PAPER No. 130.

PUNJAB BUILDING TIMBERS AND METHODS OF EXTRACTION.

By H. M. GLOVER, I.F.S.

It is with some diffidence that I venture to write a short account of the building timbers indigenous to the Punjab and the methods adopted to bring them to market. I can claim no special engineering knowledge and can only give an account of the operations actually employed by the Forest Department and by traders. These methods often appear to an outsider to be crude and inefficient but they are well adapted to the conditions of the locality and to the level of intelligence of indigenous labour and are often ingenious and have been evolved as a result of practical experience.

The Punjab plains are devoid of all true timber forest: in former years much of the central and south-western Punjab contained vast areas of so-called forest covered by scrub and small trees, but with the immense extension of irrigation during the past generation these tracts have been surrendered for cultivation, and with the exception of a few irrigated plantations and riverain areas the Punjab now possesses no forest in the fertile areas of the plains.

Large tracts of coniferous forest occupy the inner regions of the Himalaya but are situated far from the market and the sole means of export is by river to the plains. Most of the forests lie in Native States subject generally to a certain amount of control by Government through the Forest Department.

The main species extracted are deodar (Cedrus deodars), blue pine (Pinus excelsa), *chir* (Pinus longifolia), spruce (Picea Morinda) and silver fir (Abies Webbiana). All these species grow gregariously either pure or in admixture with other species. The *chir* pine occupies the lowest zone at altitudes from 3,000 to 5,500 feet; above the *chir* zone the deodar and blue pine forests occur, sometimes in pure woods but more often mixed, and from 8,000 feet upwards merge into spruce and fir woods. The hill sides are generally steep and the forests lie well above the main rivers to which timber can be carried only with great difficulty.

The deodar forests were exploited heavily in the years succeeding the British occupation, and the cream of the deodar was taken before 1864. The forests were then subject to fires, to shifting cultivation and to every form of abuse, but for the last 50 or 60 years have, for the most part, been managed under conservative working plans prepared by trained forest officers. The areas devastated have been gradually restocked and the area occupied by deodar has increased, but the woods are young and are not ready for the axe. They generally lie in isolated blocks of not very great extent much cut up by cultivation which occupies the easier ground.

There is a general shortage of mature deodar trees which will continue for some years to come until the present trees grow to exploitable dimensions. It may interest you to know that under favourable circumstances it takes 120 years for a deodar tree to reach dimensions suitable for conversion to railway sleepers, and that with the unfavourable conditions prevailing in the dry zone of the Central Himalaya the time increases to two hundred years and more.

Working plans are drawn up in order to eke out the supply of large timber until the young woods mature, and to provide for the regeneration of areas felled over and for orderly schemes of tending the woods and opening out the estate by suitable communications, it being an axiom of management that an even or increasing supply of timber should be available annually for the market. Any serious diminution in the supply would be disadvantageous to the economic welfare of the country as a whole and the fact that deodar timber is still available is a tribute to the foresight of the pioneers of forestry in India.

As supplies of deodar timber decreased the *chir* forests, being the most accessible, were brought under the axe, but in the Punjab *chir* does not occur over very extensive areas. For some years before the war traders had extracted blue pine timber which easily occupies a second place in the market and is likely to maintain its position ; during the war large quantities of spruce and fir timbers were extracted for the Munitions Board.

Uses of Timber.

For strength see appendix.

The Deodar.—Available both in log and short scantlings. The deodar is the main sleeper and building timber used in Northern India. It contains a natural oil which renders it resistant to white ants and weather. The heartwood is strong and durable and the timber can be used for all outside works. The average life of a deodar sleeper in the main line is 14 years and in sidings several years longer. The sapwood is as strong as the heartwood but is attacked by white ants and rots when exposed to weather. For furniture and indoor work the only advantages of deodar over other woods are its resistance to the white ant and the weather ; it does not give a better finish than other timbers and when painted the natural oil oozes and causes the unsightly smudges on white paint with which we are all familiar. In former years deodar was always used for roofing beams and rafters, but with cheap iron girders and reinforced concrete the use of deodar for such purposes is restricted.

