



Climate monitoring:

Measurements and equipment

GARY'S WEATHER FORECASTING STONE

CONDITION	FORECAST
Stone is Wet	Rain
Stone is Dry	Not Raining
Shadow on Ground	Sunny
White on Top	Snowing
Can't See Stone	Foggy
Swinging Stone	Windy
Stone Jumping Up & Down	Earthquake
Stone Gone	Tornado



Temperatures

- Standard temp' measurement at the height of 2m' in a weather shield/screen.
- Dry bulb- An ordinary glass thermometer.
- Wet bulb- A thermometer that has its bulb saturated with distilled water.
- Frost- zero celsius measured at 0.5m'.

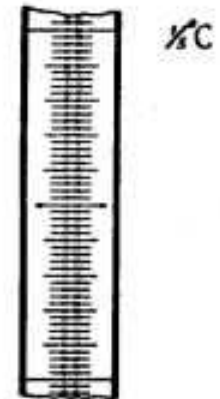
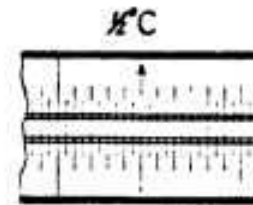
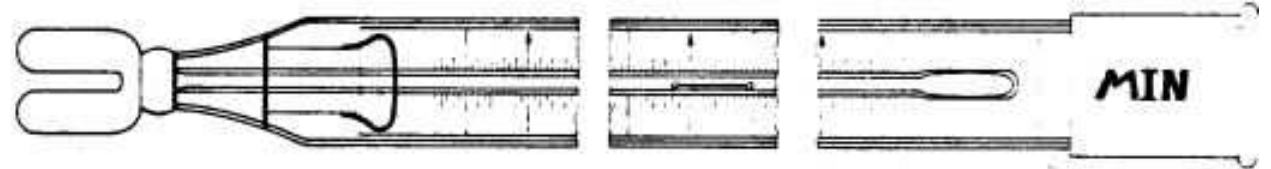
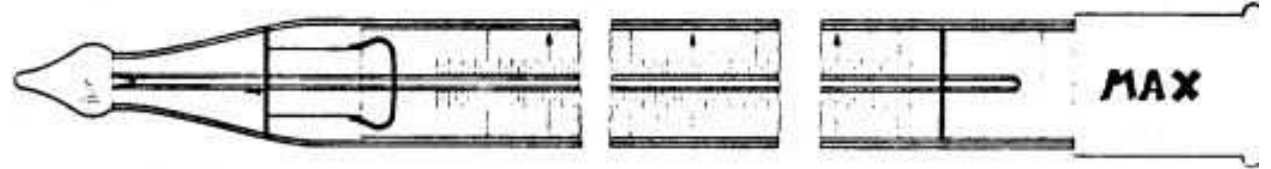
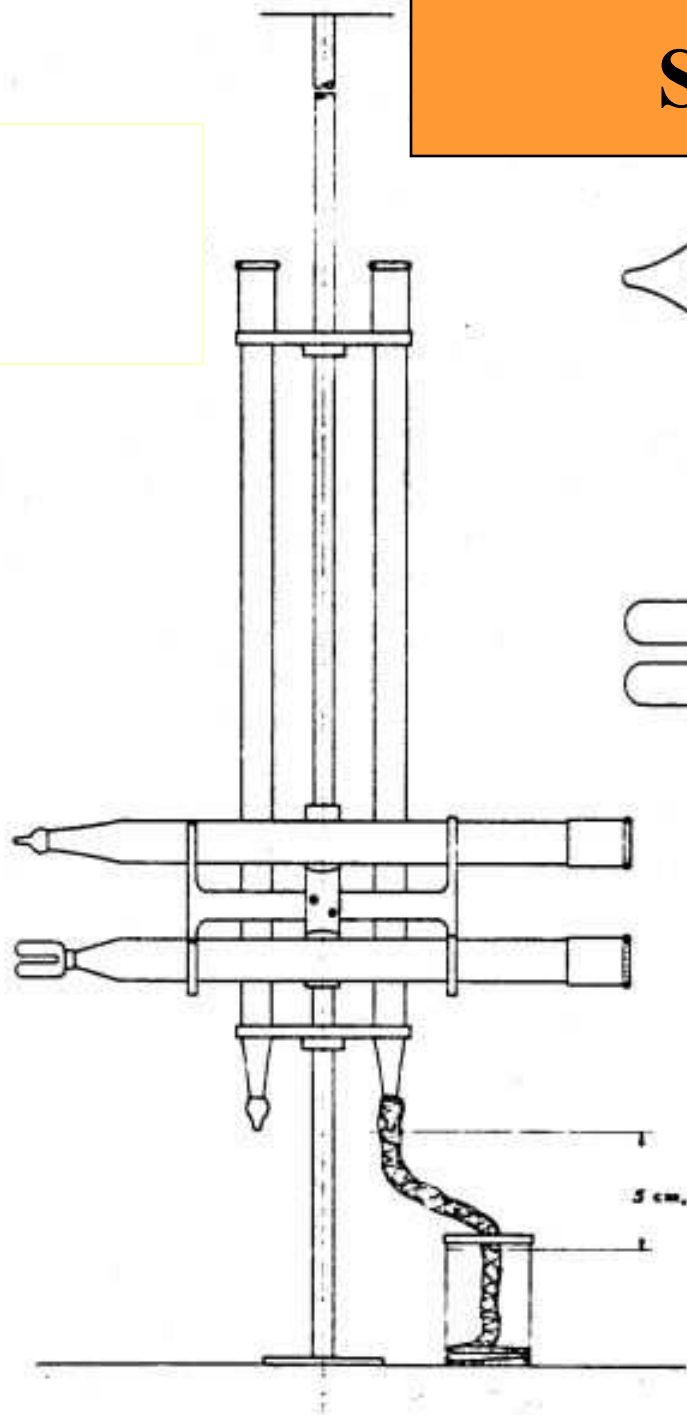
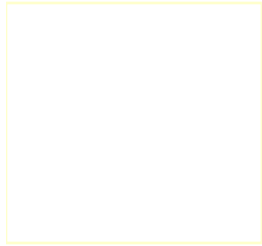
Meteorology weather screens

