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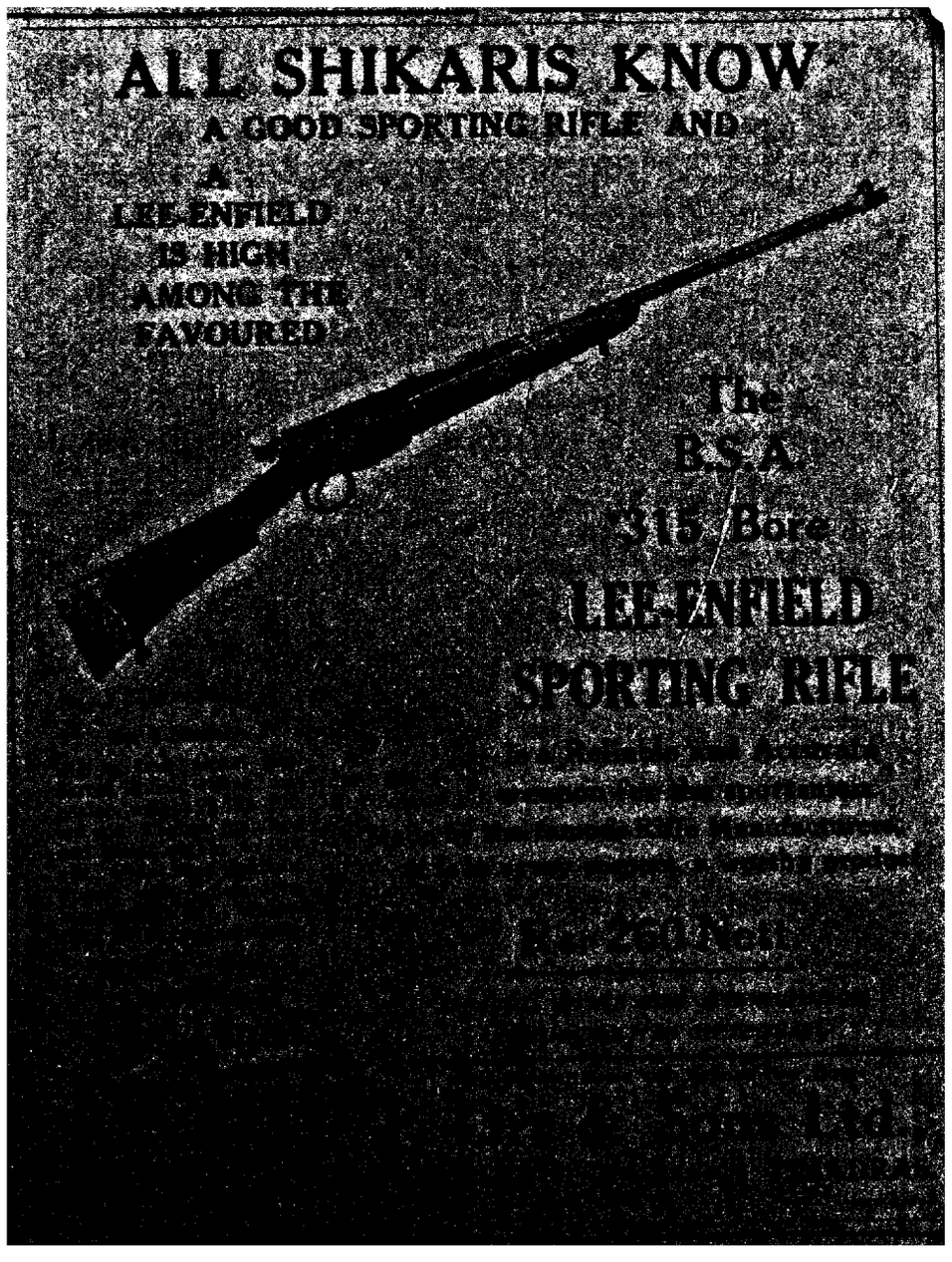

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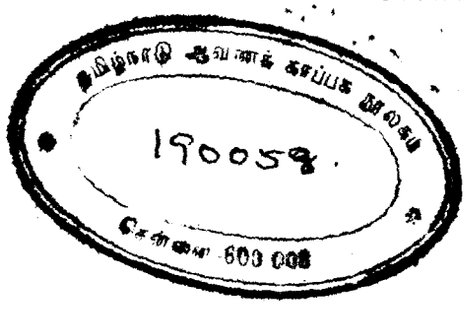


The Madras Forest College Magazine.

(Published Quarterly).

Vol. XI.] MARCH 1927 [No. 3.

How Teak plantations are raised in South Indian Forests.

Teak is considered to be one of the best timbers in the world, as it can be made use of for a great variety of purposes, in ship building, house building, implements, machinery, railway sleepers, in fact for any purpose where a strong durable timber is required. On account of the rapid depletion of Teak from the Natural forests in the middle of the last century, artificial regeneration had to be resorted to to ensure a steady and continuous supply. Teak is not gregarious, and in natural forests forms only a small portion of the crop. The natural regeneration is scanty and is difficult to obtain, because of its dependence on a diversity of circumstances, such as the spread of seed, factors influencing the germination, and the after development of the seedling. It is not only soil exacting but requires a good temperature, soil aeration, and burial of seeds for germination, and light, soil aeration and moisture afterwards. Unless the above conditions are satisfied, which hardly occur in nature, regeneration will be impossible, or at least poor. Hence to ensure good success, artificial regeneration has to be resorted to.

Artificial regeneration is advantageous only where the growth is quicker and better than the natural one. It is always expensive, and at the same time, the future results are more or less uncertain, and it is mainly due to these draw backs, that planting work is discouraged. Provided the soil is suitable, the essentials of success are the low cost, and suitable method of regeneration. The method to be adopted depends upon the factors of the locality. The climate being suitable, the important factor which influences the method of regeneration is the amount and nature of rainfall. Dibbling is no doubt cheap but it is suitable only where the rainfall is evenly distributed, throughout the year as in Mount Stuart. Though Nilambur gets a heavier rainfall, the major portion is precipitated in 3 or 4 months and any seed, sown is liable to be washed away in the torrential rains. To ensure success in planting the plants should be of correct size, and be put out in the forest at the correct time, that is, at the commencement of the rains, so that the critical period of planting may be passed off and the plants established before the end of the rainy season.

The important points in raising a plantation are :—

(1) Choice of site.
(2) Aeration of the soil.
(3) Planting at the right time.
(4) Weeding and tending operations.

Teak, being soil exacting, the most important point is the "selection of site" for regeneration, upon which the whole success

depends. In years gone by, the authorities of the Forest Dept. disregarded the suitability of soil and planted Teak in laterite areas in Nilumbur in their anxiety to have Teak woods. But alas! the result is a total failure. In the plantation Working circle (at Nilambur) where the 2nd rotation is going on, there is no necessity for the selection of a site. But in conversion Working circle. *i. e.* the places where the existing natural forest is clear felled and planted with Teak, the quality of the locality has to be carefully determined by the examination of the soil (*i. e.* by digging trial pits in the areas) and the species growing there. Deep and well drained alluvium is the best soil for teak.

All the saleable trees from the site so selected for Teak regeneration, are first removed and then subsequently the whole area is clear felled and thoroughly burnt. This operation is commenced after the monsoons in the month of August, and completed within the shortest possible time, so that the felled stuff may be dry enough for a thorough burning. Generally speaking, felling is completed at the latest by the end of February. As soon as the saleable trees are removed, and the whole area clearfelled, all the debris are collected and burnt as it should always be remembered that the greater the material to be burnt, the fiercer is the fire, the weaker is the weed growth in the ensuing monsoon, and the better the resultant growth of teak. The big logs, which do not get a good burn are cross cut and split and reburnt. The whole burning is completed by the end of March. As the cost of cross cut and reburn is great the area clear-felled in one year, may be left for the next year without burning so

that the felled material may be very dry and burn without cross cutting. When the burning is completed, alignment for pitting is done and completed in April, sometimes, the pits are dug well in advance for their exposure to the atmosphere influences, which aerate the soil and this is done in May–as we observed at Mount Stuart. Now the area is ready for planting, which will begin when the monsoon breaks.

As the plants are to be of correct size, at the time of planting, it is essential to start the nursery operations in advance. In march, the site for nursery is selected close to the area, to be regenerated, and to the river, but high above the maximum flood level. The size of the nursery depends upon the area to be planted, and about 1/5th acre of nursery can supply plants for 100 acres. The ground is dug up to a depth of $2\frac{1}{2}$ to 3 feet and broken into fine powder, so as to have a well aerated soil. Great care is taken to have the original surface soil at the top as it is rich in vegetable matter and consequently very fertile. Raised beds 22 to 25 feet × 3 feet are prepared. The monsoon begins by the beginning of June, and to ensure success in planting, the seedlings should be at least 6 weeks old. Early in April, seeds, which are cellected in advance in Junuary, and February, are packed in bags, and soaked in running water for 24 hours. The seeds are then loosely spread in the nursery beds and covered with straw, the object of which is to keep the moisture and an even temparature. It has been found by experience that dense packing of seeds produce only weak plants. The seeds are watered twice a day till germination is observed. Germination genrally occurs in 11 to 15 days. When it is observed, the stand is removed, and the beds are watered systematically and

kept free from weeds. In 6 weeks time, the plants are 3" high with two pairs of leaves. The nursery being a temporary one, the fencing is made of bamboo and thorns. The average expenditure is about Rs. 5 per acre to be planted:

The cost of forming a nursery for one acre is as follows :—

1.	Working the Soil	Rs. 1–4–0
2.	Laying out and fencing	0–8–0
3.	Watering	2–0–0
4.	Collection of teek seeds $1\frac{1}{2}$ para (one para = 5 Madras measures) at 0–12–0 per para	1–2–0
5.	Collection of Rosewood and Terminalia tomentosa seeds for undergowth	0–5–0
	Total.	5–3–0
	or Rs.	5–0–0

Early in June, when the monsoon breaks out, all the available labour and staff are concentrated, and planting is finished as quickly as possible as it is important that work should be done in the rains. When the rains stop, the work is also stopped, and again continued when the rains set in, as otherwise failure results as we saw at Walayar camp. Planting is done with bare roots in pits which are dug already, espacing 6 feet × 6 feet. Casualties are replaced at the time of 1st or 2nd weedings.

The key to successful raising of a teak plantation is timely weeding operations as teak is intolerant of suppression at any time of

its life. Owing to the neglect of this important item of work, many planting operations of teak have become absolute failures. For a light-demanding and quick growing species like teak, the number of weeding operations in a year, and the number of years during which weeding operations have to be done, depend entirely upon the qualities of the locality. Hence the number of weedings are not definitely prescribed. But generally, in the 1st year, three weedings are done in all the qualities of the locality. The first weeding is done, when the weeds show signs of flowering, the second, when they are thick, and the 3rd before the 20th of December. If it is not completed, all the plants under one foot are mulched when weeded. In the second year, the first quality gets one weeding, the second two, and the third three weedings. In the 3rd year, all the plants under 3 feet high are weeded. So the "3rd year weedings" are generally required in third quality areas. Pruning is done before the commencement of monsoons and is confined to forked stems, and to those having stout side branches. This operation is done in the 1st, 2nd and 3rd years. If the last weeding in any year is not completed before 20th December, all plants under one foot high are mulched when weeded. The system of weeding (at Nilambur) in rough is line weeding in which weeds in strips 4 feet broad and 2 feet on each side of the plant rows are uprooted weeds of the intermediate strips are also cut and the uprooted weeds are piled up on the top.

This system of weeding has proved to be expensive and they have introduced, at Nilambur, a method of weeding known as "Gang weeding" on an experimental scale to lessen the cost. Under

this system, the whole work is let on contract and the coolies should see that the plants are free from suppression.

The object of the whole working, being the maximum quality and quantity increment, it is essential that the trees of future crop should be provided with space and development throughout their life. Teak being a quick grower and light demander, the thinnings should be done very early, and fairly heavy. Therefore the exact time at which thinnings should commence depends upon the quality of the locality. At Nilambur, which is noted for the production of the best-quality Teak trees, we have noticed that 1st thinnings are done in the 5th year, and then repeated at 10th, 15th, 20th, 25th, and 40th year. In poor quality area, time cannot be definetely prescribed, and hence thinnings are done when the struggle for existence commences and are repeated as required.

The cost of forming a plantation up to the time of 1st thinnings is as follows:—

1.	First burning the debris	.... Rs. 3	per acre.
2.	2nd burning including Cross cutting of logs, splitting them etc.	.... Rs. 16	"
3.	Raising of nursery	 5	"
4.	Aligning the area for pitting	 1–4	"
5.	Pitting	 5	"
6.	Planting	 1–8	"
7.	Weedings	 10	"
		41–12 or Rs. 42	per acre.

The Teak crop, as it attains maturity, tends to become more open owing to the shrinkage in crowns. The trees shed their leaves in early part of the cold weather and remain leafless thoroughout the greater part of the hot weather and thus expose the soil to the scorching rays of the sun. Since the crowns are thin, the annual fall of leaves, and hence the accumulation of humus in the soil, is very little. The violent rush of rain-water may waste away the soil as it is not protected by the thick layer of humus. As the trees of the final crop are few in number and as the stems are better developed than the crowns, the debris left, after clear felling, on the area is quite insufficient to give a fierce burn. Want of fierce burn in the area and hence less aeration of the soil, act unfavourably on the new crop raised subsequently on the area.