Excellent deodar logs can be obtained at Jhelum in the Punjab, and there is at present at Nowshera and Khairabad in the N. W. F. Province a very large stock of magnificent deodar logs from the virgin forests of trans-border States where till recently overexploitation and forest destruction were unchecked. Cost Rs. 1-12-0 to Rs. 2-0-0 per c. ft. ex depot. The main outturn is extracted in sleeper form of

dimensions 9′×10″×5″ but all I class sleepers are taken by the North-Western Railway at Rs. 6-8-0 each. "A class" sleepers containing knots at the rail seat are useful for outdoor work and cost from Rs. 4-12-0 to Rs. 5-0-0 each, and specially selected sleepers cost about Rs. 8-0-0 to Rs. 9-0-0 each. Ten feet sleepers are available at about Rs. 7-4-0 unsorted.

The Chir Pine.—*Chir* timber is available only in scantlings of dimensions 10′ and 12′×10″×5″, but at Jhelum and Wazirabad beams of length 16 feet and cross section 13″×7″ are obtainable, cost about Re. 1-0-0 to Rs. 1-4-0 per c. ft. ex depot. The timber is as strong or stronger than deodar *vide* appendix, and works up well, but it is essential to see that the grain is straight as otherwise the timber warps. It is easily creosoted when its suitability for outside work is equal to that of deodar.

The North-Western Railway have a most efficient pressure creosoting plant at Dhilwan and the *chir* has already given excellent results and its use for railway sleepers is limited only by the shortage of supplies. Even with the simple open tank treatment *chir* sleepers have lasted. 14 years in the open line. *Chir* timber absorbs creosote with ease. Untreated the timber is useless for outdoor work and is of use only for rough furniture and indoor work.

The Blue Pine.—Vernacular *kail, biar, anundar* available in scantlings of 10′, 12′ and occasionally 14′ lengths. This timber is light and strong and most suitable for indoor work but is attacked by white ants and cannot stand exposure to wet. It planes easily and gives a good surface. The heartwood turns a good brown colour which is brought out well by varnish. The timber imported by unreliable traders sometimes show signs of rot and should invariably be rejected. This timber is very popular in the open market, and as its price is somewhat under two-thirds that of deodar its use for all kinds of indoor work is likely to increase ; cost Rs. 1-2-0 to Rs. 1-5-0 per c. ft. ex depot for ordinary sizes and Rs. 1-8-0 for 14′×10″×5″ scantlings. Your attention is called to this valuable wood.

Fir Timber.—Vernacular *partal, rai, tosh, palundar,* vailable in scantlings 10′ and 12′. Spruce and fir timbers may be considered together ; both are comparable with ordinary European or American deal and Douglas fir and they are suitable for all purposes for which deal and Douglas fir are used. Untreated they will not stand exposure to the weather and are readily eaten by the white ant, and treatment is not easy as they resist the penetration of creosote and other oils. The North-Western Railway is experimenting with special apparatus and hopes to be able to treat fir sleepers properly.

The fir forests occupy large areas of the Himalaya and the amount of timber available for the next generation is limited only by the labour available and the cost of extraction. Fir costs half the price of deodar and is suitable for all uses such as temporary planking concrete moulds,

etc., where durability is not essential. Untreated fir should not be used for any but temporary work, but should the experimental treating now being undertaken by the North-Western Railway prove a success its use will be extended in future. Cost ex depot Re. 1-0-0 per c. ft. for I class sleepers and about 10 to 12 annas for railway rejections which are suitable for rough work.

Methods of Extraction.

Timber is extracted either in log or in scantling.

Logs.—Logs were extracted largely in the past from the more accessible forests with a direct lead to rivers which contain sufficient water during the monsoon to enable the logs to pass the numerous rocks which obstruct the beds of the higher reaches of all rivers. With the exception of Kashmir and trans-border States all the more accessible forests were worked out long ago. There was a revival of logging in Bashahr during the war when logs were extracted from very remote forests often lying two to three thousand feet above the Sutlej river.

