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# Suggesting a Simple Scientific Method of Measuring Dew.

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**ABSTRACT**
*One of the most important forms of precipitation is dew. Like other forms of precipitation, dew is a source of moisture in the atmosphere of which its importance is of immense value to man, plants and in the continuity of the hydrological cycle. Dew is measured like any other weather elements daily and in the morning before sunrise. The method and instrument used for measuring dew are faced with a lot of problems compared to the merits associated with them. This study employs the use of cobalt chloride paper (5% solution of cobalt II chloride solution) or alternatively, filter paper. It was carried out in the synoptic station of the Department of Geography, Nigerian Defence Academy, Kaduna over a period of 10 years (19998-2007). Summary of each year findings were analysed. Results showed that the method is an improvement over the earlier one quantitatively, and can easily be reverted to if in doubt of the measurement got. Other findings are discussed in this paper.*
**KEY WORDS:** Academy, Bands, Chloride paper, Condensation, Dew, Deposition, Frost, Gauge, Humidity, Precipitation, Radius

## 1. INTRODUCTION

Dew is a form of precipitation which according to Ayoade (2005) is defined as any solid or gaseous material coming from the atmosphere. The materials range from snow, ice, hail, frost to fog, rime, dew and so on. In West Africa, all these forms of precipitation have been recorded and so dew is no exception. Differences in the characteristics of natural resources especially with regard to vegetation produce spatial contrast in the distribution of the incoming component of the water budget (Smith, 2002). Dew's importance is also shown by being a very essential element in the water balance of vegetated areas. This amount of the precipitation is directly evaporated back to the atmosphere without entering into the land-based part of the water cycle (Hobbs, 2004). Dew has been found to contribute to about 75% of moisture to the total water supply and comprises about 10% of the annual precipitation in any area it occurs (Miller, 2004).

Dew is a condensed form of atmosphere vapour in small drops (Aremu, 2008). It is formed when air temperature comes in contact with ground surface that is cooled by night or nocturnal radiation. It can also be formed if a warm moist air comes into contact with cool surface with the temperature below the dew point of air. The dew point is a critical temperature in which air that is being cooled reaches saturation with the relative humidity being 100% (Ayoade, 2005).

Below the dew point, condensation of dew takes place. It is a commonly formed weather element in any place when there is a clear night sky. Like other weather elements, dew is affected by some factors during formation. Factors like variations in soil or vegetation cover of the area and others, usually affect dew deposition (Adefolalu, 2003).

Dew is measured by a wooden instrument called dew gauge. This is a specially painted wooden block. It is normally place in the open space or outdoor in the evening after sunset. On it, the dew settles. It must be checked and recorded before sunrise and if after sunrise, should be before evaporation starts to occur (Oke, 2001)

The method is simple to carry out but is faced with many problems. Its merit is that the gauge is portable and demand less cost. Among its demerit is the fact that a recorder needs many gauges say 10 at least in a standard weather station. This will let accurate recording of the dew be tenable. Also, practical observation reveals that dew amounts vary always over the surface. Thus, the use of the gauge is still not correct and this causes the problem of maintaining regular observation of the gauges (Aremu, 2008).

Another terrible problem facing the use of gauge is that it is difficult to use this method to find the amount of dew deposited on the gauges on one hand and those on wood compared with the dew deposited on surrounding natural surfaces (which is also unknown) on the other hand. The method is very subjective and unsystematic thus unscientific. Animals, insects, birds and so on can tamper with the deposited dew on gauges. This tends to alter the final result and lead to a wrong conclusion. In a situation where the recorder fails to do the recording before sunrise, which is an unsocial hour of the day, the dew deposited could evaporate leaving nothing behind. Little wonder then that renowned climatologist (Smith, 2002; Nieuwolt, 1982 and Oguntoyinbo, 2000) believe dew is an equally difficult weather element to measure. These problems of gauges imbue this study. Thus, this study was aimed at simplifying and bringing quantification to the study and recording of dew in weather stations.