Prevention of the above evil *i. e.* the deterioration of the quality of the locality has become a great problem at Nilambur, where the 2nd rotation of the plantation has already commenced. A great mistake was formerly made there in the regular clearance of the undergrowth in the plantations. The benefit of keeping the undergrowth having now been felt, this operation of clearance has been stopped, but the loss of the productive capacity of the soil after the 1st rotation cannot be mitigated unless some evergreen or semi-evergreen species be introduced into the crop as a second storey.

The advantage of the introduction of such species will be three fold :—

1. The soil will be better protected.
2. The Teak trees will be cleared of epichormic branches.

3. There will be a sufficient material for a good burn of the area after clear felling of Teak.

The species best suited for the purpose, will therefore be some shade bearing and slow growing species, and must be at least paying the cost of putting them up at the final filling. As the Teak crop is very close at the start and becomes open only after thinning, the next point for consideration is the age at which the under planting should be done. This depends upon the rate of growth and also the age of exploitability of these species. Except bamboo, no species can be expected to yield a return if planted in the late age in the life of the plantation. Bamboos should be introduced at the 30th to 40th year of the plantation when there is no chance of their over-topping the Teak trees.

To solve the above problem, many experiments are being carried out at Nilambur. Rosewood, Hopea, Mahagony, Artocarpus hirsuta, and A. integrifolia have been tried.

The first has failed, and the next two may be successful as we infer from the growth in some of the older Teak plantations. But their growth is very rapid and there is every likelihood of their over-topping the Teak at the later stage when they become open. Even in young teak plantations, as young as 1921, some of the Hopea have attained a height of 10 feet. The other two species have only of late (last year) been introduced and hence we cannot arrive at any definite conclusion.

RASH BIHARI GUPTA.
Senior Student M.F. C., *1925–27 Division.*

The Æsthetic aspect of Forests and its practical value in life.

Time and again, the utilities of forests have been dealt with at length. and the students of forestry are only too well acquinted with the manifoldness of their nature, and it will be presumptuous on my part to add in any way to their very many direct and indirect effects on our every day life. Of these aspects, I propose to confine myself in this essay, to the æsthetic one; and however remote it may seem, from the view point of a practical man, the very fact, that it has a bearing on the life of every individual, is in itself a sufficient excuse for its production. My apology would be incomplete if I do not add that an essay in this line should prove specially interesting to forest officers. The value of æsthetics, if it is not of worth in practical life, would be worse than useless. It is a peculiar taste to see and feel the beautiful and sublime in nature, and it does follow that the progress of individuals in this line, leads towards a perfect harmony in actions. and consequently the betterment and advancement in life is assured.

The æsthetic aspect is one of the many indirect results which you derive from the forests. The mechanical hygeinic and the atmospheric effects can be felt in some shape or other. Their forms are various, either in increasing the rainfall of a place, or in reducing the temperature of the soil, and atmosphere, either in increasing the relative humidity of the air, or in preventing erosions and landslips, also the drying up of springs, and either in improving the healthiness of a locality by an increased production of oxygen, or in enriching the

happy farmer down in the fields below, when he realises his crop. And the value of the direct results are better known to the forest r who in consonance with his yield tables, fixes the most pr fi rotation for a sustained, uniform, annual yield. And in th ne benefit is corporeal, and we are quite complacent. In ire more than satisfied.

But in the aesthetic aspect, the very fact of its occupying only a sec ndary place in the eye of the pragmatist, has a redeeming feature in that it has the unique value of being the monopoly of only a selected and privileged few. True it is not tangible. It is ever present only in your mind. You cannot see the beautiful and sublime in the forests, unless you have at least a particle of the sense of the sublime. It is a thing to be felt, purely transcendental, emotional. Let me conjure up a vision of the virgin forests. "It is a vision of sombre vistas, like the nave of a cathedral, the pillars formed by the enormous boles of the trees, soaring into the dim and religious half light caused by the interlacing branches forming the vault of the pane. Here and there gigantic lianes climbing into the soaring crowns of the trees, while the smaller growths of the shrubs or herbaceous plants are scanty, and the eye travels far into the sombre depths of the forests." The picturesque description of the forests, itself constitutes a beauty. When you are actually in the midst of such forests, "the heather crowned summit of hills bathed in soft climbing mists of the coloured flowers, the lonely purple light that dances on the mountains at the sinking of the sun" sets your heart in quick vibration. In the great

silence that reigns supreme, you feel the loss of your voice. But hark! the sweet cooing of the birds, the gentle murmur of the wind between the foliage, and the distant rippling of the little brook singing its eternal song "Men may come and men may go, but I go on for ever" break the spell, and you are elated beyond description. You feel the ecstasy of joy. It is all the feeling, the spontaneous effect of which is in the beautiful and sublime ever present in the forests. "In the woods" says Emerson "a man casts off his years, as a snake his slough, and at whatsoever period of his life, is always a child. In the woods is perpetual youth. Within these plantations of God, a decorum and sanctity reign, a perennial festival is dressed, and the guest sees not how he should tire of them in a thousand years. In the woods we return to reason and faith. There I feel that nothing can befall me in life—no disgrace, no calamity, which nature cannot. Standing on the bare ground—my head bathed by the blithe air, and uplifted into the infinite space—all mean egotism vanishes. I become a transparent eyeball, the currents of the universal being circulated through me. I am part and particle of God. I become the lover of uncontained immortal beauty." And it is in this phenomenon, the beautiful, the value of this aspect lies. All high beauty has a moral force in it. It is a sentiment purely transcendantal and emotional. "It is a purgation of superfluities" It is the perpetuation of divine sublimity in thought. It is the power that enlarges you and shapes and moulds your character and life. It is the power that makes you to probe into the very foundations of things. It is this power that cheers your up and inspires you to noble action.

The value of this feeling of the beautiful in life is the thing with which we are most concerned. I can see the pragmatist, losing his patience. From his outlook, this is useless, since it is an unnecessary stretch of imagination. He wants practical, common place things governed by common sense. He denies that it is paying. Utilitarianism is his motto.

True, nothing holds good unless it is of some practical value; at the outset I held the view that this aspect, is the storehouse from which you derive the potentialities of existence in life. Every man has this in his possession in a greater or less degree. The power of beauty is such that is can at its pleasure hold any man and make him pay homage before its altar, though yet unconsciously. The virtue of feeling the beautiful lies in its value in practical every day life. If you feed on its surface it will get dried soon, but in its deep fountains, you will find it an eternal spring, a sustained life giver. All that are noble, valuable and virtuous in life take their origin in seeing the beautiful in nature. Imagination, inspiration, and knowledge are the essential outcome of a mind trained to see the beautiful. Are these not useful to man in life? Nothing so marks a man as imagination. It is a spontaneous act. It is a real connection between a thought and some material fact. The man inspired is a thorough man of action, and it is indeed a prosperity in life. The will to live the life comes, and knowledge is power. Who does not love to have such powers for themselves. You gain your wants and you are comforted. It does not stop here alone; your actions are untainted and complete to a finish. These powers are latent in each man and the feeling of the beautiful is the

step towards the realisation of these powers. The natural consequence is that your actions lead to perfection. The character of man is moulded & shaped and these powers act as stimulants. Man rejuvinates in a better and different form. With him the outlook of life is always a robust optimism.

Let us see what is our ideal from our stand point as forest men. It lies in the creation of a Normal forest. In getting at this ideal, we apply all the knowledge at our resources and try to reach or at least approach it. In his ideal the forester wants that the trees should consist of all age gradations, from the seedling to the exploitable tree, and each age class occupying an equal area and well stocked and lastly maintaining a sustained yield. Is it not sufficient if the sustained yield alone is got? Why should he be governed by the other two clauses. In his imagination he sees them in various age gradations and of equal area and here he is governed primarily by the artistic beauty that such a constituted forest would present to the eye and then again, such a forest would give him a sustained yield. So the first thing that strikes him is the beautiful and then he makes use of the beautiful in practical utility.

And now the practical man will have no quarrel with me when I emphasised that the training of the eye to the beautiful in nature, leads us automatically to our hearts' cherished hopes in life. And so it is in fact the aspect, as I said at the outset the basis on which you build up the resources and immensities of your other purposes. And thus we see the practical benefits, which are really immense, by profiting by the aesthetic aspect of forests.

T. M. JANARDHANAM, M. F. C.

Is Exploitation of Forests pushed too far in India.

It is held by some people that the exploitation of forests is being carried on too far in India, that the recent over-exploitation of forests already destroyed by unscientific methods of treatment in vogue in former days has greatly increased the price of wood and that the policy of overflowing the markets of Mesopotamia and Arabia with timber in fluctuating quantities far from creating a stable and well regulated timber trade for India, has on the contrary, put the whole business in a haphazard condition with no possible chance for forest industries for thriving and developing well. Thus at times continuity in trade is broken, and consequently the principle of sustained and well regulated yield is lost sight of. Besides, they say that there being not a single dissentee's voice as to the fact that India is predominently an agricultural country, the increase of the price of wood consequent upon the excessive and unregulated exploitation of forests cannot but harm the best interests of the agricultural population. Such is the reasoning sometimes put forth by some of the advocates of popular interest in the country.

Should we therefore cry halt, and carry out the work of reafforestation in various regions, and slacken the exploitation for the time being? Is it really a fact that forests in India are over worked?

The answer is "No." Statistics show that in India which abounds in vast forest areas, the work of exploitation is confined only

to 300,000 sq. miles. Excepting the inaccessible forest regions the exploitation of which if ever feasible, has not been thought of yet, the area of plains and valleys and the easily accessible hills and ridges, is many times greater than the area under exploitation at present.

We have yet to understand the potential value and the great importance of our forests and remember that when our forests will be exploited to their full extent, India would be one of the richest countries and we one of the most prosperous nations in the world. It is certainly regretable that the yield of the Indian forests at present amounts to not more than 2.4 cft. per acre, per annum in average. Thus when forest exploitation in India is so dull, matters such as the present depression in Indian agriculture, the mania of town life and consequently the continuous flow of population into towns, and the difficult problem of unemployment become problematic and necessitate more extended forest operations which have grown to be an economic necessity.

That the principle of sustained and well regulated yield being not recognised due to the over flooding of the timber market in Mesopotamia might have been true in such times as the great war, when not to speak of the continuity in forest trade the balance of world's business and trade lost its equilibrium but sure it is that forestry in India is progressing in well defined lines and on true sylvicultural principles. The sustained yield of forest has been given the paramount importance in forest working plans, and the management of Indian forests has been placed on safer and more reliable basis though absolute security cannot be easily established soon.

The plea that over-exploitation of forests has led to the increase of price of wood is proved to be null and void in consideration of the fact that civilization with its various wants and complex necessities has given rise to competition in different industries in the world market and the result has been the rise of prices everywhere. Wood being a commercial commodity cannot remain as an exception to the laws of economics. Thus it is not over-exploitation of forests in India but the general laws of Economics that have increased the price of wood.

True it is then, that the forest exploitation is in its infancy in India. What is it due to? Is it due to the fact that exploitation worth the name has begun comparatively recently or are there anyother impediments for its further extension?

We know that there is no market for ready sale for all little known timbers. More than 50 per cent of our timbers has not yet been experimented upon to prove their suitability or otherwise for any work; but it is the considered opinion of all foresters of repute in India that every cubic foot of wood whether of hard wood or light wood species, has its own use and therefore its own value. It is therefore the question of adequate funds that concerns us most.

We have mentioned above that exploitation of forests on a large scale has become an economic necessity is India, and for our forests to be so utilised the establishment of saw-mills in suitable quarters and the installation of timber seasing plants preferably near the mills, are matters of vital necessity.

Now, schemes like this require considerable intial outlay which it is not possible for various weighty reasons on the part of Government to sanction. The question that, therefore, remains is "are we to remain content with our present work of exploitation which is very often handicapped for want of adequate capital or, should rich persons like the Rajahs and Zamindars come half way between, and help the Government who is always ready to respond to such beneficial schemes for the furtherence of the best interests of the country, in carrying out the work of forest exploitation to its desired extent?" How long will there remain in India, the shyness of capital and the want of the spirit of public enterprise? No country has ever become great with its shy capital and dull spirit of public enterprise. The example of Mr. Tata is more than enough for us to understand that it is the outlay of capital in business and its later successful handling that can enrich the nation.

Assuming therefore that funds will be forthcoming for the initial outlay to bring into fruition all our proposed schemes the question is, how to manage the business on true commercial lines, with the maximum efficiency and minimum cost.

Now private individuals left to themselves cannot successfully carry out the management on business lines. The question of Co-partnership in which government is suggested to be a partner, Government's share being stock of timber, though a very nice idea involving no breach in the policy of continuity and warranting all the efficiency and promptness vitally essential for the commercial undertaking, has

nevertheless its inherent defects in view of which its initiation has been considered to be objectionable. Besides the fact that the government has to yield a share of profit to private individuals and that there are great difficulties involved in the assessment of profits, the greatest draw back in this system of management is lack of interest of the different co-parteners owing to divided responsibility, and the manager, who is but a paid servant of the company and not a state holder of the concern. The directors in this case are not business experts but only lay men.