The ground is precipitous and contour or slightly inclined roads some 12 to 14 feet in width were built above precipices leading to earth shoots. The greatest difficulty is met with in preventing the logs from gathering such speed as to smash themselves to pieces in the shoots, which is prevented by building check walls at short intervals. The photos reproduced by the courtesy of the Editor of the *Indian Forestor* give some idea of the difficult country traversed and the somewhat spectacular character of the work.

Scantlings.—Many of the forests lie on very steep and precipitous ground and are full of young seedlings so it is often impossible to extract logs. Trees are felled with an axe and are roped and constrained to fall up hill. Felling is very well done indeed by specially trained gangs and it is common for tree after tree to fall with its stem up hill and its butt resting on its stump even in precipitous ground. The trees are cut into logs with a cross cut saw which are then squared with a specially broad and heavy axe. Scantlings are sawn with an ordinary pit frame saw, men, or a man and woman, working in pairs. Scantlings must be of dimensions small enough to be carried by a man to ropeway heads except in the comparatively few forests on easy ground where they can be slid along the ground or extracted by shoots. This factor of man carriage limits the weight and consequently the size of the scantlings commonly extracted: further limiting factors are the steepness of the side streams and the very rocky nature of the upper reaches of the main rivers in which long scantlings are broken. Mature trees are scattered at such wide intervals that it does not pay to erect heavy machinery for assembling logs at one centre except possibly in the fir forests—*vide* a later paragraph.

Light wire ropeways were first used successfully by Mr. C. H. Donald in 1912, who later sold his patent rights to Government for the extraction of timber by departmental agency from forests under the charge of the Punjab and North West Frontier Forest Departments. They consist of three parallel 1" circumference wire ropes in one plane on which the sleeper is hung by pulleys. An endless $\frac{3}{4}$" control rope runs over vertical sheaves on the lower of which is a band brake. Ropeways had not been used previously in the inner Himalaya forests owing to the weight of the materials as these could not be transported on steep hill sides, where there are no paths other than those fit for pack animals or more often man carriage. The ropeways have proved a great saving, and enable timber to be delivered in good condition, which is not always the case when slides are used. The longest ropeway span erected stretched for 4,700 feet to the Sutlej river, and the vertical distance between the stations was 2,500 feet. Frequently spans of 3,000 feet and upwards are used. The more precipitous the country the greater is the saving, and the least angle at which a ropeway can work is about 17°. The local labour is expert at erection and works these ropeways with only a limited amount of supervision and local repairs are easy.

Another form of ropeway of the heavy endless cable type was erected in 1910 at Patriata for bringing firewood to the troops at Murree and has done yeoman service ever since and also carries timber. The photos give a good idea of its construction, and you may be interested to learn that the Khyber ropeway was erected on the same plan in consequence of General Sir Gerald Kitson's acquaintance with the Patriata ropeway in 1912. The Khyber ropeway has now been dismantled and part has been re-erected by the Forest Department in three sections of total length 8 miles for bringing firewood to Abbottabad.

Scantlings are carried to a side stream or to the main river and are launched at the end of monsoon. These side streams come down in spate throughout the monsoon and timber would then be smashed to pieces; in the winter they contain very little water, too little ordinarily for floating timber, so the floating has to be correctly timed. Even under the most favourable conditions timber cannot be floated freely but has to be sent down slides. These are of two kinds:—

(*a*) *Telescopic*, whereby the bed of the stream is floored for short distances with scantlings over which the water runs and scantlings are shot into pools formed by damming the stream. Each scantling moves over other scantlings and is used to build the slide in its turn. A *ghal* may stretch for a couple of miles or more and takes from two to five months to reach the main river.

(*b*) *Pukka Slides.*—Scantlings are morticed to cross pieces erected on props to form a trough of even slope down which water pours, and the sleepers float in the trough which may be several miles long. This form of slide can be used only on ground of moderate slope but is most economical.