## 2. MATERIALS AND METHODS

This study uses cobalt chloride papers which contains 5% solution of cobalt II chloride solution. Filter paper or blotting paper can be used instead in a situation where cobalt chloride paper is unavailable. A total of 1300 pieces of the paper were used over a period of 10 years (1997-2006) in the month of February and March each year. This makes it about 130 paper per year. For each month, 10 days were randomly picked making 200 days in all the years. The experiment was carried out at Nigerian Defence Academy Weather Station and the Departmental laboratory (Geography) where it was done and monitored. The weather station is situated at about 500metres to the department of geography premises in an open land with no barriers in the surrounding. Daily weather observation recordings were done twice daily (10.00AM and 1.00PM/900hours and 1200hours GMT) by a trained meteorologist. The papers for each experiment were placed outside in the evenings (6.30PM) in the station before night falls and dew allowed to settle on them. The papers were blue in colour and with the touch of water droplets turned pink. The points of contact with water droplets (dew) formed bands that are cylindrical in shape (Figs 1, 2, 3, 4 and 5) when dried. These shapes have remained permanent after drying up.

The bands formed were measure in millimeters. A known amount of water droplets using syringes were dropped on another set of cobalt chloride papers in the physical laboratory of the department. The bands formed were then compared (size wise) with the ones formed from the weather station. Through this, the amount of water droplets/dew that can form a band was known. For example, 0.01cm$^3$ of water droplet (through laboratory practical experiment) will produce a band of about 18mm in diameter or radius 9mm. Thus all those obtained from the weather station with about 18mm in diametres (Table 1) were believed to have the same amount of water droplets that produced same in the station. 35 samples were finally made use of (Table 1). This was done for both consecutive years repeatedly in the dry months of February and March. From the results got from the field (Weather station) and the laboratory analyses, a range of scale of measuring dew was derived and suggested as the dew scale (Table 2)

## 3. RESULTS AND DISCUSSION

From the analyses of the bands formed, it was observed that no dew is as big in size as 1cm$^3$, that is , producing a band with radius 49mm (4.9cm). From table 1 above, about 16 samples using 0.01cm$^3$ water equivalent of dew produced bands with average radi to be 7.6mm. For 0.02cm$^3$ water equivalents, about 12 samples were observed with average radi to be 10-15mm and so on. Where the radius as measured in the cobalt chloride papers, is greater than 30mm, then the dew measurement ranges between 1cm$^3$ and above (Table 2).

Unlike before with the dew gauge, this method is quantitative, has units of measurements, can be subjected to analysis and even , if the observer couldn't go at the normal time of recordings, he/she will still see the bands on the papers for measurement though dry. The measurement using the suggested scale can be known easily.

Bands with known radi can be interpreted using the scale. From table 2, any band with R=6-8mm will be a droplet /dew with water amount equivalent of 0.01cm$^{3.}$ So dew amount will be 0.01cm$^3$ . With R=14-16mm, dew amount =0.05cm$^3$ and so on. R is used and suggested as the code meaning radius of the band formed on the paper. The scale is in two(2) units starting from the least formed band, R of 6-8mm (0.01cm$^3$ of dew) to the highest formed band, R=30mm (though very rare) giving 1cm$^3$ of dew (Fig. 1-5).

This method makes it impossible to get inaccurate result, since as the droplets of water touches the paper, it absorbs it and forms a band turning the point from blue to pink colour and be there permanently. None can be evaporated thereby leaving something to record unlike if it happens on the wooden gauge. The papers (materials) are cheap, can be improvised for in the laboratory (if not available) and portable. This method makes it impossible for animals, insects and birds to lick or suck the dew droplets before measurement. As the dew settles on the paper, it absorbs it. The scale is easy to read, simple and easy to interpret. The only demerit of the method is in the number of papers used. Once a paper is used, that is all. Thus, more papers are required. A paper is for a day and once used cannot be used again.

