

Report
of the
Sleepers Enquiry Committee
1923-24



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INTRODUCTION.

1. The forests of India including Burma are owned by the Government of India to a very large extent; the railways want a very great number of sleepers annually, the forests hold a considerable quantity of suitable wood, even when it is untreated, and the efforts of Mr. R. S. Pearson and the Forest Research Institute of Dehra Dun have indicated that large quantities of timber which will be suitable for railway sleepers when treated antiseptically are available: in the past the business between the Forest Department of the Government of India and the Railways has amounted to a very large sum of money annually and is certain to increase with the growth of the railway system of India and the use of treated sleepers.

2. The interests of these two departments are, and must necessarily remain, in conflict, for each is intent on improving its own revenues. On the one hand, the Forest Officers, more or less regardless of the market price of timber, want the railways to pay as much as they will up to the limit at which some substitute for an Indian wood sleeper becomes more economical; on the other, the railways, while admitting the right of the Forest Department to charge the upper limit of price when the market price for large quantities of Indian timber is high, expect to obtain sleepers at a lower price when the public demand for timber is below the supply and the market price is low. Recent prices of Indian wood sleepers have reached and even exceeded the price at which railways can obtain satisfactory substitutes—timber, steel, or cast iron, in many cases from overseas, and there can be no doubt that the thoughts of the Chief Engineers of Railways are turning more and more to the use of these substitutes; it is possible, too, that the Railways might enter into long term contracts for these substitutes even when they were not more economical than Indian wood in order to beat down the price of Indian sleepers for the future, a procedure which would certainly do a great deal of injury to Forest revenues and might possibly be injurious to Railway revenues as well.

3. Moreover a system has recently arisen of leasing forests to private individuals in which the Forest Departments assesses royalty on an assumed sale price of railway sleepers which is not communicated to the Railways and, then, if the railways purchase these sleepers at a higher rate half the excess price is claimed by the Forest Departments as additional royalty: thus the railways in contributing a considerable sum to the revenues of the Forest Department put an equal amount into the pockets of contractors who would have received sufficient profits from the sale of sleepers at the originally assumed price. This agreement holds good in the sale of railway sleepers only—all other timber sold in the market not being subject to it—and it is not surprising that the railways characterise the additional impost as iniquitous.

4. It ought to be inconceivable that two departments of the state should enter into a rate war and methods such as that mentioned in the last para, whereby one department secures an advantage for itself at the cost of an injury to the other ought to be equally inconceivable.

5. Considerations such as these have impelled the Railway Board to make a thorough examination of the sources of supply of wooden

sleepers in India and Burma, the methods of purchase, the possibility of development and the reduction of costs, and the necessity for the use of substitutes."

"Connected with the general question of methods of purchase is the form of contract to be adopted, the best way of keeping down prices, and the possibility of direct arrangements with the Forest Departments. The methods to be adopted will no doubt depend on local conditions and in certain areas, such as Coorg and the Andamans, which are directly under the Government of India, it may be possible to set up some form of co-operative development with the Forest Department whereby the supply of sleepers at a low price may be stimulated."

"And in this connection it is possible that investigation will show that the present method of rough classification at the time of passing and the fixing of varying rates for the different classes will require considerable modification. The specification for 1st class sleepers is a very exacting one and the actual classification depends very much on the experience and idiosyncrasies of the passing officer."

"The enquiry will also cover the whole question of substitutes and the treatment of sleepers and the aim will be to indicate for each railway and for sections of the larger railways, the most economical sleeper to be used, the sources of supply, and the method of purchase."

"For this enquiry it is clear that we must have the assistance of an experienced Forest Officer who has knowledge of distribution of suitable timber in India, and the local methods of extraction, and it is proposed to ask the Forest Department for the loan of such an officer to work with Mr. Allum, at present officiating as Chief Engineer with the Railway Board, whose services will be available on 1st November. The enquiry will necessitate visits being paid to the various forest areas and to the headquarters of the Railways and local Governments and it will be necessary to ask Railways and local Governments to prepare certain information in advance of these visits."

6. In accordance with this decision the Railway Board obtained the services of Mr. R. N. Parker, Forest Botanist, from the Forest Department and directed Mr. F. W. Allum, Officiating Chief Engineer of the Indian State Railways, to make the enquiry in conjunction with him.

7. Mr. Parker joined the Railway Board's Office in Simla on the 1st October 1923, drew up a questionnaire which was circulated among the Forests Departments of the Indian, Kashmir and Mysore Governments and Burma and the programme of the tour and, then, on the 10th November started on the enquiry: Mr. Allum, after a preliminary visit to the Dehra Dun Forest Research Institute, joined him at Parbatipur on the 18th.

8. Messrs. Allum and Parker beg leave to record here their deep obligation to the Agents of the various railway systems over which they travelled for granting the use of reserved carriages, passes, and other travelling facilities, which contributed greatly to their convenience and comfort: to the Chief Engineers of Railways and Forest Officers for supplying the information they required; and to the Agents and Chief Engineers of Railways, Forest Officers, and other officials for their hospitality.

ADDENDUM.

After the report had gone to Press Mr. Parker sent me the following notes.

Para. 6.—The deodar supply is as follows by rivers:—

Average of	Logs.	Sleepers.	Other sawn timber.	REMARKS.
	C. ft.	C. ft.	C. ft.	
Indus, 4 years	703,510	991	451	
Hazara, 3 years	221,784	15,248	*	May be added to Jhelum figures.
Jhelum, 5 years	375,969	808,273	53,323	
Chenab, 5 years	67,780	1,415,772	53,047	*Figures not available for
Ravi, 5 years	4,236	178,053	60,291	sawn timber other than
Beas, 5 years	8,994	167,200	*	sleepers so all shown as
Sutlej, 5 years	43,113	495,849	*	sleepers.
Jumna, 5 years . . . . .	..	784,000†		†5,41,000 c. ft. from Chak- rata Forest Division, and 2,43,000 c. ft. from Jub- bal State.
TOTAL	1,425,386	3,865,336	1,67,112	

Note.—These figures are averages over 3 to 5 years ending 31st March 1924. This means deodar sawn timber is about 4 millions c. ft. per annum plus 1,425,000 c. ft. of logs. (About 4·8 million c. ft. of sawn timber. F. W. A.).

Para. 31.—As regards chir, for the present Rs. 3/8/0 looks a satisfactory price for a broad gauge sleeper but in 1923-24 this timber has risen by Rs. 0/6/6 per broad gauge sleeper compared with 1922-23. During 1923-24 Hazara sold 137,895 c. ft. of chir at Havelian for an average price of Rs. 3/7/0 per B. G. sleeper: this price, of course, includes everything sold, big and small, good and bad, so that B. G. chir sleepers at Rs. 3/8/0 are out of the question as regards Hazara: At present a price of Rs. 3/8/0 for a B. G. sleeper will exclude all the chir west of the Chenab, and this area has the biggest and the best supplies at present on the market.

As regards the east Punjab and the United Provinces, it is possible that contracts could be entered into at Rs. 3/8/0 per B. G. sleeper: this rate would certainly pay on the Beas and Sutlej but the supply on these two rivers is too small to be worth considering. In the United Provinces I understand the cost of extraction is higher than in the Punjab and, as the B. G. specification should exclude all sleepers showing twist and those with the heart badly placed, I do not think Rs. 4 too high a price: but Tehri supplies are said to be 200,000 and can, possibly, be obtained at Rs. 3/8/0.

Para. 32.—At the rate proposed I should recommend the Punjab guarantee being 5,000 B. G. as a maximum: to be supplied on the Beas and Sutlej.

Para. 53.—I am not at all certain of the soundness of pressure treatment in the case of powellizing. One of the main objections is that the solution attacks iron and may ruin the plant in a very short time. In any case it should be tried out at Dehra Dun to see (1) whether the solution penetrates as well as it does in open tanks and (2) what the effect of the solution is on the plant, before erecting pressure tanks for powellizing.

F. W. ALLUM.

REPORT OF THE SLEEPER ENQUIRY COMMITTEE 1923-24.

I.—THE WORKING OF FORESTS FOR SLEEPERS.

1. There are two methods of working forests for timber (i) departmental and (ii) sale to purchasers. In the case of departmental working, the owner of the forest arranges, usually with petty contractors, for felling the trees, sawing the sleepers, and transporting them to market. In this system of working the sleepers remain the property of the forest owner until they reach the railway. In such cases it is clearly advisable for the railway to deal with the Government or Native State or private owner instead of buying sleepers through a middle man and paying his profits on the transaction as well as the original price of the sleepers. At the present time many thousands of sleepers are being bought through a middle man at Rs. 1-8-0 each over the price at which a local Government or an Indian State has sold the sleepers to the original purchaser.

2. In the case of sale to purchasers there are two main systems and a system which combines the two; the trees may be sold outright or a fixed rate of royalty may be taken on the outturn only; in the combined system a low rate of royalty is fixed on the outturn usually about half the estimated value and, in addition, the purchaser pays a lump sum for the trees, which is usually determined by a public auction subject to a reserve.

3. Whatever the method of sale it is clearly advisable for the railways to deal with the purchaser of the trees in the forest, otherwise they will pay not only the forest contractor's profit but also an additional profit to every intermediary through whose hands the sleepers pass, and in one transaction there are often several such middle men.

4. In some cases where the sale system is in vogue Forest Officers have come to an agreement with Railways for the supply of a certain number of sleepers at a given price, and to ensure the outturn have made it a condition of the sale that the buyer must supply a certain number of sleepers to the railway at the given price. This system works well in practice and has several considerable advantages: on the one hand the buyer, having an assured outlet for his timber, is able to obtain credit when he wants it for the conduct of his work and on the other the Forest Officer is assured of the early payment of his royalty.

II.—THE SUPPLY OF WOOD SLEEPERS.

5. We have enquired of Forest Officers all over India and in Burma of the quantity of sleepers they can provide and from many have received replies informing us of the numbers that can be supplied if the railways will pay more for the timber than the general public but, as there is always competition from this source, we are left to determine what the railways may expect to obtain at a reasonable price.

Deodar.

6. Beginning with Deodar we are informed that the available quantity of sleeper wood is:—

	C. ft.
Kashmir	3,000,000
The Punjab	500,000
The States of Chamba and Jubbal, Jaunsar in the United Provinces, etc.	500,000
TOTAL	4,000,000

7. Last year the public demand for Deodar was much below normal and the depression of the market still continues. Comparing market prices* the railways could secure the whole of this supply at a price which will knock out all substitutes, such as steel, cast iron, or reinforced concrete in the areas where Deodar sleepers have been used in the past.

8. Examining the annual demand of Indian railways for Deodar sleepers for maintenance purposes only in the next five years (Financial years 1924 to 1928) a possible distribution of Deodar sleepers would be:—

Railway.	B. G.	M. G.	—
N. W. Ry. (in thousands)	400	..	
E. I. Ry. "	60	..	
G. I. P. Ry. "	60	..	
B. B. & C. I. "	60	70	
J. B. Ry. "	..	90	
Total No.	580	185	
C. ft.	1,740,000	2,78,000	= 2,000,000.

In present circumstances when the public demand for deodar is small it is certain that the demand can be met, with sufficient margin for specials and ordinary sleepers, required on capital account, at satisfactory prices.

9. It is difficult to say if this happy state of affairs will persist for any considerable time—all that can be done is to examine the question in the light of past history; in the years 1909-15 the price of a B. G. sleeper stood with fair constancy at about Rs. 4/4/0† in the clash of public and railway demands and during this period the railways obtained about 4,50,000 B. G., 3,00,000 M. G. and 50,000 N. G. sleepers annually‡—a total of 1,550,000 c. ft.; from the information before us it is probable that the outturn of Deodar timber suitable for railway sleepers was about $\frac{3}{4}$ of the quantity now said to be available (para. 6 above) and it appears that the railways were able to secure about $\frac{1}{2}$ of the available supply at a satisfactory price, but the pinch of the market was beginning to be felt acutely. Assuming competitive effects will be felt in the future to an equal extent it follows that the railways cannot hope to obtain more than 2,000,000 c. ft. of Deodar sleepers in the near future, at a suitable price.

* See Trade Supplement of the "Indian Forrester" for April 1924—items 82 to 89.

† Appendix VIII, Vol. IX, Part I of Indian Forest Records.

‡ Technical Paper No. 231, Appendix I.

Sal.