It does not follow that the scantlings can be launched immediately they have reached the main rivers. The Sutlej for instance has discharges which vary from 3,500 to 2,00,000 cusecs and in floods timber is swept away and is either lost completely or salved at great expense. Another trap for the inexpert forester is the Katholu gorge where the rocks, submerged during the summer and early autumn, can be crossed dry shod in the winter as the river then runs under ground for a short distance. Scantlings can pass the Katholu obstruction and be caught again only during the latter half of August and part of September. Down the main rivers the scantlings float singly, large *ghals* being worked down by special gangs of men who are expert swimmers. Once the rocky beds have been passed, and generally near where the river debouches into the plains, the timbers are collected in a boom and tied into rafts and brought to depots on the various rivers where they, or navigation canals, meet the railway.

This paper has already taken too much of your time, but I must now pass to the question which will be inevitably asked "why does not the Forest Department use sawmills and machinery?" We should like to avoid hand sawing if practicable, particularly as elaborate arrangements have to be made to feed labour most of which is imported; but milling is not practicable under present economic conditions. In the first place the remoteness of our forests, the steep slopes on which they lie and the complete lack of communications fit for wheeled traffic ordinarily rule out local mills. Several other factors are also adverse, *viz.*, the scattered nature of our forests; the expense of imported mechanics and foremen, the difficulty of replacing broken parts, and the initial capital cost. Uneconomic as he appears the hand sawyer still can saw more cheaply than a mill and can be obtained in numbers sufficient to cope with present demands for timber. There is one great advantage of hand labour over machinery in that the output can be increased without erecting additional plant and can be reduced without cost when market conditions are bad.

The fir forests are virgin forests of mature trees occurring over large concentrated areas with a very large volume of timber per acre. Proposals were submitted in 1919 for a local mill in Bashahr at a place where logs could be assembled and where power, either water or hydroelectric, could be developed cheaply. The project was "vetted" by the Hydro-electrical Advisor to Government and was passed as sound on the basis of the power available. A consulting engineer from America, the best man we could get, pronounced in favour of a mill at rail head and work was started. However this project was dropped at once before any financial commitments had been incurred as it was considered that the expense of taking logs to market had been under-estimated. On the Beas river a sawmill was bought to deal with the Kulu output. For several reasons, of which the difficulty in assembling logs and the fall in the market price of timber were the most cogent, the project was dropped after Government had incurred considerable expense.

I have not dealt with the plains timbers at all, but I would invite your attention to the way in which the plains have been depleted of timber and the value of the shisham, which in the immediate neighbourhood of Lahore has recently realised a maximum price of Rs. 164-0-0 per tree, the average price of 22 shisham trees sold in the Ravi Park being Rs. 96-0-0. The Irrigation Department possesses a belt of land bordering its canals of some potential value as forest, but most difficult to protect from being overrun by sheep and goats. The Superintending Engineer, Sirhind Canal, has realised the value of canal plantations and has made an excellent start at Doraha. May we wish him all success with his experiments and an extension of such work on other canals.

Note.—Photographs reproduced by permission of the Honorary Editor, *Indian Forester*.

Appendix showing timber stren ths stated as percentages of the strengths of Teak.

Teak=100 in each case.

Species.	Weight relative to teak.	Strength as a beam.	Stiffness as a beam.	Suitability as a post or strut.	Shock resisting ability.	Shear.	Hardness.	Shrinkage.
Teak (Tectona Grandis)	100	100	100	100	100	100	100	100
Deodar (Cedrus deodara)	80	75	75	75	65	80	60	130
Kail (Pinus excelsa) ..	71	50	60	55	..	65	35	..
Chir (Pinus longifolia)..	80	60	80	70	70	75	50	185
Spruce (Picea Morinda)	70	55	70	60	60	60	45	170
Fir (Abies Webbiana) ..	75	65	80	75	70	75	55	175
Shisham (Dalbergia Sissoo)	116	90	85	85	..	125	115	135