- Stevenson screen- a wooden box painted white mounted on a stand two meters above the ground. The double louvered sides have openings allowing the flow of air. In Israel the screen's doors always face the north.
In addition to the dry and wet bulb thermometers, it contains max' and min' thermometers.
The screen protects the thermometers from rain, radiation, gale winds and dirt.





Screen interior









HOBBO PROFESSIONAL





HOBBO PROFESSIONAL SCREEN









Advantage of AWS

- Computerized on line data.
- High initial cost, but a very efficient method for data processing and archive.
- A possibility to collect data from far and remote areas.
 - Modem (communication).
 - Solar panel & battery (energy).

Data base applications

- Climate zoning.
- Crop type and variety planning.
- Knowledge of area climatic averages and repeat periods.
- Improving micro forecasting.
- Research data.

Data credibility



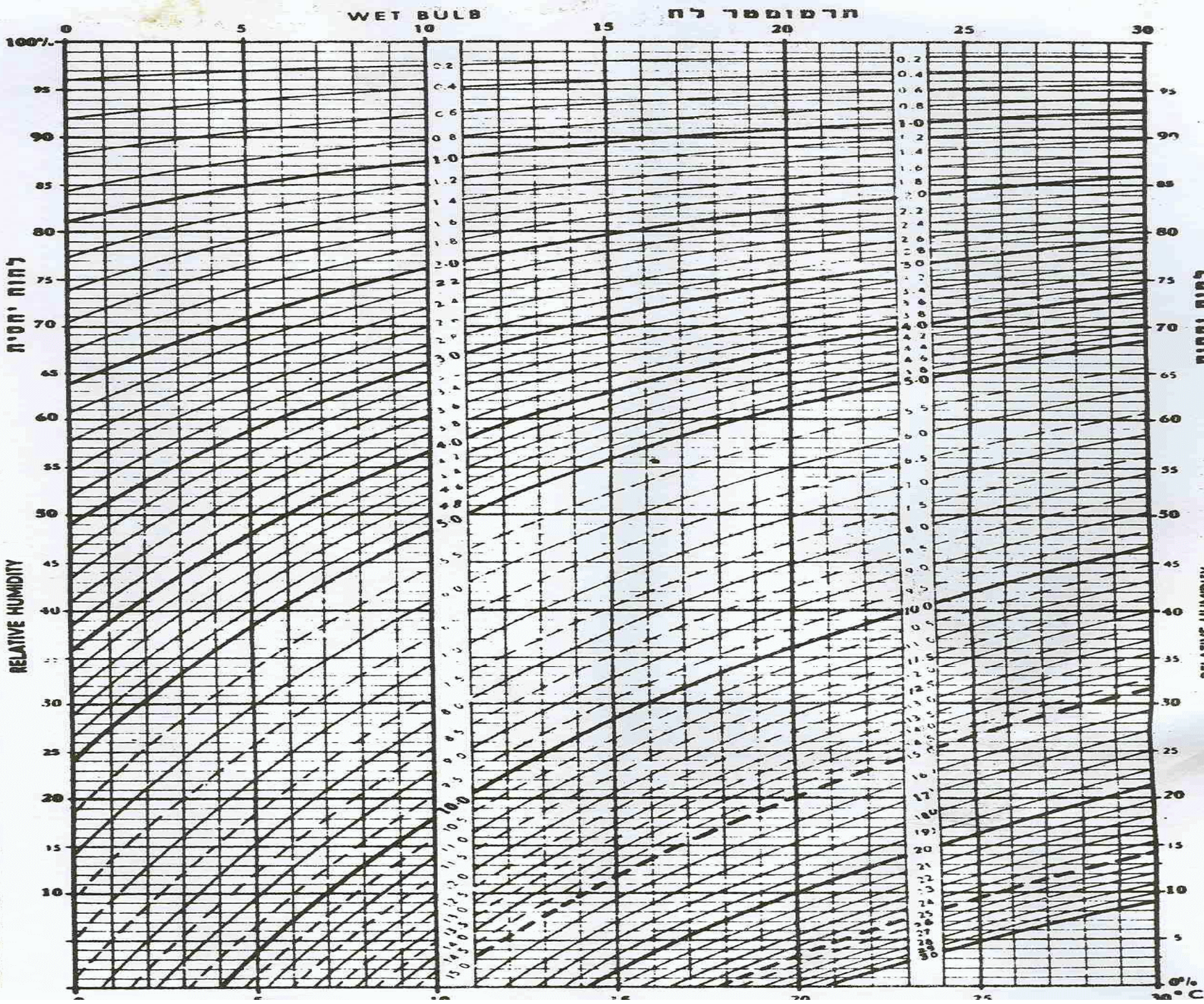
- The national meteorology data archive has to be monitored and edited !!!