10. Turning now to Sal we find that in 1912-13 the Forest Department made a very detailed investigation of the economic value of this wood which is recorded in Vol. II, Part II of "The Indian Forest Memoirs." From this publication we deduce that the quantities of Sal timber, suitable for railway sleepers extracted from the various forests of India and Nepal in 1910-11 were as follows:—

Sal timber of sizes suitable for railway sleepers extracted in India and Nepal. (In thousand of c. ft.), 1910-11.

		Total in thousands of c. ft.	
United Provinces	{	Trees	324
		Logs	12
		Scantlings	705
		1,041	1,041
<i>N. B.—Railways took about $\frac{1}{2}$ the supply for ordinary sleepers.</i>			
Bengal	{	Trees	83
		Logs	235
		Scantlings	5
		Sleepers	146
		469	469
<i>N. B.—Railways took about $\frac{1}{2}$ the supply for ordinary sleepers.</i>			
Bihar and Orissa	{	Trees	51
		Logs	153
		Scantlings	81
		Sleepers	55
		340	340
<i>N. B.—Railways took about $\frac{1}{2}$ the supply for ordinary sleepers.</i>			
Assam	{	Trees	14
		Logs	22
		Scantlings	18
		Sleepers	175
		229	229
<i>N. B.—Railways took about $\frac{1}{2}$ the supply for ordinary sleepers.</i>			
Central Provinces	{	Trees	16
		Logs	24
		Scantlings	2
		Sleepers	70
		112	112
<i>N. B.—Railways took about $\frac{1}{2}$ of the supply for ordinary sleepers.</i>			
Madras	{	Trees	3
		Logs	24
		27	27
Nepal, Railway sleepers			480
Bihar and Orissa Feudatory States and Private forests, Railway sleepers			1,000
			3,098

11. Comparing these figures with the ordinary track Sal sleepers used by Indian Railways at the same period we conclude that when the market is normal the railways can obtain the following quantities of sleepers—

	Thousand c. ft.
United Provinces	350
Bengal	150
Bihar and Orissa Indian Govt.	110
Bihar and Orissa Feudatory States	1,000
Assam	170
Central Provinces	70
Nepal	500
TOTAL	2,350

To this total must be added recent developments which are expected to mature in the near future :

Assam	2,50,000
Nepal	15,00,000

making a total of 4,100,000 c. ft. available for ordinary railway sleepers.

12. Looking at the statement of railway demands for sleepers (Appendix I) we may say that the demands on Sal will be approximately as follows :—

Railways.	No. of sleepers in thousands.	
O. & R.	B. G.	
E. I.	155	Nepal.
G. I. P.	150	Central Provinces.
B. N.	177	Nepal & U. Provinces.
M. & S. M.	90	Nepal.
E. B.	252	Central Provinces.
"	20	
Port of Calcutta	85	Assam.
B. B. & C. I.	82	Nepal.
	30	Central Provinces.
	60	Nepal.
	$1,000 \times 3 = 3,000,000$ c. ft.	
	M. G.	
A. B.	100	C. P., Assam and Bengal.
B. B. & C. I.	350	
Bengal Dooars	25	Bengal & Nepal.
J. B.	47	U. P. and Nepal.
M. & S. M.	30	
B. & N.-W.	270	U. P. and Nepal.
R. & K.	78	Do.
E. B.	220	Assam, Bengal & C. P.
	$1,100 \times 1\frac{1}{2} = 1,650,000$ c. ft.	
	N. G.	
Darjeeling Himalayan	14	Nepal and Bengal
Saharanpur Shahdara	20	United Provinces
Branch lines in Bengal	58	Nepal and Bengal.
B. N.	250	Central Provinces.
	$342 \times 1.1 = 376,000$ c. ft.	
	Total	5,026,000 c. ft.
	or say	50,00,000 c. ft.

13. Taking the figures as they stand it will be noticed that the probable supply is below the estimated demand by 9,00,000 c. ft., the equivalent of 3 lakhs of B. G. sleepers, but there are factors which are likely to modify this conclusion—thus, cast iron sleepers can be obtained now for Rs. 14/- in Kulti and Calcutta and they are a much better financial proposition than a C. P. Sal sleeper at Rs. 9/-, the life of which is stated by the E. B. Ry. to be $12\frac{1}{2}$ years and by the B. N. Ry. to be 15 years; the correct comparative value of the Sal sleeper is between 7 and 8 rupees and it is certain the Indian Railways should and will make strenuous efforts to get the price of C. P. Sal sleeper (B. G.) down to Rs. 8/- when the present contracts expire (1926-27) with comparable prices for U. P. and Nepal Sal. The reduction of price, if effected, will probably reduce the supply.

Pyinkado.

14. Pyinkado is considered somewhat more durable than Sal, but it is expensive to produce (See Appendix II) and if the price of a C. P. Sal sleeper goes down to Rs. 8/- it is doubtful if it will be possible to use it to any appreciable extent to make good a shortage of the Sal supply.

15. At present prices Pyinkado sleepers from Burma can compete with C. P. sleepers, at all events in the vicinity of Calcutta, and a lakh was recently obtained at Rs. 9/4/- c. i. f. Calcutta.

Teak.

16. Last year the slump in the timber trade, was so acute that even Burma teak descended to the level of a sleeper wood and a lakh of mill sawn B. G. sleepers of excellent timber was delivered to the G. I. P. for Rs. 9/8/- a piece c. i. f. Bombay, but such a windfall is not likely to be frequent.

17. On the Bombay side of India a considerable number of half round teak sleepers produced is sufficient to supply the needs of the Bhavanagar, Morvi, Jamnagar and Dwarka railways in Kathiawar (90,000 M. G.). The sleepers are cheap (Rs. 2/12/- to Rs. 3/- each) and have an effective life of 15 to 20 years.

18. The Bombay Forest Department supplies 85,000 M. G. squared teak sleepers to the Southern group at Rs. 4/4/- and at this price they are good value as their life is estimated, after long experience of their use, at 20 years. The Conservator of Forests, Coorg, has told us he can supply 6,600 B. G. and 6,600 M. G. teak sleepers (or say 20,000 M. G.) at approximately the current rates (i.e., Rs. 4/4 for a M. G.) at Yedatore station. The quantity is small but the southern group should take note of it and get into touch with the Conservator. A teak sleeper @ Rs. 5/- (to allow for freight) which will last $17\frac{1}{2}$ years is a better proposition than a steel sleeper @ Rs. 8/- which will last 40 years. The Forest Officer of Mysore State considers he can supply 30,000 M. G. sleepers of teak and doubtless will be prepared to do so at Rs. 4/4 a piece at stations between Harihar and Shimoga.

Malabar 'Hardwood' sleepers.

19. We now come to the most unsatisfactory market for wood sleepers in India, but, fortunately, the demand of the Railways for these sleepers is small.

20. To begin with the estimated demand for the next 5 years, we may exclude H. H. the Nizam's Guaranteed State Railways from the southern group as they want only 2,000 B. G. and 2,000 M. G. a year and intend to obtain most of them from the State forests and, then, we are left with the following demands—

	B. G.	M. G.
M. and S. M. (thousands)	80	137
S. I. (thousands)	33	83
TOTAL	113	220

and from this we must deduct 60,000 M. G. teak, 30,000 M. G. sal and 20,000 B. G. sal, which the M. and S. M. Railway has obtained in the past, leaving about 90,000 B. G. and 130,000 M. G. to be obtained from South Indian hardwoods—4,65,000 or say 5,00,000 c. ft.

21. The hardwoods of South India excluding a small quantity of teak which these railways use for ordinary track sleepers are:—

Local name.	Scientific name.	Life in years.
Irial	<i>Xylia xylocarpa</i>	
Karimaradu	<i>Terminalia tomentosa</i>	6 to 7 years in main line.
Nangal (or Surli)	<i>Mesua ferrea</i>	
Kingu (or Irumbogam)	<i>Hopea parviflora</i>	

22. The price of a B. G. sleeper is Rs. 8/12/- and of a M. G. from Rs. 3/4 to Rs. 4/-, say Rs. 3/8/- on the average, and at these prices there is no difficulty at present in obtaining all the sleepers required by the railways, but the durability of the timber is so little that steel and cast iron sleepers at current prices are far preferable.

23. The demands for sleepers by Indian Railways which are given in Appendix I and referred to above are for open line requirements merely and do not include the requirements for new railways. At the present time projects for constructing 50 miles of M. G. in Assam, 200 miles of B. G. between Herala and Anukpur, and 150 miles of metre gauge extensions of the South Indian Railway system are in hand and other constructions surely will follow. For new construction railways usually prefer to use wood sleepers because of their lower initial cost and, it is perhaps not exaggerating to say that the railways will require 600,000 c. ft. of sleepers a year for such works.

III.—THE NEED FOR SUBSTITUTES.

24. From the above analysis it will be seen that there is bound to be a considerable shortage of sleepers of reliable Indian woods when the timber market returns to normal conditions even for the minimum demands; we estimate the shortage will be about 2 million c. ft. (paras. 9, 16 and 19 above) so that the use of substitutes for Indian woods is inevitable.

25. Apart from the fact that substitutes for the approved Indian woods must be used in any case there is the fact that they have often been useful in the past for keeping down the price of wood and it is certain they will continue to serve the same useful purpose in the future, and this consideration indicates that they will be used often when wood sleepers can be obtained.

26. Steel and cast iron sleepers have long been used in India as satisfactory substitutes for wood and their value can be fairly accurately estimated by railway engineers. Reinforced concrete sleepers are now being tried but it is too early to say if they will prove satisfactory. Another substitute, inferior and less valuable Indian timber rendered durable by antiseptic treatment, was proposed many years ago and its value has been practically tested on a comparatively small scale, but the results are sufficiently definite and sufficiently favourable to demand close attention. The work of the Forest Research Institute, Dehra Dun, and particularly of Mr. R. S. Pearson, C.I.E., I.F.S., the Economist of that Institute, in this connection is too well known to Railway engineers to need comment.

27. The figures in Appendix I show that cast iron and steel sleepers have shared the patronage of our B. G. railways equally with wood and it is safe to forecast that they will hold their own in the future: at present prices wood cannot compete with cast iron and, only to some extent, with imported steel: when India begins the manufacture of steel sleepers, for which arrangements are well in hand, wood will be still more out of the running. In appendix IV* we have indicated how present prices affect the choice of different B. G. railway systems. Wood has been cheaper, comparatively, for metre (and narrow) gauge railway sleepers and there has been no great endeavour to substitute steel or cast iron for it in the past, but even at the present time a steel sleeper delivered f.o.r. Madras for Rs. 8/- or Rs. 9/-, and with a life of 35 years, is preferable to a Western India hard wood sleeper @ Rs. 3/8/0 f. o. r. with a life of only 6 or 7 years.

28. We proceed to examine the question of establishing sleeper treating plants in India.

IV.—THE SUPPLY OF TIMBER SUITABLE FOR ANTISEPTIC TREATMENT.

29. **The Punjab.**—In the North West of India two varieties of timber, Chir (*Pinus longifolia*) and Kail (*Pinus excelsa*) are available in large quantities and they are both eminently suitable for treatment. The annual Kashmir supplies of Chir are placed at a minimum of 150,000 B. G. sleepers, and of Kail at 200,000 B. G. sleepers. The Punjab

supplies are 115,000 Chir and 190,000 Kail B. G. sleepers. The United Provinces could supply 250,000 B. G. sleepers of Chir and 30,000 of Kail. It is believed that these three areas and Tehri could furnish 500,000 B. G. sleepers annually of Chir alone without any Kail. The present prices for both species are abnormally low, so much so that there is difficulty in selling trees.

30. Chir and Kail as B. G. sleepers are now quoted by the Conservator of Forests, Kashmir, as selling Re. 0/8/0 and Re. 1/0/0 per c. ft. and experience indicates that there is little to choose between the two in the matter of treated railway sleepers; certainly the latter is not worth twice as much as the other.

31. For the present experimental period the life of a treated Chir sleeper cannot be taken as more than 12 years and if a Deodar sleeper is valued at Rs. 6/8/0 the cost of a treated Chir sleeper should not exceed Rs. 5/8/0: the treatment will cost Rs. 2/0/0 so that only Rs. 3/8/0 can be paid for an untreated sleeper—and it is believed that this price will be acceptable, at least for the experimental period.

