at that time, various and innumerable. Then he became associated with the London, Catham and Dover Railway and its extensions to the Crystal Palace at Sydenham and to Greenwich. He has since been in practice in Westminster, London, for nearly 30 years, during which period he has been engaged upon a great variety of works in various parts of the world as well as in the United Kingdom. Mr. Shelford was Chief Engineer in the design and construction of the Hull and Barnsley Railway, which is the most recent addition to the main line systems of England and he has acted in the same capacity for several other railways, constructed under agreements with the Great Northern, Caledonian, Great Eastern, Great Western and other railway companies.

Mr. Shelford has visited Canada and the United States and having become practically acquainted with American methods he has successfully applied them in many instances. In the Argentine Republic he made good use of the opportunities for comparing the practice obtaining on either side of the Atlantic. On the continent of Europe, in Italy especially, he has also been largely concerned in the design, construction and working of railways. In all these lines the resources of civilization were at hand and quickly obtainable. But Mr. Shelford has also experienced the want of these aids to rapid progress, having promoted and carried out pioneer railways in the Malay Peninsula, in Sierra Leone and in other parts of Africa. He is now one of the consulting Engineers for Railways to the Colonial Office, and it will be gathered from the foregoing that any opinions in which he may enunciate with regard to matters concerning railways of any kind, are entitled to respect, and will carry the greatest weight with them. We therefore hope that Mr. Shelford will persevere in the course he has so brilliantly entered and that he will aid us with might and main in the development of our means of communication and *pari passu* of our prosperity.—*Indian Engineer.*

"ADHATODA VASICA" AS AN INSECTICIDE.

(To the Editor of the "Tropical Agriculturist.")

SIR,—I enclose copy of correspondence on the subject of "Adhatoda Vasica" as an insecticide.—I am, sir, yours faithfully, A. PHILIP,

Secretary to the Planters' Association of Ceylon.

Relugas, Madulkelle, Oct. 21st.

The Director, Royal Botanic Gardens.

Sir,—I have the honour to forward for your perusal some papers sent to me, by the Indian Tea Districts Association referring to a plant, whose infusion is supposed to be an insecticide and to request that you will kindly inform me whether the plant grows in Ceylon and any other information you may think desirable.

Please return the enclosure to me.—I am &c,

(Signed) MELVILLE WHITE,

Chairman Ceylon Planters' Association.

Royal Botanic Gardens, Peradeniya, 22nd October 1894.

Sir,—I have to acknowledge the receipt of your letter of yesterday and now return the papers referring to *Adhatoda Vasica*. As these have reached me from two other sources,* I am already well acquainted with what has been done in India in the matter.

2 The plant is found in the low-country of Ceylon but not in the Hills: but cannot be considered common here.

Indeed I have usually seen it planted as a hedge in native gardens. It has a considerable reputation in native medicine as a remedy for coughs especially of children; the leaves are bitter to the taste and I notice that they do not seem to be eaten by insects. The Sinhalese name is "Agaladara" or "Wana-epala," and the Tamil one "Aditodai" (whence the scientific name) which I am told means that goats will not eat it.

3 It appears certain that the plant possesses the power of clearing water of low organisms, both animal and vegetable, and that this property has been long known to the inhabitants of certain parts of India, but the destructive power of an infusion of the leaves on *insect* life seems to be scarcely yet fully established. That this is probable however is shown by the chemical analysis of Mr. Hooper of Ootacamund in 1888, who found it to contain a well-marked bitter alkaloid—"Vasicine" of which small quantities in water found to kill leeches, centipedes and insects.

4. If I can obtain sufficient material I hope to experiment here. The plant is easily grown and a small plantation is readily made. The large lithographic sketch accompanying the papers is very rough and not very accurate. If desired I can send you a specimen.—I am, yours faithfully. (Signed) HENRY TRIMEN, (Director R. B. G.)

Relugas, Madulkele, October 25th, 1894.

The Director Royal Botanic Gardens.

Sir,—I have to acknowledge your letter of 22nd October (No. 117) with enclosures and to thank you for the information contained therein.

Should you be able to make any satisfactory experiments with the plant, I shall feel obliged by your communicating the results to me, as the matter may turn out to be of general interest and utility.—I am, &c. (Signed) A. MELVILLE WHITE, Chairman C. P. A.

[From the series of papers referred to above, We give the following as containing the gist of the information available so far.—ED. *T.A.*]

Khonikor Tea Estate, July 16th, 1894.