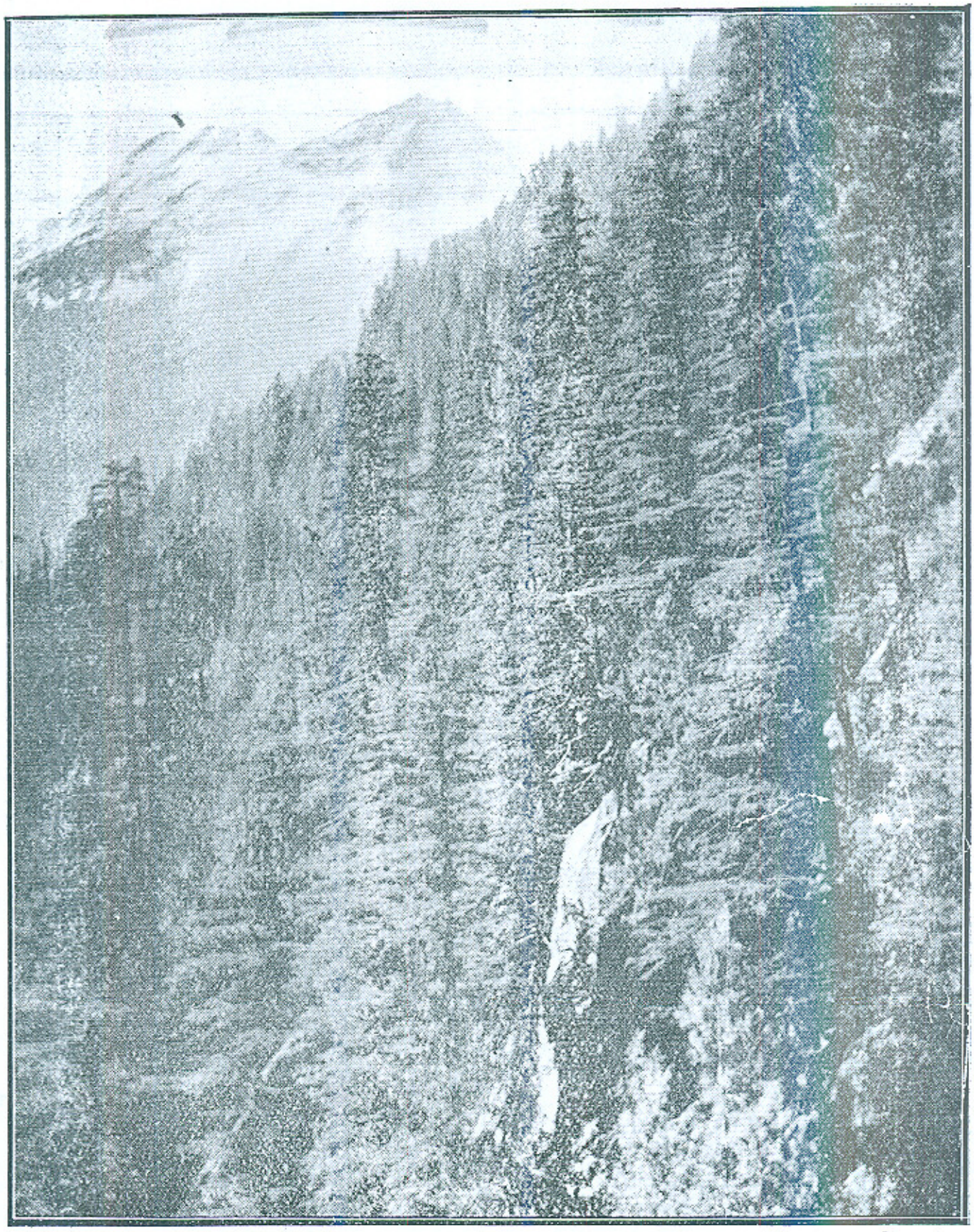
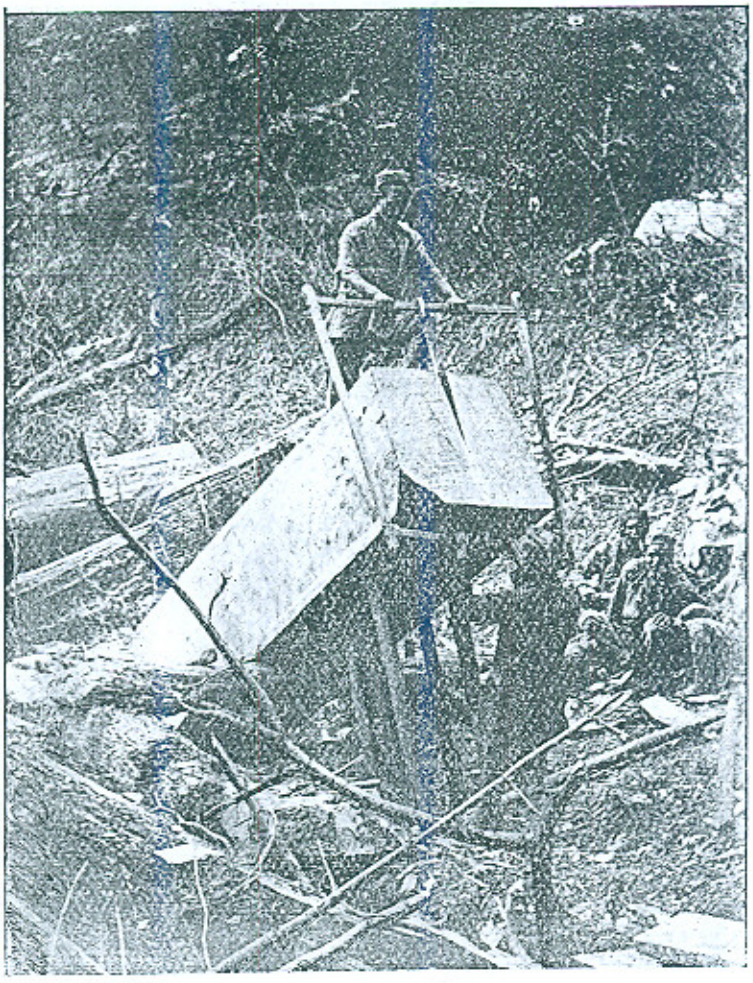


