

six host larvæ in this culture were successfully parasitised.

In a second culture, also treated with parasites emerged from field-parasitised pod-borers, one successfully parasitised host-larva, yielded two parasites (one male and one female).

From a third culture exposed to a mixture of a few parasites of the first generation bred from the first culture and others emerged from field-parasitised pod-borers, a third set of eight parasites (one female and seven males) from two successfully parasitised host-larvæ, emerged out. In the second and third cultures, the prevalent micro-climatic conditions were not quite typical of those present in the first.

As far as the writers are aware, this is the first instance, in India, of successful breeding of this beneficial larval parasite on a host, other than its natural host; i.e., on a laboratory host. It may not be out of place, here, to state that the egg of this same laboratory host, *Corcyra cephalonica* St., is already being used for the past ten years, at the Mandya Parasite Laboratory, for the mass-production of the beneficial egg-parasite, *Trichogramma minutum* R., utilised against the destructive stem-borer pest of sugarcane, in the Irwin Canal tract.

This, now, opens up possibilities of mass-rearing, in the laboratory, *Microbracon hebetor*, and probably other beneficial larval parasites for utilisation in the biological control of certain harmful pests, which are at present, being controlled by other methods.

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March 10, 1944.

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#### ON THE OCCURRENCE OF *CNAPHALOCROCIS MEDINALIS* AS A PEST OF PADDY IN TRIVANDRUM AND THE INDIGENOUS METHOD OF COMBATING THE SAME

VERY recently some of the late-sown paddy fields in Trivandrum showed heavy attack by this insect pest which, as a rule, appears only occasionally. In those fields sown at the proper time the injury was slight but in the late-sown fields the seedlings were tender and weak and the deprivations of the insect were most obvious. In two or three blocks all the seedlings had become whitened and sickly and from a distance looked as if lime had been splashed over the whole field.

The way the local peasants handled the situation was very ingenious and interesting. They brought twigs of a wild tree—*Holigarna arnotiana* (Anacardiaceæ) and moved them amongst the seedlings and even planted them amidst paddy seedlings. In a fortnight the seedlings began to recover. On examination these fields were found to be crowded with spiders of various types. Towards dusk the spiders were busy spreading their snares in all directions. The innumerable snares formed a sort of canopy on the seedlings, and the moths that emerged at night were very probably destroyed by these spiders. Other spiders (Attidæ) were noted destroying the caterpillars which are directly responsible for the damage to the paddy.

This method of control is a very simple, yet efficient type of biological (Predatorism) control, used by a people most of whom are illiterate. In January 1944, the fields referred to above presented a different spectacle. The insect pest was not at all seen. The crop had mostly recovered. The abundant spider fauna had also reduced to a small number.

Spiders form a large group of exclusively insectivorous animals. They naturally play an important part in the biotic control of insects in any locality. But little attention has been given to their role in the balance of nature and very little effort has been made to estimate or understand the service rendered by this group of animals to human welfare. The above-mentioned observation is a very vivid attempt on the part of the illiterate Indian cultivator to make use of these creatures for his purpose.

In the course of certain observations on the destruction of insect pests by spiders around the writer's house in Trivandrum large numbers of spiders were found busy spreading their snares which were observed, to contain, in addition to sucked up bodies of the major victims innumerable gnats and mosquitoes entangled in the viscid threads. These gnats and mosquitoes on the spider webs near the doors and windows of the house, indicated that they were probably attracted by the light in rooms and that they would have got in, but for the interception of the silky webs.

A large spider (*Herennia*) which had made its snare on the bark of a tree, destroyed certain hairy caterpillars which attempted to climb that tree.

The common house spider (*Heteropoda*) is well known as a destroyer of cockroaches and such other undesirable insects intruding into the household.

In the local wooden granaries several forms of spiders building their webs inside are probably responsible for destroying many adult moths (*Sitotroga cerealella*) a common pest of stored paddy, and keeping down the incidence of the pest.

The foregoing instances would clearly demonstrate that these much neglected animals form a very important cog in the wheel of life, serving as natural check on the undue increase of insect pests, especially in the tropics and deserve much more attention and recognition than has been usually bestowed on them.

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January 15, 1944.

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#### A HOME FOR THE LEPERS

"Poor without kin or friend or ties of

blood am I  
Save me, before it be too late from this,  
my curse."

THE "curse" has assumed a dreadful shape. We have to-day a half of world's lepers amidst us. Fighting this malady out is pretty difficult. But fight we must somehow. Success depends on co-ordinating the work hitherto done and the Central Government taking the initiative. The problem may be examined under four heads, namely, Investigation, Segregation, Treatment and Control.

Investigation consists in ascertaining the exact numbers suffering as also the enlistment of new cases, the best instruments for that being the Public Health Department and the medical profession in general. But investigation can be successful only with the patients' co-operation ensured through propaganda and promise of attractive life within the Leprosaria. One method is a systematic examination of school children, college students, employees of Government Departments and commercial houses.

Segregation is the organisation of Leper Colonies, climatic suitability and sanitation being of primary importance in selecting sites. Each must accommodate: (1) those to whom the disease is a newly begotten wealth, those suffering for a long time and those in whom the disease is extinct, (2) intimate relations, dependants, children born in the Leprosarium and the healthy children of the patients.