32. The present creosoting plant at Dhilwan is capable of turning out 4 lakhs of B. G. sleepers a year, (and is at present turning out 3 lakhs a year, the whole of which is required by the North Western Railway) and we suggest that the Forest Departments of the Punjab, United Provinces, the States of Kashmir and Tehri Garhwal be asked if they will guarantee 4 lakhs of B. G. sleepers annually at Rs. 3/8/0 each for 5 years, starting from the end of the present contract.

33. We have not referred to the large supplies of Fir (*Abies Pindrow*) and Spruce (*Picea morinda*) which are available as it is very doubtful at present if they will yield satisfactory sleepers and at existing prices of Chir and Kail there is no need to use these timbers at all.

34. There will be no need to put down additional plant in the Punjab, for the treatment of sleepers for some time to come.

35. There does not appear to be any necessity for a sleeper treating installation in the United Provinces while the Nepal Government is prepared to supply Sal sleepers. It is worth noting however, that the forest department of the United Provinces can supply 15,000 B. G. sleepers of Asna (*Terminalia tomentosa*) at a price of Rs. 5/8/0 each which will bring the price of the creosoted sleeper to Rs. 7/8/0 or a little more; recent experiments at Dehra Dun show that the timber takes the creosote mixture thoroughly (7 to 8 lbs. per c. ft.) and it is a very hard strong wood, so that the creosoted product promises to be exceedingly durable; it should serve admirably for special as well as for ordinary track sleepers and we recommend that the North Western Railway contract with the United Provinces forest department for the available supply and creosote the timber for their own use at Dhilwan.*

36. **Central Provinces and Bihar and Orissa.**—The whole of the Sal rearing area on the Bengal Nagpur Railway produces a certain amount of inferior timber, such as *Terminalia tomentosa* and *arjuna*, *Eugenia jambolana*, and *operculata*, *Scheichera olesa*, *Albizzia procera*,

*The gaugers maintaining the Powellized Asna sleepers on the O. & R. Ry. near Lhaksar, now 12 years in the track, told me the timber held dogsplikes far better than U. P. or Nepal Sal—F. W. A.

and odoratissima, *Anogeissus latifolia*, etc., which will probably yield serviceable treated sleepers, but, as these timbers have been sold in small quantities only, no figures of possible outturn can be supplied by the Forest Department. The Forest Officer, Balaghat Division, says he could supply 5,000 B. G. *Terminalia tomentosa* sleepers annually at Rs. 4/0/0 each; the Bilaspur Division could give 4,000 B. G., 10,000 M. G. and 12,000 N. G. at Kargi Road and Pendra Road; the South Raipur Division could give "a large quantity at Rs. 5/0/0 at least." The Forest Officer of Angul Division says that 7,000 B. G. sleepers of *Terminalia tomentosa* could be given annually at Cuttack at Rs. 5/0/0 or Rs. 5/8/0 a sleeper but, as the market rate for such timber has never exceeded Re. 0/12/0 to Re. 0/14/0 a c. ft., the proposed rate appears unduly high. The Forest Officers of other Divisions in Bihar and Orissa cannot give reliable estimates of the outturn of *Terminalia tomentosa*.

37. **Bengal.**—One Division in Bengal estimates the supply of 7 inferior species at 116,000 c. ft. of sawn timber and the price F. O. R. Re. 0/14/0 to Re. 1 per cubic ft. This should mean about 15,000 B. G. and 30,000 M. G. sleepers from one Division, and Kurseong and Jalpaiguri Divisions are situated nearly as well. The Conservator of Forests writes "There are *Hollong* and *Dipterocarpus*, of other species in the Chittagong Hill Tracts but very little is known of the available supply." Mr. R. S. Pearson is enthusiastic about the Gurjan (*Dipterocarpus turbinatus*), *Ajhar* (*Lagerstroemia flos-reginae*), *Bischofia javanica* and the *Eugenia* species in the Kasalong reserve; he says the quantity of fine large trees of these descriptions is very great, they grow on the edge of a river which is unequalled in the world for the purpose of floating timber, and bamboos grow in profusion to assist refractory logs in this respect. He thinks logs could be landed at Chittagong for Rs. 10/0/0 a ton and suggests they be sawn up and treated there to avoid labour difficulties.

38. **Assam.**—A pressure treatment plant has already been installed by the Assam Railways and Trading Co. Ltd., at Margherita for their own use (Dibru Sadiya Railway, coal mines, and sale to the public) and they have obtained forest rights over a considerable area in the Upper Dehing Forest Reserves and the Lakhimpur Frontier Tract. They are using crude oil only for the treatment and have no intention at present of embarking on creosote treatment; moreover, the Manager of the Company, Mr. E. A. Joseph, informs us they have no desire to enter the business of supplying treated sleepers to other Railways than their own (the Dibru Sadiya Railway) and have no objection to other railways putting up plants for the treatment of timber obtained outside their concessions.

Excluding the area over which the Assam Railways and Trading Co. Ltd., have rights there are very large areas of good forests in the vicinity of Nahorkatiya (the Jeypore Reserve) and Moriani which can supply treatable timbers, such as *Sida* (*Lagerstroemia parviflora*), *Hollock* (*Terminalia myriocarpa*), *Sam* (*Artocarpus chaplasha*), *Jutli* (*Altingia excelsa*), *Gahori Sapa* (*Magnolia* sp.), *Ping* (*Cynometra polyandra*), *Hollong* (*Dipterocarpus poliusus*), *Otinga* (*Dillenia indica*), all of which have been treated with a mixture of green oil and earth oil and tested for 8 years under light metre gauge traffic (without bearing plates) with satisfactory results.

The Forest Officer, Lakhimpur Division, writes:—

“Nahorkatiya on the Assam Bengal Railway is admirably situated for the erection of a treating plant. The Dehing river would afford an excellent extraction route throughout the year for sleepers converted in the Jeypore reserve, which contains vast quantities of mature and over-mature Hollong that has scarcely been tapped at all. Nahorkatiya is also connected by a good cart road with the Jeypore reserve and, being situated on the Assam Bengal Railway, would enable sleepers cut in the Barrajan reserve (which also contains excellent Hollong trees in large numbers) to be conveniently brought for treatment from Charali Siding.”

“Large quantities of mature and over-mature Mekai exist in the Jeypore Reserve, mixed with Hollong and Nahor, and it is estimated that 25,000 Mekai (*Shorea assamica*) sleepers would be available annually for the first period of 10 years.”

“The Jeypore reserve might with advantage be exploited jointly by the Railway and Forest departments. An exploitation tram line might be laid along the existing Hakanjuri road which at present extends as far as the Tippam river; this however could be extended southwards to tap large areas of virgin Hollong (with Mekai) forests; the treating plant in connection with this scheme would be erected at Nahorkatiya.

A great deal of suitable timber is also believed to be obtainable from the forests near the railway in the neighbourhood of Moriani and southwards as far as Lunding. Figures of the probable annual outturn cannot be given as accurate surveys have not been made of the contents of these forests, but it is certain that a very large number of both B. G. and M. G. can be produced annually: at least a couple of lakhs of each. Extraction would be fairly cheap and the Assam Government is prepared to accept a low royalty for the material.

39. Bombay Presidency.—There is said to be a large quantity of timber suitable for treatment in Kanara and the Chief Conservator estimates that 60,000 metre gauge sleepers of *Terminalia tomentosa* and as many of other varieties of wood could be supplied annually at Rs. 2/14/0 each which includes only 6 annas for royalty. He adds “collection of material in Kanara is extremely expensive and I do not think B. G. sleepers could be delivered on rail at less than Rs. 6/8/0 a piece which with a royalty of 12 annas would make it cost Rs. 7/4/0.”

40. Mysore.—The Forest Officer of the State said he could supply 2,00,000 M. G. sleepers annually of several varieties at stations between Harihar and Shimoga at a rate which would be about Rs. 2/4/0 each. If the choice was confined to 7 of the more important species the supply would be 1,50,000 M. G. sleepers.

41. Coorg.—In Eastern Coorg (on the plateau) 12,000 B. G. and 12,000 M. G. sleepers of *Terminalia tomentosa* and 16,000 B. G. and 16,000 M. G. of other varieties suitable for treatment could be supplied annually at Yedatore station.

In western Coorg 1,50,000 c. ft. of timber suitable for B. G. and M. G. sleepers when treated can be supplied annually at Azikhil station at present, and the quantity could be doubled in a few years if there was a demand for it.

42. **Madras.**—The Madras Government have supplied no figures but it is known that large quantities of timber useful when treated are available.

43. **The Andamans.**—The Deputy Conservator of Forests writes:—

“We could soon work up to 10 tons (300 c. ft.) a day if the price (Dipterocarpus turbinatus) and Badam (Terminalia procerca). We get at present Rs. 90 a ton in the square for the former and Rs. 70/0/0 (rising) for the latter. We could cut B. G. sleepers as cheaply as N. G., in fact we could probably clear more profit off the larger by selling at the same figure.

“If we get held up in selling squares Rs. 125/0/0 a ton would pay us quite fairly, delivered Calcutta.

“We could soon work up to 10 tons (500 c. ft.) a day if the price offered is good enough. The possibilities of supply are vast and extraction uncommonly cheap.”

A rate of Rs. 125/0/0 per ton (16 B. G. sleepers) is prohibitive for sleepers requiring preservative treatment and, in the case of gurjan, needing bearing plates.

V.—THE PROSPECTS OF ‘TREATED’ WOOD SLEEPERS.

44. Having mentioned the sources from which timber suitable for railway sleepers when treated antiseptically can be obtained we go on to indicate where treating plants should be installed, but before doing so we think it right to refer to the anxiety which we believe is present in the minds of Forest Officers that as soon as the railways succeed in making a ‘good thing’ out of treated sleepers they will neglect the Sal and Deodar and other valuable timbers which can be used without treatment and from which the Forest Department can obtain a higher royalty. Fortunately as regards Government forests there is no occasion for this anxiety for the amount of such timber as Sal and Deodar which they can supply to railways in normal times is relatively small. Burma is an exception but the costs of conversion and freight on Burmese sleepers is so great that it is not likely to be a serious factor in the problem for many a long day. In any case there does not appear to be any danger that the railways will ever decline to take as much of the valuable timber as the forest departments care to give them; when market prices of timber are low the railways can use the treated sleepers in place of steel or cast iron or other substitutes; when market prices are high the forest departments will have less of the valuable timber to sell to the railways and treated timbers will be used in its place.

45. Assam appears to present a good opportunity for the establishment of a treating plant near Moriani; the A. B. Railway is hard put to it at present for M. G. Sleepers and has to import nearly a lakh a year from the Bengal Nagpur Railway Sal area; these cost Rs. 3/4/0 a piece

at present and, allowing Annas 4 for saving in freight, Rs. 3/8/0 could be paid for a treated sleeper which may reasonably be expected to last equally long (12 years).

46. The Eastern Bengal Railway expects to need 210,000 Sal sleepers from the Bengal Nagpur Railway area annually during the next 5 years and, allowing 100,000 M. G. Sal sleepers from Assam and 50,000 from Nepal, it may be estimated that this railway could utilize 50,000 treated sleepers from Moriani and pay at least Rs. 3/4/0 for them without loss.

47. Turning now to B. G. requirements it is noticed that the Eastern Bengal Railway require 167,000 a year, of which Assam hopes to be able to give 100,000 in the near future and Bengal about 10,000 leaving something like 60,000 sleepers for which Assam treated sleepers could compete with C. I., Burmese Pyinkado, and C. P. Sal. Taking C. P. Sal in the vicinity of Calcutta as the standard of comparison it will be seen that the Assam product has a longer lead to Calcutta by about 350 miles which, at 'home line' rates ($2\frac{1}{2}$ pies per ton mile, 12 sleepers to the ton), will cost 6 annas a sleeper: that is, if Rs. 8/0/0 is considered a fair price for a C. P. Sal sleeper, the price for an Assam treated sleeper which may be expected to be equally durable* would be Rs. 7/10/0. But many, if not most, of the Assam treated sleepers would need bearing plates for B. G. traffic and Rs. 1/2/0 should be deducted for these leaving Rs. 6/8/0 as the allowable price for a B. G. treated sleeper at Moriani. Deducting Rs. 2/0/0 for the cost of treating a B. G. sleeper and Re. 1/0/0 for a M. G., the allowable price for untreated sleepers at Moriani must not exceed Rs. 2/4/0 and Rs. 4/8/0, respectively.