## 4. CONCLUSION

This paper has presented a method of measuring dew, a weather element of importance in the atmosphere for agricultural activities, human comfort, hydrological cycle and so on. This is advancement over the earlier method whereby wood gauges are used. This method is especially suitable for developing countries, because it is affordable in contrast to the modern and very expensive drosometres now in use. In this proposed method, the papers (material) are available, can easily be read (due to colour separation), easily understood and can be revisited or re-measured anytime, any day unlike on the wood gauge and to some extent the drosometre. This method is also scientific and eliminates a lot of ambiguities associated with the use of the wood gauge.

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**Table 1: NO OF SAMPLES USED WITH RADII AND BAND DIAMETRE**

| Serial Number of Sample | Amount of $H_2O$ | Diametre of Band | Radius of Band |
|---|---|---|---|
| 1 | 0.01cm$^3$ | 18mm | 9mm |
| 2 | 0.01cm$^3$ | 16mm | 8mm |
| 3 | 0.01cm$^3$ | 16mm | 8mm |
| 4 | 0.01cm$^3$ | 16mm | 8mm |
| 5 | 0.01cm$^3$ | 16mm | 8mm |
| 6 | 0.01cm$^3$ | 16mm | 8mm |
| 7 | 0.01cm$^3$ | 16mm | 8mm |
| 8 | 0.01cm$^3$ | 17mm | 8.5mm |
| 9 | 0.01cm$^3$ | 16mm | 8mm |
| 10 | 0.01cm$^3$ | 16mm | 8mm |
| 11 | 0.01cm$^3$ | 16mm | 8mm |
| 12 | 0.01cm$^3$ | 16mm | 8mm |
| 13 | 0.01cm3 | 15mm | 8mm |
| 14 | 0.01cm$^3$ | 16mm | 8mm |
| 15 | 0.01cm$^3$ | 20mm | 7.5mm |
| 16 | 0.01cm$^3$ | 20mm | 8mm |
| 17 | 0.02cm$^3$ | 20mm | 10mm |
| 18 | 0.02cm$^3$ | 20mm | 10mm |
| 19 | 0.02cm$^3$ | 20mm | 10mm |
| 20 | 0.02cm$^3$ | 20mm | 10mm |
| 21 | 0.02cm$^3$ | 22mm | 11mm |
| 22 | 0.02cm$^3$ | 23mm | 11.5mm |
| 23 | 0.02cm$^3$ | 23mm | 11.5mm |
| 24 | 0.02cm$^3$ | 20mm | 10mm |
| 25 | 0.02cm$^3$ | 22mm | 11mm |
| 26 | 0.02cm$^3$ | 20mm | 10mm |
| 27 | 0.02cm$^3$ | 21mm | 10.5mm |
| 28 | 0.02cm$^3$ | 20mm | 10mm |
| 29 | 0.1cm$^3$ | 52mm | 26mm |
| 30 | 0.1cm$^3$ | 63mm | 31.5mm |
| 31 | o.1cm$^3$ | 52mm | 26mm |
| 32 | 0.1cm$^3$ | 60mm | 30mm |
| 33 | 0.1cm$^3$ | 52mm | 26mm |
| 34 | 1cm$^3$ | 100mm | 50mm |
| 35 | 1cm$^3$ | 98mm | 49mm |