Education, social amenities and economic self-sufficiency are important. Agriculture and small industries may be made the chief occupations for the milder cases. A Leprosy Expert, assisted by an Administrative Officer and a host of medical men, will be the Colony-Chief. A Research Laboratory attached to the Leprosarium will have three qualified scientists who will be in constant touch with the Federal Leprosy Institute, working independently on different aspects of the disease.

We are still Atreya in the matter of treatment makes necessary the establishment of a Federal Council of Research to devote its complete attention to Leprosy research. The governing body must consist of a Member of the Viceroy's Executive Council, Director-General of Medical Services, Director of the Indian Institute of Science, Director of Industrial Research and the Director of the Federal Leprosy Institute attached to the Council, with the Assistant Director as its Secretary. The Council shall conduct a Journal, namely, *The Transactions of the Federal Institute of Leprosy* as also a special course in Leprosy.

Control can be made easy and effective by restricting the number of Leprosaria to one for each Province and making the Director of Public Health its administrative head, administration of justice being entrusted to the nearest magistrate. A new "Indian Leprosy Act" will set the scheme in motion.

Madras,  
March 6, 1944.

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### THE CRITICAL DISCHARGE OF STREAMS IN UNIFORM FLOW

IN two recent communications,<sup>8,9</sup> the writer has shown how to deal with the problem of the critical shear stress. There are in use, two more methods of correlating the particle characteristics with the hydraulic elements of streams, when the sediment particles, initially lying quiescently on their beds, are ejected and propelled forward. These are respectively known as the *critical discharge* and the *critical mean velocity* relations.

At present, there is no satisfactory solution of these, any existing formulæ being true for certain special particle sizes and with little physical significance.

However, the writer has made certain satisfactory calculations of these, and their full account will be published elsewhere. In this note and a subsequent one, I summarise these, the present note being devoted to the question of the critical discharge and the relevant calculations.

There are various ways of arriving at the same result. One of these is to obtain it from the solution of the critical shear stress, there being two lines of attack. Both of these are quite general, but the procedure we adopt here appears to be more significant. It establishes in an instructive and convincing manner, the close interrelationship between the various critical relations. And so, the claim of superiority for one over the others, made by some of the investigators,<sup>7,10</sup> appears to be invalidated.

The law of the critical shear stress velocity for particles with the same fineness ratio reads

$$U_{\tau_c} V_s = f(\rho_w U_{\tau_c} k / \mu) = F(\rho_w V_s k / \mu), \quad (1)$$

where

$U_{\tau_c} = \sqrt{\tau_c / \rho_w}$  = critical shear stress velocity at the bed [L T<sup>-1</sup>],  $\tau_c$  [M L<sup>-1</sup> T<sup>-2</sup>] being the critical shear stress at the stream bed,

$\mu$  = fluid viscosity [M L<sup>-1</sup> T<sup>-1</sup>],

$\rho_w$  = fluid density [M L<sup>-3</sup>],

$V_s$  = terminal velocity of the sediment particles [L T<sup>-1</sup>], and

$k$  = particle diameter [L].

In this, we first split up  $U_{\tau_c}$  and write it as  $(U_{\tau_c}^2 \cdot U_{\tau_c}^2 \cdot U_{\tau_c})^{1/5}$ . Then making use of the equality

$$U_{\tau_c}^2 = g D_c i_c, \quad (2)$$

where

$g$  = acceleration due to gravity [L T<sup>-2</sup>],

$D_c$  = critical channel depth [L], and

$i_c$  = critical channel slope [-],

we get for  $U_{\tau_c}$ , the equivalent expression

$$(D_c i_c)^{1/5} (g^2 D_c i_c)^{1/5} U_{\tau_c}^{1/5}. \quad (3)$$

We next multiply this quantity by  $(5.75 \log_{10} \frac{0.4 D_c}{o_y})^{1/5}$  and divide it by  $(D_c i_c)^{1/5}$ , where

$y_1$ , [L] is a small distance inwards from the bed, where the velocity is taken as zero. Both of these are non-dimensional,  $(D_c i_c)$  being divided by a unit width. Hence, as the critical mean velocity relation reads

$$\bar{U}_{mc} = 5.75 U_{\tau_c} \log_{10} \frac{0.4 D_c}{y_0}, \quad (4)$$

we get

$$U_{\tau_c} V_s = f_1(\rho_w U_{\tau_c} k / \mu) = F_1(\rho_w V_s k / \mu) = F_1(\rho_w \bar{U}_{mc} k / \mu), \quad (5)$$

where  $\bar{U}_{mc}$  [L T<sup>-1</sup>] is short for  $g^{2/5} Q_c^{1/5} i_c^{1/5}$ ,  $Q_c$  being the critical discharge intensity. This *new variable* has the dimensions of a velocity and so we call it the *critical discharge velocity*.

In sharp contrast to the existing relations, each of these has been verified against very extensive experimental data obtained from independent sources. Table I, recording the approximate lower and upper limits of the various variables (ordinarily varied), gives an idea of the range of the data employed, whereas Fig. 1, typical of its kind, demonstrates the high correlation of the data on these bases.

The figure shows how the critical discharge