48. Estimating sawing, felling, and stacking, at Annas 8 a c. ft., conveyance to railway line @ Annas 4 a c. ft., supervision charges and profits @ Annas 6 a c. ft., and royalty @ Annas 3 a c. ft. we get Rs. 2/0/0 as the price of a M. G. and Rs. 4/0/0 for the price of a B. G. sleeper.

49. We would remark, parenthetically, that in estimating the cost of carrying sleepers by railway in such calculations as the above the lowest rate which will cover the actual expense of the carriage (treated as 'additional' traffic) should be used: the rate actually charged may be and is probably much more but the excess over actual cost (which is credited to railway revenues) should be credited in such calculation to working expenses. For the present we are taking the home line revenue rate of $2\frac{1}{2}$ pies per ton mile to represent the actual cost of carriage.

50. It is probable that the Assam Government will accept a lower royalty than Annas 3 a c. ft., on the outturn, at least while the scheme is in an experimental stage—say for 10 years.

*In our discussion of treated sleepers we have assumed on the basis of present experience that they will live for 12 years—i.e., about as long as C. P. Sal—under fairly heavy traffic on B. G. Railways provided adequate bearing plates or chairs are used where necessary, but this is almost certainly a low estimate. In the Bulletin of the International Railway Association for August 1921 it is stated that "on the London and North Western Railway the creosoted sleepers ('Red fir' principally from the Baltic) have a life of about 20 years in the main line" and I am not aware of any cause to prevent treated sleepers of suitable Indian timber from attaining an equal life if equally good bearing plates, fastenings and ballasting are supplied. Chief Engineers of Railways all over India are inventing new forms of the cast iron sleepers so I may be excused for strongly advocating the 'treated' sleeper: in this connection I would repeat what a great French mathematician said to the readers of his books "Go ahead and faith will come to you."—F. W. A.

51. We consider the project for installing a plant for treating 3,00,000 c. ft. of timber, chiefly M. G. sleepers, with a mixture of creosote and oil promises success, and we suggest that the authorities of the Assam Bengal Railway be asked to submit an estimate and report on the financial prospects at an early date.

52. Even after the railways have decided that the scheme is promising a very detailed survey of the forest resources in the area to be worked in the first 20 years, by which time the cost of the plant could be written off, must be made as there must be no doubt whatever that the resources are ample before the plant is installed.

53. In South India treatment is the only solution for the sleeper difficulty and we recommend powellizing which is easily applied to hardwoods, as effective as creosote, so far as the experiments of the Dehra Dun Forest Research Institute show, and will be cheaper in Southern India where molasses can be obtained at a favourable rate: furthermore, it is not wise to put all our eggs in the creosote basket as we have to depend for some time on Europe for our creosote. The Chief Engineers of the South Indian and Madras and Southern Mahratta Railways are in favour of powellizing and Mr. Pearson has put forward the suggestion that the tanks should be fitted for pressure treatment so that a change over to creosote treatment or to a pressure treatment of the powellizing mixture can be effected without scrapping of plant: the additional cost of such tanks will not be great.

54. Prices for most of the timbers used for sleepers at present in South India are high and their life is absurdly short. Large forest exploitation schemes are now bringing timber on the market, relying on exports to Europe, and it is fairly safe to prophesy that some of the timbers being extracted will be difficult to place on the European market: some of these should be available at prices sufficiently low to make treated sleepers economical. There are two big forest exploitation schemes, one in the Western forests of Coorg bringing timber to Azikhil, and one in Madras bringing timber to Olavakot. The Coorg scheme is the more advanced but, as the forest department is negotiating with a private firm to establish a saw mill to take over the whole outturn of logs, it is not in a position to entertain any definite proposals for sleepers at present. The Coorg Forest Department is prepared to deliver logs at a mill at 10 annas or, in some cases, 8 annas per cubic foot. At this rate, allowing 40 per cent. waste in conversion and off-cuts, and paying Re. 1 for sawing a B. G. sleeper costs just under Rs. 4/0/0: adding Re. 1/0/0 for profit and Rs. 1/8/0 for powellizing, a treated sleeper will cost Rs. 6/8/0 which is a reasonable price even for timbers requiring bearing plates. The Madras scheme is more favourably situated but is not so far advanced as the one in Coorg: the costs of bringing logs to a mill are likely to be about the same as in Coorg but it is understood that a more or less fictitious supervision charge of 6 annas per cubic foot is to be added: as this will increase the price of sleepers by Rs. 2/0/0 each it is evidently better to obtain supplies from Coorg. We suggest that the Forest Departments in Coorg and Madras be approached with an offer to take "approved" west coast timbers at Rs. 5/0/0 and Terminalia tomentosa and paniclata B. G. sleepers at Rs. 6/0/0 per B. G. sleeper provided sufficient can be guaranteed to make a treating plant worth

erecting. By 'approved west coast timbers' are meant those mechanically suitable for sleepers and capable of being treated: this should be ascertained as soon as possible from the Forest Research Institute, Dehra Dun, as only a few of the species in question have been tested though many others are now under trial at Dehra Dun.

55. We have said above that Coorg is willing to co-operate with the railways in the treating of timber on what we think are favourable terms and we have considerable hopes, after interviewing the Forest Utilization Officer of the Madras Presidency, that Madras will do likewise.

56. There appears also to be an opportunity for the treatment of sleepers obtained from Kanara, Eastern Coorg and Mysore: excluding a small quantity of teak metre gauge sleepers; which, when the market is normal, cannot be expected to exceed 50,000 from Kanara, 15,000 from Coorg and 20,000 from Mysore, no untreated wood sleeper can compete with the steel sleeper for metre gauge lines but the lead of steel sleepers in this area is considerable and, so far as can be foreseen, will remain as it is: the Madras and Southern Mahratta Ry. is taking 15,000 *Terminalia tomentosa* a year from the Kanara forests at Rs. 3-4-0 and it is safe to say that they will prove uneconomical: the Mysore State railways are taking untreated hard woods: the Nizam's Guaranteed State Railway estimates a need for 36,000 B. G. and 64,000 M. G. steel sleepers annually during the next 5 years. If *Terminalia tomentosa* sleepers (a strong and hard timber needing no bearing plates, holding spikes as well as sal or pyinkado and found by actual tests of 10 to 12 years to be durable when powellized) can be supplied at railway stations at Rs. 6-0-0 for B. G. and Rs. 3-0-0 for M. G. sleepers, and other varieties of likely timber at Rs. 5-0-0 and Rs. 2-8-0, respectively, and allowing Re. 1-8-0 and Annas 12 respectively, for powellizing, these sleepers will beat all competitors except teak which we have expressly excluded.

57. There is, further, the considerable demand for special sleepers for bridges and points and crossings and for constructional timbers for which the railways are paying very high rates at present: treated *Terminalia tomentosa* at least and, probably, other timbers could take the place of the first class timbers now used by the railways with much advantage.

58. It is certain that the Coorg and Mysore and even the Kanara Forest Administrations will be prepared to supply *Terminalia tomentosa* and other sleepers at the rates given in para. 56 above in sufficient quantity to enable the railways to start the treatment of sleepers on a reasonable scale.

59. The Forest officers we have interviewed quite recognise that the treatment of second class Indian woods is experimental and they are willing to co-operate with the railways in the experiment by charging as low a rate of royalty as they possibly can; they are prepared to classify the sleepers they supply for treatment according to species, to pass the sleepers to the satisfaction of Chief Engineers of railways (as the ultimate court of appeal), and to accept responsibility for the fulfilment of their contracts with the railways. We consider that for treated sleepers railways should place contracts directly with the forest department: it may be necessary to aid them with funds in advance of supplies

but in dealing with responsible people this will involve no risks and, as a matter of fact, it has been done already in one important instance.

60. We know that the Chief Engineers of the Madras and Southern Mahratta and South Indian Railways are in favour of treating sleepers if the experiment promises a fair chance of success: we believe it does, and we recommend that the Agent of the Madras and Southern Mahratta be asked to consider the desirability of installing timber treating plants as soon as possible in Southern India in consultation with the Agents of the B. B. C. I., G. I. P., N. G. S., Mysore State, and South Indian Railways and of the Forest departments of Coorg, Mysore, Madras, Cochin and Travancore. The railway systems in the South of India have already obtained a good deal of information regarding both powellizing and creosoting treatments: if, as we believe, they can obtain timber at a reasonable rate from the various forest departments the advantage of treatment is practically assured: it only remains to co-ordinate the demands of the various railways and to install sleeper treating plants of suitable size at convenient sites and at the cost, in proportionate degrees, of the railways interested in the project.

VI.—THE SPECIFICATION OF RAILWAY SLEEPERS.

61. Several Forest Officers we have interviewed or consulted have protested against the exacting standard of sleeper the railways demand. They say that the standard is unnecessarily high and, certainly, the specified standard of most railways, perhaps of all, supports their contention, and in some cases the specification has deterred prospective suppliers. In actual practice, however, experienced passing officers of the railways do not follow the specification exactly and accept a sleeper with blemishes not allowed by the specification but which, in their judgment, will have no deleterious effect on the life or efficiency of the sleeper; and it is doubtful if the sleepers taken over by the railway on the whole are above the right standard. Experienced contractors recognise that this is the railway practice, and tender on the assumption that the specification will not be adhered to rigidly. Nevertheless, we consider it is quite practicable to draw up a brief specification of the minimum requirements of a sleeper of a given species of timber which will leave very little to the mere judgment of the seller or of the passing officer.

62. One railway specification runs as follows:—

“The sleepers are to be of first class sound and seasoned wood, perfectly straight and out of winding, sawn uniformly square and free from sapwood, heart shakes, large cracks, or rotten knots, or knots which may interfere with the driving or screwing of spikes, or other defects which may affect the life of the sleepers. Every sleeper shall be of the full specified dimensions throughout; all undersized sleepers will be rejected.”

“Wane will be allowed, provided always that it does not occur in more than five per cent. of any lot under inspection, and that it does not measure more than one and a half inches on any face.”

and it is certain that if it was literally followed very few of the sleepers put up for inspection would pass the test.

63. Some railways accept two or even three classes of sleepers but this in our opinion is bad practice and unnecessarily adds to the difficulties of passing officers. It is sufficiently tiresome and difficult to decide if a sleeper is suitable: to place it in one of the 2 or 3 classes is an appalling task if it is done carefully.

64. One railway classifies sleepers as 1st or 2nd class, or serviceable, or rejected. They are taken over on the results of close examination of 10 per cent. of the sleepers and in a recent form of contract the whole supply is taken over at the one price if (i) the 2nd class and (ii) the serviceable and rejected sleepers together do not exceed certain percentages: a specification which reminds us of the specification of Indian wheat for export which permitted 5 per cent. of dirt so the wheat was sent clean and sweet to Karachi and then 5 per cent. of Karachi earth was duly added to each bag. It was explained to us that the number of sleepers taken over annually was very large and that it would not pay to examine each sleeper individually but the exercise of a little arithmetic will show, we believe, that this conclusion is wrong.

65. In our opinion the specification of railway sleepers should be sufficiently elastic to embrace all the sleepers that the railway will take in a single class, all others being rejections; the sleepers are required for a given purpose and all sleepers that are expected to fulfil that purpose should be taken and only such:—in dealing with the material of which sleepers are made it is impracticable to make fine distinctions of splendid, good, and not quite so good.

The specification should deal with each variety of sleeper, Deodar, Sal, etc., separately; it should define the minimum and maximum lengths, the minimum thickness and the minimum width.

66. Most of the sleepers supplied to railways are hand sawn and some departure from the specified dimensions must be expected but such departure should be on the outside of the minimum. Forest Officers are unanimous that nothing should be done to encourage carelessness or deliberate wrong doing on the part of sawyers.

67. The specification of the minimum width will need careful definition—in most timber we want to avoid having the heart near the centre of the cross section of the wood. Cracks start from the centre and spread out radially in all directions, getting finer as they go, and the least cracked and most durable sleepers are obtained from the wood near the sap: but if a sleeper is cut from small trees, and we must accept the fact that they frequently are, and if it is to be free of heart the top width will be less than the standard dimension.* All sapwood in untreated sleepers, even in teak, must be rigidly excluded from consideration; it should not be cut away from the sleeper, as this operation will enhance the price of the sleeper to no purpose whatever, and it will decay and drop off in its own good time, but it cannot be regarded as sound wood. Excluding sap there is a minimum width of sound wood at the

* If we accept the theory of the "narrow bearing" which we consider to be sound this is all to the good.

rail seat and for a short distance on either side which should satisfy the railways: we suggest $8\frac{1}{2}$ " for a B. G. and $6\frac{1}{2}$ " for a M. G. sleeper: elsewhere in the length of the sleeper the minimum top width may be less, let us say 6" for a B. G. and 4" for a M. G. sleeper: the minimum width of the opposite face should be the standard width.