Humidity

- **Relative humidity-** The ratio of the actual vapor pressure of the air to the saturation vapor pressure. In meteorology the relative humidity is expressed in percent and can be computed from psychrometric data.
- **Psychrometer-** An instrument that measures the water vapor content of the atmosphere. It consists of two thermometers - dry & wet.
- **Absolute humidity-** The mass (weight) of water contained in a unit of moist air.

RELATIVE HUMIDITY DIAGRAM FOR NON-VENTILATED PSYCHROMETER

דאגראמה ללחוח יחסית בשביל פסיכרומטר בלתי מאוורר



RELATIVE HUMIDITY

לחוח יחסית

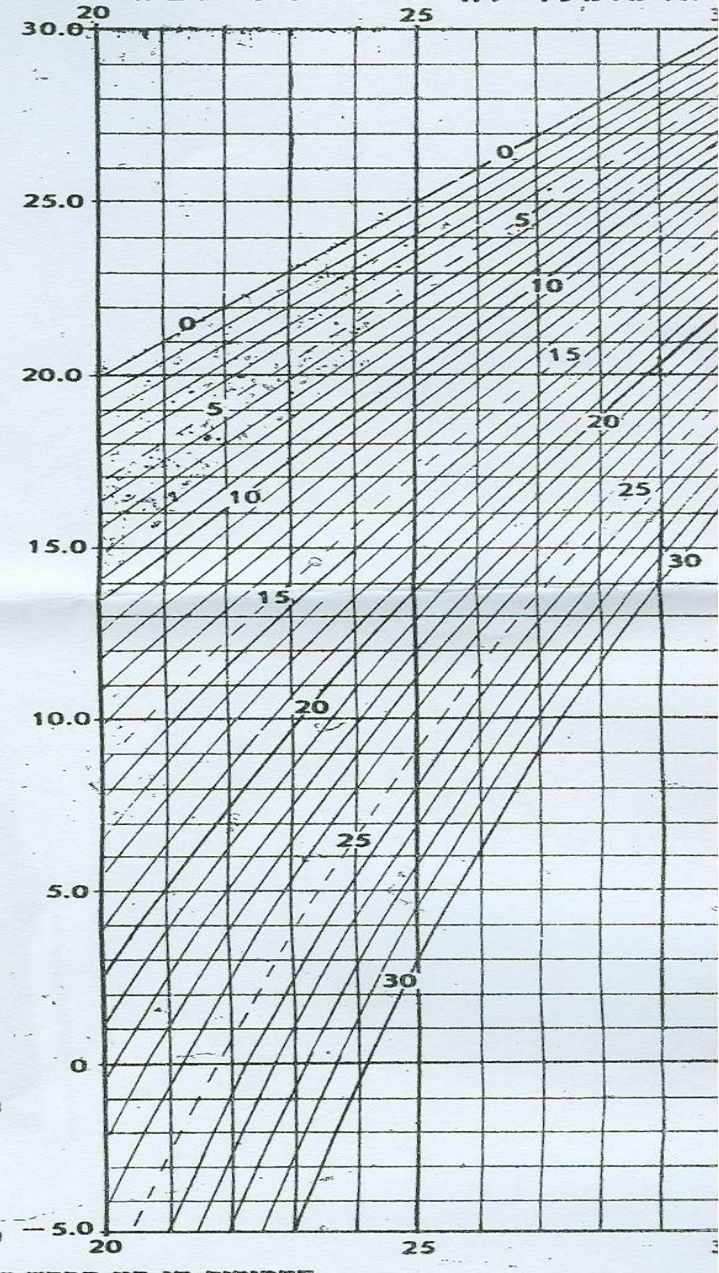
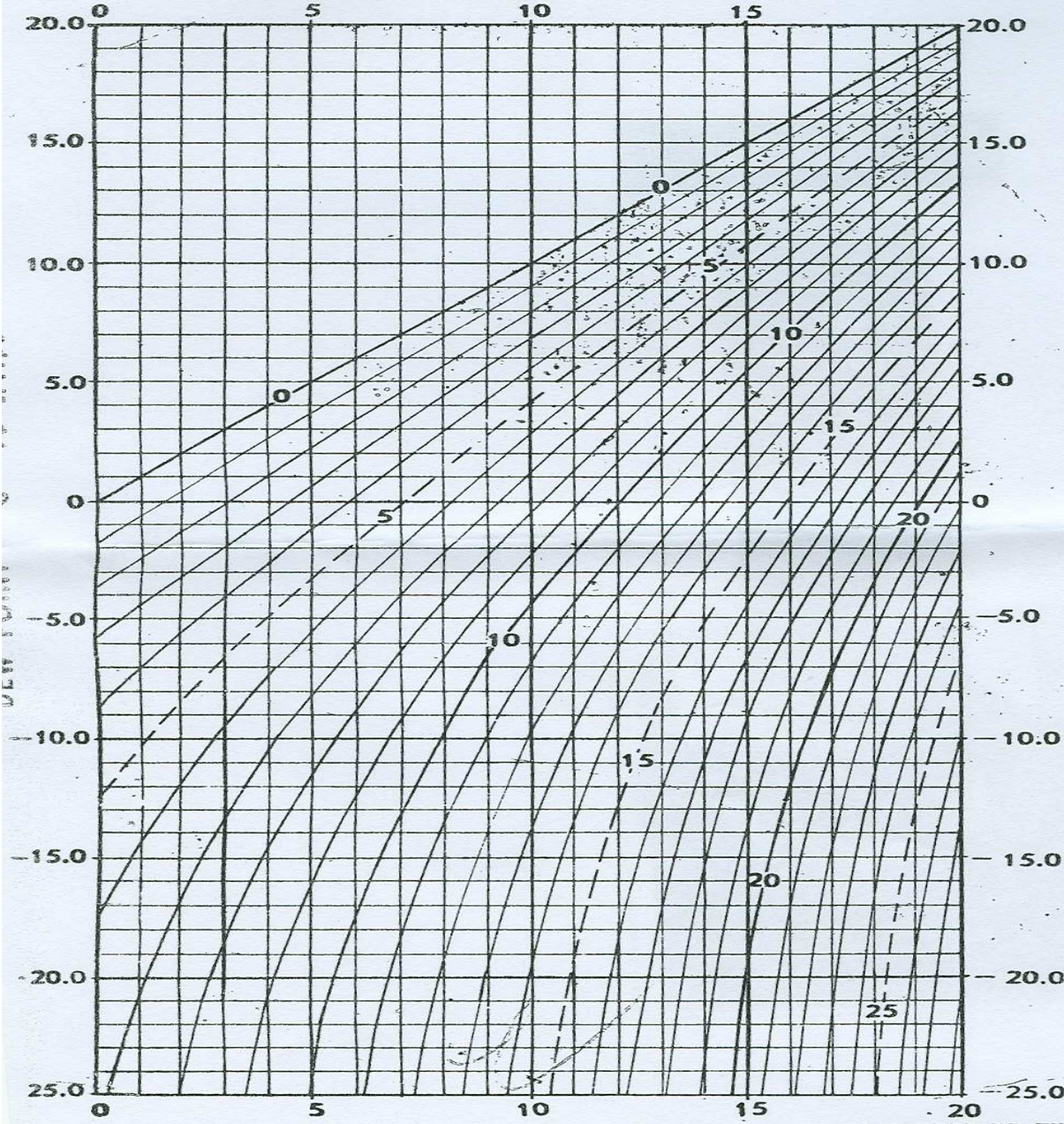
CURVED LINES ARE LINES OF EQUAL WET BULB DEPRESSION IN °C

