Micro-Climatology in relation to Crops.*

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IN a recent note[1] the importance and scope of micro-climatological studies were discussed. The present note is a continuation of the above with special reference to conditions inside crops as compared to those in the 'open'.

INFLUENCE OF VEGETATION ON MICRO-CLIMATE.

Not only does the climate of a place determine what crops or vegetation would thrive there but also the latter in their turn modify the climate and in particular the "micro-climate".

The influence of plants on "micro-climate" would depend upon the nature of plant surfaces, the convective processes in the neighbourhood of plants and the height and density of vegetation.

A surface of vegetation greatly alters the thermal conditions of the earth. Plant surfaces absorb solar radiation. A part of the absorbed energy is utilised in transpiration and photosynthesis while the rest of the energy goes to increase the temperature of the plant material which also loses part of the energy by emission of thermal radiation. Transpiration and evaporation from plant surfaces also play an important part in controlling the distribution of moisture in the air layers near the ground.

The convective processes in the neighbourhood of plants differ from those in the open. Inside vegetation air movements are feeble and loss or gain of heat by convective processes is correspondingly suppressed.

Apart from the direct effect of solar radiation on plants there is also the shading effect of plants on the surface of the soil according to the density of foliage. This decreases ground heating. The micro-climate is influenced by the height and density of vegetation and therefore by the stage of growth of a particular crop during the growing season. Four stages in the evolution of plant climate may be broadly distinguished.[2]

In the first stage the seeds have just sprouted, the ground is yet bare and so the micro-climate is not essentially different from that over bare ground.

In the next stage, there is a lateral spreading simultaneously with vertical growth, with complete shading of the ground. The seat of diurnal transfer of heat is still near the ground but the micro-climate differs from that over bare ground. The temperature range at the ground is now considerably reduced.

In the third stage plants grow in height and foliage is more uniform with height. An interspace between the ground and the surface of vegetation is also created. The top surface of the crop absorbs solar radiation during day and radiates heat during night. It therefore acts as a second active surface besides the ground.

In the final stage, *e.g.*, in case of a forest, the foliage near ground is less, the second active layer is raised farther from the ground and appreciable air movement is possible in the interspace.

MICRO-CLIMATIC OBSERVATIONS INSIDE CROPS.

Measurements of air temperatures and humidity at various heights are being taken daily inside a few crops and in the 'open' in the Agricultural Meteorological Observatory, Poona, at the epochs of maximum and minimum temperature by means of an Assmann Psychrometer. Observations in the 'open', jowar, and sugarcane, indicate that while pronounced differences are found in the micro-climates of these crops as compared to the 'open' at the epoch of maximum temperature, the differences are not so great at the epoch of minimum temperature.

MAXIMUM TEMPERATURE EPOCH.

It may be observed that at the maximum epoch, the dry bulb temperature in the 'open' is very high near the ground and falls rapidly with height during clear weather. Temperature inside jowar near the ground is lower than in the 'open', but at higher levels it is slightly higher than at corresponding heights in the 'open'.

In the case of sugarcane (an irrigated crop) the dry bulb temperatures near the soil are much lower than those in the open as well as those inside jowar (an unirrigated crop) and they have a tendency to increase with height, but even at 6 ft. it is about 2° lower than that of the 'open'. The largest difference between 'open' and sugarcane is 14°C. near soil, 5·5°C. at 2 ft., and 3°C. at 4 ft.

There is a tendency for vapour pressure to decrease rapidly with height and inside crops the moisture content is higher at all heights than in the 'open'.

MINIMUM TEMPERATURE EPOCH.

Variation of micro-climate is much less at the epoch of minimum temperature. The dry bulb temperature decreases at first with height both in the 'open' and inside crops and then begins to increase, the level of inversion being about 6″ in the 'open' and about 2 ft. inside jowar and sugarcane. Temperatures inside jowar and sugarcane are higher than in the 'open' but tend to the open air value at higher levels.

Vapour pressure in the 'open' is throughout less than that inside crops. In the 'open' as well as inside jowar it increases with height. In sugarcane, however, it decreases with height in the lower levels but variation is negligible after 3 ft. Vapour pressure inside sugarcane continues to be higher than in the 'open' and inside jowar at this epoch also.

CORRELATION OF MICRO-CLIMATE OF CROPS WITH THAT OF THE 'OPEN'.