68. If a relaxation of the standard width of the top surface of a sleeper, such as we have suggested, is accepted it may be considered necessary, in order to prevent deliberate attempts to cut undersized sleepers, to specify that only a small percentage of the sleepers offered to the railway will be approved but, if the specification expressly lays down that the width of the under surface of the sleeper (nearer the centre of the log) must be not less than the standard, this proviso will not be necessary.

69. A clear definition of the 'knots' and 'shakes' that will be tolerated is not easy but something more precise is possible than the usual clause which runs somewhat like this "the sleepers must not contain large knots or shakes likely to shorten their life and no knots of any kind where the rail seats and spikes will come." A careful inspection of old sleepers in the track will show the size of knot near the rail seat or elsewhere in a sleeper, of sal or deodar or other wood, which may safely be expected to have no effect on its useful life.

70. Cracks are the chief bugbear of the passing officer in the case of Sal and Pyinkado and other hardwood sleepers and the most frequent cause of complaints against his judgment. A clause like that of the Western Australia Government which runs thus "Every sleeper shall be free from pronounced sun cracks and seasoning cracks which run more than six (6) inches into either end."

71. We are firmly of the opinion that if the railways will freely accept the 'minimum' sleeper that will satisfy all their requirements they will obtain sleepers at a lower price than they do at present. One prominent firm of dealers in railway sleepers declared with much self-gratulation that they never 'picked over' the sleepers they produced and sold the best of them to the public. Our inspection of the sleepers they had supplied to the railways has not convinced us that much virtue can be attached to their claim. Apart from our own opinion there appears to be no reason why the absolutely best timber that is produced should not be devoted to more noble uses—the railways do not really want it for sleepers.

72. To increase the range within which railways can obtain Indian timber we invite their consideration of the "half round" sleeper, which is simply a log of small diameter sawn through the middle into two sleepers; teak sleepers of this description are already in use on the Bombay side, chiefly by metre gauge railways, and to a small extent on the B. G. section of the B. B. and C. I. and the Chief Engineer of this railway, Mr. Arnould, says they are the best sleepers he has. His specification says:—

"If half round sleepers are offered it should be noted that the absolute minima after adzing for rail seat should be width 8" and depth 5" for broad gauge and 6" and $4\frac{1}{2}$ " respectively for metre and narrow gauge."

but a more practical specification, which we believe is in use on a metre gauge railway, that depends on half round timber for its sleepers, would lay down a minimum width of base and a minimum depth, both exclusive of sap wood, within 6 inches on each side of each rail seat.

73. Many of the half round sleepers we saw in the road were not nearly as wide as the B. B. and C. I. have specified but they were very good. Mr. Barrie, Chief Engineer of the E. B. Railway, showed us some that had been sent from the Central Provinces as samples to his order which were thoroughly useful sleepers: Mr. Gibbs, the Sleeper Passing Officer of the B. N. Railway group whose experience of Sal sleepers is unrivalled, is strongly in favour of half round Sal sleepers as a measure of economy.

74. A log 13" in diameter, exclusive of sap, or 15" diameter including sapwood, will give one squared sleeper 10" x 5" with the heart in the middle, the worst possible position, but the same log will yield two much more serviceable half rounds and the cost of conversion will be reduced.

75. We are of opinion that a half round sleeper of timber that has been proved to be durable without treatment, such as sal and deodar or teak is worth the consideration of railways: regarded as a second class sleeper it is worth the price at which it can be offered.

76. We have been informed that some passing officers will not accept a hewn sleeper and one contractor was candid enough to tell us that he often rough hewed sleepers and then planed them, which operations were cheaper than sawing, in order to satisfy the sleeper inspector. The objection to hewn sleepers appears to be unreasonable.

77. We recommend that the sleeper pool consider the questions of using half round sleepers, and of the desirability of more detailed and more elastic specifications of the principal untreated sleepers that are now in use.

We suggest that the various groups of the pool should draw up specifications of the sleepers with which they are most familiar, and should obtain the advice of the chief forest officers in their districts and their approval of the specifications in their final forms.

VII.—METHODS OF PURCHASE AND CONSIDERATIONS OF PRICE.

78. At present railways purchase their supplies of wood sleepers almost entirely from contractors who obtain forest leases from the Forest Departments and sell the timber in the required form to the railways and general public. The railways, with a few exceptions, have grouped themselves into territorial divisions each of which has a single agent, the Chief Engineer of one of the railways in the territory, for the purchase of sleepers within its boundaries: the collection of groups is called the Pool. The system was put into effect a few years ago with the object of eliminating competition between railways and thus keeping down prices.

79. The railways that have adopted the pool system communicate their requirements annually to the groups with which they wish to deal and the groups place out contracts for the required quantity: tenders are invited publicly and contracts are let in the usual way.

80. We are of opinion that the prices thus obtained are not really competitive as the tenderers either combine to ask for much the same rate, or the rate at which the fashionable tenderers propose to sell their sleepers leaks out and their competitors group their offers as near to this rate as they consider wise.

81. Forest officers all over India have remarked that the railways should pay the "market price" for timber when buying sleepers. In the abstract this seems sound but there is a tendency to base the market price on prices paid by the public for comparatively small quantities of timber sold after the railway demand has been satisfied. In fixing a price to be paid for sleepers the railways can reasonably claim a rate well below the market price, if this price is seriously affected by the demands of the railway, and, as the only purchasers on a wholesale scale, are entitled to get the reduction that any business firm would expect in similar circumstances. The term "market price" was used in the case of Sal in the C. P. and Bihar where, except for sleepers, there is scarcely any demand for Sal timber. Here, the market price merely means the rate the railways care to pay.

82. Chief Engineers of railways appear to have paid little attention in the past to the cost of producing sleepers and they have not been in a position to gauge the public demand for timber, with the result that contractors have forced up prices and the Forest Departments, seeing that the rates for sleepers have risen, have raised the royalty in order to share the extra profit made by contractors. Very probably it was in this way that the harmful system of fixing royalties, which has been referred to in paragraph 3 of the introduction, originated.

83. We have not been able to determine quantitatively how valuable the custom of the railways is to the Forest Department in the matter of timber that is sufficiently durable for sleepers without treatment, such as Deodar, Sal and Pyinkado; of course it varies from year to year and is different in each forest area; from published statistics it would appear that in the Deodar area, comprising the Punjab, Kashmir and other Indian States, the consumption by the railways is only 1/5th of the total production in normal years, but the current distress among dealers who have not got a railway contract throws considerable doubt on this conclusion. Some statistics of the trade in Sal show that railways take only 1/4th of the total quantity that is marked, but this result is based on figures that include poles for scaffoldings, derricks, pit-props, rafters, ballahs and posts for village houses and timber for many other common uses which are obtained from trees that could not provide railway sleepers. On the other hand the principal merchants who deal with railway requirements in the Central Provinces and Bihar and Orissa, where more than half the supply of Sal sleepers is obtained, have told us that the public demand for sawn Sal timber of good quality, exclusive of the railway demand, is so small as to be negligible. Only one or two Forest Officers have definitely said to us that they considered the custom of the railways of great importance.

84. Whatever may be the full value of these considerations it is clear that the custom of the railways is of appreciable value to the Forest Departments in most parts of India, and even in Burma, where the

predominating value of teak overshadows the importance of other timbers.

85. We have been told repeatedly by Forest officers, and the belief appears to be general among them, that the railways prefer wood sleepers even when steel or cast iron sleepers are more economical, but there is little real foundation for the belief in the case of main lines with the heaviest and fastest traffic in India, and absolutely none in the case of second class and branch lines which constitute much the larger portion of railway mileage. The best track in India is laid largely on cast iron sleepers, and the definite policy of one of the principal Broad Gauge railways in India is to lay the main line with cast iron sleepers and relegate wood sleepers to branches and sidings. On the whole it may be accepted that Indian Railway Engineers decide to use wood or metal sleepers solely on considerations of the life and price of the sleeper.

86. In paragraph 2 of our introduction we have referred to the conflicting interests of the State Forests and State Railways of India and the best that can be hoped for is a compromise, to effect which we suggest it should be officially ordained that, some time before the Chief Engineers of the various groups place their annual contracts for sleepers, the Chief Forest Officers of the provinces concerned with each group should hold a formal discussion, either in person or through their Utilization Officers, with the Chief Engineer of the group. The Forest Officers of the principal Indian States and other private owners should be invited to the meeting, or permitted to attend if they desire to do so, and the proceedings of the discussion should be reported to the Local Governments concerned and the Railway Board by the Chief Forest Officers and the Chief Engineer of the group respectively. The Forest Officers should be able to say at the meeting how much timber suitable for sleepers they can turn out, what the public demand for such timber is likely to be, and the price they expect to realize from the public in the light of the past few years, the quantity they can supply to the railways, and the price they expect for it: the price at which the sleepers are offered, the price the railways are willing to pay, and their reasons for fixing this price should be examined in full detail, and every effort made to fix a price satisfactory to both the Railways and Forests Departments.

87. We are aware that informal discussions have been held in the past between the Forest Officers of the Indian Government and the Chief Engineers of Indian Railways—with results which the Indian Railways, at all events, consider unsatisfactory. The matter, so far as it concerns the Forests and Railways of the Indian Government, appears to be a question of policy and we now recommend that the discussion between R. the Forest and Railway Departments of the Government of India should be an official fixture; that the proceedings should be reported soon after the meeting to the Provincial Governments and the Railway Board, so that, in the event of disagreement between the Railway and Forest Departments, a compromise may be effected, if possible.

88. The procedure recommended above may seem cumbrous, but we do not think it will be found so in practice as we are in favour of long term contracts, of from 3 to 5 years duration, in spite of the fact that the railways, having made 'forward' contracts when prices for sleepers of

all varieties were high, are now lamenting their losses when prices are falling. Forest leases, usually, must be of long duration, 3 to 5 years, to enable contractors to realize the full value from their venture—and even when owners of forests contract direct with the railways they must know their liabilities for a considerable time ahead, to enable them to lay out money for roads and plant with confidence.

The Forest Officers of the Punjab and of Kashmir State have already agreed to recommend the adoption of such a system for fixing prices to their respective Governments.

89. In the case of forests belonging to the Government of India we consider that contracts for the supply of sleepers should be made direct with the Forest Department of each province. Several Forest officers have expressed this view, and though past experience of direct dealing is not altogether in its favour, there is no reason whatever why the system should not be altogether successful. Forest officers know the individuals to whom they have given leases and the amount of timber each can be trusted to take out, which the railways do not: the railways want their sleepers delivered at as low a rate as possible and, unless they deal with persons who have forest leases, they must introduce a middleman and his profits into the transaction. Where a province or a private owner of forests is unwilling to enter into a direct contract with the railways or, in the case of an Indian State, where a contract with the State is ineffectual in law the contract should only be given to contractors who can prove that they have forest leases.

VIII.—THE RAILWAY SLEEPER 'POOL.'

90. Most of the railways of India have recently come to an agreement by which India and Burma are divided into territories producing wood sleepers, and all sleepers they require from any territory are purchased, passed and despatched for them by the order of an appointed officer, the Chief Engineer of one of the railways in the territory: the system was devised to bring to the knowledge of the railways in the 'pool' the extent of the supply, to make a fair division of the supply among them, and to prevent reckless competition when wood sleepers were urgently required and the supply was deficient: this combination of the railways has made it economical to employ 'whole time' controlling and passing officers in each territory whose sole duty is to attend to the purchase and distribution of sleepers from their territories: these officers become acquainted with the conditions of the sleeper market in which they are concerned, and acquire a thorough knowledge of the qualities, good and bad, of the timbers with which they deal: sleeper suppliers in any territory know the officer and, more particularly, the passing officer with whom they must deal: in the bad old days a railway purchased sleepers at a place often miles away from the portion of India with which its officers were acquainted, at a price which was obtained by tender and not regulated by intimate knowledge of the conditions of supply: they were passed by an officer of the railway sent to the place, or by an officer of a railway passing near the place who was deputed to the task by a friendly arrangement between the two railways, and in either case any old Dick, Tom, or Harry was sent to do the work, and

not always the same man for two consecutive years: naturally, suppliers of sleepers have complained of the idiosyncrasies of passing officers with which they had to contend in the past and, though some contractors are averse to the railway sleeper 'pool' possibly because the element of a gamble has been eliminated, we are confident that the 'pool' for the purchase of railway sleepers is a sound system in the interests of both railways and sleepers suppliers. The Chief Engineers of railways in the 'pool' all favour the system, though they consider improvements can be effected in the rules, and none of the Forest officers we have interviewed has objected to it seriously.

