These findings prove definitely that three species of *Plasmodium* occur naturally in the blood of the Oriental monkey, *S. irus* from Malaya, namely:—

(*a*) *P. knowlesi* Sinton and Mulligan, 1932, having a 24-hour asexual cycle;

(*b*) *P. cynomolgi* Mayer, 1907, having a 48-hour asexual cycle; and

(*c*) *P. inui* Halberstadter and Prowazek, 1907, having a 72-hour asexual cycle.

All these species are easily transmissible by blood inoculation to *S. rhesus*, and pure infections are being maintained in the laboratories of the Malaria Survey of India, Kasauli.

The facts (*a*) that the common brown monkey of Northern India (*S. rhesus*) is susceptible to experimental infection with these three species of simian Plasmodia, (*b*) that these monkeys appear to have no malarial infection in nature, and (*c*) that they are easily and cheaply available in India, open up a wide field in this country for the investigation of many important malaria problems. Such facilities are available in few or no other countries of the world.

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## Permeability of Protoplasm—A Probable Factor in Transpiration.

### (Being a Study of Transpiration Response under Ultra-Violet Radiation.)

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OF the various factors that appear to control transpiration it is the atmospheric ones which have received by far the greatest attention and much stress has been laid to show that transpiration is a relatively simple process, probably the simplest of all the plant functions yet known, governed largely by the environic complex. The behaviour of transpirational loss of water under controlled environment, however, has led Plant Ecologists to believe that there exist some internal factor or factors in transpiration, the nature of which does not seem to be well understood.

The present brief note is an outcome of some observations on the influence of ultra-violet radiation upon transpiration, and when taken in conjunction with an independent parallel study on permeability in plant tissues, seems to provide repeated conclusions of an uncommon interest, revealing that protoplasmic permeability performs a regulatory function in transpiration.

While investigations relating to the influence of ultra-violet radiation are known to exist, in an incomplete form though, upon such individual functions as photosynthesis, respiration and permeability in plants, to our knowledge, no observations appear to have been made so far as to the influence of such rays upon transpiration. The observations herein recorded are an attempt in this direction.

The procedure of experimentation in brief consists in selecting healthy mature cut twigs of *Cajanus indicus*, *Triticum vulgaris* and *Andropogan sorghum*, fixing them in hermetically sealed glass vessels containing sufficient water in which the cut end always dips, and estimating the hourly loss of water after the method already described elsewhere.[1] The experimental material is subjected to desired doses of 0, 5, 10, 15, 20, 30 and 40 minutes exposure to ultra-violet radiation.

On plotting the mean transpiration values for the treated plants obtained for a period of five successive hours against time (Fig. 1) it is noticed that the general nature of the response in all the three cases under consideration is similar in spite of material differences. We shall, therefore, try to explain the phenomenon on the basis of the data obtained for any one crop.

A reference to Fig. 2 would indicate that transpiration of irradiated plants exhibits two maxima, one under ten minutes treatment while the other under thirty minutes exposure. Both these pitches are preceded and followed by a decline in the transpiration curve which, in general, shows an unusual contrast to the curves of transpiration obtained for the control plants.

The increase or decrease in the rate of transpiration of treated plants as against the control, may be explained on the basis of certain imminent possibilities:—

(i) Variation in the supply of water from the roots.

[1] Singh, B. N., "On the Use of Bates Evaporimeter and Evaporimeters in general in Studies on Plant Transpiration," *Journ. Ind. Bot. Soc.*, 1924.

