

RESULTS OF EXPERIMENTS ON TABLE MOUNTAIN
FOR ASCERTAINING THE AMOUNT OF MOISTURE
DEPOSITED FROM THE SOUTH-EAST CLOUDS.

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(Plate VII.)

The climate of the south-western corner of South Africa is characterised by a rainy winter and a dry summer. While the total annual rainfall at the Royal Observatory is 27·95 inches,* three-fourths of this quantity, viz., 22·04 inches, fall during the six winter months, and 2·15 only, or 8 per cent., during the three summer months (December to February). Small as this latter quantity may be, it is often not reached, and it will even happen that two months pass without a drop of rain, or four months with less than a total of 1 inch.

Under these circumstances it is quite justifiable to call our summer practically rainless, although sometimes a single summer month may show as much as 3 inches of rain.

As I was induced to study this question principally on account of the influence which the rainfall and its distribution over the seasons have on the vegetation of our mountains, I may point out at once that the occurrence of an occasional wet summer in a country where this season is generally rainless would not affect the typical xerophilous nature of the vegetation, while, on the other hand, an exceptionally dry summer in a district which generally receives its rains during that season would weed out all plants which are without means of protection against such a calamity. These means of protection may be of various kinds, but they must enable the plants to tide over the period of drought and to preserve their life until better times, even if all delicate parts have to be sacrificed.

Bearing these facts in mind, it is easy to recognise from a glance

* The average for the ten years 1885 to 1894, taken from Mr. A. Buchan's report.

at its vegetation, that the south-western corner of the Cape has a dry and practically rainless summer, for the hills and lower slopes of the mountains from Cape Town to Clanwilliam, and from Caledon to Worcester and Ceres, are covered with dull-coloured, highly xerophilous shrubs and shrublets. Quite a different aspect, however, is presented by the higher mountains. Wherever one ascends them one finds that even in summer the vegetation of the higher parts is much denser than that of the slopes below. While on Signal Hill or the Paarlberg, at Caledon or at Tulbagh, a good deal of bare ground is visible between the shrubs, the higher mountains are covered with a thick layer of closely set vegetation. Every crack and crevice, every little depression, every ledge is occupied, and even precipitous walls are often clad with a luxuriant mass of shrublets, reeds and rushes.

Having visited many of the mountains of this area, and having spent many a day on their lofty heights, I felt more and more convinced that the vegetation of these higher regions could not exist without a regular supply of moisture, and that it consequently could not depend on the rainfall only for its water supply, but that the clouds, which cover these mountains during the south-east winds, must provide them with an additional and not inconsiderable quantity.

That there is no lack of such moisture in a south-east cloud is easily realised by any one who has ever spent a couple of hours in it. Grass and bushes may have been perfectly dry while the weather was fine, yet a few minutes after the formation of the tablecloth every leaf and every reed is covered with drops of water, and if the wanderer has to force his way through these reeds and rushes,* he will soon be as wet as if he had been out in a drizzling rain for a couple of hours.

For years it had been my wish to obtain some definite figures concerning the amount of water condensed from clouds in this way, but it appears that no such experiments have been conducted either here or anywhere else; at least, I could not find any records in handbooks on meteorology. It became, therefore, necessary for me to endeavour to obtain this information myself.

In November, 1901, I took two 5-inch rain gauges to the top of Table Mountain, and placed them about midway between the east

* The designation reeds and rushes is not correct in a botanical sense. The plants resemble them only in their appearance, but they belong to another order, viz., *Restionaceae*.

and west ends of the upper plateau. One I left open in the usual way, the other one I surmounted with a framework representing a bunch of reeds. The arrangement consisted of two rings of 5 inches diameter, which were connected by four rods of stout wire, the whole frame being 1 foot high. Pieces of wire netting were fixed inside the rings, and reeds were drawn through the meshes and fastened with thin wire. The frame was then inserted into the other rain gauge, fitting into its opening by means of a narrow socket. Four wires attached at opposite sides and fastened to stones near by protected the frame against the fury of the wind. I had consequently one ordinary gauge and one with an imitation bunch of reeds 1 foot high.

The first reading of my gauges was made eleven days afterwards, on the day when I had the pleasure of revealing the charms of our mountain to a distinguished party of explorers, viz., to Professor von Drygalski and several members of the German Antarctic Expedition. The gauge with the reeds had overflowed, while the other one was also nearly full, there having been a heavy rain a few days before. Although the difference was not large, it was evident that the reeds had caught some water. With the aid of some members of the Mountain Club the readings were made at intervals of seven or ten or fourteen days. We found, however, very soon that the bottles which I used were too small; at least that one with the reeds was full every time we came there. I substituted a bottle of double the size, but also that one was generally quite full, compelling me to take up another one which was capable of holding still more. By that time, however, the summer of 1902 was nearly over, and although we continued the readings for some time during the winter, I do not intend to include this part of my observations in this paper, because I found that the reeds caught an enormous amount of rain, which is so largely in excess of that shown by the open gauge, that it may well form the subject of another investigation.

