Letters To The Editor

THE MOBILITY OF THE SMALL IONS OF THE ATMOSPHERE AT POONA

Atmospheric-electric observations were started some years ago at the Instrument Section of the Meteorological Office, Poona, with a view to determine the values of the various atmospheric-electric elements and to study the relations between them and meteorological phenomena at this station. The results obtained have been discussed in a number of papers. In this note the mobility of the small ions of the atmosphere at Poona as derived from the simultaneous measurements of the conductivity and the ion-content of the air, carried out at the Meterological Office, Poona during 1935-37 is discussed. The numbers of positive and negative small ions were obtained by means of an Ebert ion-counter while the polar conductivities were measured directly with a Gerdlan apparatus. Details of the instrumental equipment and of the methods employed for obtaining the data were the same as those described in a previous paper by Sil. The values of mobility for the positive and the negative ions have been computed from all satisfactory individual determinations of $\lambda$ and $n$ from the relation $K = \frac{\lambda}{n^2 e}$, $K$ being the mobility, $\lambda$ the conductivity, $n$ the ionic number and $e$ the unit charge.

All the data are based on observations taken at 10 A.M., Indian Standard Time. In all, 151 determinations have been made use of and the monthly average values of the mobilities together with the number of determinations for each month are given in Table 1; the monthly average values for mobilities are also plotted in Fig. 1.

It is seen that the mobility values are generally high during the summer months—March to May—as well as during the monsoon season—June to September—and are the highest in May; they are generally low during the post-monsoon and winter seasons and reach a minimum value in the month of December. So far as the monsoon (rainy) season—June to September—is concerned, the occurrence of higher mobility is understandable as the air during this period at this station is in a comparatively purer state and its dust contents reach the minimum value. As regards the low mobility values noticed during the winter months, it may be mentioned that during winter at Poona, fog is a frequent

<table>
<thead>
<tr>
<th>Month</th>
<th>$K^+$</th>
<th>$K^-$</th>
<th>No. of determinations</th>
</tr>
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<tbody>
<tr>
<td>January</td>
<td>0.91</td>
<td>1.09</td>
<td>14</td>
</tr>
<tr>
<td>February</td>
<td>1.09</td>
<td>1.01</td>
<td>15</td>
</tr>
<tr>
<td>March</td>
<td>1.03</td>
<td>1.11</td>
<td>10</td>
</tr>
<tr>
<td>April</td>
<td>1.17</td>
<td>1.19</td>
<td>11</td>
</tr>
<tr>
<td>May</td>
<td>1.20</td>
<td>1.21</td>
<td>12</td>
</tr>
<tr>
<td>June</td>
<td>1.14</td>
<td>1.14</td>
<td>17</td>
</tr>
<tr>
<td>July</td>
<td>1.17</td>
<td>1.19</td>
<td>20</td>
</tr>
<tr>
<td>August</td>
<td>1.15</td>
<td>1.14</td>
<td>15</td>
</tr>
<tr>
<td>September</td>
<td>1.07</td>
<td>1.10</td>
<td>9</td>
</tr>
<tr>
<td>October</td>
<td>0.86</td>
<td>0.92</td>
<td>9</td>
</tr>
<tr>
<td>November</td>
<td>0.94</td>
<td>0.96</td>
<td>9</td>
</tr>
<tr>
<td>December</td>
<td>0.85</td>
<td>0.88</td>
<td>10</td>
</tr>
</tbody>
</table>

Mean     $1.06$ $1.09$ Total 151
Maximum value $113\%$ $111\%$ of the yearly means.
Minimum value $80\%$ $80\%$

Fig. 1. Monthly average values of positive and negative mobilities at Poona at 1000 IST.
occurrence in the mornings followed by haze up to the time of observation and sometimes even continuing till noon. During haze, the air is full of dust and Aitken nuclei and the presence of these is probably responsible for the occurrence of fall in mobility and for the lowering of conductivity to a large extent. The mean value of mobility for the year works out to be 1.06 cm.\(^2\) volt\(^{-1}\) sec\(^{-1}\) for the positive ions and 1.09 cm.\(^2\) volt\(^{-1}\) sec\(^{-1}\) for the negative ions; the maximum and minimum monthly values are about 12 percent and 8 percent respectively of the yearly means for both ions. The present yearly mean values are in fairly good agreement with the observations taken at most land stations. They are, however, below the figures given by a few workers\(^4,5\) and are also found to be much lower than those obtained over the ocean\(^6\). At Poona, the average value for negative mobility being higher than that for positive mobility, the average value of the ratio \(K^-/K^+\) is greater than one and amounts to 1.03.