DR. GEORGE WATT, M.B., C.I.E., SIMLA,

Dear Sir,

I beg to thank you for your letter to Messrs. Barry & Co., regarding the "Adhatoda Vasica," copy of which has been forwarded to me. I have done my best to carry out your suggestions with the following results:—

1st—Samples of leaves, and shoot with bud and leaves, have been dried and sent to your address at Simla, as desired. I hope they will reach you in good enough condition, for you to be able to pass an opinion on as to whether it is the Adhatoda V. written about by Mr. Bamber, or one of the same family.

Leaves soaked in cold water, without being bruised give a perfectly clear water.

Leaves thoroughly bruised and soaked in water (cold) for 12 hours give a dirty brownish bitter liquid. Some leaves soaked, after being bruised, for 48 hours gave a thickish brown liquid, which had an oily film over it. Proportion 1 lb. leaf to 1 gallon water.

* We ourselves forwarded papers to Dr. Trimen, a short time ago.—ED. *T.A.*

2nd—I have had some slimy stagnant water from drains brought in and put into a bottle with a frog and placed two leaves of the Adhatoda V. in it. The leaves in a measure did disintegrate the stuff in the water, had no effect on the frog, but did not clear the water, the water remained of a greyish yellowish colour.

3rd—I had a number of Mosquitos brought in and placed in a box with top and bottom covered with net, the infusion was freely used twice (leaves soaked for 24 and 48 hours) it seemed to have no effect on the Mosquitos beyond in a way stupifying them. I had some dozens in the box for a day and a night; they were twice wetted with the infusion—strength 1 lb. to 1 gallon water—they seemed lively enough at evening, but were all dead in the morning. Now the question arises—what is the duration of a Mosquito's life? how long does it live? did they die a natural death? or were they killed by the infusion? I have not so far found, after my experiments on tea bushes, and dead Mosquito's or even full grown ones, but any number of young ones in, I should say, a state of coma. Only in one case have they returned to the same bush and that after a lapse of nearly a month—they decidedly leave the bush after it has been syringed, but whether they die, or take long flights I have not been able to ascertain. I have now tried some 20 patches attacked by this blight, and in every case they have disappeared after 4 to 6 applications. They are easier got rid of in dry than in wet weather,—Yours faithfully,

(Signed) F. C. MORAN.

Simla, dated August 1st, 1894.

To F. C. MORAN, Esq., Khonikor Tea Estate,
Dibrugarh, Upper Assam.

DEAR SIR.—Yours of the 16th, as also your samples of leaves, reached me here yesterday. It is a little difficult to identify the plant by leaves only, as a great number of the *Acanthaceæ* are almost identical in their foliage. The leaves sent by you are a little longer and narrower than those of the plant in Bengal, but still I suspect they may be the correct thing. The Bengal ADHATODA, on being dried nearly always turns a yellowish brown colour and the leaves are generally thicker and smaller than in your sample. If not the right plant, since it belongs to the same family undoubtedly, your experiments would point to the same property being possibly possessed by other *Acanthaceæ* than ADHATODA.

2. Your experiments with life-infested water, I do not think very satisfactory. If the water chanced to contain mineral impurities, as well as animal and vegetable forms of life, the ADHATODA would not clear it of the mineral matter. What you should have done was to have taken two clear glass jars and to have filled these with the self same water at the same time. You should have next examined the contents of both with a low power microscope to see if they were equally infested with the same forms of life. Then you should have put into one of the jars a few leaves squeezed or broken a little or a measured quantity (to be recorded) of your standard infusion. After, say, 2 or 3 hours you should have then examined both fluids to see the action comparatively. By 4 to 5 hours (according to my results) the jar treated with ADHATODA would have been found to have had all the contained minute organisms not only killed but more or less decomposed, and the water thus cleared of these impurities, while such higher forms of life as a frog or fish would be seen to have remained unaffected. The drug is in other words perfectly harmless on the higher forms of both animal and vegetable life.

3. To obtain satisfactory evidence your experiments must be comparative. Since the minute forms of life are found to remain in the jar of water not treated with ADHATODA—a jar filled from the self same source and at the same time as that which had been treated—the comparison would show that whatever change had been effected in the jar treated with the insecticide must be attributed to the ADHATODA, since all other conditions remained the same. Even if you do not chance to possess a microscope, by which to examine the minute forms of life in the water, two jars, the one to compare with the other, would be preferable to working with one, the more so if they both contain visible (that is, to the naked eye visible) green slimy *algæ*, the destruction of which could be recognized. Moreover, in a day or two the one jar would be seen to contain life, its contents would gradually get darker coloured, the *algæ* would begin to stain the glass by growing upon it and the proportion of life to visibly increase, whereas if ADHATODA had killed the lower organisms, no such further growth would take place, and the one fluid as compared with the other would then appear cleared. It was in this sense that I used the word "cleared," not cleared in the sense of having all animal, vegetable *and mineral* matter precipitated. The expression cleared or purified was intended by me, when originally used, to be a literal translation of the expression employed by the Sutlej valley cultivator, when he drew my attention to the fields that had been treated with ADHATODA as compared with those that had not been so treated.