Source: Fieldwork, 2010

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**TABLE 2: SUGGESTED DEW SCALE**

| | |
|---|---|
| R= 6mm or < | Insignificant amount of dew formed |
| R= 6- 8mm | $0.01cm^3$ of dew formed |
| R = 8- 10 mm | $0.02cm^3$ of dew formed |
| R= 10- 12mm | $0.03cm^3$ of dew formed |
| R= 12-14mm | $0.04cm^3$ of dew formed |
| R=14-16mm | $0.05cm^3$ of dew formed |
| R=16-18mm | $0.06cm^3$ of dew formed |
| R= 18-20mm | $0.07cm^3$ of dew formed |
| R=20-22mm | $0.08cm^3$ of dew formed |
| R=22-24mm | $0.09cm^3$ of dew formed |
| R=24-26mm | $0.10cm^3$ of dew formed |
| R=26-30mm | 0.1- $0.15cm^3$ of dew formed |
| R= 30mm | $1cm^3$ of dew formed |

**Where R= radius of the band formed**
**Source: Fieldwork, 2010**

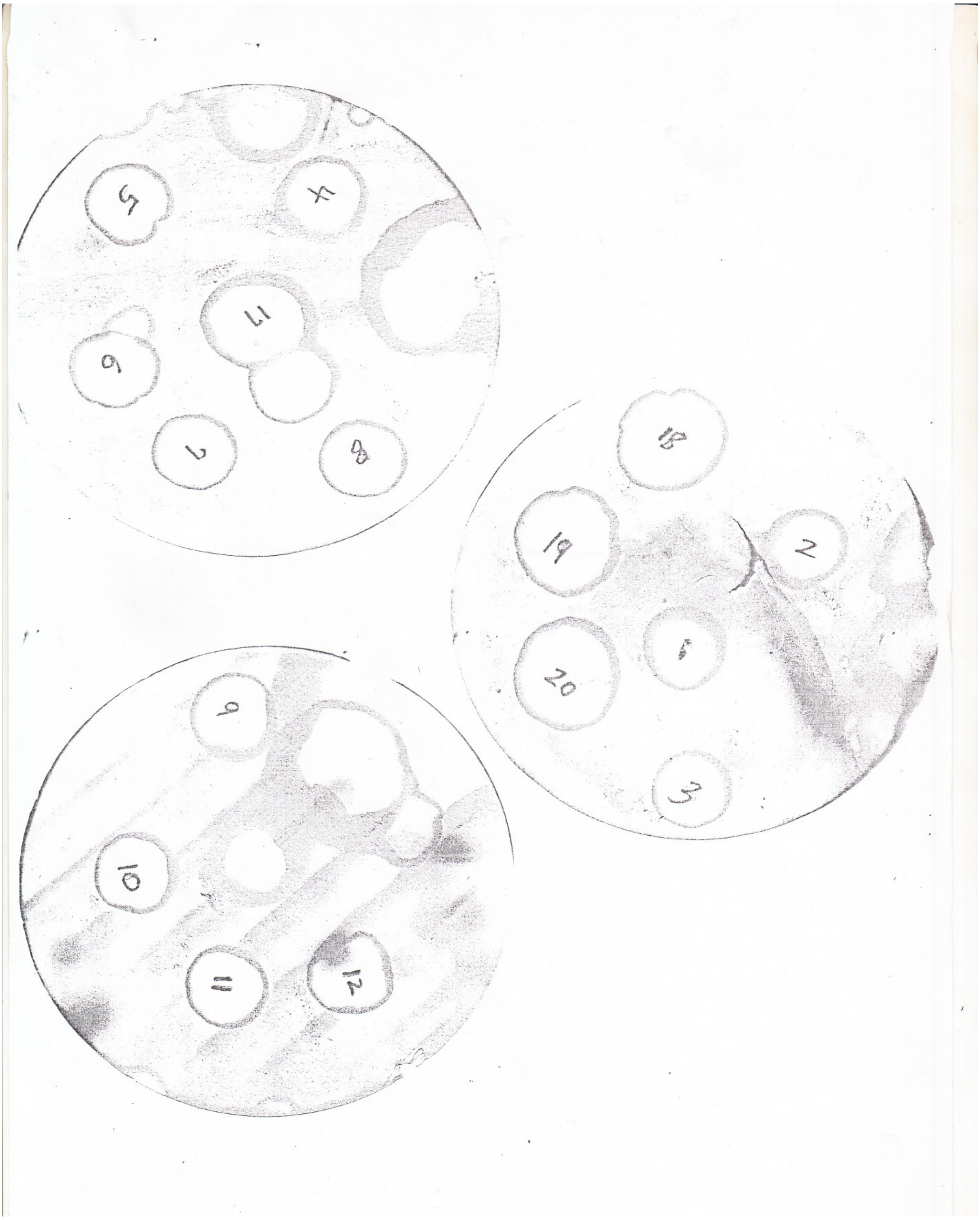

Fig. 1: Cylindrical Bands formed As a Result of Contact with droplets (dews)
**Source**: Fieldwork, 2011

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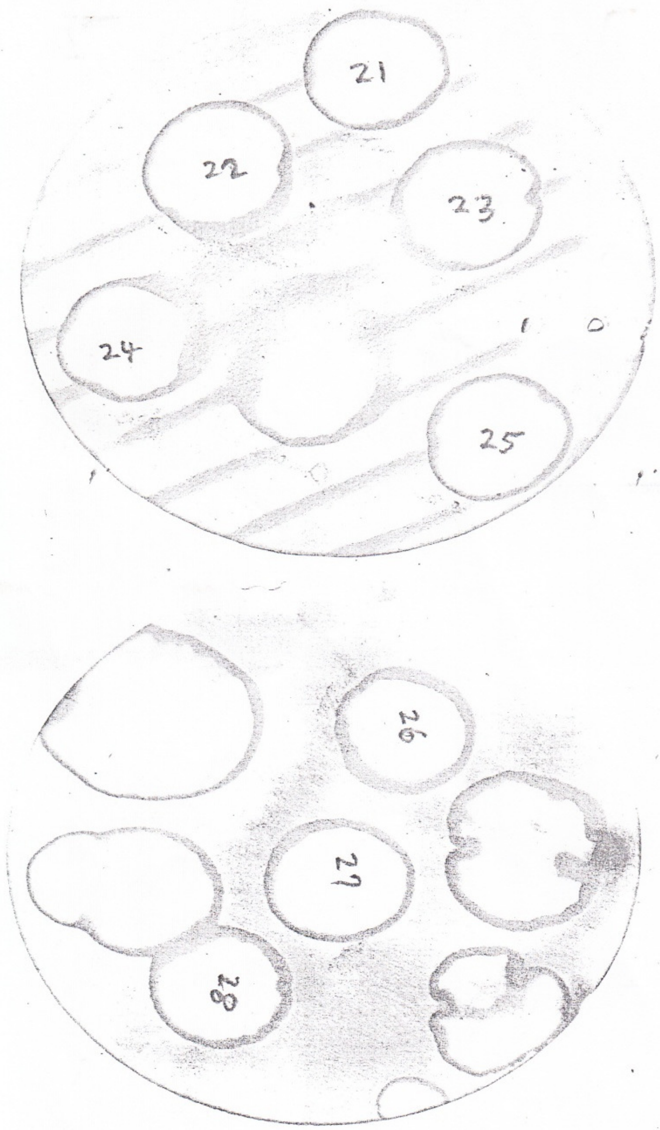


Fig. 2: Cylindrical Bands formed As a Result of Contact with droplets (dews)
**Source**: Fieldwork, 2011