The next practicable alternative is the raising of a consolidated public loan which is to be set aside for the development of the business in question, and the services of some experts who are experienced in technical and commercial knowledge are to be obtained. No doubt under this system of management the difficulty of limiting and controlling expenditure will be done away with and if conducted well, the business will fetch enormous profits to the company. But here again the control and management resting with men in no way concerned with the loss or profit as in the system of co-partnership, the same lack of interest in business, slackness in duty and fraud which is the constant companion of business, destitute of control and interest, will play prominent part and the failure of the concern will be the inevitable result.

D. C. PATNAICK, B. A.,

Revenue Administration by the Forest Department.

III.

Accounts and their simplification.

As a preliminary to the maintenance of revenue accounts, a few words about the classification of lands, are necessary. During the settlement of 1906, all the lands on the Javadhi Hills were classed as "Dry" though there were wet cultivations here and there with the aid of water from jungle streams. This sort of simplification dispensed with the maintenance of several of the important village accounts relating to water rates etc. During the resettlement of these villages by the Forest Department, the same classification of lands was kept up though the classification of soils was altered in many cases.

The rates of assessment varied from three annas to fourteen annas per acre There was a special rate of two annas per acre in the case of lands assigned for the benefits of the community. Such assignments, I shall deal with, at a later stage; suffice it to say now that some lands were assigned for the communal benefits such as grazing, and thatch grass for the temples etc.

So village accounts which were found quite indispensible for the proper check and control, were selected combined and introduced in a conveniently altered form.

1. ***Adangal.*** The first and the fore most of the accounts was named 'Adangal.' It was only a slightly improved form of the 'Digloth' Register. It had the headings of (1) Survey No. and sub

division, (2) Dry wet or Por, (3) Taram (4) Class and sort of soil (5) rate per acre (6) extent of the field (7) assessment (8) particulars (No. and Name of the pattadhars) (9) Recomendations of the Land Revenue Deputy Ranger (10) Final orders of the Dt. Forest officers (Remarks). In this Register, the survey numbers were entered serially. It contained all the lands, whether, patta land or poramboke or assessed waste. In case of porambokes and the assessed wastes the recomendations of the Land Revenue Deputy Ranger were entered in Col. 9, and the Dt, Forest officer passed orders on them in the same register in Col. 10. This is an original account and formed the basis of all the accounts. Settlement orders were passed only in this Register. All orders relating to subsequent assignments, patta transfers, and sub-division of whole fields into parts, were passed in the Register itself, and this method of passing orders faciliated personal enquiry, and avoidance of too much of correspondance. One copy of this register was maintained by the Land Revenue Deputy Ranger for each 'Nad', and another copy (a duplicate copy) was maintained in the Dt. Forest office.

2. ***Chitta.*** The second of the accounts maintained is called a "chitta." It was maintained pattawar and it was only a copy of the patta issued to the pattadhars. It is the village account 10 section 1. It is a register of holdings in the village. This was adopted by the Forest Department with slight modifications. The various survey numbers contained in a patta were entered in this account with their extents and assessments. A separate page was set apart for each patta, and totals were struck for it. At the end of the Register, tree

pattas also were entered. At the end of each patta, the cess payable by each pattadhar was calculated and entered at the bottom. A separate register for each hamlet was maintained and at the end of the Register, an abstract was written for each patta, under L. R. cess and tree tare, and each line totalled gave the total of these items of revenue and grand total for the hamlet also was entered. This modification adopted by the Forest Dept. dispensed with separate registers for Land cess, and tree tare etc. Any alterations such as relinquishments of lands, assignments, patta transfers and sub divisions, were entered in the register itself and the corrections were supported by authorities such as the orders of the Dt. Forest Offices. Every year before jamabandy, the registers were closed for that year and total 'Beriz' for the year was calculated. One copy of this Register was maintained in the Dt. Forest office while the land Revenue Deputy Ranger maintained another copy. Both the registers were compared and checked during the jamabandy of the year. Thus, all the accounts pertaining to the changes in the nature of the lands, in holdings and registers showing the cess and other items of miscellaneous revenue were combined in the chitta itself. Whenever these registers were filled with too many corrections, new registers were written.

Collection of kists from the ryots.

Though there was a separate 'Monigar' or village headman for each village the kist collections were made by the Land Revenue Deputy Ranger. This was done with a view to simplify the collection

accounts. Moreover the village headmen who were malayalees were not literate enough to collect, maintain accounts, issue receipts to the ryots, and to remit the collections into the Treasury. One Deputy Ranger cannot attend to these works and cooperate with the village headmen simultaneously during the kist collection every month. Hence it was that the L. R. Deputy Ranger was ordered to collect the revenue and for him to do it the collection accounts were simplified a great deal.

According to the social organization of the malayalees on the javadhis, each hamlet had a headman nominated and he was called a "Oran" or "Or-gounden." He is the head of the village for all communal and social function. Several hamlets are grouped together into a "Nad" and the head of this "Nad" is called a "Nattan." There is also one supreme Nattan above all the Nattans. Usually this grouping of the hamlets was taken advantage of, by the Government and each "Nad" was taken to be a Revenue village, and the Nattan who was usually the most influencial man in the Nad was appointed the Monigar, or Village head-man. Hence it was that the three villages were named as Pungampatti Nad, Pudur Nad, and Nellivasal Nad. Pungampatti Nad contained fourteen hamlets, Pudur Nad, ten, and Nellivasal Nad eight, each hamlet having a oran of its own. Though all the survey fields were numbered serially for each Nad, each hamlet had separate set of serial patta numbers. This was purposely done to facilitate the collection of kist and maintenance of account.

Thus this social village organization was taken advantage of, and each oran was made responsible for the whole kist amount of his hamlet. He was more or less taken in as a contractor of course without any remuneration. Whenever the L. R. Deputy Ranger sent information to the village for the payment of the kist, the oran collected all the pattadhars of the hamlet and took them to the village chavadi or other revenue collecting place. The Deputy Ranger collected the kist from all the pattadhars and issued one single form 20 receipt (Forest code form 20) in the name of the oran, noting on the back of the receipt, the individual payment of each pattadhar. There is only single receipt issued for each hamlet for a kist and in this way the L. R. Deputy Ranger had to issue only thirty-two receipts in all for a single kist. This greatly facilitated the writing work of the L. R. Deputy Ranger. Maintenance of Thandal (village account No. 13) and issue of Katchayats to the ryots were dispensed with. Instead of the Thandal (Account 13) the L. R. Deputy Ranger maintained a cash book (Forest code form No. 31) and the daily collection of the revenue was shown in it. After the collection for the kist was over the L. revenue was remitted into the Sub-Treasury at Tirupattur in one or two remittances with a chalan form duly filled up and the duplicate of it, was received back from the treasury. This transaction also was naturally noted in his cash book. At the end of the month, the L. R. Deputy Ranger submitted his cash sheet to the Dt. Forest officer through the Range Officer Tirupattur Range, but it was not incorporated in the latter's cash book. In the Dt. Forest Office a ledger was maintained (Forest code form No. 45) setting aside a page for each hamlet. The ledger was

in the name of the Oran of the hamlet. At the top of the ledger the amount due from the village hamlet (*i. e.*) from the Oran on behalf of the hamlet was noted and the collections of each kist were noted in the same page. After the four kists were over the balance due from the village, if any, was noted. This maintenance of the ledger in the District Forest office dispensed with the maintenance of several Taluk accounts relating to collections and D. C. B. (Demand collection and balance of Land revenue). The amount due from each village was posted in the ledger from the chitta (Register of holdings). As the kist was collected in four instalments, only four entries for each hamlet were necessary in the ledger.

Stone Depot and Stock register of stones. There was a stone depot in each village and a Stock register of stones for the receipt and issue of stones to the ryots. For the collection of the cost of stones, Form 20 receipts were issued and the transactions were shown in the cash book as Land revenue collections. In the Dt. Forest office, another stock register and D. C. B. register for this, were maintained and extracts from these were submitted monthly to the collector for the floating advances received from him known as " Revenue survey advances, Collectors, West Vellore Division." Cultivations were not noted and recorded by the L. R. Deputy Ranger. As there was no water rate levied, there was no necessity to record the cultivations. The maintenance of cultivation accounts was dispensed with, by the Government as the absence of statistics of these three villages would not materially alter those of the Presidency. Further as all the lands

were classed as Dry, whether they were cultivated or not, there was no question of remission.

The monigars or the village headman maintained, the Death and Birth registers, cattle mortality register, vaccination register, etc. Monthly returns in these were submitted by them to the Tahsildar of Tirupattur direct. These returns had nothing to do with the Forest Department.

The pay of the L. R. Deputy Ranger was paid from the Forest Budget by the Range officer of Tirupattur to whose establishment he was attached and through whom all his correspondence and diaries passed to the District Forest officer.

As already mentioned, each village had a monigar and three village menials. The latter were reduced to two subsequently. The pay of the village officers and the menials was paid by the Revenue Department from the treasury. The village officer every month prepared a pay bill in the usual form and submitted to the L. R. Deputy Ranger who countersigned it and submitted it to the District Forest officer. It was passed by him and returned to the village officer who cashed it in the treasury. The paid bill was again resubmitted to the Tahsildar. An office copy of this paybill was maintained in the District Forest office to facilitate checking of the bill.

So much only for the accounts. The correspondence also was simple. As the L. R. Deputy Ranger was subordinate to the

Range officer of Tirupattur Range all the D. R. correspondence passed to and fro, through him. A separate current Register was maintained in the Range office. In the District Forest office also, a current Register and a Disposal register were maintained. The correspondence consisted mostly of petitions from the ryots for lands, patta transfers and for some 'tagarars' which were usually forwarded to the L. R. Deputy Ranger for enquiry and report. When he resubmitted the petitions, through the Range officer, several of them, he inspected during his monthly tours on the hills, and endorsed his opinion. During the tours of the District Forest officer on the hills, usually once in two or three months, he inspected all personally and disposed of as many petitions as possible. Thus more than 60 or 70 per cent of the papers were disposed of after the personal inspection of the officers higher than the L. R. Deputy Ranger. Thus the Forest officers were in constant touch with the ryots and their grievances.

Jamabandy of these three villages was conducted by the District Forest officer every year. He camped in a central place in or near each village and after checking the accounts of the village, settled the Beriez and heard the grievances of the ryots, if they had any, and redressed them. A copy of the settlement of the Beriz of the village with a report was submitted to the District Collector after the Jamabandy was over and a similar copy was sent to the Tahsildar of Tirupattur for his incorporation of the details of settlement of the beriz into his Taluk accounts. The pending cases of Darkhasts and patta transfers were disposed of during the Jamabandy tours finally

for the year. The District Collector did his Jamabandy once in five years when he took up the Taluk for it.

An administration report about the Land Revenue work with several statements and enclosures was submitted to the chief conservator through the conservator of Forests fourth circle, and the Collector of North Arcot on the 15th of September every year. Since the administration was handed over originally to the Forest Department in September, this date for the submission of the administration Report was adopted. The chief conservator in his turn forwarded it to the Government with his remarks. The Government after the receipt of the report, extended this administration by the Forest Department as an experimental measure for the next year, and a reply to the administration report was received by the Dt. Forest Officer through proper channel.

The Land Revenue Deputy Ranger had to camp on the hills for at least twenty days in a month to earn his fixed travelling allowance. The remaining ten days he spent in his headquarters at Tirupattur either in the Range Office or in the Dt. Forest Office attending to the posting of his register and those of the office. His diaries and his stay on the hills were scrutinized by the Ranger Officer and the Dt. Forest Officer both in his diaries and in his monthly tour statements. Whereas, a karnam had no diaries and his visits to the village were according to his sweet will and pleasure. The Firka Revenue Inspector had no records to check the movements of the karnams. After all the Land Revenue Deputy Ranger was not paid

more than the pay of these karnams put together. The three karnams were paid at Rs. 15, each a month and the Deputy Ranger received his grade pay (usually a third grade man was posted) *i. e.* Rs. 30 with Rs. 10, his F. T. A. and Rs. 10, as L. R. allowances.

Thus the Forest Department at first, by delimiting the villagers with a broadline aed assigning all possible sivayijama cultivation and evicting the objectionable cases of it, put an end to indiscriminate unauthorised cultivations on the hills, then, by issuing conditional pattas, safeguarded the sandal trees on the patta lands and finally by combining several village accounts into one and introducing a few new accounts of the Forest Department in place of revenue accounts simplified the maintenance of elaborate accounts. By their constant tours on the hills, the Forest Officers came into close contact with the hill tribes—the "malayalees" redressed their grievances, after personal enquiry in most of the cases and finally ensured their better cooperation in the matter of protection of the Sandal forest, in departmental works and fire protection. Mutual understanding between the malayalees and the Forest Department, and mutual help were the objects of this Land Revenue scheme. Both the objects were fullfilled and the scheme was a success as will be proved by the results of the inspections of the officials of the Revenue Department and Forest Department such as the commissioner of Land Revenue and settlement and the conservators of Forests. This Land Revenue scheme was started in 1917 and the system of accounts and the precedure mentioned in the foregoing paragraph continued till 1921.

Till 1919 a Deputy Ranger was in charge of it. During that year when the subordinate service was reorganised, the Deputy Rangers were styled as foresters. Usually forester of the old Deputy Ranger cadre was posted for this work and he was known as Land Revenue Forester.