At the beginning of last summer I set to work again, but, owing to some delays, the gauges were put in order only on December 21, 1902. The first reading of the season was made on January 1, 1903, when it was found that the open gauge contained nothing, while the other one showed 15.22 inches of moisture, and that for a period of ten days. The next reading took place on the 11th of January. The open gauge was again dry, the other one showing 14.64 inches. In twenty-one days the reeds had condensed moisture corresponding to 29.86 inches of rain, while the open gauge showed nothing.

The following table gives the results of the readings from December 21, 1902, to February 15, 1903:—

Period.	Open Gauge.	Gauge with Reeds.	Difference.	Gauge at Maclear's Beacon.
1902-3.				
Dec. 21 to Jan. 1.....	...	15·22	15·22	From Dec. 17, 1902, to Feb. 16, 1903.
1903.				
Jan. 1-11	14·64	14·64	
Jan. 11-18	1·04	16·66 (full)	15·62	
Jan. 18 to Feb. 1.....	3·51	16·66 "	13·15	
Feb. 1-15	0·42	16·66 "	16·24	
Total	4·97	79·84	74·87	6·99

For the sake of comparison I have added the total rainfall observed at Maclear's Beacon, and kindly communicated to me by Mr. Thomas Stewart.

The observations came to an untimely end on the 15th of February, because a week afterwards the gauges were found to be destroyed. Although this incident prevented me from continuing the observations to the end of the summer, it does not affect the main question or the main result.

This result is, that from December 21, 1902, to February 15, 1903, that is, in fifty-six days, the gauge with the reeds had condensed a quantity of moisture equivalent to 74·87 inches of rain, and that quantity was recorded although the last three times the gauge had overflowed. It is not too much to assume that, as the season of the south-east clouds extends over double that time, there would consequently be a condensation of moisture, exclusive of all rain, of at least 150 inches during the summer alone.

If one considers that the average annual rainfall at Cape Town (Town House) is 23·84 inches, at the Royal Observatory 27·95, and at Newlands (Bishop's Court) 55·54, which is almost the highest record for any low-level station in the Cape Colony, the extraordinary nature of these results is obvious, and it is not surprising that the vegetation of our mountains is so different from that of the hills.

I do not wish to be understood to say that this amount of moisture condensed by the reeds is in other respects equivalent to a similar quantity of rain. It is well known that the first rainfall at the end of the summer hardly affects the springs, the reason being that

practically all that water is absorbed by the soil and the vegetation. The roots and underground stems of the plants penetrate the earth in all directions, and form a spongy, matted mass, varying in thickness from a few inches to several feet. This sponge absorbs a large amount of moisture, and only when it is fully saturated will it allow any excess to drain away into the fissures of the rocks below. Simultaneously the plants refill their tissues every time the roots become moist, hence it is obvious that a large quantity of the moisture thus condensed is retained by the plants and the soil. There may be an inch of condensation or more and yet nothing might be able to flow away, for where the condensation is at its highest the vegetation will be the thickest and tallest. As soon as the condensation ceases evaporation begins. It is well known that even the south-east wind blows sometimes without forming a cloud on the mountain. During clear weather the store of water in the huge sponge on the mountain becomes rapidly exhausted until another good south-easter comes to fill it again. When, however, the south-east clouds cover the mountain for several days in succession, a considerable quantity of water must find its way into the rocks, and finally into the springs, hence I am of the opinion that the varying yield of the springs in summer, especially during the latter part of it, is largely influenced by the longer or shorter duration and the frequency or rarity of the south-east clouds.

It was interesting to me to find the other day that a similar effect had been surmised by others. In Dr. Brown's book on the "Water Supply of South Africa" occurs the following passage: "These springs (springs above Cape Town) were produced, in all probability, in a great measure by the percolation through the masses of Table Mountain of moisture deposited on the summit by the cloud produced on the mountain by the south-easters in the summer season," and a few pages further on the author quotes a statement by Mr. P. Fletcher: "I believe, from what I have observed, that there is much more moisture deposited in the mountain in summer than is generally supposed."

In support of this view I may also mention the experience of Mr. William Hunt at Stellenbosch, who, as the owner of the mills, has a permanent right to a certain share of the stream coming from the Jonkershoek valley. Naturally he has watched the quantity of water in the stream, especially during the dry season, and he states it as his experience that invariably after a severe south-easter the quantity of water in the stream increases considerably.