תקופות זה קיי הדרגות שווה בין הטרמפרטור והצטו וזמן הטרמפרטור זהו ב°C

דיאגרמה לנקודת טל
 בשביל פסיכרומטר בלתי מאוורר

WET BULB °C תרמומטר לח 0 5 10 15

WET BULB °C תרמומטר לח 20 25



ש"מ 1125

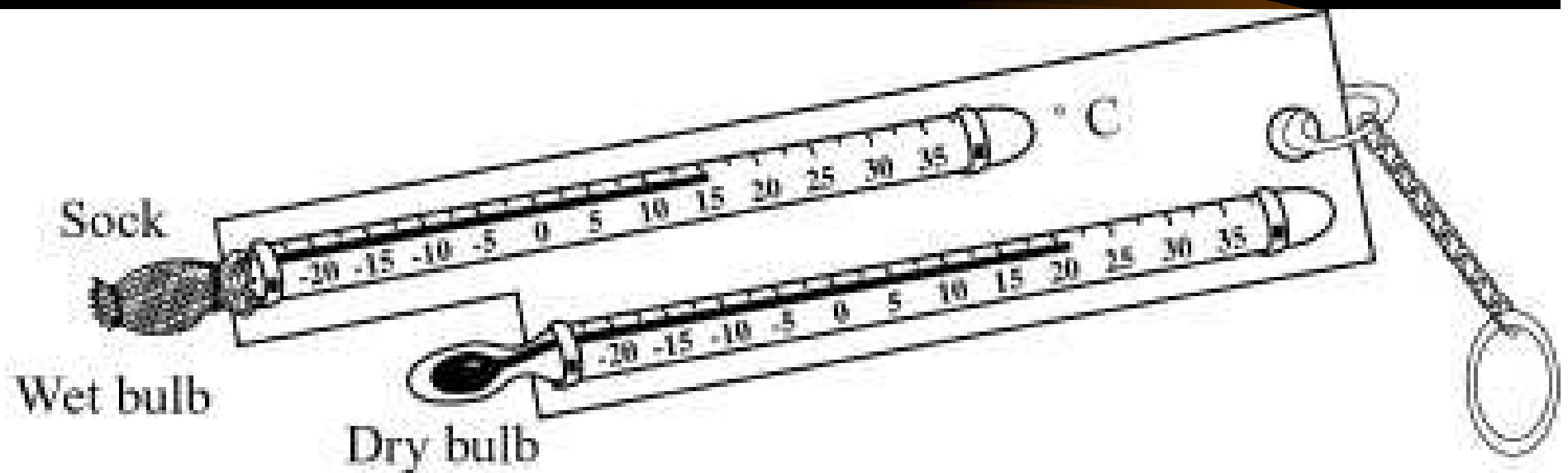
הצקומות הן קרי הסרש שזה בין התרמומטר היבש ובין התרמומטר הלח ב °C

RELATIVE HUMIDITY CALCULATION

- $RH\% = (AVP/SVP) * 100\%$
- AVP= VAPOR PRESSURE.
- SVP= SATURATED VAPOR PRESSURE.

$$AVP = SVP(t_{wet}) - CW(t_{dry} - t_{wet})$$

<u>HEIGHT M'</u>	<u>CW</u>
-210 - 290	0.805
290 - 750	0.763
750 - 1250	0.717



A Sling Psychrometer

As this instrument is "slung" through the air, rapid evaporation from the wet "sock" will result in a lower temperature reading on the wet-bulb thermometer. The dry-bulb thermometer will read the true air temperature.