In 1922 the commissioner of Land Revenue and settlement and the conservator of Forest of the fourth circle inspected the working of the scheme and they introduced a few improvements and modifications in the working and the accounts which I shall deal with in the next issue of the magazine.

T. N. V. RAMANUJACHARI.

On the working of Hydraulic Rams in general, and of the Blake's Hydraulic Ram at Kargudi in particluar.

Introductory:—I lay no claim to originality in this article for obvious reasons. It is not all Forest Officers that can assess fully the utility of this valuable device for pumping up water (though a good many do) and as a knowledge of its working and use will result in a more general installation of Hydraulic rams, I have, under the advice of Mr. C. R. F. Williams, the principal of our College, visited the hydraulic Ram at Kargudi, studied it as far as possible without dismantling it, and after further study of some literature on the subject, embody the result in an article here.

My thanks are due to the District Forest Officer Nilgiris, the Forest Range Officer Mudumalai Range, Mr. Narasimha Iyengar Assistant Engineer at the Agricultural College, and Messrs. Harrison and Crossfield Ltd. at Quilon, all of whom very kindly placed at my disposal the records aud literature necessary for this purpose, and to my students Mascarenhas and Dubashi who executed the line drawings for me; and I am also indebted to an old advertisement by the Rumsey Pump Company, and a current catalogue of Messrs. Marshall and Company, for some of the information.

Definition. A hydraulic ram is a simple, durable, efficient, and comparatively cheap machine, which utilizes the kinetic energy of a large quantity of flowing water from a small head for pumping a part

of that water to a much higher level, varying from 3 to 30 times the original fall. Hydraulic rams are commonly used to provide water supply from a low stream to a house or colony on a hill at an elevation.

Invention. This apparatus was invented more than a hundred years ago by a Frenchman Montgolfier.

Working parts. Please refer to Figure 1. The skeleton diagram is a slight improvement on the diagram given in Messrs. John Balkes' book on water supply by Blake's Hydraulic rams, and will explain the general working of Hydraulic rams.

D is a feed tank raised some convenient height above the site of the hydraulic ram itself. B B is the Drive pipe, also called the Injection Pipe or the Feed Pipe, connecting the Feed Tank D with the Body X of the Hydraulic Ram. C is a one way valve on the drive pipe, such that it will allow water to flow from the feed tank into the drive pipe, but not in the reverse direction. G is the dash valve, or escape valve which when it is down, allows water to escape out of X whereas when pushed up against its seating, stops the flow of water, and thus creates a back pressure. It is also called the waste outlet valve. A is the air chamber, connected to the body X by the Passage Y, and separated therefrom by the Check or Delivery valve R. This valve permits water to flow from X through Y to A, but not in the reverse direction. I is a snifter valve screwed into the ram casing immediately below the check valve and performs the important function of replacing by fresh air the air in A that would otherwise be lost by solution under pressure in the water passing through. K K is the

rising pipe or the delivery pipe through which water rises and discharges itself into the storage cistern, where the water is wanted. It is an advantage if the air chamber end of the pipe K K has got a valve so that water from the air chamber may flow into K but not in the reverse direction.

Principle of Working :—First Stage; Assume that the Feed Tank D is full of water, that the dash valve is closed up against its seating, and that the Gate valve on the dash pipe if any is opened. Water would flow down the drive pipe into the body X, and as the dash valve is closed, it cannot escape into the open air through that, and would therefore rise through the passage Y, open the check valve R, rise in A, driving the air through the tube K before it, until the lower end of this tube is sealed by the water; and then the water will continue to rise in KK until when it comes to rest the free surface in the tube KK will be at the same level as the free surface in the feed tank D. There would also be a slight rise of water in the air vessel A above the lower end of the tube K, and equilibrium here will be established when the Hydrostatic pressure above the lower end of K due to the water alone in the air chamber plus the pressure of the imprisoned compressed air in A is equal to the hydrostatic pressure at the same point in K due to the column of water in KK plus the actual atmospheric pressure at the surface of that column. By pressure here, we mean the intensity of pressure per unit of area. Now a state of rest and equilibrium prevails.

Second stage. If the dash valve G is now allowed to drop down open, immediately the following phenomena will take place. Though for convenience of description, we give them one after another, they will take place practically simultaneously, or within a short space of time.

(a) The water in the body X will escape into the open air. (This escape water can not be utilized any further in the ram, and hence it is also called Escape valve or waste water valve.)

(b) Consequently the water in A also tends to run down to X, but in this attempt closes the check valve R, and cannot escape out of A (Hence the appellation Check valve to R.)

(c) The water in Y tries to continue the downward movement, and consequently there is a fall in pressure at the head of Y below Atmospheric pressure, resulting in a partial vacuum there, and some Atmospheric air is therefore sucked in through the Snifter valve I and imprisoned at the head of the passage Y under the valve R.

(d) There is also a fall in the pressure of the water in the drive pipe, and hence the valve at C opens, and water flows down the drive pipe BB into the chamber X and out through the valve G; and as it does so it gains in velocity, and therefore in momentum until the momentum is sufficient to dash up the valve G against its seating, and thus close this exit. (Hence the application of the term Dash valve to G.)

(e) As soon as G closes, the water which has been rushing down tries to return to the Feed tank, and in this attempt closes the

valve C. In other words the check to the flow of the water in the dash pipe, causes a back pressure which closes the valve C.

(f) Another course is still open to this water. The kinetic energy of motion is converted into an equivalent potential energy of increased pressure in X and Y. As a result of this increased pressure a minute quantity of water may escape through the snifter valve, but this does not reduce the pressure considerably. Hence the water opens the check valve R, and rises into the Air chamber. (Hence the appellation alternatively of Rising valve to R), and in doing so, the air previously sucked in by the Snifter valve and imprisoned at the head of Y is also carried into the Air chamber. So long as the pressure in Y is greater than the pressure in A, the valve R keeps open, and the flow of water continues. When equilibrium on both sides of the valve is established, the check valve closes. The compressed air in Y now tries to expand, and it forces water through KK and so the water in KK rises higher than it was previously.

(g) Due to the increase of pressure in the air chamber some of the air in it is dissolved by the water there, and were it not for the introduction of some extra air at each stroke by the snifter valve as described above, the air in the air chamber, would ultimately be completely absorbed. This complete absorption is not good for the machine, for the air in the air chamber performs two important functions. Firstly it cushions the hammering action of the water, and by such give and take action, reduces chances of breakage of joints, valves

etc. and secondly it serves as a temporary store house of energy, for the ***gradual*** raising of water through the pipe KK and the ***continuous*** discharge thereof into the cistern. The great importance of the snifter valve, which maintains the quantity of air in A undiminished, would now be understood and can never be over estimated.

(h) After this the cycle of operations from (a) to (g) is automatically repeated and automatically continues. The air in the chamber gets more and more compressed at each cycle, stroke, or pulsation, and mindful of Boyle's law its pressure rises, and hence the water in the pipe KK also rises higher and higher, until it discharges itself into the Cistern, whence it may be piped off under gravity if necessary to wherever it may be wanted.

Efficiency. With a properly designed Hydraulic Ram, in good working order, when everything is tight, and there are no leakages, a very high efficiency (as much as 80 % to 90 %) can be obtained. The advertisements are usually worded somewhat as follows which is a typical case chosen at random from an actual advertisement.

Available water supply (gallons per minute.)	Available Fall in Feet.	Water raised into cistern (Gallons per 24 hours)	Height to which the water is raised. Feet.
X.	X.	X.	X.
105	10	19900	10

To the casual reader it appears that 105 gallons falling through 10 feet raise 19900 gallons through 50 feet. Perpetual Motion? Cer-

tainly not. For the question of time enters here. The necessity for careful reading is apparent.

105 gallons of water per minute falling through 10 feet. equals 105 x 60 x 24 or 151200 gallons per day falling through 10 feet, and the energy stored up in this water is 151200 x 10 x 10 foot-pounds (because one gallon of water weighs 10 lbs) that is 15120000 foot pounds. This is the measure of the Kinetic energy, assuming no friction in the drive pipe. This energy is used to raise 19900 gallons through 50 feet in a day of 24 hours. After rising, the stored up energy in this raised water is 19900 x 10 x 50 foot pounds i. e. 9950000 foot pounds. The Efficiency therefore is.

$$\frac{9990000}{15120000}$$

i. e. 0.658

i. e. 65.8 % or very nearly 2/3

There is no perpetual motion here, but this a very high efficiency indeed compared to any other engine, and the power for a ram costs us nothing. It may be of interest to know that a ram of this size costs only about Rs. 1500, though the inclusion of the pipes, tanks sheds, masonry work, supervision, reconnaisance etc, may raise the total initial cost to five to six times the amount. But as the actual working and supervision after installation cost next to nothing even for a quarter of a century or more, such installations are financially feasible.

It is observed that about one third of the driving power is lost, and an appreciation of the causes may help us to minimise such loss, and thus get maximum efficiency. Some of such causes are.

(1) Frictional resistance in the drive pipe BB to the flow of water (viscocity) The remedy is to get a pipe of comparatively large diameter, and free from bends, with a smooth bore.

(2) Frictional resistance to rise of water in the rise pipe. Remedy similar, though a large Diameter pipe is not feasible. Avoid bends (specially sudden bends) as far as possible, and unnecessary valves. See (8) below.

(3) Weight and friction of the Dash valve D, which has to be lifted at each stroke,. and thus consumes some of the energy of the feed water. Remedy : A proper selection of a ram constructed to a proper design. Lubrication with any oily stuff is not likely to solve the problem, because the oil would soon be washed off by the flowing water, but the water itself may serve iedifferent ly well as a lubricant. The extent of the lift can be adjusted in the Blake's Hydraulic Ram, by a lock nut provided on the valve stem. The shorter the stroke, the greater the efficiency.

(4) The weight and friction of the check valve. A proper selection is indicated.

(5) A small quantity of water slipping past the check valve when it closes. A proper selection is indicated. But loss due to this cause is not likely to be serious.

(6) Defective fitting of the faces of the Dash and Check valves on their seatings. Grinding the valves where possible just as we do in Petrol Engines, may mend matters, but as the valves are comparatively cheap, if too bad, replacement of valves is best.

(7) The sudden closing of the dash valve causing eddies in the space X, meaning loss of power. Remedy: Now a-days the bigger sized rams are designed so that the dash valves close gradually, avoiding (a) eddies and (b) unnecessary shock to the machine.

(8) Valves, bends and elbows on the feed and rising pipes result in a loss of efficiency, and should therefore be avoided as far as possible. A back pressure valve with hinged flap resists water flow as much as about 10 feet of straight piping ; a bend of radius up to 5 times the diameter of the pipe equals about 3 feet of straight pipe, a round elbow about 18 feet. The introduction of these would therefore reduce the efficiency, i.e. the height of delivery, and the quantity of delivery.

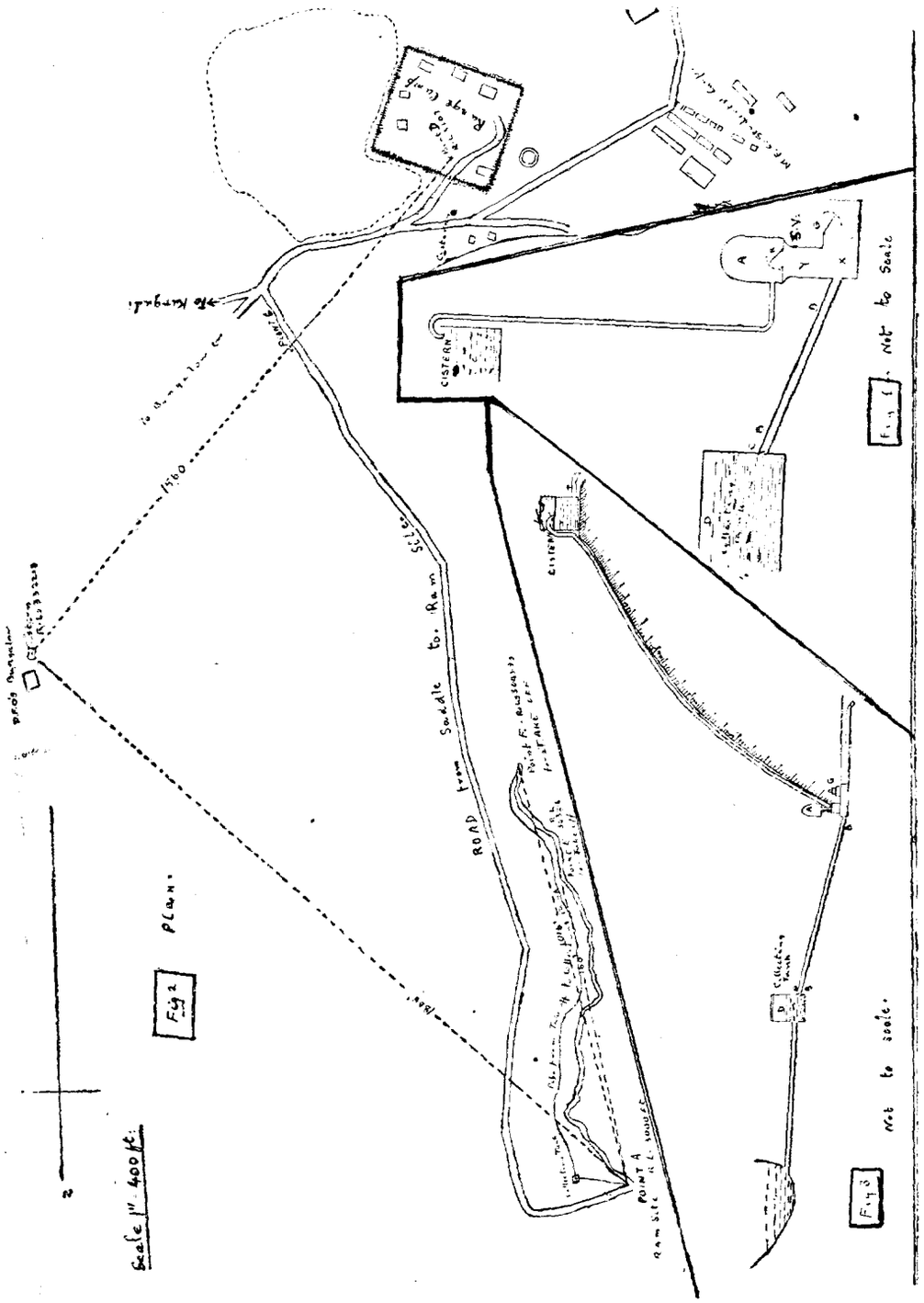
(9) A very little loss of water through the snifter valve. But loss of efficiency due to this cause is negligibly small.