In order to ascertain the frequency-distribution of determinations of mobility the individual determinations were grouped separately for both types of ions according to the values of mobility ranging from 0.4 to 2.0 for which the frequency curves for both \(K^+\) and \(K^-\) have been drawn and given in Fig. 2.

The frequency curves indicate different mobility-groups. The most prevalent group of the positive ions has mobilities ranging from 0.9 to 1.1 and there are four other groups with mobilities of 0.7, 1.4, 1.7 and 0.5 cm.\(^2\) volt\(^{-1}\) sec\(^{-1}\). The negative ions also appear to fall in five mobility groups; the most prevalent group has a mobility of 1.1 and the remaining four have mobili

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**Fig. 2**

Frequency distribution of determinations of mobility at Poona at 1000 I.S.T.
ties of 0.9, 1.2 to 1.3, 1.6 to 1.7 and 0.6 to 0.7 cm$^2$ volt$^{-1}$ sec.$^{-1}$. It would be seen that the mobility values for the different groups agree favourably for the ions of the two signs.

During the course of the observations, it was noticed that the mobility measurements showed fluctuations depending upon the meteorological conditions prevailing at the time of observations, e.g., the observations indicated that higher mobilities were associated with rain. Mean of 14 observations during rain gave values of 1.21 and 1.15 for $+ve$ and $-ve$ mobility respectively against the values of 1.06 and 1.09 based on all observations. This is due to a purification of the air by rain drops. During hazy conditions, it was noticed that the mobility generally decreased to a considerable extent owing to the presence of dust and certain other impurities in the air.

The observations discussed here were taken during the years 1935 to 1937 when the author was working in the Instruments Section of the Meteorological Office, Poona, under the guidance of Mr. J. M. Sil, to whom the author wishes to express his gratefulness. Thanks are also due to the Director General of Observatories for affording facilities for the work.

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REFERENCES.


COMPUTATION OF CONVERGENCE IN A HAILSTORM SITUATION

In recent years various workers$^{1-8}$ have tried to measure horizontal velocity convergence at different levels of the atmosphere. With a view to study the nature of convergence in various synoptic situations in India, the author calculated convergence patterns in a number of cases including a western disturbance and a tropical storm. The results of comparison between the calculated convergence and the weather experienced have been encouraging. An interesting situation is presented below; a fuller account of this study will be discussed in a subsequent paper.

A shallow 'low' had appeared over Saurashtra on the evening of 23 November 1947. It weakened into a trough of low pressure with discontinuity line on the surface running from Bhavnagar to Neemuch at 0800 I.S.T. on the 24th. It remained practically stationary till 0800 I.S.T. of the next day. In the upper air, southerlies or southeasterlies prevailed over south Gujarat since the morning of the 20th up to 7000 ft. These winds had brought in a good amount of moisture.

Cumulonimbus clouds were visible from Ahmedabad Airfield at 1600 I.S.T. of the 24th with distant precipitation in sight. Clouds grew and at about 2300 I.S.T. Ahmedabad experienced a severe thunderstorm which lasted for six hours with almost non-stop thunder and lightning, accompanied by rain and hail. By 0800 I.S.T. on the 25th, it was seen that only Ahmedabad had recorded 3 inches of rain and other neighbouring observatories did not report any precipitation except Bhavnagar which experienced slight drizzle in the night with an insignificant amount of precipitation and Brijnagar which experienced a dry thunderstorm at 1800 I.S.T. of the previous day.

With a view to see how far the method of calculation of convergence from $u$, $v$ isopleths can account for such a localized phenomenon, divergence charts for levels 3000, 5000, 10,000 and 15,000 ft. above sea level were prepared. The wind reported by each station at 1600 I.S.T. on the 24th November 1947 was resolved into its components $u$