Wind

- Wind vane- Used to measure the direction and velocity of the wind.
- Wind direction- measured in degrees.
- Wind speed- measured in knots, m/sec & kph.
- Height at 10 m'.

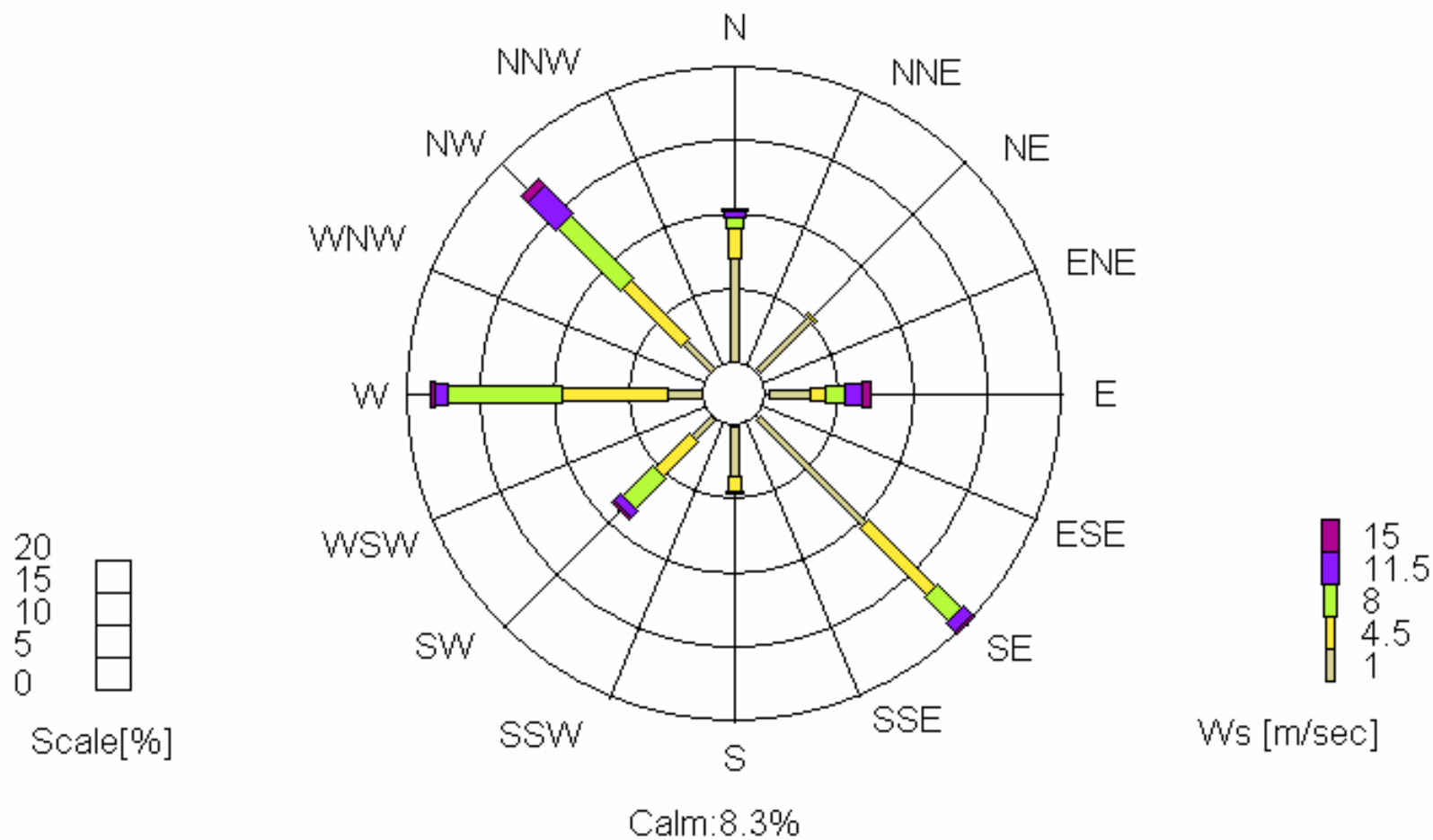




Periodic Wind Rose Ako 01/01/2002 01:00-31/12/2005 24:00

Station:Ako

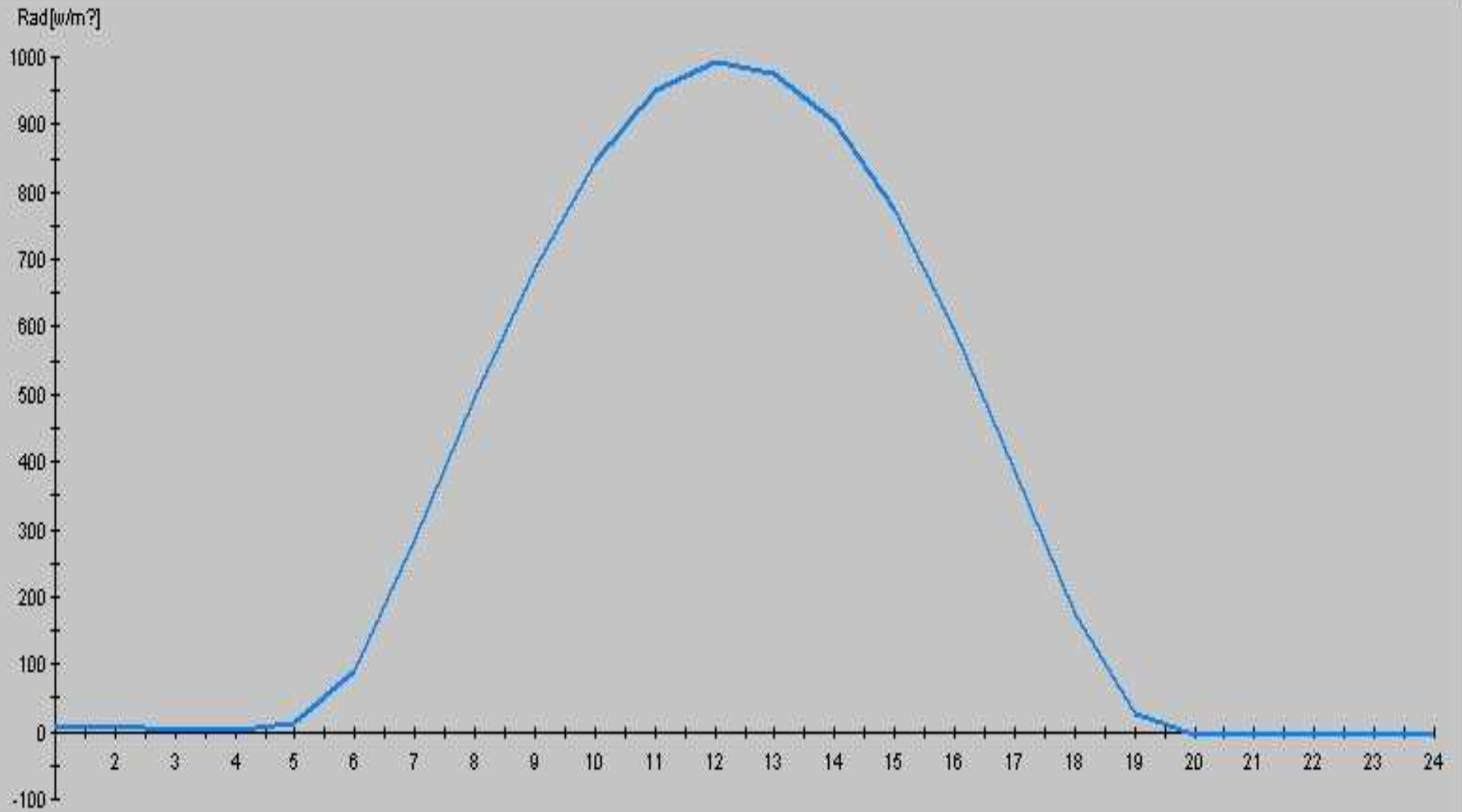
AVG:1 Hour



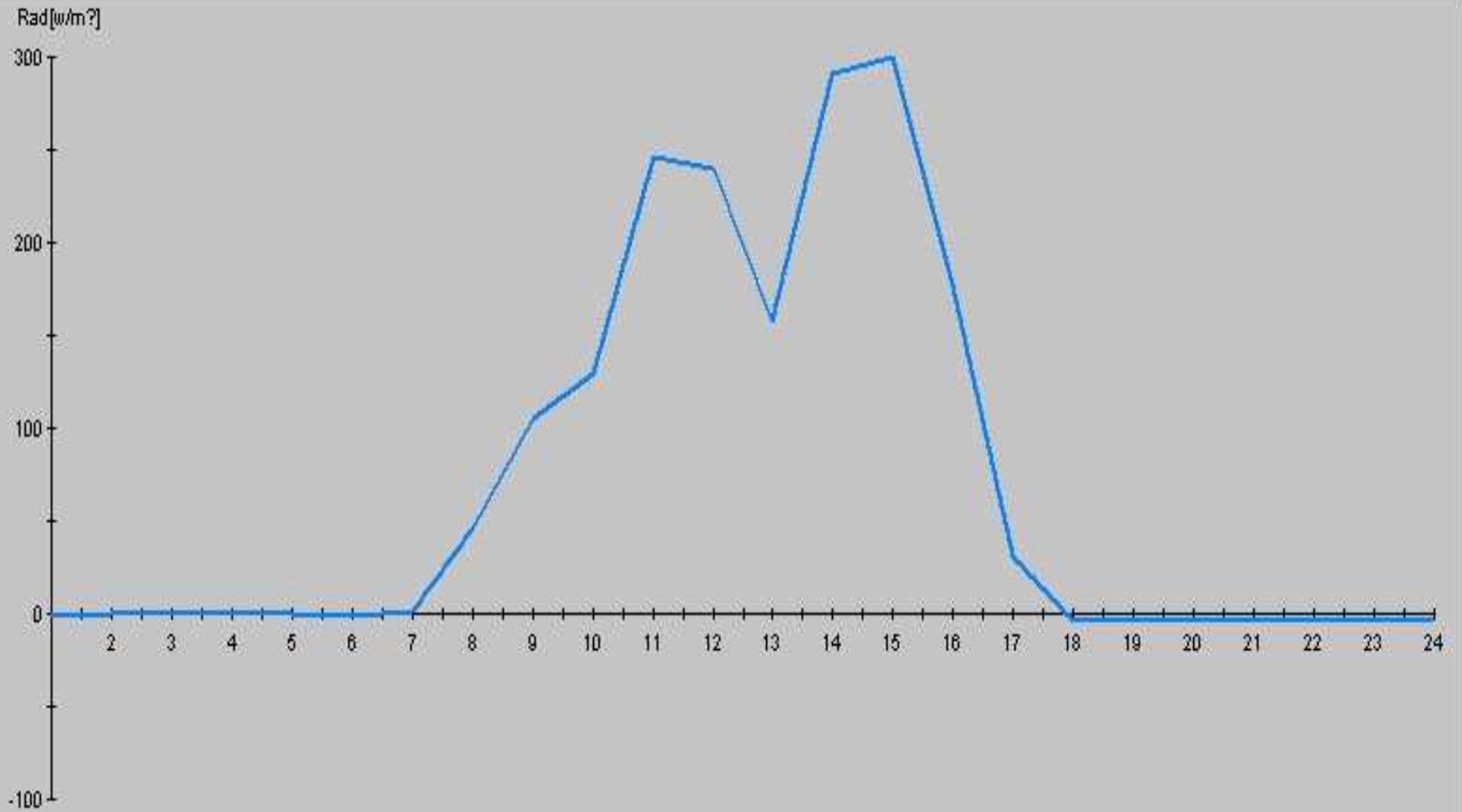
Radiation

- Global radiation- The total of direct solar radiation and diffuse sky radiation received by a unit horizontal surface.
- Pyranometer- measures solar radiation. It is also used with a solar shading device to measure diffuse solar radiation.
- Max radiation- maximum radiation measured during the day per unit of time. (watt/m^2)
- Total radiation- total amount of radiation measured during the day. (Mj/m^2).