91. The Chief Engineers of the railways in the pool decide about July of every year how many sleepers they are sure they will require for the next official year, and the various 'groups,' or territorial divisions of the pool, place contracts for the total number of sleepers demanded by the railways, or such number as they can secure from their areas, in October, and these may be called the 'principal' contracts for sleepers for the year: as a matter of fact, the wise ones in charge of the groups place their principal contracts for much less than the quantity required by their clients, for the Chief Engineers who announce their demands in July for the next financial year, though they may have the approval of their Agents in their pockets, have no credit whatever, as none can say what the grant for next year may bring forth, and so the heads of 'groups' apply a factor of safety, depending on temperament, to their calls for the principal supplies: for 'long term' contracts we daresay the factor of safety is increased. We consider the hazard of such transactions can be and should be removed.

92. It frequently happens, when the principal contracts have been let, that railways require more sleepers and find they are able to pay for them, but it is one of the rules of the pool, we understand, that the clients of a group pay the average price (worked out at the end of each year) for the sleepers purchased for them by the officer of the group: to be more definite, if the principal contract for all the railways dealing with a group is 4 lakhs @ Rs. 8-0-0 each, and then 20,000 sleepers are bought for a railway @ Rs. 6-0-0, that railway pays, not Rs. 6-0-0 for each sleeper but, within a small fraction of Rs. 8-0-0, i.e., the average price of 4.2 lakhs of sleepers purchased for 33.2 lakhs of rupees. The effect of this rule may be illustrated by the following example: a railway worked by a company wanted 40,000 sleepers and wood sleepers @ Rs. 6-8-0 or Rs. 7-0-0 were available in India but, because the railway was part of a group that had contracted for a large number of sleepers @ Rs. 8-0-0 each, the cost of the sleepers was correctly assessed by the railway at nearly Rs. 8-0-0, at which price a steel sleeper from Europe was a little more economical and was ordered: had the cost of the wood sleeper been taken at its actual price the advantage was in its favour but, because of the pool rule, it was lost. A Chief Engineer of the pool with whom we have discussed this rule argues that there is no point in a pool unless its members are prepared to share the cost of its transactions equally but we do not accept this conclusion; the essential advantage of the pool lies in the appointment of a single agency for the purchase, selection, and despatch of the sleepers from a given area: we acknowledge the advantage of placing all contracts of the group through this agency and recognise the stability of the prin-

cipal contract but, when this has been placed, we consider that each R. railway in the group should be free to purchase the additional sleepers it requires (through the group agency, of course) at the competitive price at the time; otherwise, the initiative of both purchasers and suppliers is killed and, as we have just exemplified, uneconomic results may be induced.

Summary of Principal Recommendations.

1. A small creosoting plant should be established in North Eastern Assam, and the Agent Assam Bengal Railway should be asked to submit a report on the financial prospects and an estimate of cost by an early date.—Paras. 51 and 52.

2. One or more sleeper treating plants should be installed in South India.—Para. 60.

3. The sleeper pool should consider the desirability of using half round sleepers, and should draw up more elastic specifications of sleepers in consultation with forest officers.—Para. 77.

4. The prices of wood sleepers in each area should be fixed from time to time in formal conference between Forest officers and Chief Engineers of Railways, and the results of discussions should be reported to the Local Governments and the Railway Board.—Paras. 86 to 88.

5. In the case of forests belonging to the Government of India contracts for the supply of sleepers should be made direct with the Forest Department of each province.—Para. 89.

6. The Pool system of purchasing wood sleepers should be retained.—Para. 90.

7. After the railways have placed their principal contracts for wood sleepers they should be free to purchase additional sleepers (through the group officers) at the market price.—Para. 92.

F. W. ALLUM.

R. N. PARKER.

Sleepers in Indian Railways,

Railways.	WOOD.			CAST IRON.		
	Main Line.	Sidings.	Total.	Main Line.	Sidings.	Total.
5' 6" GAUGE.						
Bengal Nagpur	1,784	682	2,466	721	43	764
B. B. and C. I.	1,138	509	1,647	1,325	109	1,434
Bombay Port Trust	270	..	270	..	..	..
Calcutta Port Commra.	50	203	253	..	..	..
Eastern Bengal	1,609	413	2,022	140	253	393
East Indian	2,573	1,064	3,637	4,648	1,241	5,889
G. I. P.	1,705	..	1,705	7,109	..	7,109
	(incl. sidings).			(incl. sidings).		
M. and S. M.	649	116	765	2,523	556	3,079
Nizam's Gtd. State	179	35	214	79	28	107
North Western	10,156	1,596	11,752	1,138	..	1,138
Oudh and Rohilkhand	2,148	286	2,434	650	109	849
South Indian	266	34	300	595	79	674
TOTAL	22,537	4,938	27,475	18,928	2,508	21,436
3' 3½" GAUGE.						
Assam Bengal	1,986	353	2,339	..	..	..
Bengal Dooars	308	41	349	..	..	..
Bengal and N. W.	3,949	749	4,698	100	48	148
Bhavanagar	569	79	648	..	..	..
Bombay, Baroda and C. I.	4,650	750	5,400	154	38	192
Burma	3,847	905	4,752	..	..	..
Dibru-Sadia	182	95	277	12	10	22
Eastern Bengal	2,230	560	2,790	15	47	62
Gondal	334	31	365	..	..	..
Jamnagar and Dwarka	336	..	336	..	..	..
	(incl. sidings).					
Jodhpur Bikaner	2,260	..	2,260	3	..	3
	(incl. sidings).					
Junagadh	273	30	303	..	..	..
M. and S. M.	1,494	260	1,754	..	..	..
Morvi	167	16	183	..	..	..
Mysore	525	57	582	..	..	..
Nizam's Gtd. State	75	104	179	..	..	..
Rohilkund and Kumaon	1,156	237	1,393	..	..	..
South Indian	782	214	996	1,685	146	1,831
Udaipur Chhittorgarh	262	18	280	..	..	..
TOTAL	25,385	4,409	29,894	1,969	289	2,258
NARROW GAUGE.						
Arakan Light	3	..	3	..	..	..
Arrah Sassaram	130	10	140	..	..	..
A. K., B. K., B. D., K. F., and J. J.	416	38	454	..	..	..

I.

1924. (In thousands.)

STEEL.			OTHER KINDS.			Grand total of each line.	REMARKS.
Main Line.	Sidings.	Total.	Main Line.	Sidings.	Total.		
1,831	426	2,257	..	..	..	5,487	Approx.
373	15	388	..	..	..	3,469	
..	3	3	..	..	..	270	
..	..	..	..	..	..	256	
..	..	..	..	..	..	2,415	
607	..	607	..	..	..	9,526	
(incl. sidings).	..	..	..	..	..	9,421	
214	24	238	..	..	..	4,082	
464	58	520	..	..	..	841	
956	..	956	132	..	132	14,078	
269	126	395	19	21	40	3,718	
..	..	..	..	..	..	984	
4,714	650	5,364	151	21	172	54,574	
..	..	..	..	..	..	2,339	
..	..	..	..	..	..	349	
..	..	..	..	..	..	4,846	
..	..	..	..	..	..	648	
154	..	154	..	..	..	5,746	
33	..	33	..	..	..	4,785	
..	..	..	..	..	..	299	
..	..	..	..	..	..	2,852	
54	12	66	..	..	..	431	
..	..	..	..	..	..	336	
709	..	709	19	..	19	2,991	
2,198	185	2,383	..	2	59	303	Approx.
..	..	..	57	..	..	4,196	
..	..	..	..	..	..	183	
1,198	37	1,235	..	..	..	582	Approx.
..	..	..	..	..	..	1,414	
184	19	203	..	..	..	1,393	
..	..	..	..	..	..	3,030	
..	..	..	..	..	..	280	Approx.
4,530	253	4,783	76	2	78	37,003	
29	..	29	..	..	..	32	} Approx.
..	..	..	..	..	..	140	
..	..	..	..	..	..	454	

Sleepers in Indian Railways,

Railways.	WOOD.			CAST IRON.		
	Main Line.	Sidings.	Total.	Main Line.	Sidings.	Total.
* NARROW GAUGE—contd.						
Baraset Basirhat	104	9	113	..	..	..
Baroda Durbar	600	70	670	..	..	..
Barsi Light	9	..	9	..	..	..
Bengal Nagpur	1,853	170	2,023	..	..	..
Bengal Provincial	68	2	68	..	..	..
B. E. and C. I.	135	12	147	..	..	..
Bukhtiarpur Bihar	66	7	73	..	..	..
Cutch State	74	5	79	..	..	..
Darjeeling-Himalayan	280	29	309	..	..	..
Dehri-Rohas	50	10	60	..	..	..
Dholpur Bari	30	3	33	..	..	..
Futwah Islampur	53	3	56	..	..	..
G. I. P.	22	3	25	67	5	72
Guzerat	13	2	15	..	..	..
Gwalior Light	336	16	352	..	..	..
Howrah Amta	88	12	100	..	..	..
Howrah Sheakhala	36	3	39	..	..	..
J. B. (Pipar Bilara Lt.)	45	1	46	..	..	..
Jorhat Provincial	65	2	67	..	..	..
Kulasakara Putnam Lt.	17	..	17	..	..	..
Madaya Light	30	2	32	..	..	..
Morvi	8	1	9	..	..	..
Mysore	258	10	268	..	..	..
N. G. S. . . . .	..	..	..	..	..	..
North Western	784	174	958	..	..	..
Shahdara Saharanpur	207	18	225	1	..	1
South Indian	207	11	218	..	..	..
Tezpur Balipara	20	1	21	..	..	..
Trivellore Light	5	..	5	..	..	..
Jagadhri Light	6	1	7	..	..	..
TOTAL	6,016	625	6,641	68	5	73

1924. (In thousands.)

STEEL			OTHER KINDS.			Grand total of each line.	REMARKS
Main Line.	Sidings.	Total.	Main Line.	Sidings.	Total.		
..	..	..	..	..	..	113	
256	29	285	..	..	..	670	
..	..	..	..	..	..	294	
20	1	21	..	..	..	2,023	
..	..	..	..	..	..	89	Approx.
..	..	..	..	..	..	147	
..	..	..	..	..	..	73	
..	..	..	..	..	..	79	
..	..	..	..	..	..	309	
..	..	..	..	..	..	60	
73	8	81	..	..	..	114	Approx.
..	..	..	..	..	..	56	
325	10	335	..	..	..	432	Approx.
165	18	183	..	..	..	198	
148	8	156	..	..	..	508	Approx.
..	..	..	..	..	..	100	
..	..	..	..	..	..	39	
..	..	..	..	..	..	46	
..	..	..	..	..	..	67	
17	..	17	..	..	..	34	
2	1	3	..	..	..	35	Approx.
43	4	47	..	..	..	56	
..	..	..	..	..	..	258	
..	
..	..	..	..	..	..	958	
..	..	..	..	..	..	226	
..	..	..	..	..	..	218	
..	..	..	..	..	..	21	
..	..	..	..	..	..	5	
..	..	..	..	..	..	7	
1,078	79	1,157	..	..	..	7,874	

*Estimated Annual Demands of Indian Railways for Sleepers in next 5 years,
1924-29. (In thousands.)*

Railways.	Wooden	C. I.	Steel.	Other kinds.	Total.	REMARKS.
5' 6" GAUGE.						
Bengal Nagpur	252	..	32	3	287	
Bombay, Baroda and C. India	120	20	..	..	140	
Bombay Port Trust	..	..	..	..	..
Calcutta Port Comms.	30	..	..	..	30	
East Indian	387	300	..	..	687	
Eastern Bengal	160	..	..	..	160	
G. I. P.	150	25	130	..	305	
M. & S. M.	80	2	..	..	82	
Nizam's Gtd. State	2	..	36	..	38	
North Western	700	200	..	..	900	
Oudh & Rohilkhand	155	..	..	5	160	
South Indian	33	10	..	..	43	
TOTAL	2,069	557	198	8	2,832	
3' 3½" GAUGE.						
Assam Bengal	145	..	..	..	145	
Bengal Dooars	25	..	..	..	25	
Bengal & North Western	270	..	..	..	270	
Bhawnagar	80	..	..	..	80	
B. B. & C. I.	430	126	..	..	556	
Burma	370	..	..	..	370	
Dibru Sadia	40	..	..	..	40	
Eastern Bengal	220	..	..	..	220	
Gondal	25	..	..	..	25	
Jamnagar & Dwarka	5	..	..	..	5	
Jodhpur Bikaner	117	..	..	..	117	
Junagadh State	10	..	..	..	10	Approx.
M. & S. M.	137	..	..	..	137	
Morvi	2	..	..	..	2	
Mysore	20	..	..	..	20	Approx.
Nizam's Gtd. State	2	..	64	..	66	
O. and R.	..	..	..	..	..
Rohilkhand and Kumaon	78	..	..	..	78	
South Indian	86	20	..	..	106	
Udaipur-Chhittorgarh	10	..	..	..	10	Approx.
TOTAL	2,072	146	64	..	2,282	
NARROW GAUGE.						
Arakan Light	..	..	2	..	2	Approx.
Arrah Sassaram	11	..	..	..	11	"
A. K., B. K., B. D., K. F. & J. J.	30	..	..	..	30	"
Barasat Basirhat	10	..	..	..	10	"
Baroda Durbar	5	..	2	..	7	"
Barai Light	..	..	..	..	..	"
Bengal Nagpur	240	..	..	..	240	"
Bengal Provincial	5	..	1	..	6	"
B. E. and C. I.	..	..	..	..	..	"
Carried over	301	..	5	..	306	

Annual Demands in next 5 years—Slaeper—contd. (In thousands.)