(10) As the waste water escaping through the dash valve has still got some velocity, it is obvious that some energy would be lost because of this also.

Utilizing Power from a Turbid Stream, and Supplying Pure Water from another Conveniently Situated Source :—Hydraulic Rams though usually designed to pump up a part of the power water itself,

have also been adapted for pumping up pure water, using impure wate for power. Various designs are of course on the market. But the essential underlying principle is practically the same. Assume that instead of a check valve R we had a sliding fit piston plunger closing water tight the cylindric orifice at the valve seating, and that the air chamber was connected by a subsidiary pipe to the source of pure water, and that this pipe had a valve so arranged that water from the pipe can enter the air chamber, but not escape in the reverse direction, (Inlet valve) and also that the pipe KK had a valve permitting water from the air chamber to enter the pipe KK, but preventing movement in the opposite direction of the water in KK (Outlet valve). Now the machine will work as follows. When water flows into the space X and the dash valve closes, the piston plunger will be forced up. Increase of pressure in the air chamber will close the inlet valve, and open the outlet valve, and some air will escape into the tube KK. When the dash valve opens, the water in Y will tend to recede, and the suction of this together with the weight of the piston, will withdraw the piston from the air chamber. The pressure in the air chamber falls. Hence the outlet valve closes, and the inlet valve opens, and some air and water from that tube will enter. The repetition of this process a number of times will fill the inlet tube with water, as all the bottom of the air chamber with water, and thereafter, the pure water in the air chamber will be forced up the pipe KK at each pulsation.

Sometimes instead of the check valve, the stretching of an elastic membrane, and fitting up of the same, so that the water in



Y cannot enter the air chamber, will do the same work as the piston plunger mentioned above, the rest of the design being as above.

To keep the air vessel sufficiently supplied with air, a snifter valve may be fitted between suction and delivery pipes here also.

Makes and Sizes. Various makes and sizes of hydraulic rams are on the market such as Blake's Hydraulic Rams sold in South India by Messrs. Harrison and Crossfield Ltd. Quilon ; Hayward Tyler Hydraulic Rams sold by Messrs. Marshall and Co. Ltd., of Madras, Rumsey Hydraulic Rams (I do not know who represents them in South India) Gould's Hydraulic Rams etc. Each of these makers makes several different sizes and designs to suit different conditions of available quantity and pressure and requisite rise and discharge. Selection may be difficult. The wisest policy is to select a reliable firm of suppliers At Kargudi Messrs. Harrison and Crossfield Ltd., have installed a Blake's Hydraulic Ram A type, and I have seen this working satisfactorily.

Preliminary Investigations. Prior to the installation of a Hydraulic Ram the following necessary information must be carefully collected.

(1) The available fall in feet or inches which can be obtained from the stream, lake or other source of supply to the ram site.

(2) The approximate quantity per minute of in gallons of the water flowing through the stream at the site selected for diverting the feed water.

(3) The distance from the Ram site in which the working fall can be obtained.

(4) The horizontal distance from the Ram to the point of discharge.

(5) The elevation to which the water has to be raised.

(6) The quantity of water required to be raised per day of 24 hours.

(7) If a ram for pumping up pure water, using impure water for power is used, the comparative distance and elevation of the pure water source with reference to the ram site should also be given.

These data will help the dealers in supplying rams of a suitable size, and are essential for obtaining reliable information and suitable quotations from them. I append a few instructions on the collection of each of these data.

(1) Available fall or working fall.

Any fall from about 15 inches to 150 feet can work Hydraulic rams; but the greater the working fall the cheaper will be the cost of the ram, where a limited quantity of water is available. But where

plenty of flowing water is available a large ram working on a small fall would be cheapest in the end. If the power water is taken from a stream a line of levels are run along the stream, using a Dumpy Level, and the reduced levels of a number of possible points for the take off is noted, with reference to a possible site for the ram itself. At these points the discharge of water will have to be measured, as will be explained below, and a position for the feed tank take off in relation to the ram site will be so chosen that the product of the discharge into the difference in level between the ram site and the take off might be the maximum available consistent with cost, and actual needs.

If the point on the stream so chosen is at a considerable distance from the ram in hilly country (Vide Fig. 3) it would be economical to build a dam across the stream at the point so chosen, and lead the water practically level (gradient from the take off not steeper than 1 in 300 down) in open channels or closed tubes to the feed tank site. The site for the feed tank should be so chosen that a straight iron tube connecting it with the ram may have a longitudinal slope of about 1 in 5 or 1 in 6. The feed tank may be raised above ground, and sunk into the ground, according to convenience, and may be a masonry, cement-lined structure, or even a wooden cask depending on the purse of the owner. The open mouth of the feed tank should be about a foot higher than the level of the imprisoned water at the dam, and the upper end of the Feed pipe must be at least a foot under the free surface of water, and be protected by a coarse strainer to permit free flow The difference in height between the top surface of the water in the feed tank, and the dash valve of the Ram itself, will be the available fall.

(2) Measuring Driving water.

Two methods are available. The first method is simple, and therefore possibly the only method, that will be useful to Forest Officers for erection of Rams operating from small streams. The stream is dammed up a few inches by turf or sods of earth, so that the water is allowed to discharge itself through one or more hollow bamboo tubes passed through the dam without overflowing the dam. If the water is too much for one tube, more than one tube is used, but it is not necessary that all the tubes should be discharged equally. Two people are required to conduct the experiment, and the following apparatus are requisite.

1. A bucket of about three gallons capacity, or an old Kerosine Oil Tin.

2. A pint measure. An ordinary pint bottle will do. Any Mobil-oil Gallon tin will also do.

3. A watch, or time piece, or clock.

One man keeps the bucket ready to be thrust under the spout from one of the bamboo tubes at a signal from the other man who is the time keeper. The signal is given, and the bucket immediately thrust under the spout of water. Exactly 10, 15 or 20 seconds after this a second signal is given by the time keeper, and the bucket immediately withdrawn by the other man. The water in the bucket is now correctly measured by the pint bottle measure, and the discharge in gallons per

minute calculated therefrom. If the same thing is done for each of the bamboo tubes, where there is more than one bamboo tube, the sum of all the discharges per minute so calculated, obviously gives the total discharge of the stream per minute.

The second method is applicable in the case of larger streams, where a rectangular or right angled wire guage board and certain tabulated data are used. Though there is nothing very difficult about this method, as Forest Officers are not likely to use this method, I do not give it here. In such cases it will be advisable to ask the firm to depute some Engineer of their own to collect all data, and of course, unless the plan matures into an installation some charge will have to be paid for this service.

3. The distance within which the working fall can be obtained. Hydraulic rams require a calculated length of drive pipe according to the conditions of working fall available as has been indicated under (1), and hence this area will solve this question, if coupled with the line of levels. If a contoured plan is prepared it will be of considerable help. Mordern Foresters know how easy it is to prepare a reliable contoured plan using the prismatic traverse of the whole area for mapping, and the line of levels for a base line, with the help of the Trailer Tape and Improved Abney's Level.

4. The horizontal distance from the ram to the point of discharge. With reference to measurement same remarks as in previous paragraph apply.

In this connection it might be interesting to note that Hydraulic Rams can force water through pipes to a horizontal distance of as much as 10 miles, and it is claimed that several Blake's Hydraulic Rams are actually working at the present day with delivery pipes 2 to 3 miles long.

(5) The elevation to which water has to be raised. By running a line of levels from the ram site to the storage tank sit, or position of the proposed delivery cock into the storage tank, this elevation can be determined. With sufficient driving water rams can force to as much as 1000 feet of elevation.

(6) The quantity of water required to be raised per day of 24 hours varies with varying needs. On the average under Forest camp conditions 12 to 15 gallons per individual all told is a fair supply. Each horse bull or cow would need about 10 to 15 gallons, each sheep if any about one gallon, each horse carriage about 20 gallons, per day, and each motor car about 50 gallons if it has to be washed. But the coat will have to be cut according to the cloth, and where water is scarce it should not be wasted.

Rough Calculation of Possiblility in a Ram Scheme. Given the head h of water in the feed tank over the Ram, and the discharge per minute d of the Feed pipe (same as stream) the height of delivery H, then the quantity of water that can be pumped up in 24 hours. (Q) can be determined, by the following general formula where e is the efficiency per cent of the ram.

$$Q = \frac{e \times d \times h \times 1440}{100 \times H}$$

Assuming the efficiency as has been shown previously in an actual case as 2/3 i. e. as 662/3 % we have the formula.

$$Q = \frac{2 \times d \times h \times 1440}{3 \times H}$$

$$= \frac{960 \times d \times h}{H}$$

which is a convenient and fairly reliable formula for use.

(7) The seventh condition is self explanatory.

The value of a contoured plan including the Ram site, site for the Feed Tank, sites on the stream for the take off, site for the supply tank, where the heights of these point and their distances from each other can be correctly found out will now be apparent.

Earth Work and Masonry in Connection with Rams.

(1) Where a dam is required across a stream for a take off a solid masonry dam in Lime mortar with Cement pointing is indicated. Costs will obviously vary according to conditions.

(2) From this dam an open masonry drain running nearly level may carry water to the feed tank.

Where the water supply is small, an open masonry drain will mean loss due te evaporation mainly, some spilling, percolation, and overflowing due to accidental block by leaves earth etc. For Forest work a closed pipe would be better. But whereas the block in an open drain can easily be located and removed, in a closed pipe the removal of a block if one exists is not an easy matter. But the provision of a large meshed filter at the dam end of this pipe, will obviate this danger. It is advantageous slightly to burry this pipe underground, to prevent damage by animals.

(3) The feed tank itself (18" square by 24" deep for the smaller sized rams) may be masonry structure (Brickwork in Lime mortar, plastered interior with cement plaster) provided with a planking cover as at Kargudi. If a saving in its cost is desired an ordinary barrel will serve.

4. The Ram fonndations. A level foundation of timbers or concrete should be prepared and the ram bolted on to this. Provision should be made for the effective drainage of the waste water from the ram site. A wall ½ brick thick may be built all round to a height of about 3 feet, and covered over with corrugated iron with a pitch of 1 in 10. This is quité effective for housing the ram, though an inverted cask can be made to do duty almost equally well at a much cheaper cost.

5. *Service Reservoirs*. As rams are constant and reliable in working, very large service Reservoirs are unnecessary, and a reservoir that can hold just two days' supplies would be more than sufficient.

Iron or steel tanks may be built for this purpose, provided with a man hole at top to facilitate cleaning, and a delivery tap at bottom to deliver water. Personally I prefer a brick-in-mortar open tank with its base about 3 feet above ground level, with a delivery tap built in at the bottom, the whole tank being plastered in and out with cement plaster. The top may be covered with 1 inch planking. The advantage will be easy cleaning, easy construction, easy repairs, because Indian workmen in the Districts would understand this sort of work better than rivetting Iron tanks etc. But of course opinions differ on this.

The cost of construction of these will differ with the design and the locality.

Estimating and Selection of Rams. A number of detailed measurements have been shown to be essential, and a flaw in any of the details may mean an unsatisfactory scheme Consequently great care must be exercised in taking the measurements. The wisest course will be to request a firm of repute (such as Messrs Harrison and Crossfield Ltd. who have installed for us the Blake's Hydraulic Ram at Kargudi) to send a representative to do all the preliminary reconnaisance work, and to ask them to recommend the correct size of ram, and to do all the installation themselves and ultimately to pay them for all this. This will ensure satisfactory working, and if anything goes wrong, the credit of the firm which did the whole business will be at stake; and hence they will see to it that the ram works satisfactorily. Whereas if we try to do somethings departmentally asking one firm to supply the

Ram, another the piping, and so forth, almost certainly when something goes wrong, esch party to the transaction will try to shove the blame on the other or others, and in complicated technical questions, the apportionment of blame is not easy for us ordinary foresters (laymen from an Engineering point of view.) Also it is no secret that the Forest Department is undermanned, and with the present advent of more specialized and intense Forestry proper, we can not undertake unnecessary rosponsbilities for work which can be better done economically by others specially trained for that purpose. Hence if we leave it to the manufacturers or their agents they will undertake to test the site, select the ram, construct all that is necessary, and deliver the scheme in working order, and to keep it in working condition for a reasonable length of time after installation in proof of the good workmanship. Details of course involve direct personal correspondence, and preliminary agreement.