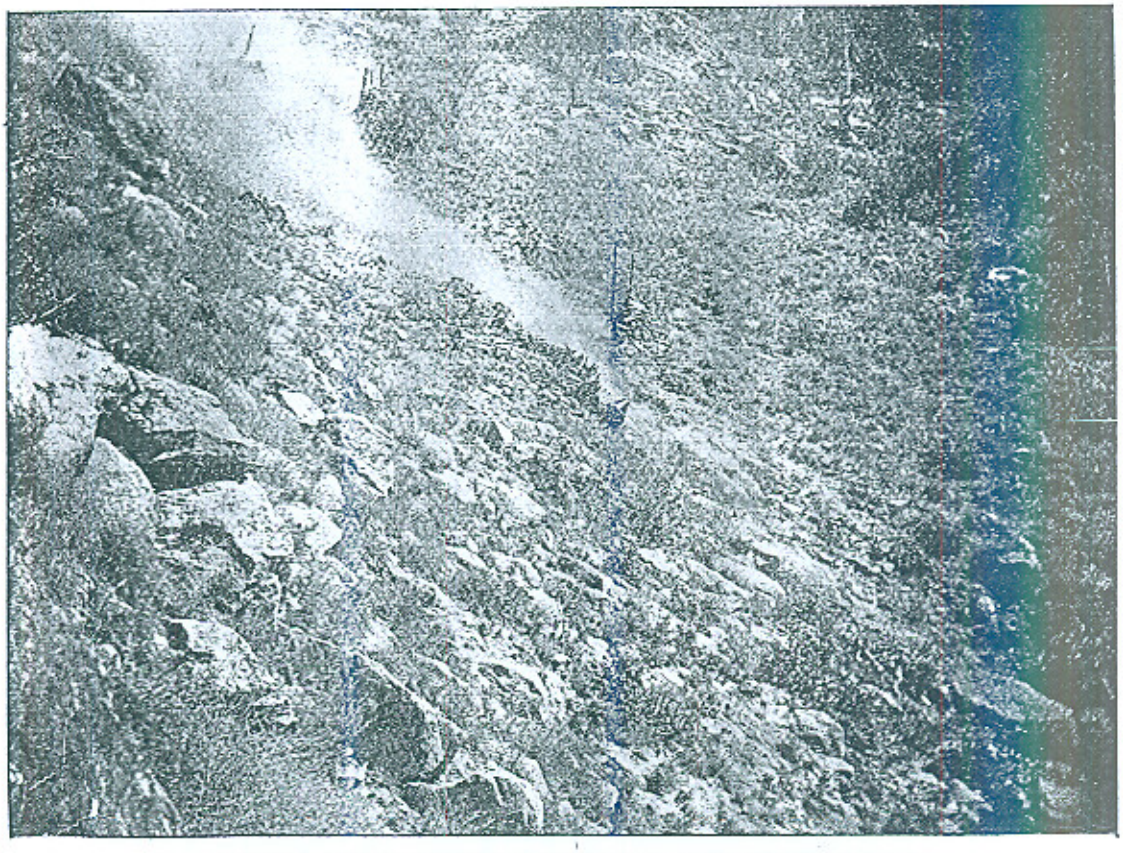
Fig. 1. A deodar forest in the Upper Sutlej Valley.

