The Rainfall in Natal.

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The weather of Natal shows a distinct eighteen-year periodical fluctuation in rainfall similar to that which has been traced in so many other parts of the world. Thus the epochs of heaviest rainfall in Natal centre round the years 1855-56, 1873-74, and 1892-93, which are separated by intervals of about eighteen to nineteen years, and during the last two years there have occurred many indications that there will be a similar exceptionally heavy rainfall centreing round the year 1910-11, at a similar interval of about eighteen years. This excess of rain is usually spread over a period of some five years, with generally an intervening dry year near the beginning of the epoch of heavier rains: sometimes in the third year, but more usually in the second year of the group.

The actual cause of this periodical variations in the rainfall of Natal has not yet been definitely ascertained. It is easy to find a plausible explanation, but the difficulty is to establish that this, and this alone, is the true explanation. To effect this proof it is necessary to have the means of testing the different possible hypothical causes by seeing how far the minor features of each hypothesis are in accord with the actual minor fluctuations shown by the observed rainfall, and not merely rest content with showing that one of these possible causes suffices to explain an eighteen-year inequality in the rainfall. But the details of the minor features of this fluctuation in the rainfall can only be derived from the comparison of the observations of a considerable number of years, sufficient in number to extend over several complete periodical variations in the rainfall.

At present the necessary data do not exist, as proper records are not available for the earlier years, but they are being gradually accumulated by the observations that are being systematically made at the Observatory at Durban and its subsidiary stations.

As far as the observed variations are available, they seem to indicate that the origin of the excessive rainfall in Natal at these periods is due to the gradual northerly drift of the great rain belt, whose normal position is to the south-east of the Cape Colony. From some cause, at these periods this great southerly rain belt seems to move sufficiently towards the north as to impinge on the coast of South-East Africa, and produce heavy and continuous rain storms where it is deflected by the ranges of lofty mountains lying close to the coast.

This alternate drift to the north and south is a normal feature of the great cloud belt extending over the southern portion of the Indian

Ocean, and reaching its greatest intensity in about 40 degs. S. latitude. Usually its sway on either side of its mean position does not exceed a few degrees, but at intervals of some eighteen years the drift is sufficient to enable it to reach the coast of Natal, and then the rainfall rises from twenty to fifty per cent. above its average amount.

It is noteworthy that the epoch of these heavy rainfalls coincides with that of the approach of the node of the moon's orbit to the position of the vernal or spring equinox, when the inclination of the plane of the moon's orbit to the plane of the terrestial equator reaches its maximum value, as if there were some connection between the two occurrences, and this coincidence points to a possible cause of this eighteen-year fluctuation in the rainfall.

The attraction of the moon on the terrestial atmosphere must have the effect of deforming it into an ellipsoidal form with the longest axis in the plane of the moon's orbit, pointing a little behind the actual place of the moon in its orbit. And as the earth is itself spheroidal in form with its longest diameter in the plane of the equator, the effect of this deformation in the form of the earth's atmosphere under the attraction of the moon must be considerably enhanced when the plane of the maximum diameter of the atmosphere no longer coincides with that of the earth. When the node of the moon's orbit is near the vernal equinox, the inclination of the plane of the moon's orbit to the plane of the equator reaches its maximum value, and the range of the moon's distance from the equator reaches as much as 28 degs. on either side, whereas when the moon's node is near the autumnal equinox the moon never departs more than 18 degs. from the equator. Hence if the great rain belt has any tendency to follow the deformation of the atmosphere under the attraction of the moon, as it should according to theory, then the greatest northerly drift will occur when the moon's node approaches the vernal equinox, and this is exactly what is indicated by the observations.

It is to be noted that this is purely a local cause affecting South-East Africa, and not necessarily holding of any other place. The great cloud belt sways backwards and forwards over its mean place every year, owing to the motion of the sun, first to the north and then to the south every year, but this motion is not sufficient to bring it into contact with South Africa under ordinary conditions. The effects of the attraction of the moon is to increase the sway of the cloud belt, and when this effect reaches its maximum every eighteen years it suffices to bring the clouds belt on to the coast of South-East Africa. This by itself might not be sufficient to produce any marked increase in the rainfall of the year, were it not for the effect of the lofty ranges of mountains bordering this portion of the coast of Africa, which, by deforming the rain belt, break it up, and produce heavy rain-storms whenever this occurs.

Were there no such cloud belt with its great accumulation of mois-

ture, this motion of the atmosphere might produce no effect on the local rainfall, and the actual effect in increasing the rainfall obviously must depend on the amount of aqueous vapour accumulated in the cloud belt at the time.

The actual existence of this great cloud belt must be ascribed to the action of the sun, and any changes in this effect of the sun must affect not only the dimensions of the cloud belt but also the amount of potential rain in the form of great accumulations of aqueous vapour. Hence, if it be true, as many meteorologists believe, that there is an eleven-year periodical variation in the action of the sun, giving rise to a similar eleven-year periodical variation in the density of the great terrestial cloud belt, then this variation will give rise to corresponding variations in the extra amount of rain falling at the epoch when this cloud belt reaches the coast of Natal at intervals of eighteen years. When this period of heavy rainfall coincides with the period of greatest density of cloud belt as produced by the varying action of the sun, then the excess of rainfall will be very heavy; but when it coincides with the view of least density of the cloud belt, then the excess of rainfall will be comparatively insignificant.

It is noteworthy that three eleven or twelve year solar periods of variation in density of rain belt are not very different from two eighteen year lunar periods, so that every thirty-five or thirty-six years the two should coincide and give rise to a specially heavy excess of rain, similar to that which is recorded by the observations. Thus the excess of rainfall near 1855-56 and 1892-93 was much heavier than that at the intermediate eighteen year epoch in 1873-74. If this be so the coming heavy rains of 1910-11 will not be so heavy as those of either 1855-56, or 1892-93.

It is distinctly to be remembered that much of this is mere hypothesis at present, and so it must remain until the observations in South-East Africa have sufficiently accumulated to enable adequate tests to be applied and definite theories to be formed and properly tested.

Book on Trout.—Readers of the *Journal* interested in trout may be glad to know that an interesting and discursive little book has lately been published by Messrs. Adam and Charles Black, London, from the pen of Mr. Wilson H. Armistead, on "Trout Waters: Management and Angling." The book is written with a knowledge based upon a considerable amount of personal observation and experience, and the views and experiences of the author are narrated in a pleasant and attractive manner. The price of the book is 3s. 6d.