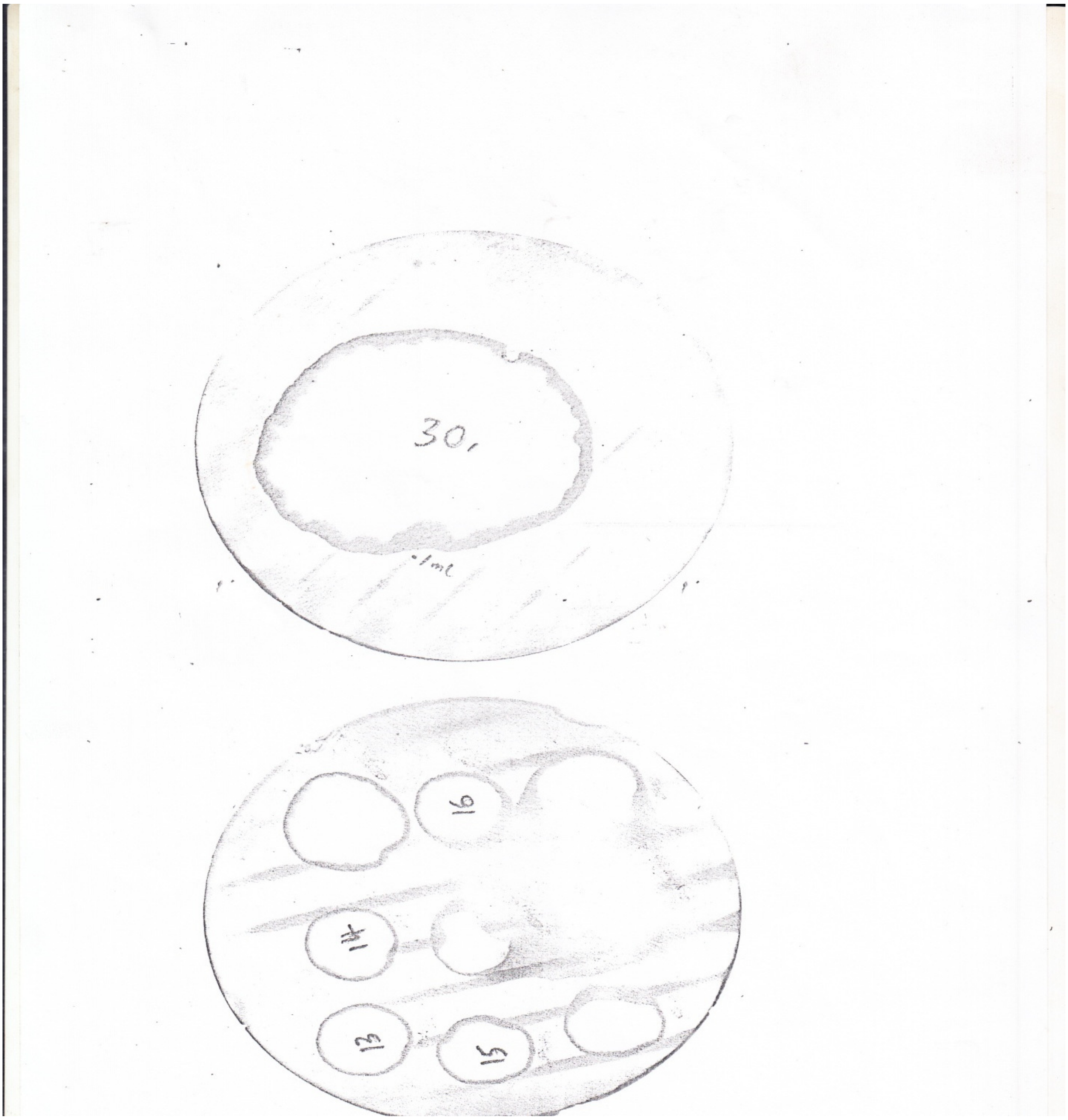


Fig. 3: Cylindrical Bands formed As a Result of Contact with droplets (dews)
**Source**: Fieldwork, 2011