Rad[w/m²] Daily Report Negba 13/07/2005 Interval 1 Hour



Rad[w/m?] Daily Report Negba 13/01/2006 Interval 1 Hour

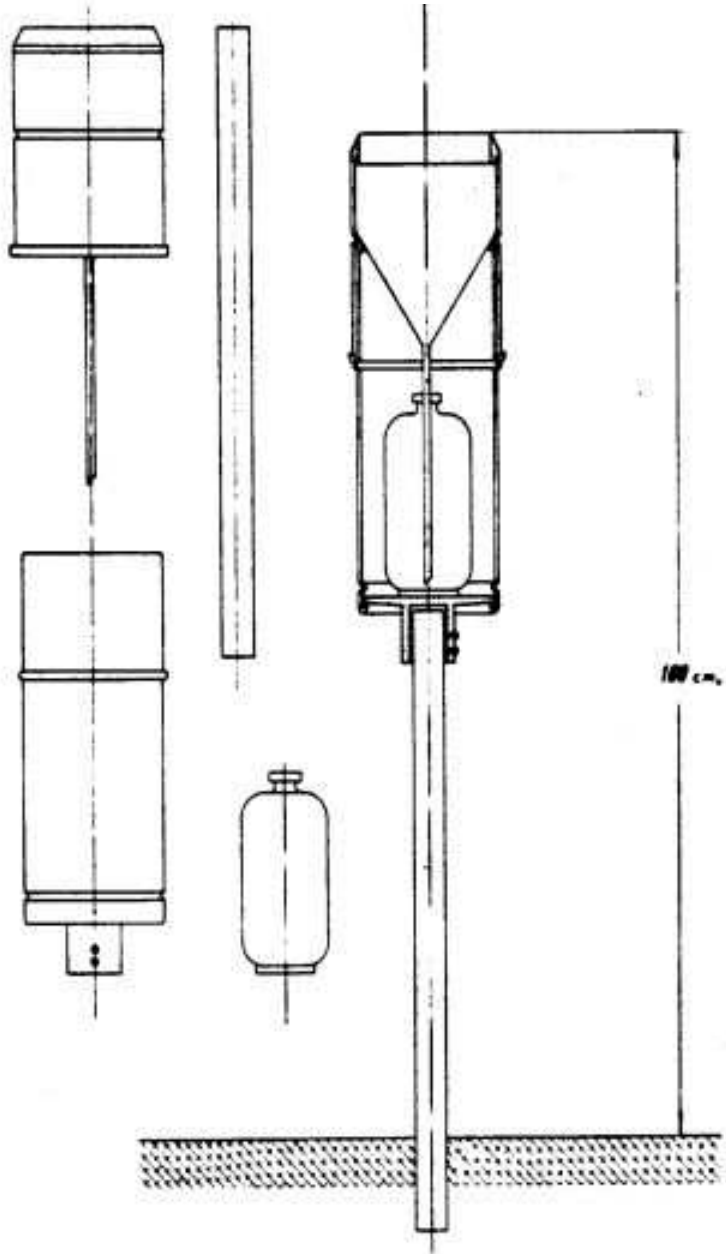


precipitation

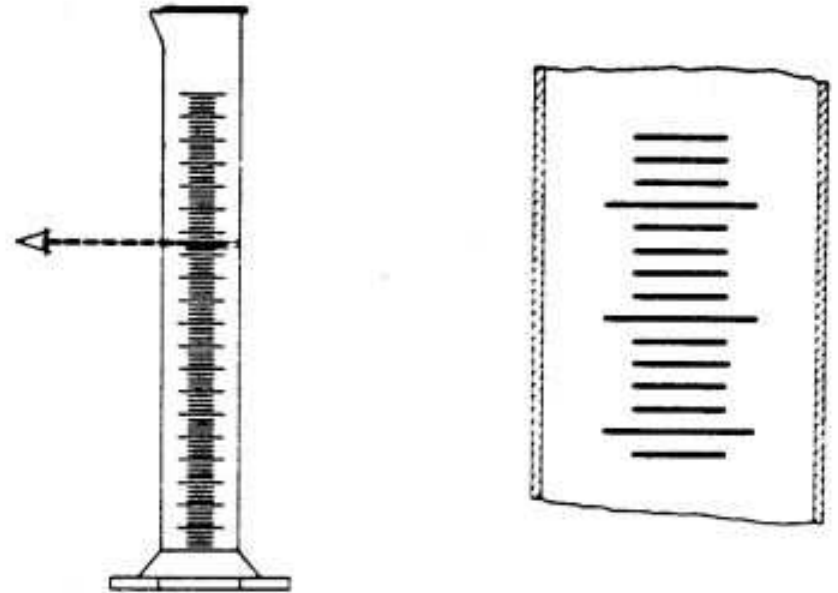
- Precipitation- rain & small amounts of snow and hail.
- Rain gauge- Funnel to Measuring glass ratio 1:20.
- The rain gauge should be located on a horizontal surface free of any high obstacles (trees, buildings).
- Annual rain- September-May.



Standard rain gauge



Measuring glass







Evaporation



- The physical process by which a liquid is transformed to the gaseous state, the opposite of condensation.
- Evaporation rate- quantity of water evaporated from a given water surface per unit of time.
- Evapor transpiration- the amount of water transferred from the soil to the atmosphere by evaporation and plant transpiration.

Evaporation pan

- A fairly deep tank with a large surface in which the lowering of the level of water under the action of evaporation can be measured.
- Design:
 - 60 c”m deep.
 - 180 c”m in diameter.
 - Bottom supported by wood frames.
 - Built from galvanized iron with a stilling well.
 - Some pans are covered with fine wire to prevent birds & other animals drinking the water.

THE PARAMETERS THAT EFFECT THE EVAPORATION RATE



- TEMPERATURE.
- RELATIVE HUMIDITY.
- RADIATION.
- WIND SPEED.

Utilization of AWS as a replacement for the evaporation pan

- All the meteorology parameters are measured by the AWS.
- Advantage:
 - Easy to activate compared to the pan.
 - Direct connection to computer and communication system.
 - On line real time data.
- Disadvantage:
 - Knowledge gap.
 - Time & research to develop irrigation coefficients.

Irrigation using calculated evapotranspiration & crop coefficients

- Always use the same formula (ASCE).