4. I do not for a moment think that on being syringed, the bushes should be regarded as for ever after freed from Mosquito. On the contrary, that would necessitate that the tea leaf had been so saturated that it was permanently poisoned to the Mosquito and possibly thereby injured in flavour as an article of human consumption. If 50 square yards in the middle of a badly infested plantation be treated, it might be but a matter of a few days only when the cleansed portion would be again attacked from the neighbouring bushes. But I do not doubt that assuming that ADHATODA has been found a specific against Mosquito and other such pests, the systematic treatment of all and every portion of the plantation where these insects appear should in time result in their complete extermination.

5. Your experiment with Mosquito in a specially prepared cage I don't think very satisfactory for the same reason as detailed in paragraph 2 and 3. You should have made two cages at least, and placed them under identical conditions, the one with the leaves syringed and the other not. The question you raise as to the cause of death of the Mosquito would have then been placed beyond doubt. Your observations on the general effect on bushes treated in the plantation are more instructive than your specific experiments. The remarks for example, that "they decidedly leave the bush after it has been syringed," and again that "I have now tried some 20 patches attacked by this blight and in every case they have disappeared after 4 to 6 applications," show that the subjects is well-worthy of thorough investigation. I would recommend you to try the following method of substantiating these observations. Select two plots as remote from each other as possible, and each in the middle of badly infected portions of the estate. Syringe them both at the same time and to the same extent, the one with pure water and the other with the ADHATODA infusion. This would prove whether the mechanical action of syringing or the substance used as an insecticide possessed the action attributed to it. But even such an experiment would have to be repeated many times and by different observers in order to obtain an absolute opinion. So far as I can see, it is more important to deal with the infant or even the egg, than the perfect insect, and if these were destroyed by Adhatoda the pest could at all events be thereby controlled. This might be solved by syringing young twigs that are seen to possess the eggs,—some with one dose, others with two, &c., and then placing these twigs in cages or by carefully tying them within muslin cloth (without separating the twigs from the plant) in order to see if subsequently the mature insect escaped from the eggs.

6. You ask me as to the duration of the mature Mosquito life. I have read through every article that I can find on that subject, and have failed to procure you the required information. This point might easily be solved, however, by cultivation in a cage, such as that mentioned in my former letter and as already indicated in paragraph 5 above. The late Mr. Wood-Mason (as you doubtless are aware) wrote a paper on the Tea-mite and Tea-bug. He published thereby certain interesting contributions to our knowledge of

these insect pests, but did not complete the life history of either. The question as to the duration of Mosquito life he does not even touch upon. But he showed that the eggs were *deposited on the young twigs*: that the respiratory processes of the newly laid eggs so closely resembles the fine pubescence which clothes the surface of the shoots as to be quite indistinguishable from it to the unaided eye: that the knobbed ends and also the sides of the two tubular processes of the mouth of the egg-shell, to a greator or less extent, are studded with button-shaped elevations, each of which has a minute pit in his centre; that these pits are probably the ends of minute tubes which place the lumens of the processes in direct communication with the exterior, and thus serve to carry air to the developing ovum: that the eggs are provided with deep saucer-shaped lids, perforated sieve-like, with holes which are large enough to admit spermatozoa.

These and one or two more of Mr. Wood-Mason's observations, I venture to think, are of much practical value. By thoroughly saturating the young twigs, it may be possible to cause the insecticide to penetrate through the respiratory tubes and thus destroy the embryos.

But if attention be directed to the destruction of the embryo, it should not be forgotten, as pointed out by Mr. Wood-Mason, that the females instinctively avoid puncturing the shoots or parts of the shoots in which they have laid their eggs, for, says Mr. Wood-Mason, "one can rarely find eggs on badly injured shoots." A thorough syringing of affected bushes, more especially of the sprouting buds of these (which to the casual observer may seem free from the pest) would give full scope to the treatment. But in concluding this paragraph, I would caution you against the mistake made on more occasions than one, of regarding the eggs as young insects; the two unequal processes which spring from the mouth of the egg have been regarded as the antennæ of young (perfect) insects deposited in that state.