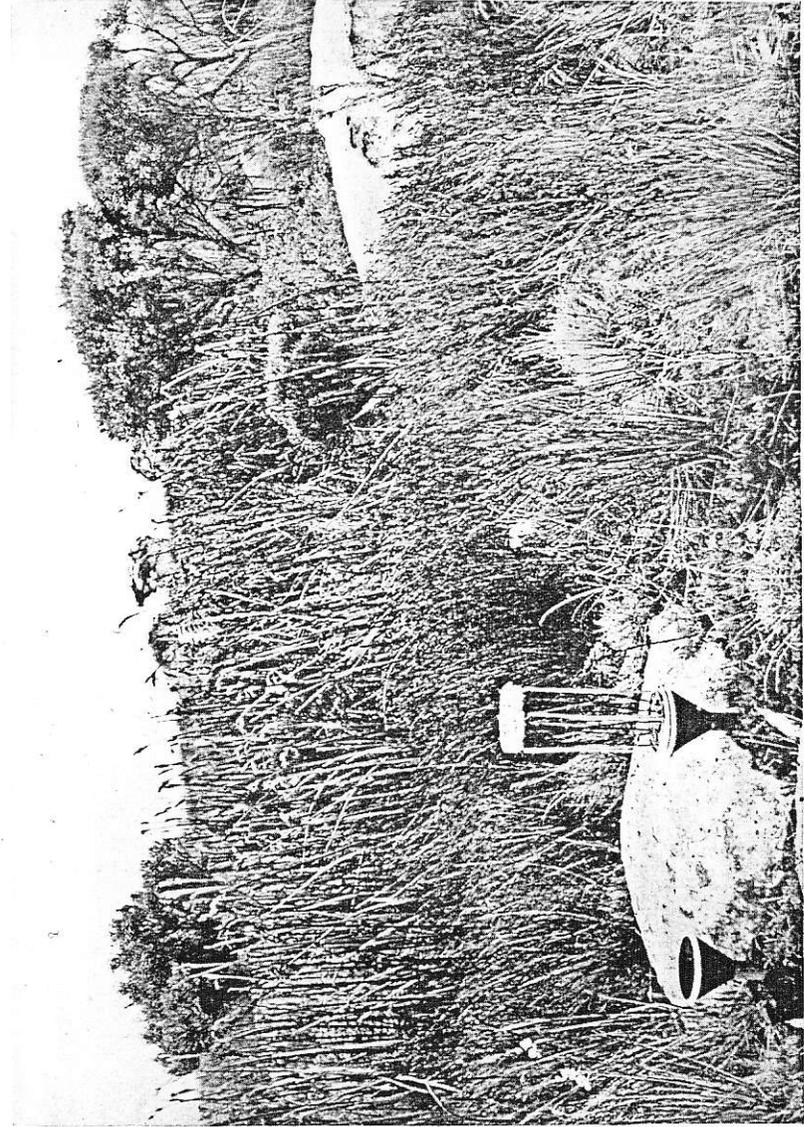
This side of the question, however—that means to say, the influence which the south-east clouds have on the yield of springs

and streams—requires further investigation. It will hardly be possible to investigate all the mountain ranges on which they occur, for they often cover all the higher parts from Table Mountain to the Zwartbergen and the northern end of the Cedarbergen, but a beginning might be made with Table Mountain.

If the days on which the mountain is covered with clouds were recorded, if daily gaugings of some of the streams on and around the mountain were taken, and if then after a number of years these records were compared with each other and the rainfall, it would be quite possible to demonstrate the amount of this influence.

My object in undertaking these experiments was a different one. I stated at the beginning of my paper that I wanted to ascertain more exactly the climatic conditions under which the plants on the mountains existed. That side of the question has been answered. Their summer is not dry. Their climate is that of a swamp—a permanent swamp in winter, a periodical swamp in summer, which dries up during a long spell of fine weather, but becomes soaking wet during the days of the south-east cloud. These results explain why such luxuriant and thickly set vegetation prevails on the upper parts of these mountains, why shrubs 6 to 8 feet high crown the summit of Devil's Peak, why thickets of beautiful heaths 4 to 5 feet high grow on the top of the Jonkershoek peaks, why there is a little forest of yellow wood, *Kiggelaria*, *Olinia*, and other trees on the top of Klapmuts Hill, why the cedar grows only at a certain level of the Cedarbergen, why *Proteas* and heaths abound on the Zwartbergen, and why there are little lakes, even late in summer, on the top of Table Mountain as well as close to the summit of Dutoit's Peak.

It was my object to understand these facts and to be able to explain them to others. This I think I have done. The purely meteorological side of the question I leave to others for further investigation.



R. Marloth photo.

West, Newman proc.

MARLOTH : Gauges of the Table Mountain for ascertaining the amount of Moisture deposited from the South East Clouds.