- Cooperation with agriculture instructors in order to develop the crop coefficients.
- Comparison with the pan.
- Comparison with lysimeters.





Dew



- Condensation- Transition from the vapor to liquid state.
- Dew point- The temperature which a given parcel of air must be cooled in order for condensation to occur.
- Fog- suspension of very small water droplets in the air, generally reducing the horizontal visibility at earth's surface to less than 1 km.
- Radiation fog- Caused by radiation cooling of the earth's surface and therefore cooling of the surface air, to a degree sufficient to cause condensation of water vapor contained in the air.

Climate data

- Most annual rain – Harashim (Galilee) 960 m”m.
- Least annual rain- Eilat 32 m”m.
- Max daily mean temp’- 39.9° (Eilat, July).
- Min daily mean temp’- 1.4° (Golan Heights, Jan).
- Max daily temp’- 54°- Tirat tzvi.
- Min daily temp’- -13.7° Netofa valley.
- Max monthly rain – 744 m”m Meron 1969.
- Max daily rain- 272 m”m Haifa 1921.
- Max wind speed- 86 knots Jerusalem 1974.
- February 1950- Heaviest snow storm (10 c”m in Tel Aviv).

Eilat	Beer Sheva	Jerusalem	Tzfat	Beit Dagan	Tel Aviv	
47.4	*46.0	*44.4	*40.0	45.6	*46.5	'Max temperature
2002/7/31 1961/6/8	1933/6/13	1881/8/28 1881/8/30	1942/6/22	1970/5/21	1916/5/17	Date
+0.9	*-5.0	*-6.7	-9.0	-2.2	-1.9	Min temperature
1950/2/7	1925/1/31	1907/1/25	1950/2/6	1972/12/27	1950/2/7	Date
78	339	1134	1168	1102	1064	Max annual rain
54/1953	65/1964	92/1991	69/1968	92/1991	92/1991	Year
1	42	210	385	289	234	Min annual rain
96/1995	63/1962	99/1998	73/1972	99/1998	99/1998	Year
67	186	418	476	475	506	Max monthly rain
1975/2	1965/1	1974/1	1969/1	1974/1	1949/12	Month
64	64	130	122	106	133	Max daily rain
1975/2/20	1934/12/5	1930/1/15	1969/1/22	1964/12/10	1955/11/8	Date