Virgin deodar, the Kashang Forest, Bashahr.

Preparing deodar logs for sawing.

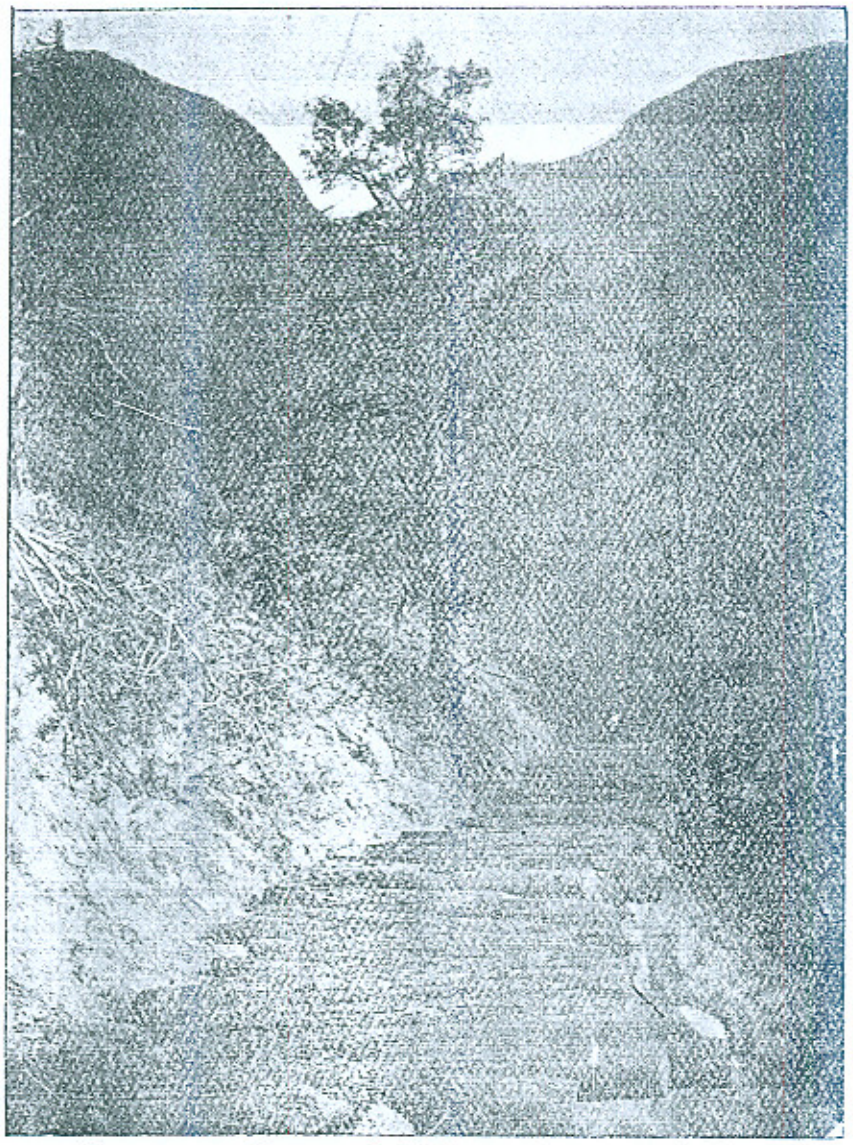


Sawyers at work.