Railways.	Wooden.	C. I.	Steel.	Other kinds.	Total.	REMARKS.
Brought over	301	..	5	..	306	
NARROW GAUGE—contd.						
Bukhtiarpur-Bihar	6	..	..	..	6	
Cutch State :	6	..	..	..	6	Approx.
Darjeeling-Himalayan	14	..	..	..	14	
Dehri-Rohtas	5	..	..	..	5	"
Dholpur Bari	1	..	1	..	2	"
Futwah Islampur	4	..	..	..	4	"
G. I. P.	2	3	2	..	7	"
Guzerat	1	..	14	..	15	"
Gwalior Light	28	..	2	..	30	"
Howrah Amta	8	..	..	..	8	"
Howrah Sheakhala	4	..	..	..	4	"
J. B. (Pipar Bilara Lt.)	3	..	..	..	3	"
Jagadhri Lt. : . . . . .	..	..	..	..	..	"
Jorhat Provincial	5	..	..	..	5	"
Kulasekara Patnam Lt.	1	..	1	..	2	"
Madaya Bight	2	..	..	..	2	"
Morvi	1	..	2	..	3	"
Mysore Ry.	2	..	..	..	2	"
N. G. S. . . . .	..	..	..	..	..	"
North Western	76	..	..	..	76	"
Shahdara-Saharanpur	20	..	..	..	20	"
South Indian	12	..	..	..	12	"
Tezpur Balipara	2	..	..	..	2	"
Tripvellers Light	1	..	..	..	1	"
TOTAL	505	3	27	..	535	

Increase of Track Mileage of all Broad Gauge Railways in India (1905-1913).

Railways.	1905.			1913.			TOTAL INCREASE IN 8 YEARS.			AVERAGE INCREASE PER YEAR.		
	Main Line.	Sidings.	Total track mileage.	Main Line.	Sidings.	Total track mileage.	Main Line.	Sidings.	Total.	Main Line.	Sidings.	Total.
Bengal Nagpur	1,759	303	2,062	1,950	453	2,403	191	150	341	23.9	18.71	42.61
B. B. & C. L.	1,082	155	1,237	1,476	264	1,740	394	109	503	49.3	13.6	62.9
E. B.	610	258	868	665	310	975	55	52	107	6.87	6.5	13.37
East Indian	2,739	767	3,506	3,380	1,008	4,388	641	241	882	80.1	30.1	110.2
G. I. P.	3,388	439	3,827	3,599	773	4,372	211	334	545	26.3	41.8	68.1
M. & S. M.	1,070	182	1,252	1,087	214	1,301	17	32	49	2.12	4	6.12
N. G. S.	351	43	393	351	45	396	..	2	2	..	-25	-25
N. W.	4,141	720	4,861	5,588	1,412	7,000	1,447	692	2,139	181	86.5	267.5
O. & R.	1,195	251	1,446	1,608	321	1,929	413	70	483	51.62	8.8	60.42
S. I.	385	60	445	446	71	517	61	11	72	7.62	1.4	9.02
TOTAL .	16,720	3,178	19,898	20,150	4,871	25,021	3,430	1,693	5,123	429	211	640

Increase of Track Mileage of all Metre Gauge Railways in India 1905-1913.

Railways.	1905.			1913.			TOTAL INCREASE IN 8 YEARS.			AVERAGE INCREASE PER YEAR.		
	Main Line.	Sidings.	Total track mileage.	Main Line.	Sidings.	Total track mileage.	Main Line.	Sidings.	Total.	Main Line.	Sidings.	Total.
Assam-Bengal	775	95	870	812	140	952	37	45	82	4.62	5.03	10.25
B. & N. W.	1,467	226	1,693	2,120	454	2,574	653	228	881	81.62	23.5	110.12
B. B. & C. I.	2,065	355	2,420	2,215	418	2,633	150	63	213	18.75	7.88	26.63
Bengal Dooars	153	16	169	153	17	170	..	1	1	..	..12	..12
Bhavnagar, Gondal, Junagadh and Porbandar.	446	45	491	614	74	688	168	29	197	21.00	3.62	24.62
Burma	1,340	229	1,569	1,671	343	2,014	331	114	445	41.38	14.25	55.63
Dibru-Sadiya	83	22	105	92	23	115	9	1	10	1.13	..12	..1.25
Eastern Bengal	788	139	927	1,127	254	1,381	339	115	454	42.37	14.38	56.75
Jodhpur Bikaner	833	44	877	1,281	85	1,366	448	41	489	56.0	5.12	61.12
M. & S. M.	1,978	220	2,196	2,091	240	2,331	115	20	135	14.37	2.5	16.87
Morvi	74	8	82	74	8	82	..	..	..	..	..	..
N. G. S.	391	44	435	442	57	499	51	13	64	6.37	1.63	8.00
R. & K.	291	37	328	554	32	636	263	45	308	32.87	5.63	38.5
South Indian	1,117	147	1,264	1,208	197	1,405	91	50	141	11.37	6.25	17.62
Udaipur-Chitorgarh	67	5	72	67	5	72
TOTAL	11,866	1,632	13,498	14,521	2,397	16,918	2,655	765	3,420	331.87	95.63	427.50

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APPENDIX II.

Estimates of cost of producing a B. G. wood sleeper in India and Burma.

B. G. Deodar from Kashmir State in depôt at Jhelum or Marala.

	Forest Officer's estimate.			Contractor's estimate.		
	Rs.	A.	P.	Rs.	A.	P.
1. Felling	0	1	0	0	1	0
2. Sawing	0	8	0	0	9	0
3. Carriage to river side by coolies	0	8	0	0	10	0
4. Floating down to Boom	0	5	0	0	8	0
5. Rafting	0	4	0	0	4	0
6. Establishment and contingencies	0	4	3	0	4	0
7. Grain compensation to labour	0	2	0	0	2	0
8. Royalty	3	0	0	3	0	0
9. Loss on river at 10 per cent.	0	8	0	0	8	0
10. Interest on capital locked up	0	1	0	0	1	0
11. Profit	1	0	0	1	0	0
TOTAL	6	9	3	6	15	0

Notes.

Item 3.—The rate is Re. 0/0/3 per sleeper mile.

Item 10.—Estimated @ 9 per cent. on Rs. 5/0/0 for 18 months.

Item 11.—A profit of Re. 1/0/0 on each B. G. sleeper is the universal expectation of sleeper contractors throughout India. In the above estimate it will be noticed that all expenses including supervision charges and interest on capital locked up have been included, so that a profit of Re. 1/0/0 amounts to 18 per cent. on the capital expenditure (Rs. 5/9/3) which strikes us as excessive. We consider a profit of 12½ per cent. or, say, 10 annas a sleeper is sufficient.

Item 8.—As a matter of fact the Kashmir State claims a royalty of Rs. 3/0/0 on a sleeper which it expects will be sold at the 'rock bottom' price of Rs. 6/8/0: if the contractor obtains a higher price than this from the Railway, then, half the difference is handed over to the State as additional royalty. As the rate at which the public, other than the railways, buys its timber from the contractor cannot be watched this arrangement holds for railway sleepers only.

B. G. Pyinkado from Burma.

The Deputy Conservator of Forests, Utilisation Circle, Rangoon, gave us the following estimate:—

	Rs.	A.	P.	
1. Royalty	15	0	0	}
2. Felling fees	1	4	0	
3. Felling and logging	1	8	0	
4. Dragging log from jungle to road	5	0	0	
5. Carting log 15 miles to mill	10	0	0	
Total	32	12	0	

Per 'round' ton of 50 c. ft. measured by the square of one quarter of the mean girth of the log into its length. Delivered at mill in log at Shwebo and Pyinmana forests.

If there is additional carriage by water to the mill, as in the Moulmein forests, add:—

	Rs.	A.	P.	
6. Rafting	4	0	0	
7. Bamboo	7	8	0	
Total	44	4	0	delivered in log at mill

8. 3 round tons give 1 ton = 50 c. ft. sleepers = 16 B. G. sleepers, and one ton of scantlings.

9. Milling costs Rs. 15/0/0 a ton (50 c. ft.) of converted timber at Rangoon and Rs. 18/0/0 a ton at Moulmein.

10. Scantling sell at Rs. 60/0/0 a ton, at least, so the cost of 1 ton of sleepers = 16 B. G. sleepers, will amount to Rs. 132/12/0 + 36—60 = Rs. 109/0/0 in mill yard Moulmein, and the cost of the sleeper in India will be:—

	Rs.	A.	P.
Cost in mill yard as above	6	13	0
11. Handling from mill into steamer	0	6	0
12. Sea freight to Calcutta	0	12	0
13. Insurance	0	1	0
14. Unloading from ship into trucks	0	2	0
15. Supervision charges and interest on deferred capital	0	5	0
16. Profit	1	0	0
Total	9	7	0

Notes.

Railborne sleepers coming from a distance of 300 miles would cost Rs. 1/8/0 less.

Item 1.—The figure of Rs. 15/0/0 for royalty is an average; the actual charge varies from Rs. 10/0/0 a ton for timber in Upper Burma and localities in Lower Burma to which access from the railway and port is difficult or lengthy, to Rs. 20/0/0 for the most favourably situated places in these respects.

Item 5.—Contractors say average lead is nearer 20 miles and cost Rs. 15/0/0.

Items 6 and 7.—Contractors say

	Rs.	A.	P.
* Rafting to Revenue station	3	0	0
Rafting from Revenue station to mill	0	8	0
Cost of bamboo rafts	4	8	0
	<hr/>		
Total	8	0	0
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Item 8.—Contractors accept the statement that 16 B. G. sleepers are obtained, on the average, from 3 tons of round timber.

Item 10.—Contractors say Pyinkado scantlings sell @ Rs. 100/0/0 a ton when the market is high and Rs. 80/0/0 per ton may be taken as a fair average rate.

**COORG—HARDWOODS (EXCLUDING TEAK) SUITABLE FOR
SLEEPERS WHEN TREATED.**

EASTERN COORG—B. G. SLEEPER.

	Rs.	A.	P.
1. Royalty	1	8	0
2. Felling and sawing at site	1	11	0
3. Carting from Nagarhole to Hunsur, 21 miles on Kacha road	1	2	0
4. Carting from Hunsur to Yeddatore, 14 miles on pukka road	0	6	0
5. Supervision and interest on capital	0	5	0
6. Profit	1	0	0
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Total	6	0	0
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Notes.

Item 2.—Moplah sawyers come to Nagarhole from Olavakot, 4 days journey; they want Re. 1/0/0 a day and just manage to earn it, but they are clumsy workmen.