Advantages of Rams over other Water Pumping Machines, Rams require no extraneous power of any sort, such as derived from animals or from various types of fuel, no oil for lubrication, no packing for frequent replacement to prevent loss of compression etc. no attention by way of skilled or even unskilled labour, they have got a very high efficiency, work quietly for years, the only parts requiring occasional replacements are the dash valve and the check valve, both of which can he got through the post comparatively cheap, and the only adjustment occasionally necessary is the extremely simple adjustment of the nut on the dash valve stem.

Stoppages. Sometimes but very very occasionally rams might cease to operate. For example If the ram is submerged in a heavy flood it may stop. After the floods subside it may easily be started again simply by pressing down the dash valve a few times and releasing it, just as we do at initial starting.

If there is no flood and the ram stops with the dash valve up, it indicates leakage somewhere near the valve seating or thereabouts. Though grinding may help, the best thing to do is to get a new valve.

If the ram stops with the dash valve down it means an insufficient supply of water. Either the strainer at the Feed Tank end of the Feed pipe, or the feed pipe itself may be blocked; or if there is a gate valve at the feed tank end of the feed pipe it may not be open fully. Remedy: Open the valve, or remove the obstruction.

If the ram stops similarly due to insufficiency of water in the Feed tank adjust the lock nuts on the dash valve stem for a shorter stroke.

If the dash valve flutters at top of each stroke, it indicates presence of air in the feed pipe, and the chamber X due either to leakage in the feed pipe, or the end of the feed pipe not fully submerged under water in the feed tank. Remedy: locate and close up the leak, or if due to insufficient water in the Feed tank, close the valve here, and allow water level in Feed tank to rise well above feed pipe end, and then start the ram again after opening the gate valve.

If there is any obstruction in the check valve the water would not rise but be forced back every time. The only remedy is dismantling the air chamber with its bed plate, and then removing the obstruction from the check valve, and fitting up air chamber again, making the joint air-tight by India Rubber washers, and Red lead paste.

If the snifter Valve is not functioning properly the air in the air chamber would ultimately be exhausted by solution in the water, and when there is no more air, though the dash valve may be apparently functioning, there wont be a satisfactory discharge of water. To remedy this, two stop cocks are provided (on the ram at Kargudi) one near the top of the air chamber, and another near the bottom. The method of procedure is: Stop the ram. Close the Gate valve on the Drive pipe. If the rising pipe is also provided with a valve as it ought to be, close this also, to prevent emptying of the water in this pipe into the air chamber. Open the two stop cocks in the air chamber. Air will enter this chamber by the top stop cock, and water will flow out at the bottom cock. When all the water has been thus emptied from the air chamber, and the air chamber is therefore full of air, close both the stop cocks and open both the valves on the Feed pipe and Rising pipes and start the ram by pressing down the dash valve a few times.

Work that Rams cannot do. Rams also obey the law of Conservation of Energy and as has been proved already, there is of course no possibility of perpetual motion. An essential condition for the working of a ram is that the water which enters the body X of the ram through the drive pipe shall have some velocity, and hence some

kinetic energy of momentum, and all the work that the ram does is to convert a high percentage of this Kinetic energy into a corresponding amount of potential energy which is stored up in a part of the water which is raised to a greater height. Hence the water in the feed pipe should flow to the ram either under gravity, or because of some pressure as in Artesian wells. Rams cannot utilize water at rest for this purpose. Hence they cannot raise water from deep wells either for water supply or for driving themselves nor can they work in situations where water is at rest. Of course they cannot run other machinery.

PART II.

The Hydraulic Ram at Kargudi.—(Vide Fig 2 for details).

A narration of the several stages in the promulgation of the Kargudi hydraulic ram scheme in chronological order is sure to be of considerable interest and value to those who are concerned with similar schemes. It is in several respects a valuable object lesson.

In February 1922 the position of the Kargudi Forest Station on the top of hillocks, the precariousness of water supply except from one perennial spring, which itself had only a small catchment area, led firstly to the construction of a cart track from a point on the perennial spring (where water supply can be depended on) to the site of the old Motor shed at the Forest Station at a cost of Rs. 415 to facilitate transport of water in barrels on bullock carts and led secondly to a consideration of the feasibility of the installation of a hydraulic ram at the site. By July 1922 all the necessary information was collected

including the discharge of the stream at three points with an interval of 3 chains between the first and 2nd and a three chain interval between the second and the third. The data was collected in Kerosine oil tins per hour, but when converted into gallons per minute at one kerosine oil tin as equal to 3. 7 gallons, were

Date.	Discharge of as water measured at Bund No. 1.	Bund N. 2.	Bund No. 3.	Remarks.
28–3–22	15.4	14.8	7.4	
6–5–22	14.8	Not taken	22.2	
22–6–22	18.5	Not taken	22.20	

Bund No. 3, subsequeutly called Take Off point E was ultimately adopted. Another take off point F is mentioned in the records, but I am unable with the help of the records alone to connect it either with bund No. 1 or Bund No. 2. But as F was not adopted the insufficiency of data does not hinder us in our narration.

All the data were forwarded to a Firm of Engineers in Bombay, an opinion obtained, and with a costlier ram than the one now installed, and for pumping to a greater height than at present completed, an estimate for Rs. 4250 was prepared, and submitted to the Conservator of Forests in November 1922, after the estimate was examined by the firm in Bombay and found by them to be in order. In January 1923 the question was referred to the Principal of the Madras Forest College firstly for verifying the data, on which the proposals were made and secondly for considering the possibility of drainage of

the sullage from the Forest College, and Rangers' Camps in such a way as not to pollute the source of water-supply. Soon after this, by orders of the Principal, the Madras Forest College, when it was camping at Kargudi, collected all the data needed again, and these were forwarded by the Principal to the Conservator of Forests. This verification indicated the existence of material errors in the first work, and so the revised data were again sent to the firm towards the end of February 1923. After some correspondence in July 1923 an opinion was obtained that the stream will have to be bunded at point E, and that the drive water will have to be carried in an open masonry channel or by stone-ware drain pipes to a point 32 feet above the Ram site in elevation. and 160 feet horizontally from it. As a further precaution the data and and scheme were also referred to a Madras Firm of Engineers dealing in Hydraulic Rams of a different make. This firm examined this scheme made their recommendations and gave an estimate for Rs. 5025 including a ram costing Rs. 750 and capable of discharging about 780 gallons per day into the service tank placed at the Rest House, about 53 feet above the present site, but not including Masonry and foundations. They recommended in May 1924 an open Masonry channel instead of piping because of the prohibitive cost of the latter (about 3000 Rs.) for conveying the latter from the dam to the Feed tank. In May 1924 the Chief Conservator of Forests ordered reconsideration of the scheme in view of possible reduction of cost that might be effected by placing the service tank (1) on the saddle between the rest house and rangers quarters, or (2) at the bottom of the Ranger's compound, and of collecting information whether deepening an existing well near

the saddle, or the construction of a new well at a site pointed out by a water diviner (an Officer) would not be feasible. A new well shaft sunk to a depth of 35 feet, contained only a little rain water in July 1924, and so construction of a well seemed to be ruled out. It was estimated that the location of the storage tank at the saddle would mean a saving of Rs. 787 whereas its location at the Range Officer's Compound would mean a saving of Rs. 574 in addition to any saving that might be effected by the installation of a smaller ram than was originally designed because of the smaller lift. In January 1925 the Chief Conservator decided on the installation of the storage tank on the saddle, and directed that the new data should be sent to the Bombay firm for revised specifications and estimates. This was done in February 1925, and the following data were sent to them for opinion.

Height of point E above Ram site	32.66	feet.
Distance of point E from Ram site	765	feet.
Height of storage thank above Ram site	167.50	feet.
Distance (horiz) of storage tank from Ram site.	2150	feet.
Minimum flow at point E (as given)	5	gallons per minute
Minimum supply required	800	gallons per day

In February 1925 the feasibility of the question was also referred to Messrs Harrison and Crossfield Ltd. of Quilon for an opinion and they were invited to send a representative to examine

the scheme on the spot; and to give their quotation for the complete installation, and delivery of the ram in running order. In May 1925 Messrs. Harrison and Crossfield replied recommending that the dam should be constructed at E and that a covered pipe should be used to convey the water from the dam (take off) to the feed tank because considering the same quantity of available water (5 gallons per minute) an open drain would mean loss of about 25 per cent, by evaporation, seepage, etc. According to them Scheme No. 1 (take off at E, and delivery of about 860 gallons per 24 hours at the saddle) the total cost was estimated to be Rs. 3160/ nearly exclusive of Travelling, and Engineer's charges, and exclusive of masonry work; whereas scheme No. 2 (with point E as Take Off, and delivery of 450 gallons to the head Tank at D. F. O.'s Bungalow per 24 hours) was estimated to cost about Rs. 3884; travelling, Engineer's visits, and masonry work extra. In June 1925 a revised estimate for delivering 480 gallons per 24 hours under scheme 2 was obtained, and the estimated cost was 4950, Rs. The increase in cost was Rs. 1066, accounted for thus.

	Rs. to nearest Re.
For 260 feet extra of 3" diameter piping	405
For 1 off 3" bend extra	10
For 3 lbs. extra red lead	2
Extra erection charges	100
Supervision and travelling charges	500
Approximate transport from Calicut of materials	50
Total.	1067

The difference of one Rupee between 1067 and 1066 is due to rounding off to nearest rupee each individual item in the above statement, as nothing is gained here by giving fractions of a Rupee.

Obviously scheme 1 was the sounder proposition. The amount of Rs. 3159–3–0 included a tank and cover for Rs. 180, Two suitable tanks were on stock at Kargudi and a new one was unnecessary. But the estimate did not include the erection of Masonry work, supervision, travelling, or transport of materials from Calicut. Hence the estimate for scheme 1 was revised as below in July 1925.

		Rs.	As.	Ps.
Estimate prepared in May		3159	13	0
Less for tank and cover		180	0	0
	Balance.	2979	13	0
Add Erection of Masonry work		100	0	0
Supervision and travelling		500	0	0
Transport of material from Calicut to Kargudi approximately		50	0	0
	Total.	3629	13	0
Add for supply of rough stone lime, sand and unskilled labour		70	3	0
	Grand total.	3700	0	0

An estimate for Rs. 3700, was therefore prepared, and the sanction of the Conservator of Forests Sixth Circle Ootacamund was obtained.

The following material was collected for the work at the points mentioned.

At Point E—Take off		
Rough Stone Rubble pieces 9" × 6" × 4"	140	c. ft.
Well washed sharp River sand	50	c. ft.
Cement	5	barrels.
At point A Ram site:		
Rough stone as above.	80	c. ft.
Broken metal to pass through ¾ " ring.	50	c. ft.
Sand as above	40	c. ft.
Cement	4	barrels.

In April 1926 the work of installation was completed. The actual total cost was Rs. 3919–5–0 as detailed below.

		Rs.	As.	Ps.
The ram (Blake's A type.)	....	360	0	0
2469 ft. of 1 " piping at 7 annas per foot for delivery pipe	....	1076	4	0
184 feet of 1½" piping at 11 annas per foot for Drive pipe	....	126	8	0
780 feet of 3" pipe for Dam to Feed tank at Rs. 1–9–0 per foot	....	1218	12	0
3 one inch bends at 14 annas each	....	2	10	0
1 three inch bend at Rs. 10, each	....	10	0	0
1 one inch tap at Rs. 5,	....	5	0	0
10 lbs. red lead at 11 annas per lb.	....	6	14	0
Erection of Ram and piping, supply of coolies	....	90	6	0

Supply of stone Lime Cement etc.	191	6	0
Clearing site etc.	7	4	0
Erection of Masonry work	100	0	0
Erection of thatched shed over Feed tank	2	10	0
Transport from Calicut 9 carts at Rs. 20, per cart	180	0	0
Extra Coolies for carrying spares from Ooty to Kargudi	2	15	0
Supervision and travelling	500	0	0
Travelling expenses of Engineer for preliminary report on the feasibility of the scheme	38	12	0
Total.	3919	5	0

Supplemental sanction was obtained for the extra amount spent The sanction of the Government was specially obtained for the purchase of the ram from the firm (that actually supplied the instrument) after the Account General in August 1926 had objected to such a purchase.

In January 1926 the Junior Division of the Madras Forest College aligned for a drain to carry off the drainage from the Forest College and Range Camp sites to a different stream, without reducing materially the catchment area of the spring which supplies water, thus ensuring the purity of the water supply. This drain was constructed by the Division in 1926. In April 1926 after the installation of the ram it was found that after all only a head of 24 feet was available for the feed pipe against an estimated 32 feet. This naturally reduces the expected discharge by 25%. Also it appears that a small flaw appeared in the air chamber, through which some water and air were escaping, but when I inspected the ram in February 1927 no such flaw was visible probably due to temporary or permanent cure by corrosion in the interior. The spurt of water I observed was from the snifter valve.

