modern instruments are electronic sensors.

The English Chemist John Dalton was the first to discover that for any given air temperature there was an upper limit (saturation value) to the amount of water vapour the air can hold. The capacity of air to hold water vapour increases with temperature, air at 30C can hold more than 3x the water vapour than air at 15C . The air's humidity is important in many weather functions, including the formation of clouds and rain.

Humidity can be measured with a wet bulb thermometer. The thermometer's bulb is kept wet and evaporation causes it to record a lower temperature than a dry bulb thermometer. Tables are then used to calculate the difference between the two into a value for the amount of water vapour in the air.

Relative humidity expressed as a percentage is the most commonly used unit for measuring humidity. It is a measure of the water vapour in the air compared with the maximum amount of water which can be held at a certain temperature and pressure. In Central Australia's dry desert region the relative humidity may be as low as 10% nearer the Ocean such as Darwin it may be 80-90%. In fog it is 100%.

## A Rain Gauge or Pluviometer measures Rainfall.

The earliest rain gauges date back more than 2,000 years ago.

Benedetto Castelli a student of Galileo, is credited with inventing the modern (Pluviometer) or rain gauge in 1869 and this instrument is used all around the world.

Standard rain gauges collect and funnel water into a graduated plastic cylinder. If properly placed rain gauges give reasonably accurate readings.


Pluviometers are used by the BOM and are partially buried in the ground as level as possible, with their rims 30cm above ground level and well clear of obstacles which might restrict the free fall of rain.

## Wind Vanes measure Wind.

Wind vanes measuring the direction of the wind are probably the oldest of all weather measuring instruments. About 50BC a Macedonian Astronomer named Andronikus built the Tower of the winds in Athens. Made of marble the tower with a weather vane on top still stands today its sides aligned along compass points.

Modern wind vanes are now made with a lightweight moveable indicators which move around a fixed central spindle , point in the direction from which the wind is coming, the wind holding its tail in position. The simplest wind vane has the points of the compass North, South, east and West as fixed points. Some wind vane have a remote indicator which shows the direction without looking at the vanes. Some wind speed reports are estimates based on the Beaufort scale, which classes wind force by its action in nature, eg in "calm" -smoke rises vertically.

Anemometers provide a more accurate measure of wind-speed. The cup anemometer is the most common type, usually this is three lightweight cups rotating around a spindle. How many



times it rotates is an indication of the wind speed. This is continuously recorded on a chart noting the fluctuations in speed of the wind and its direction.

Where possible, wind vanes and anemometers are mounted on a mast at a standard height of 10m above the ground well clear of buildings and other structures that could affect wind flow. Reports on the wind direction and speed are based on measurements made every 10 minutes.

### **Exposure of instruments**

So that weather measurements from different locations can be compared, instruments need to be set up under standard conditions. For example the air temperature close to a road will vary greatly to the air temperature in a grassy area. Over either surface the temperature near your head will differ from near your feet. Direct sunshine on a thermometer will also have an effect.

Official weather stations have a standard instrument enclosure a fenced area of about 17mx17m surrounded by a 30mx30m buffer zone- and a standard layout for various instruments. In particular the thermometers are placed in a Stevenson Screen.

### **Standard observing times**

For comparison purposes its important to adopt standard observing times . internationally readings are taken every 3 hrs from 000 hours to 2100 hours local times. If any other times are used they should be noted.

Drawing of  
"Todd River"  
By: Anthony  
Age: 8