COORG—WEST COAST—B. G. SLEEPER.

Here work is done purely departmentally by the Forest Department, and contractors are not employed. The logs are extracted by means of slides and a logging railway, 7 miles long, from the Western Ghats, and are conveyed by river from Makut, at the foot of the hills, to Bimlipatam, on the seacoast near Azikhal Railway station, where it is proposed to put up a saw mill for converting the timber; the Conservator (Mr. Minchi) says the cost of timber in log landed at Azikhal amounts to Re. 0/10/0 a c. ft. for hardwoods which will not float, and Re. 0/8/0 a c. ft. for woods which will. These figures include Re. 0/1/9 a c. ft. for the general charges (supervision, direction, etc.) of the Forest Department, based on the present outturn of 6,000 round tons a year. At this rate the cost of a B. G. sleeper would amount to—

	Rs.	A.	P.
1. Extraction of timber in log	2	0	0
2. Wastage in conversion	0	10	0
3. Sawing	1	0	0
4. Interest and depreciation on plant	0	8	0
Total	4	2	0

To this must be added royalty and profit for the Forest Department, and the Conservator stated that if several of the hardwoods which are available in these forests were accepted for railway sleepers he would recommend acceptance of royalty and profit of only Re. 1/0/0 a B. G. sleeper. Thus sleepers of the following woods, all of which promise to give good service when treated, could be obtained annually at Azikhal for Rs. 5/0/0 to Rs. 5/8/0 each.

Hardwoods.

Dipterocarpus turbinatus.

Hardwickia pinnata.

Artocarpus hirsuta.

Lagerstroemia lanceolata.

Calophyllum tomentosum.

Eugenia gardneri.

Eugenia Jambolana.

Diospyros nilagirica.

Soft woods (will probably need bearing plates).

Artocarpus integrifolia.

Mangifera indica.

Canarium strictum.

Calicut.

	Rs. A. P.
1. Irool (<i>Xylia xylocarpa</i>), Karimarudu (<i>Terminalia tomentosa</i>) or Vynavu (<i>Mesua ferrea</i>) timber in log at mill site on the Kallayi river @ Rs. 70/0/0 per ton = 10 sleepers	7 0 0
2. Handling and sawing (mill)	0 12 0
3. Supervision charges	0 1 0
4. Profit	0 4 0
Total	8 1 0

Notes.

Item 1.—This is the rate at which timber in the log is sold by the man who has extracted it from the forest near Nilambur, and rafted it down to Kallayi, for spot cash to the railway contractor, who has merely to get it sawn up and hand over the sleepers to the railway.

Item 2.—Sawing in Indian Mills costs Rs. 2/10/0 per 100 sq. ft. which is sufficient for 5 B. G. sleepers, *i.e.* sawing for a B. G. sleeper costs about 8 annas.

Items 3 and 4.—These allowances for a business in which you buy the material from a dealer, arrange for a little conversion and handling, are certainly sufficient.

Carriage by sea from Calicut to Bombay amounts to Rs. 0/12/0 for a B. G. sleeper, thus:—

	Rs. A. P.
1. Carting from Kallayi river to sea front, Calicut	0 1 6
2. Boating from sea front, Calicut, to vessel	0 1 6
3. Sea freight @ Rs. 8/8/0 per ton (50 c. ft.)	0 8 6
Total	0 11 6

Item 3 is the rate charged by small country vessels which ply along the coast between December and June only and no insurance can be effected on this freight.

In the West Coast timber trade they have a class of professional assessors of timber who act between seller and buyer; they measure the log, test defects very carefully with long iron probes, and take off from the length and girth of the log to allow for them. The system works to the satisfaction of both sellers, who bear the expense, and buyers.

BIHAR AND ORISSA (CHHARHARPUR)—B. G. SLEEPER.

	Rs.	A.	P.
1. Royalty	3	12	0
2. Felling and logging	0	4	0
3. Sawing	0	12	0
4. Carting for 20 miles	1	4	0
5. Handling, i.e., stacking, spreading for inspection and loading into trucks	0	2	0
6. Supervision charges	0	6	0
7. Interest @ 9 per cent. on items 1 to 6 (Rs. 6/8/0) for about 6 months	0	4	0
8. Contractor's profit	1	0	0
Total	7	12	0

CENTRAL PROVINCES (DHAMTARI).

	Rs.	A.	P.
1. Royalty	4	4	0
2. Felling, logging and sawing	1	0	0
3. Carting for 35 miles	1	0	0
4. Handling	0	2	0
5. Supervision charges	0	6	0
6. Interest	0	4	0
7. Contractor's profit	1	0	0
Total	8	0	0

Notes.

The district is very well off for labour, sawyers and cartmen being obtained locally in sufficient numbers.

Carting is extraordinarily cheap and works out to 8.4 annas per ton of 50 c. ft. per mile (this is less than 6 annas per Avoirdupois ton mile). A cart carries 7½ B. G. sleepers over the fairly level kachcha (*muram*) roads of the district, and rates actually paid for carting a B. G. sleeper are—

- 1/- for a lead of 35 miles.
- 2/- for a lead of 58 miles.
- 3/- for a lead of 110 miles.

The last figure is for the farthest sleepers brought at present is the Railway. The carts employed in the business belong to local cultivators and are available when no cultivation is in hand, December to the *Holi* festival at the end of March.

THE COST OF CREOSOTE TREATMENT.

The North Western Railway has installed a creosoting plant at Dhilwan, primarily for the treatment of chir (*Pinus longifolia*) and fir (*Abies* and *Picea morinda*), and the cost of treatment after a year's experience is of interest.

The present antiseptic consists of creosote and 'liquid fuel' in equal proportions, and the plant can turn out 4 lakhs of B. G. sleepers a year: allowing for waste, the amount of mixture per B. G. sleeper is 23 lbs., *i.e.*, about 9 lbs. c. ft. and the cost of treatment is assessed as follows:—

	Rs.
1. Interest on Capital cost of plant, Rs. 10,23,837, at 6 per cent., Rs. 61,430	61,430
2. Depreciation on buildings, Rs. 3,22,961, at 2 per cent., Rs. 6,459	} 59,662
3. Machinery, Rs. 5,08,882, at 10 per cent. Rs. 50,888	
4. Rails, Rs. 46,307, at 2 per cent., Rs. 926	
5. Sleepers, Rs. 23,153, at 6 per cent., Rs. 1,389	} 35,000
6. Labour and Supervision charges		42,600
7. Loading and unloading charges, Rs. 17,000	} 35,000
8. Stores, <i>i.e.</i> , fuel, oil, waste; etc., Rs. 18,000	
9. Creosote 50,000 cwt. at Rs. 10/0/0 cwt.	5,00,000
10. Liquid, Fuel, 50,000 cwt., at Rs. 60/0/0 ton	1,50,000
Total	8,48,692
<i>i.e.</i> , 4,00,000 sleepers at Rs. 2/2/0 appx: per sleeper.	

As regards these figures, it should be noted that the plant was purchased when prices were very high, and it is likely that a similar installation would not cost more than Rs. 1/12/0 per sleeper treated annually, for a plant to deal with one to four lakhs of sleepers a year.

Creosote, too, may reasonably be expected to come down in price: the Indian price last year was about Re. 0/14/6 a gallon at Calcutta: the English price recently was 9½ pence per gallon and is expected to be lower in the Autumn, when German supplies are expected. If creosote was imported from England it would need to be brought out in tankers and storage tanks would be necessary at the port of discharge.

As is well known, the supply of creosote is dependent on the demand for pitch, which is small at present in India, but Turner Morrison & Co. of Calcutta, who supply a little over 200 tons a month for the N. W. R. plant at Dhilwan, think they see their way to double this quantity in the very near future if demand arises, and they believe they can compete with the foreign supply. It may be asserted with confidence that there will be no failure in the supply of creosote for such additional treating plants as we are likely to need in the immediate future.

We consider it is safe to estimate for creosote @ Rs. 7/8/0 and oil @ Rs. 3/0/0 a cwt. including freight and allowing the full charge of 28 lbs. of the half and half mixture, * we believe it will be possible to creosote a B. G. sleeper for Rs. 1/12/0, which we estimate as follows:—

	Rs.	A.	P.
Interest and depreciation on plant	0	3	6
Labour	0	1	6
Stores and other operating expenses	0	1	6
Treating mixture, $\frac{1}{4}$ cwt. @ Rs. 5/4/0	1	5	0
Supervision	0	1	0
Total	1	12	6
			or say 1/12/6

THE COST OF "POWELLISING."

Parry & Co., have a small installation for powellising wood at Kallayi (Calicut) and their Manager, Mr. Brooks, kindly gave us some figures for treating *Vateria indica*, which is about as absorbent a wood as any down South.

The standard mixture is—

- 10 lbs. Water
- 2 lbs. Molasses
- 4 oz. Arsenic

to which Mr. Brooks adds 4 oz. of soda ash, although not in Powell's specification, to dissolve the arsenic.

Molasses costs Rs. 4/0/0 per 100 lbs. at Samalkot or Rs. 6/8/0, including freight (at public rate), at Kallayi.

Arsenic is obtained in small quantities in India @ Rs. 2/8/0 a lb., but in large quantities could be obtained from England or Germany for 8 annas.

Vateria indica absorbed 1.25 lbs. of molasses and 2.5 oz. of arsenic per c. ft.

The cost of treating plant has been roughly estimated at Rs. 1/4/0 per sleeper of its annual capacity, and, allowing—

	Rs.	A.	P.
4 lbs. molasses @ Re. 0/1/0	0	4	0
8 oz. arsenic @ Re. 0/1/6	0	12	0
Interest and depreciation on plant	0	2	6
Labour	0	2	6
Stores and other operating expenses	0	4	0
Supervision	0	1	0
Total	1	9	0

* There is a reasonable expectation that the amount of creosote in the mixture can be reduced to 1/3rd without detriment, but it is not safe at present to bank on this.

we estimate that the cost of powellizing a B. G. sleeper will be about Rs. 1/8/0: to this a charge of 5 annas a sleeper probably have to be added for patent rights, making the total cost Rs. 1/10/0.

It will be seen that powellising will be somewhat cheaper than creosoting, at least in Southern India where molasses is cheap, and the opinion of Mr. Pearson of the Forest Research Institute, which is based on an experience of 12 years; is that there is nothing to choose between the results of the two processes.

In the process as used hitherto the timber is boiled in the mixture in open tanks and no attempt has been made to press the mixture into the wood: the present process is slow and Mr. Pearson thinks it could be quickened up and give better penetration if pressure treatment was adopted, and he has suggested that to give his opinion a trial some of the first tanks to be installed should be like creosoting cylinders suitable for pressure treatment: they could then be used as open tanks or, later on, used for creosote treatment at the dictation of experience.

APPENDIX III.

Weight of Cast Iron Sleepers on Broad Gauge Railways in India.

GIPR-L-XI.2-13.5.25-200.

	C. I. PLATES OR BOXES FOR 75 OR 90 LB. F. F. RAILS.			C. I. PLATES FOR 88½ LB. B. H. RAILS.	C. I. POTS FOR 90 LB. B. H. RAILS.		C. I. POTS FOR 82 LB. B. H. RAILS.
	N. W. R. Type.	Lines's.	Fowler.	E. I. Ry.'s "D.O."	M. & S. M. Ry.'s Type.	B. B. & C. I. Ry.'s Type.	G. I. P. Ry.'s Type.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
2 Cast Iron plates or boxes	228	188	224	196	..	..	..
Cast Iron fittings . . . . .	..	9	..	..	..	..	..
2 Jaws, Cast Iron . . . . .	..	..	..	29.5	..	..	..
1 Tie bar, steel	36	23	27.5	23	..	..	..
Gibs } Cotters } Keys, steel } 2 Cast Iron pots	3	2	4	4	..	..	..
2 Cast Iron keys	2.5	2.5	2	..	228	214	202
1 Tie-bar . . . . .	..	..	..	..	..	11.16	..
2 Gibs, steel . . . . .	..	..	..	..	31.5	30.33	25.75
2 Cotters, steel . . . . .	..	..	..	..	0.43	0.50	0.49
2 Double tapered wedges, steel . . . . .	..	..	..	..	1.18	1.03	1.05
2 Coiled keys, steel . . . . .	..	..	..	..	0.50	..	..
	..	..	..	..	4.00	..	4.16
Approximate total weight in lbs. of one sleeper.	270	205	258	253	266	257	233

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