It would also be interesting to investigate whether the conditions inside crops could be expressed in terms of those outside. If the correlations are high and significant, then past observations in the open may be adjusted so as to give conditions inside crops. Analysis of some of the results for tall crops show that the morning correlations of dry bulb, vapour pressure, wet bulb and relative humidity inside the crops with

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[1] L. A. Ramdas, "Micro-Climatology," *Curr. Sci.*, 1933-34, 2, 415.

[2] Von Dr. Rudolph Geiger, "Microklima und Pflanzenklima," *Handbuch der klimatologie*, 1930, Band I, Teil D.

those in the 'open' are uniformly high, whereas those for the afternoon are smaller, especially at lower levels.

Further studies on these lines and for different crops have to be continued at a few representative centres before definite conclusions could be drawn. The results obtained so far are being discussed in detail elsewhere.

Agricultural Education in India.

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THE short note on the above subject by Mr. Agarwala published on p. 33 of July issue of the Journal tempts me to make a few observations.

Leaving aside the post-graduate institutions at Pusa and Bangalore mentioned by the author, all other institutions may be said to serve the purpose of training upper and lower subordinates to various Agricultural Departments in the country. Though Agricultural Colleges were established with a view to train up practical and scientific agriculturists, they seem to have failed to attract sons of the landed gentry who by virtue of their position and wealth may reasonably be expected to go back to their estates, run farms on modern lines and thus set examples to their tenants. Unless the Zamindars and large estate owners realise their duties towards their tenants and set an example to them by running a home farm themselves, agricultural improvement in this country may not go forward at a sufficiently rapid rate. It is well known that most of the agricultural improvements brought about in England and other European countries are mainly due to the efforts of landed gentry in those countries. Even to-day, it is private land-owners in England that are leading the country in the matter of stock as well as plant breeding. Even in the establishment of research institutions, private people gave the lead in England as is well known by the history of Rothamsted, the premier research institution of the world.

The course of studies followed in Agricultural Colleges of this country may be eminently suited to train good agricultural demonstrators for the subordinate services. Still it seems to be defective in a few essential points. The economics of agriculture are taught on farms where the plots are necessarily small and cost of cultivation consequently high. The practice in Europe is to ask students to go and work on private estates which are run on business lines and get certificates from the proprietors to the effect that the students have worked satisfactorily and understood the economics of crop production, management of labour, etc. Till such places of practical training are established by private persons in this country, it seems desirable for every Agricultural Department to run at least one farm on commercial lines making use of the successful results of all experiments to show their money value by practical demonstration and not merely by propaganda.

Such a step naturally brings with it a change in the course of studies. A theoretical course combined with practical demonstrations and plenty of workshop practice in modern agricultural implements and machinery should be the main feature in the early part of the course. The practical course to be followed later on must be devised for two kinds of students :—(*a*) sons of the landed gentry to enable them to go back to their own estates and become leaders in their respective areas, (*b*) people who desire to take up service as demonstrators, farm managers and such like.

At present, practical work such as ploughing, forms an examination subject and a certain amount of proficiency is expected in it. Such practical examinations should be modified to suit various types of students. Just as Engineers are not examined in the practical work of road making, trench digging, brick making, wall construction, mortar grinding, etc., too much stress on proficiency in practical field operations of agriculture does not seem to be necessary in the case of those who are to manage estates and are not expected to do the work themselves.

The second type of institution is the agricultural school where boys of the cultivating classes get a training in the theory and practice of agriculture. They are mostly vernacular schools. Even in these schools much time should not be spent on operations which the boys can learn from their elders on their own fields. As the European farmer says, boys must be taught things which they cannot learn in their own place, *e.g.*, about modern implements, new manures, methods of seed selection, etc. Even in these vernacular schools, a large majority of students seem to be from non-agricultural classes and go through the course simply with the object of getting into the lower ranks of service. Consequently, steps have to be taken to attract boys who will go back to cultivate their own lands and practise an intensive system of agriculture.

It would be seen from the above that the whole system of agricultural education needs to be overhauled to suit various types of students that are to be benefited by it.

Himalayan Expeditions, 1934.

THE two Himalayan Expeditions, which attempted to negotiate the unconquered peaks of the Himalayas, have both been abandoned. The German Expedition, led by the well-known Herr Willy Mercle, was given up under tragic circumstances, the leader having met his end with three of his companions and a retinue of porters, before they proceeded very far. Another Expedition which was organised by the Indian Himalayan Expedition Club, did not materialise, as it is understood, necessary permission was not granted by the Government of India.