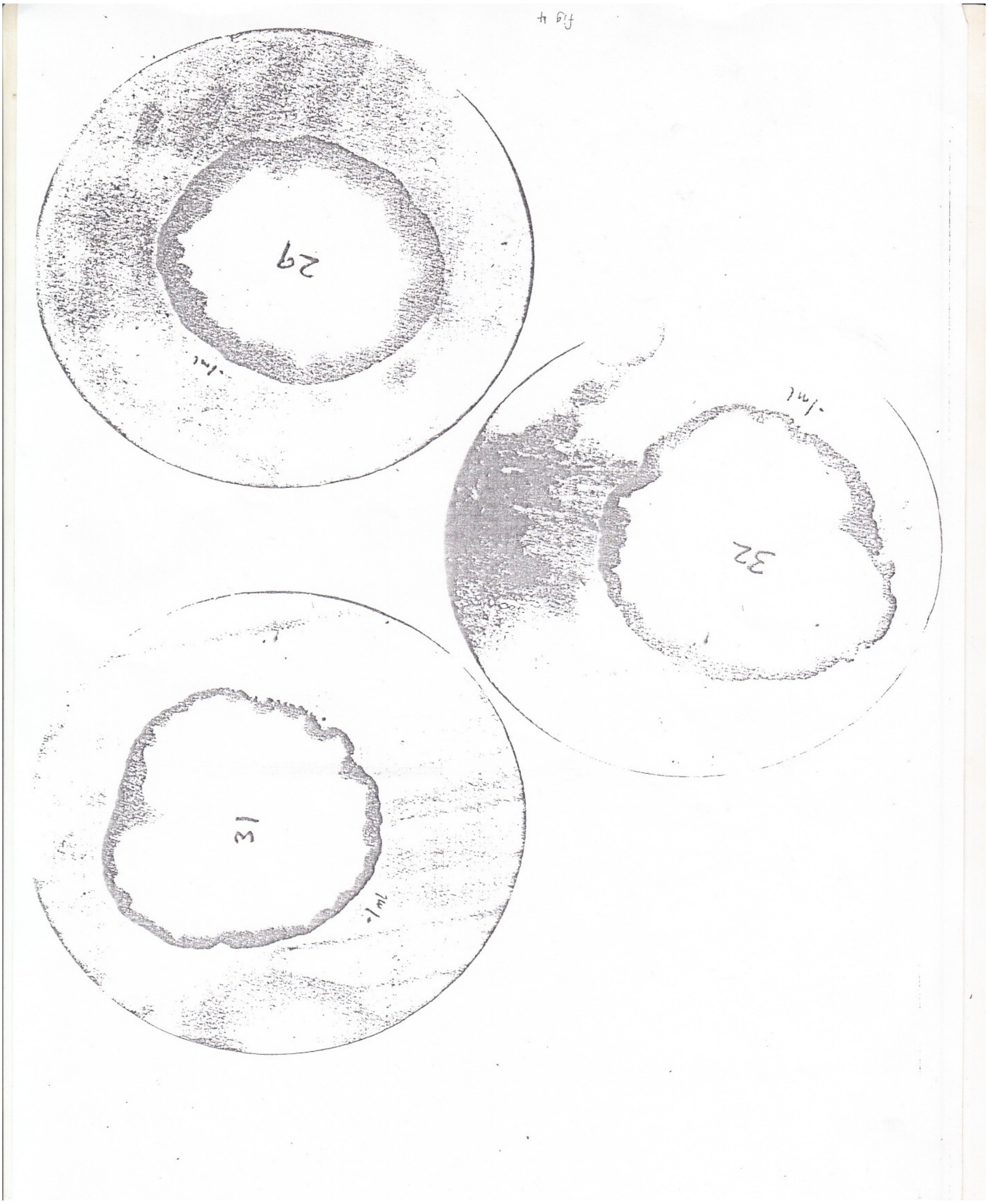

Fig. 4: Cylindrical Bands formed As a Result of Contact with droplets (dews)
**Source**: Fieldwork, 2011

 