This should be absolutely nil except for occasional repairs. So little attention is needed. The total cost of installation 3919/5/0 may be taken in round figures as Rs. 4000/ If this amount had been borrowed at 6 per cent per annum, a monthly interest of Rs. 20/ might have to be paid. Though the rams work for thirty years or more, if we assume a life of only 20 years for the ram, the monthly depreciation would be Rs. 16-10-8. Add another 1-5-4 for repairs etc. though this estimate is too liberal for a hydraulic ram. The total monthly cost of the installation is not more than Rs. 38/ as against Rs. 61/ that was the actual cost of maintenance of a double bullock cart, including wages of driver, for supplying the settlement with water prior to the installation of the ram. Facts speak for themselves. The nett profit of the scheme to the Government is thus at least 23 Rupees per mensem.

General. The unfailing reliability of a Hydraulic ram is such one may well forget the existence of the ram itself for years though all the time using water supplied by the faithful machine. The following extract from a letter received by Messrs John Blake Ltd. may be quoted in support of this.

"We put down a pair of your rams some 20 years ago to supply a country house near here, and when three years ago an additional supply of water was required, we were asked to inspect and report. We visited the site, but could not find that any of the Estate men even knew the situation of the Ram House, there being a dense undergrowth in the wood in which it was situated, and when searching for it, our Assistant stepped on the timber roof of the house and partly fell through.. *Apparently this pair of rams had been working for at least seven years without having been seen by anyone.*"

What an eloquent testimony to the value of Hydraulic Rams in general, and of Blake's Hydraulic Ram in particular! From what I have seen of it at Kargudi, I believe the Ram is to the world of water pumps what the Ford is to the world of Automobiles, steady, efficient, reliable, trouble-proof, sturdy.

M. S. RAGHAVAN B. A.
Madras Forest Service, Instructor,
Forest College, Coimbatore.

EXTRACTS.

Deforestation at Pueblo Bonito:—After six seasons' excavations on the important site of Pueblo Bonito in New Mexico, it is now possible to arrive at some definite conclusions as to the causes which led to the gradual decline and final abondonment of this once populous centre of prehistoric Pueblo culture. The population, some twelve hundred in number, was agricultural, living on the produce of the fields, once fertile, but now barren. According to a Bulletin of of the Smithsonian Institution, the expedition of the National Geographic Society, under the leadership of Mr. Neil M. Judd, archæologist of the Smithsonian Institution, in the course of its excavations has found an ancient arroyo completely filled up which has been traced for a considerable distance. Its original bed was found at a depth of 18 feet, and on it were fragments of pottery made during the third and greateat building period of the Pueblo. Further, it appears that the inhabitants used pine logs to roof the 800 rooms of their great dwelling. The nearest pine woods are at preseut forty miles away; but evidence was discovered that pine had at one time grown in the canyon. It may therefore be concluded that the present sterility of the soil was brought about by the destruction of the pine forests which once surrounded the site, baring the soil to wind and water and allowing the spring rains essential for the crops to drain oft into the arroyo, which then became wider and deeper. The fertility of the fields then became less, and the population decreased owing to migration as the food supply diminished, until the twelve hundred inhabitants had dwindled to a few families. The increase

in the number of defensive works in each successive building period suggests that marauding raids helped to drive the inhabitants from their homes. The excavations of 1926 show that there were four main periods of construction covering a period of about a thousand years. Differences in architecture and pottery indicate that two distinct populations in friendly relation inhabited the site at one time. Later arrivals of a more advanced culture made Pueblo Bonito the most famous and important settlement of the south-west, but they were the first to abondon the site.

Extract from, Nature December 18, 1926.

A new way of oiling ponds.

The breeding of mosquitoes is controlled now a days by the use of oils in ponds, marshes or swamps, which prevents the development of the mosquito in its early stages. Major William O. Wetmore, Medical Corps of the United 'States Army, stationed in Hawaii, has devised a Conical can with a diaphragm near the bottom containing two chambers. The lower one contains sand which acts as a weight, and the upper chamber contains oil. Both are equipped with a cap for filling. Along the outside lies a tube with an inlet at the top, and an opening into the oil chamber at the bottom. The apex of the chamber has a wire wick which permits the oil to escape in droplets. The can is tossed into a pond, and the weight sinks it. Oil begins to escape from the apex while water is turned into the lower portion of the oil-chamber, displacing the oil which floats to the surface, and there prevents the further propagation of mosquitoes.

A five gallon can, according to experiments made in Hawaii kept a pond the size of a city block oiled for a month. It is of course possible to deliver oil in these containers which can be constructed at a reasonable cost. A patent covering this device has already been applied for.

—Extract from The Scientific American January 1927.

Protection of wood against moisture changes.

Probably the most effective protection of wood against moisture changes is the aluminium leaf-coating. The process simply incorporates a layer of aluminium leaf in the coating, and provides a very strong barrier to moisture. The efficiency of this coating is about 98 per cent. It was developed particularly for use on of aeroplane propellers, where very slight changes in moisture content are important. The process consists of applying a filler for open grain woods, a coat of varnish for a foundation coat, and a coat of varnish which is used as a size. The size coat is allowed to dry until it is almost dust free, when the leaf is applied over the surface, lapping the edges. It is smoothed down with cotton, and a protective coating of spar-varnish, enamel or paint is usually applied over the surface.

Extract from Daily Express, April 1, 1927.

Publications received during Jan.—March 1927.

We beg to aeknowledge with thanks receipt of the following Publications received in exchange during the quarter ending 31–3–1927.

1. "The Journal of the Madras Agricultural students' Union."—Jan. to March 1927.

2. "Rural India"-(Journal of the Madras Forest Panchayats). Vol. I Nos. 5, 6, 7.

3. " The junglewallah " Jan. to March 1927.

4. " The People's Friend."

Additions to the Library for Quarter Ending 31—3—27.

1. Manual of Field works (all arms.)

2 Report of the Department of Industries, Madras, for the year ended 31st March, 1926.

3. The complete guide to Military Map reading.

4. *Blasting Pamphlets :--*

(a) Well-boring: How to sink wells using Nobel Glasgow Explosives.

(b) Blasting in collieries and Lints on Electric shot-firing.

(c) The storage of explosives (under the Explosives Act. 1875.)

(d) Ground clearing with the aid of explosives.

(e) Blasting explosives and accessories.

(d) Explosives for the farm.

5. Manual of Map reading and field sketching.

Contributions to the Gass Forest Museum.

Serial No.	Contribution.	Contributor.
1.	One small skin of a Chinkara	B. B. Wadhwani, Student, M. F. C. 1926—28 Dn.
2.	Two panels of *Dalbergia Sissoo*	The Divisional Forest Officer Buxa Division Bengal.
3.	Three herbarium specimens.	M. R. Ry. M. S. Raghavan Avl., B. A., Instructor, M. F. C.

Notice.

INDIAN FORESTER PRIZE 1927.

(PAST STUDENTS).

A Prize allotted from the " Indian Forester Fund " will be awarded to the past student of the Madras Forest College, who submits the best essay on the following subject :—

" A Typical Day in a Forest Ranger's life."

No award will be made unless a satisfactory standard is reached. Essays should be clearly written or typed on one side of the paper only and should not exceed 2,000 words; they must reach the Principal not later than the 1st June nor earlier than 20th May 1927.

Each essay must bear a nom-de-plume which must also be written on the outside of a sealed envelope inside which is a paper containing the name of the competitor.

The name of the competitor must not appear on the outside of the envelope or on the essay. Each essay must be the unaided work of the competitor submitting it.

Balance Sheet of the Madras Forest College Magazine for the year 1925—26.

Serial No.	Receipts. Particulars.	Amount. Rs.	A.	P.
1	Entrance fees from : 29 Rangers @ Rs. 2 each	58	0	0
2	Annual Subscription from : 29 new members @ Rs. 2 58–0–0 191 old " 382–0–0	440	0	0
3	V. P. P. Registration fee recoveries	20	4	0
4	By advertisement	36	0	0
5	By sale of 29 copies of Fischer's "key" to the identification of trees etc. @ Rs. 1–2–0	32	10	0
6	Interest accrued on deposit in Bank	21	9	4
7	Balance at Bank at beginning of the year	546	8	8
8	Cash balance "	4	4	9
	Grand Total Rs. ...	1159	4	9

Serial No.	Expenditure Particulars.	Amount. Rs.	A.	P.
1	Paper, Printing and Binding charges.	556	8	9
2	Postal charges.	89	6	0
3	Stationery and Sundries.	47	3	0
4	Balance at Bank at end of the year (30–6–26)	436	10	0
5	Cash Balance.	29	9	0
	Grand Total Rs. ...	1159	4	9

M. C. Chandy, *Business Superintendent.*
C. R. F. Williams. *President.*

G. Viswanatham, *Editor & Treasurer.*
K. S. Venkata Rao, *Accountant, M. F. C.*

Gazette Notifications.

21—12—1926.

M. R. Ry. V. Narayana Iyer Avl. D. F. O. Vizagapatam, will, on relief by Mr. D. A. Stracey remain attached to the division until further orders.

On first joining from England Mr. N. S. Ghate, Assistant Conservator of Forests, is posted to Vellore Dn.

28—12—1926

Mr. D. A. Stracey, E. A. C. to be D. F. O. Vizagapatam, with effect from 3rd January 1927.

Mr. C. S. Martin, to be Temporary Chief Forest Engineer with effect from the date of joining duty.

4—1—1927.

Mr. W. H. Woodhouse Aldolphus, D. F. O. South Salem, granted leave on average pay for two months from 12th January 1927.

11—1—1927.

Mr. A. A. F. Minchin, Deputy Conservator of Forests, extension of leave on half average pay for three months, and twenty-nine days from 3rd December 1926.

Mr. H. P. Ward, Deputy Conservator of Forests, to be attached to the Forest Utilization Officer, with effect from 3rd Jan. 1927, or the date of joining duty.

M. R. Ry. P. Govinda Menon Avl., E. A. C. of Forests on relief by Mr. A. M. C. Littlewood at North Coimbatore, will resume his, original duties in the South Coimbatore Division.

18—1—1927.

M. R. Ry. A. R. Narasimha Ayyangar Avl. E. A. C. of Forests, Wynaad is posted to act as District Forest Officer, South Salem during the absence of Mr. W. H. Woodhouse Adolphus, on leave or until further orders.

25—1—1927.

The following Officers appointed by the Secretary of State for India, to the Indian Forest Service reported their arrival in Bombay on the dates mentioned against their names :

Mr. E. A. Lasrado	...	3—12—1926.
Mr. N. S. Ghate	...	Do.
Mr. A. L. Griffith	...	17—12—1926.

Saiyid Abdul Qadir Sahib Bahadur, Deputy Conservator of Forests, on return from leave, to be District Forest Officer, Godaveri Lower.

Mr. J. A. Master, Deputy Conservator of Forests, Upper Godaveri, to be D. F. O. Anantapur.

Mr. D. L. Sathe, D. F. O. Anantapur, on relief by Mr. J. A. Master, to be D. F. O. South Kurnool.

M R. Ry. V. N. Seshagiri Rao Avergal D. F. O. South Kurnool, to be on Special duty in Rampa, Lower Godaveri Division, with effect from the date of joining duty.

1—2—1927.

M. R. Ry. E. K. Krishnan Avl. E. A. C., D. F. O., L. Godaveri, granted leave on average pay for 3 months with effect from date of relief.

Mr. J. A. Master, Deputy Conservator of Forests, granted leave on average pay for 10 days from 3-1-1927.

8—2—1927.

Mr. H. P. Ward, Deputy Conservator of Forests, attached to the Forest Utilization Officer, to be Assistant Forest Utilization Officer, (West Coast).

22—2 —1927.

Mr. E. S. Dawson, Forest Engineer, to be attached to the Forest Engineer in charge of the Saw-mills, and Extraction Division with effect from the date of his reporting at Sappal.

Mr. E. A. Lasrado, Assistant Conservator of Forests, Palghat is posted to the Chenat Nair Exploitation unit for stock taking.

Mr. H. A. H. G. Hicks, Working Plans Officer, Ootacamund is posted to the Coonoor Range, the Nilgiris Division, for range training.

1—3—1927.

Mr. T. A. Whitehead, Conservator of Forests, on leave, to be Conservator of Forests V Circle from, or after 7th March 1927.

Mr. A. A. F. Minchin, Ag. Conservator of Forests, on return from leave, to be Conservator of Forests VI Circle.

Mr. W. H. Woodhouse Adolphus, E. A. C. of Forests, on return from leave to be District Forest Officer, Central Salem Division.

8—3—1927.

M. R. Ry. V. Narayana Ayyar Avl. E. A. C. of Forests on leave, to be D. F. O., N. Cuddapah with effect from 6th March 1927.

Muhammad Abdul Karim Sahib Bahadur, E. A. C. of Forests, on return from leave, to be D. F. O. Guntur.

Mr. E. S. Dawson of the Indian Forest Engineering Service who has been posted to the Madras Presidency reported to the Chief Conservator of Forests for duty on the afternoon of 19th January 1927.

Forest Engineering Branch:—

29—1—1927.