7. But Mr. Wood Mason, in trying to account for the reported greater prevalence of the disease on the Chinese or hybrid Chinese stock of tea bushes, dwells on the fact that the descrimination manifested by many insect pests is doubtless due to a high sense of smell possessed by these creatures. And I would add to his observations that it is well-known that fungoid pests are remarkably good botanists. They choose not only uniformly the same hosts upon which to live, but may even frequent but one variety of the species. The practical value of these observations may lie in the fact that without poisoning the Mosquito it is just possible the ADHATODA infusion may drive the insect away by its offensiveness. If driven away and systematically kept from the tea plant, the effect would be the same to the planter as if poisoned.

My experiments with the drug satisfied me beyond all doubt, however, that to certain forms of life it is a powerful poison, and I am therefore sanguine in my expectation that careful investigations will reveal the fact that it is an actual insecticide to Mosquito and other minute insect pests that frequent the tea and other plants, such as the green fly of the garden rose. But I wish it to be clearly understood that I hold that it requires to be demonstrated in each case whether or not ADHATODA possesses that property on the pests that may be in question.

8. You do not appear to be troubled with the Tea mite. It would seem to me that ADHATODA might be even more energetic with that pest than with Mosquito, from the fact that the entire life of the mite is spent on the surface of the tea leaf. The eggs are laid in the recesses formed by the branching of the veins of the leaf, and the tapering extremities of the eggs are directed upwards in such a manner that there should be no difficulty in killing their contained embryos. The young *arachnids* leave the egg as 6-footed larvæ, but they do not emigrate from the plant as voyagers on the backs of winged insects (as many other mites do), but attain to adult state by a change of skin. It seems probable that the entire life of the Tea-mite is spent on the self-same leaf as it was born on, so that assuming that ADHATODA is a specific against this pest, its extermination should be comparatively easy matter.

9. In a communication I have had the pleasure to receive from Messrs. Barry & Company, (dated 23rd July) a tea planter, furnishes certain particulars regarding "Green fly." "It lives," he says, "entirely on the lower side of the leaf and is not got at so easily as mosquito or red spider, and I doubt if it could be syringed out in the same way. It also curls the leaf downwards on all sides and so forms a hollow dome in which in it lives and breeds. This would also be the means of protecting it from the syringe." There are doubtless many mechanical difficulties that would have to be got over, but these need not be considered at present. What we have to discover in the first place is whether green fly, mosquito and red spider are killed by the insecticide or not. To yourself and your enlightened brother planters, I trust may soon be due the credit of having brought the experiments with ADHATODA to final and successful issues.

GEO. WATT,

Reporter on Economic Products to the Government of India.

"ADHATODA VASICA."

DEAR SIR,—The plant that Mr. Melville White has recently been writing about, is common in the Western Province, it is known to the Sinhalese by no less than three names viz.: *Ayaladara*, *Wana Kpala*, and *Pawatta*. It is used medicinally by the Sinhalese in the shape of decoctions for cough, but is a most nauseating drug. The dry leaves are rolled into cigars or filled into pipes and smoked also for cough, similarly as the *Datura* (attana) leaves are for asthma. A fomentation of the leaves boiled is greatly relied on for lumbago. That cattle, sheep and goats will not eat the leaves is a fact, but whether it is an insecticide remains to be proved.

C. A. C.

THE NEW ALLEGED INSECTICIDE, "ADHATODA."

We are disappointed to see by the interesting letter Mr. E. E. Green has sent us (see below)—that an experiment instituted by him with the new insecticide has not been successful. We have given above the important portions of the letters of Dr. Geo. Watt and Mr. Moran sent to the Chairman, P.A. Dr. Watt does not speak of distillation in the required infusion, but of a few leaves squeezed or broken into a glass jar with water clearing, in 4 or 5 hours, the said water of minute organisms which would be found not only killed, but more or less decomposed. Mr. Moran was successful in clearing some 20 patches of tea attacked by mosquito after 4 to 6 syringings with an infusion from the leaves.

"ADHATODA"—AS AN INSECTICIDE; AN UNSUCCESSFUL EXPERIMENT.

Eton, Pundaluoya, Oct. 29th.

DEAR SIR,—I have noticed in the local papers some correspondence about a Ceylon plant—the "Adhatoda"—which is said to possess insecticidal properties. I hope it will be thoroughly tested and that the statement may be corroborated. But a little experiment that I have just tried with this plant failed to prove anything of the sort. Dr. Trimen very kindly sent me a small piece of the "Adhatoda," from which I brewed a strong tea-coloured infusion. The quantity was insufficient for experiment in the field. But to test its qualities I immersed in the mixture several tea branches, infested with the tea aphis *(Ceylonia theæcola)*, until both leaves and insects were thoroughly wetted. I then took them out and