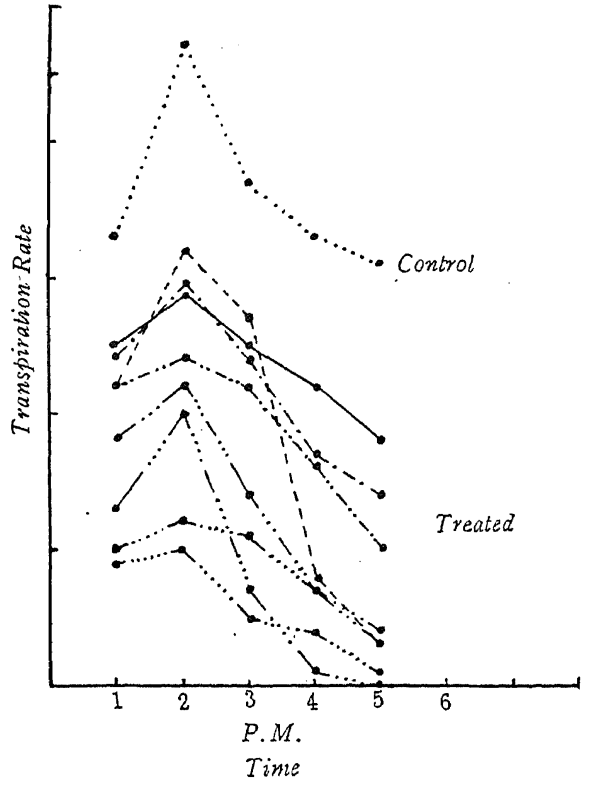


**Fig. 1.**

Showing Transpiration Rate of Cut Shoots of *Cajanus Indicus* with March of Time.

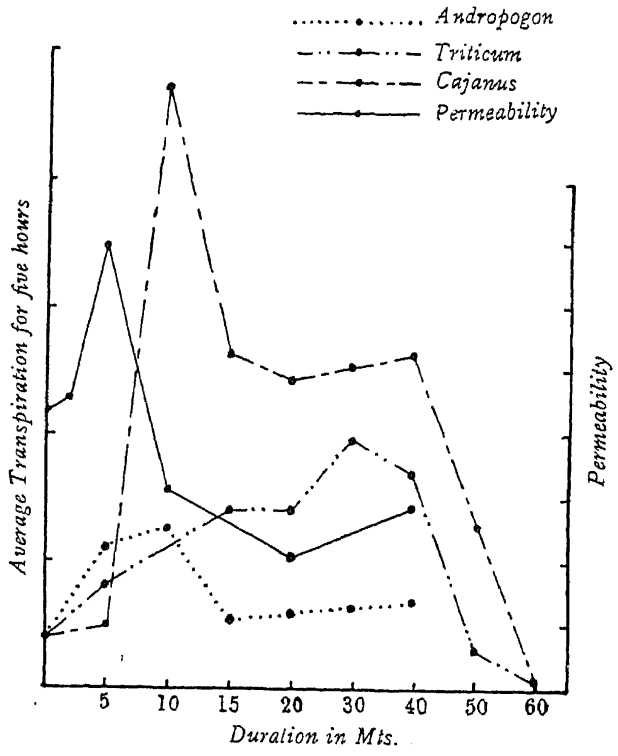


**Fig. 2.**

Showing Transpiration Rates and Permeability in Plants.

(ii) Variation in the stomatal aperture.

(iii) Changes in the leaf water-content.

The question of a deficiency of water supply should not ordinarily arise as in order to eliminate the root factor, experiments are conducted on cut shoots, with the cut ends dipping under water where a constant supply of the same is always available well above the requirements of the shoots. The experiments being conducted under moderate environmental conditions, the absorption from the roots is not expected to fall short of the demand of water made by the transpiring leaves.

For ascertaining how far transpiration is affected by the degree of stomatal opening in plants treated with varying doses of irradiation, comparative values of the average stomatal area and transpiration rate are obtained and portrayed below :—

| Irradiation period in minutes | Tn. rate relative to tn. in control | Average area of stomatal opening size × 750 |
|---|---|---|
| 0 | 1·00 | 0·28 |
| 5 | 1·04 | 0·28 |
| 10 | 2·75 | 0·28 |
| 15 | 1·90 | 0·26 |
| 20 | 1·82 | 0·26 |
| 30 | 1·90 | 0·41 |
| 40 | 0·87 | 0·28 |

A glance at the values indicates that there exists no proportionality between the degree of stomatal opening and transpiration. The stomatal area remains unchanged for control and 5, 10 and 40 min. irradiation and shows small closing in case of 15 min. exposure and a marked opening at 30 min. Thus against both the maximum and minimum transpiration values for 10 and 40 minutes treatment respectively, the stomatal aperture remains unchanged. The maximum and minimum stomatal aperture also signifies no correlation whatsoever with the corresponding values of transpiration. Repeated observations as to the relation between stomatal opening and transpiration go to confirm the above conclusion, a fact further supported by the detailed work of Loftfield[2] on stomatal regulation where he has shown that widely open stomata, as is found in the present case, possess no control over the amount of water loss. In a more detailed study Singh and Sudame[3] have

[2] Loftfield, J. W. G., "The Behaviour of Stomata," *Carn. Inst. Wash. Pub.*, 314.