M. R. Ry. K. K. Appaiah, Ranger V Grade, Logging Engineer's Division is granted leave on average pay for one month with effect from 1st May 1927 or the date of relief.

First Circle.

20—1—1927.

B. Gulam Dastagiri Sahib, Ranger VI grade transferred to First Cirlcle is posted to the Ganjam District for the charge of the Berhampur range.

22—1—1927.

Y. Venkataswami Nayudu, Ranger VII grade (due to return to duty on 14-2-1927) is posted to the Ganjam District for the charge of the Russellkonda Range.

2. On relief by No. 1 Y. Vydyanatham, Supernumerary Ranger is appointed as Junior Instructor of the Vernacular Training school 1927 session.

31—I—1927.

Ranger Mr. W. S. Fernandez is granted leave on average pay on medical certificate for three months from the forenoon of 21-1-27.

3—2—1927.

On expiry of the leave granted to him (17-2-1927) M. R. Ry. B. V. Vaideswara Ayyar, Ranger V grade, is posted to Ganjam district for the charge of the Russellkonda Range.

This cancels the posting of Ranger Y. Venkataswami Naidu to the Russellkonda Range.

3—2—1927.

In supersession of this office S. O. No. 4 1927 dated 22-1-1927, so far as it relates to the posting of Ranger Y. Venkataswami Naidu, he is posted to Upper Godavari.

Second Circle.

23—2—1927.

M. R. Ry. T. Balaramaswamy Naidu, Ranger VII grade, Pondakhol Range, is granted leave on average pay for 4 months on medical certificate with effect from date of relief.

25—2—1927.

M. R. Ry. B. S. Sankara Ayyar, Ranger VI grade in charge of Berhampur Range is granted leave on average pay on medical certificate for 4 months from the forenoon of 12-1-1927.

21—3—1927.

M. R. Ry. Y. Venkataswamy Naidu Ranger VII grade, Pulusumamidi, is granted leave on average pay for two months on medical certificate with effect from the afternoon of 13th December 1926.

19—1—1927.

M. R. Ry. T. K. Ramaswamy Ayyar, Ranger II grade, Kurnool West Division is granted an extension of leave on medical certificate for 1 month and 15 days on half average pay from 25-12-1926 in continuation of the leave granted.

31—1—1927.

M. R. Ry. A. Ranganayakulu Nayudu, Ranger II grade, on return from leave (on 16-2-1927) is posted to the charge of Turimilla Range of Kurnool East Division to relieve Supernumerary Ranger N. Rajagopala Chetty who is now temporarily in charge of the Range.

1—2—1927.

In partial modification of this office Service Order No. 142/26 M.R.Ry. A. Arogyaswami Pillai Supernumerary Ranger is granted leave on average pay for 3 months from 12th November 1926.

3—2—1927.

M. R. Ry. S. M. Krishnaswamy Ranger III grade, Gundlabrahmeswaram Range Kurnool West Division is granted leave on average pay on medical certificate for 2 months from date of relief.

2. M. R. Ry. K. Purushothama Rao Ranger VI grade on special duty in Kurnool West Division is posted *temporarily* to Gundlabrahmeswaram Range to relieve No. 1.

3. M. R. Ry. C. Rajagopalan Ranger VI grade Bellary Range is posted to Gundlabrahmeswaram Range to relieve No. 2 after the abolition of Bellary Range.

20—2—1927.

Mr. G. B. Rodrigues, Supernumerary Ranger on special duty in Gundlabrahmeswaram Range is posted to Nandyal Range. He will at once proceed to Ernipad and relieve Ranger Mr. D. N. Subrahmanyam Iyer who wants early relief.

23—2—1927.

Supernumerary Ranger T. N. Krishnamachari on special duty in Gundlakamma Range of Kurnool South Division is transferred to Cuddapah North Division for special duty.

27-2-1927.

M. R. Ry. M. Krishna Rao, Ranger III grade, Balapalle Range, Cuddapah South Division is granted leave on average pay for 4 months from 1st April 1927 or date of relief.

2. M. R. Ry. B. T. Sitaramarama Ayyar Ranger V grade on special duty in the same division is posted to Balapalle Range to relieve No. 1 after completing the stock-mapping work on which he is employed at present.

28—2—1927.

1. M. R. Ry. A. Bhaviah, Range Officer V Grade. Sidhout is posted to Porumamilla Range.

2. On relief by No. 1 M. R. Ry. B. Krishna Rao Range Officer VI grade Porumamilla is posted to Sidhout Range.

The orders to take effect on the 1st April 1927.

10—3—1927.

M. R. Ry. G. Rama Rao, Ranger IV grade, Kurnool South Division is granted an extension of leave on medical certificate for 6 months (4 months on full average pay and 2 months on half-average pay) from 25-2-1927 in continuation of the leave for 4 months granted from the afternoon of 24-10-1926.

13—3—1927.

Mr. Hussain Khan, Ranger II grade, Yerragondapalem Range, Kurnool East Division is transferred by the Chief Conservator of Forests to the charge of Pollachi Depot South Coimbatore Division.

2. M. R. Ry. D. Venkateswaralu Ranger VI grade Ganjivaripalle Range to be in additional charge of Yerragondapalem Range till further orders.

13—3—1927.

M. R. Ry. D. N. Subramanya Ayyar, Ranger VI grade, Nandyal Range, Kurnool West Division is granted leave on full average pay on Medical Certificate for two months from 2nd March 1927.

13—3—1927.

The leave granted to Ranger N. C. Mahadevan Pillai for three months on Medical Certificate from 5th August 1926 in this office Service Order No. 119/26 dated 17–9–1626 on half-average pay will be converted into leave on full average pay.

15—3—1927.

M. R. Ry. O. Venkataramana Ayyar, Ranger I grade, on return from leave (26–3–1927) is posted to Yerragondapalem Range, Kurnool East Division.

17—3—1927.

The leave on half average pay granted to Ranger T. K. Ramaswamy Ayyar for 2 months and 14 days on Medical Certificate in this office Service Order No. 114/26 dated 17th August 1926, will be converted into leave on full average pay.

Third Circle.

22—1—1927.

M. R. Ry. A. M. Srinivasalu Naidu, Ranger, Working Plans Circle, is granted leave on full average pay on Medical certificate for 7 days with effect from 3–1–1927 to 9–1–1927 (both days inclusive).

8—3—1927.

Ranger M. N. Raman Pillai is granted leave on average pay for 15 days from or after 13–3–1927.

Fourth Circle.

25—1—1227.

1. This office Service Order posting M. R. Ry. S. Ramalingam Ayyar, Supernumerary Ranger, as Assistant Instructor for the 1927 session of the Vernacular Training School, is cancelled.

2. Supernumerary Ranger M. R. Ry. P. K. Subbanarayana Ayyar on Special duty in the Vellore division, is posted as Assistant Instructor *Vice* No. 1. To join on 1–2–1927 at Salem.
3. M. R. Ry. V. P. Narayana Menon, Ranger IV grade who is due from leave on 17–2–1927, is posted for special duty in the Vellore division on production of certificate of fitness to return to duty.
4. Mr. E. W. Fernandez, Ranger V grade, due from leave on 24–2–1927, is posted for special duty in the North Salem division.

1—2—1927.

M. R. Ry. T. N. Krishnamachari, Supernumerary Ranger is granted an extension of leave on medical certificate on full average pay from 21st January 1927 to 24th January 1927 (both days inclusive) in continuation of the leave granted to him.

2—2—1927.

M. R. Ry. P. A. Krishnaswami Mudaliar, Ranger IV grade, Vellore division, is granted extension of leave on average salary for 2 months on medical certificate in continuation of the leave granted to him in this office Service Order No. 96 of 1926, dated 6–11–1926.

9—2—1927.

1. M. R. Ry. S. Nagalingam Pillai, Ranger VI grade, on return from leave on 3–3–1927, is posted to Santhavasal Range charge, Vellore division, until M. R. Ry. P. A. Krishnaswami Mudaliar, Ranger IV grade, joins.
2. M. R. Ry. T. K. Parthasarathi Ayyangar, Ranger VII grade, now in charge of Santhavasal range on relief should join duty in the Chitteri Range, Central Salem division, for stock-mapping timber etc., areas.
3. Mr. E. W. Fernandez, Ranger V grade, on return from leave on 24–2–1927 and on production of fitness certificate is posted to the charge of Cauveri Range, Central Salem division.

4. T. S. Sankaranarayana Ayyar, Supernumerary Ranger, now in charge of Cauveri range on relief by No. 3, is posted to special duty for aligning a road trace down the Chinnar slong its right bank to Hogenakal in North Salem division.

19—2—1927.

M. R. Ry. S. Ramanujam Sesha, Ranger VI grade, Central Salem division, is granted extension of leave on average salary on medical certificate from 12–12–1926 to 25–3–1927 both days inclusive in continuation of 3 weeks leave granted to him without medical certificate by the District Forest officer, Central Salem, in his S. O. No. 29 of 1226, dated 15–11–1926.

24—2—1927.

M. R. Ry. K. M. Gopalachari, Ranger III grade, in charge of Odugathur Range, Vellore division, is granted leave on average salary on medical certificate for 3 months from the date of relief.

25—2—1927.

M. R. Ry. S. Ramalinga Ayyar, Supernumerary Ranger, is granted extension of leave on average salary on medical certificate for 2 months from 24–1–1927 in continuation of the leave for 3 weeks granted to him by the District Forest officer, North Salem. On return from leave, he is reposted to North Salem division for special duty, road alignment in Dharmapuri range.

27—2—1927.

M. R. Ry., T. S. Sankaranarayana Ayyar, Supernumerary Ranger in charge of Cauveri range, Central Salem division, is on relief by Ranger Mr. E. W. Fernandez, posted to the charge of Odugathur range, Vellore division, Vice M. R. Ry., V. M. Gopalachari, Ranger III grade, granted leave.

This cancels paragraph 4 of this office Service Order No. 14 of 1927, dated 9–2–1927.

10—3—1927.

M. R. Ry., S. Ramanujam Sesha, Ranger VI grade, on return from leave and on production of medical certificate of fitness to return to duty, is posted for special duty in the Central Salem division for stock-maping timber etc., areas in the Chitteri range until relieved by Ranger T. K. Parthasarathi Ayyangar.

10—3—1927.

M. R. Ry., S. Nagalingam Pillai, Ranger VI grade, South Salem division, is granted extension of leave on average salary for one month from 3–3–1927 in continuation of the leave granted to him.

4—3—1927.

M. R. Ry., T. E. Varadachari, Ranger III grade in charge of Gudiyattam Range, Chittor District, is granted leave for 3 months (leave on average pay for 1 month and 10 days and half average pay for the remaining period) from date of relief.

2. M. R. Ry., S. Nagalingam Pillai, Ranger VI grade, on return from leave on 3–4–1927 and on production of medical certificate of fitness to return to duty, is posted to the charge of Gudiyattam Range and relieve No. 1 on or before 15–4–1927.

Paragraph 1 of this Office Service Order No. 14–27., dated 9–2–1927, is cancelled.

Fifth Circle.

1—2—1927.

On relief by Ranger Hussain Khan at Pollachi Depot Ranger A. P. Srinivasa Ayyangar should report himself to Mr. H. P. Ward at Coimbatore.

5—2—1927.

Supernumerary Ranger S. Narayanaswamy Ayyar on return from leave is posted to North Coimbatore District for check of patta Sandalwood extraction work.

11—2—1927.

K. O. Anandan, Supernumerary Ranger, Kollegal, is granted an extension of leave on average pay for one month with effect from 3rd February 1927.

11—2—1927.

Ranger T. G. Sankaran Nair should report himself for duty at Nilambur on the expiry of his leave.

23—2—1927.

Ranger K. Chaikku is transferred to Sixth Circle.

8—3—1927.

Ranger M. N. Raman Pillai is granted leave on average pay for 15 days from or after 13-3-1927.

Sixth Circle.

27—1—1927.

M. R. Ry. K. Shankaranarayana Rao, Ranger V grade, on special duty in the Palghat division is appointed as Instructor of the 1927 session of the Vernacular Training School to be held at Bandimatta in the North Mangalore division from 1st April 1927.

2. M. R. Ry. M. M. Mandanna, Supernumerary Ranger, who is due back from leave on 16-2-1927 is posted for special duty in the North Mangalore division till he takes charge of duties as Assistant Instructor of the Vernacular Training School to be held at Bandimatta on 1st April 1927. His transfer to Wynaad is cancelled.

18—2—1927.

M. R. Ry. T. G. Sankaran Nair, Ranger II grade, under orders of transfer from the V Circle to this Circle, is posted to special duty, Nilambur Range.

26—2—1927.

M. R. Ry. T. G. Sankaran Nair, Ranger II grade, is granted an extension of leave on average pay up to 1st April 1927, in continuation of the leave granted to him by the Conservator of Forests, V Circle.

19—3—1927.

M. R. Ry. P. Sankunni Nair, Ranger VI grade, in charge of the Segur Range, is granted 2 months' leave, made up of leave on average pay for 1 month and 6 days and leave on half average pay for the remaining period, from 1st April 1927 or date of relief.

2. M. R. Ry. N. Gopalan Nair, Ranger VI grade, on special duty in the Mudumalai Range, is posted to the charge of the Segur Range vice No. I.

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