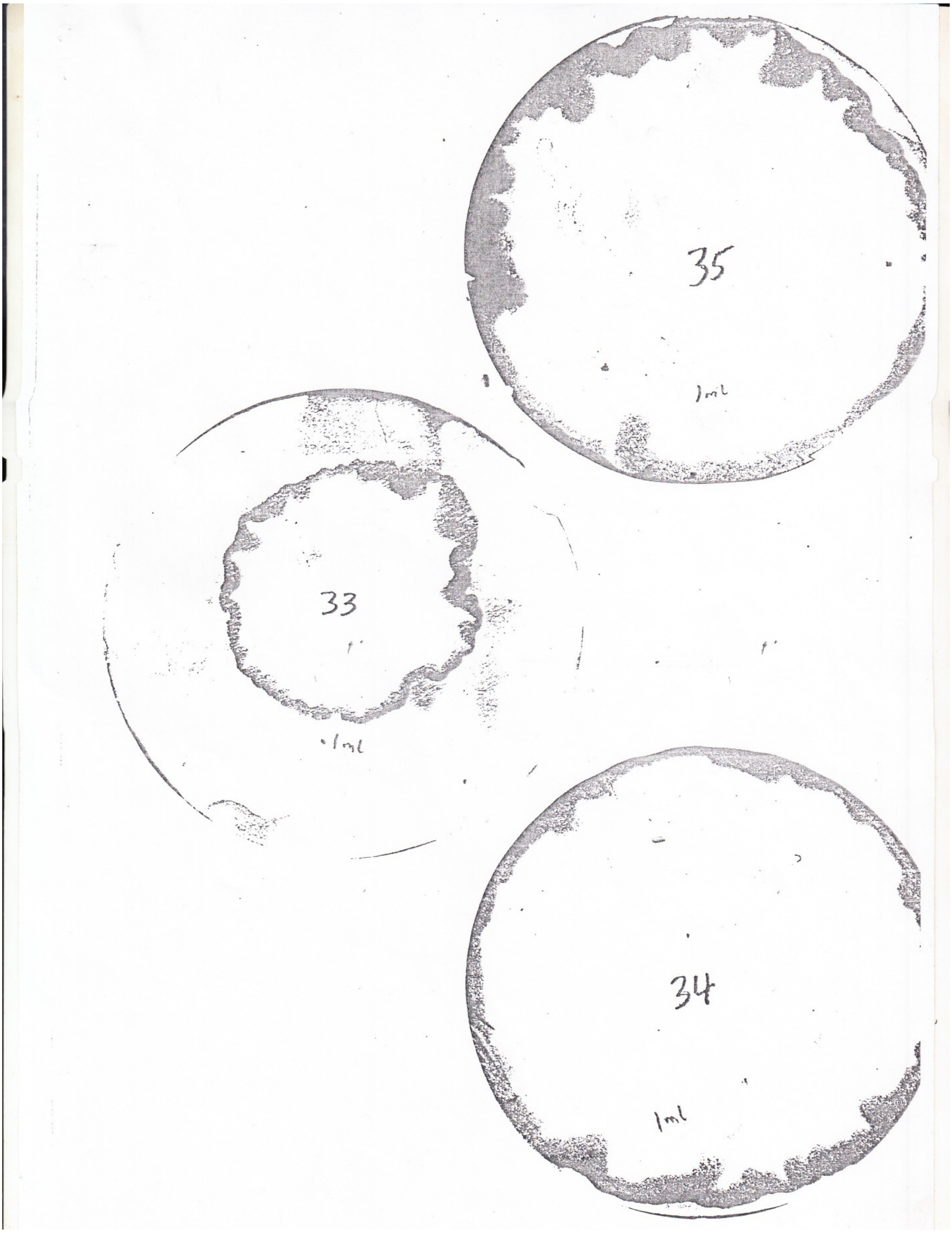


Fig. 5: Cylindrical Bands formed As a Result of Contact with droplets (dews)

**Source**: Fieldwork, 2011