[3] Singh, B. N., and Sudame, M. M., "Size of Stomatal Chamber and Pore Diameter and their Role in the Regulation of Transpiration," (*In course of publication.*)

shown that the size of the stomatal chamber and the pore diameter seem to possess little control over transpiration, thus emphasising the view put forth above.

Barring the influence of stomata and deficiency in water supply, the explanation for an increase in the rate of transpiration must be sought elsewhere. As to the regulatory influence of leaf water-content, in a recent study Singh and Singh[4] have shown that the rate of transpiration is more or less independent of the leaf water-content and is to a large extent governed by absorption of water. But in the present experiments, as has already been indicated, limitations due to absorption did not arise.

How are we, then, to account for the variation in the transpiration rate? In this connection attention may be drawn to a separate work from this Institute upon the effect of ultra-violet radiation on the permeability of protoplasm[5,6] where an initial increase with increasing dose constitutes the first maximum followed by a second one after an intervening period of decline (Fig. 2).

The general similarity in the nature of the curves for permeability and transpiration following irradiation is indeed most characteristic and leads one to the conclusion that in the absence of the operation of the other controlling factors discussed above, increased or decreased transpiration may well be explained on the basis of permeability changes in the protoplasm of mesophyll cells.

## The Study of Plant Tissue Fluids. A Critical Review.*

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### Preservation of Tissue Fluids.

THE tissue fluids thus obtained cannot be preserved even at low temperatures (0°C) without appreciable changes occurring in the fluid, the most prominent change being the precipitation of proteins through gradual coagulation. Gooke[38] has shown that, in the case of tissues, low temperatures induce an intramolecular change in the tissue proteins which leads to their denaturation; this circumstance has been correlated with winter-hardiness in plants. The coagulum adsorbs many essential constituents, particularly enzymes and viruses. Duggar[39] has found that the mosaic of tomato is not seed borne and opines that the seed proteins adsorb the virus. The failure to transmit many of the viruses through artificial injection of sap, as in the case of the spike-disease of sandal, is probably due to the circumstance that the virus gets adsorbed by the associated proteins during the preparation of the sap. In such cases, it is necessary to carry out the extraction with various buffers and the one which elutes the essential constituent chosen.

A similar procedure should be adopted for the study of enzymes on account of their analogous behaviour. The protein coagulation is influenced by tannins which in the case of certain enzymes like diastases are known to exert an inhibiting or inactivating influence. The effect of tannins and allied substances on the virulence of plant viruses has not been investigated. The extraction of sap from tannin-bearing tissues for certain enzyme studies, is best accomplished by adding hide powder during mincing and grinding. In their studies on the diastatic activity of the diseased and healthy sandal leaves, the authors have adopted this procedure. For the investigation of special constituents, certain modifications in technique have therefore to be introduced, and it is difficult to recommend any one general procedure for universal adoption.

For a study of the infectivity of viruliferous tissue fluids or for determining the resistance offered by tissue fluids to the growth of certain pathogens, the fluid should be obtained under aseptic conditions as it does not permit of heat sterilization.

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[4] Singh, B. N., and Singh, R. B., "The Relative Efficiency of Leaf Water-Content and Absorption in Transpiration." (*In course of publication.*)

* Continued from *Curr. Sci.*, 1934, **3**, 8.

[38] Gooke, *C. A.*, 1907, **1**, 196.

[39] Duggar, *J. Bact.*, 1930, **19**, 20.

[5] Singh, B. N., and Chakravarty, S. C., "Effect of Ultra-violet Rays on the Permeability of Protoplasm of *Trapa bispinosa* to Ions." (*In course of publication.*)

[6] Singh, B. N., and Sheshagiri, P. V. V., "Effect of Ultra-violet Rays on the Permeability of Protoplasm of Storage Tissues to Ions." (*In course of publication.*)