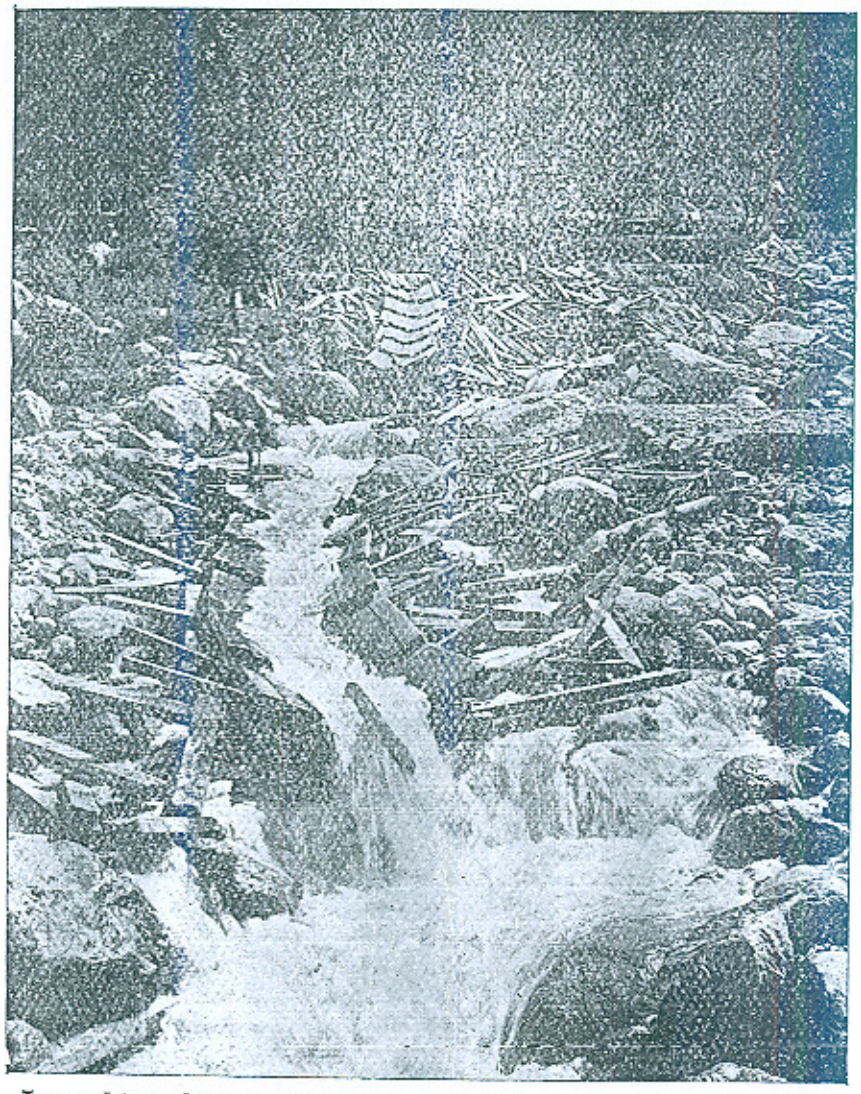
Log sliding down earth shoot, Ruhnang Forest, Bashahr.

A dry slide for beams 16′×12″×6″, the Gaura Forest, Bashahr.

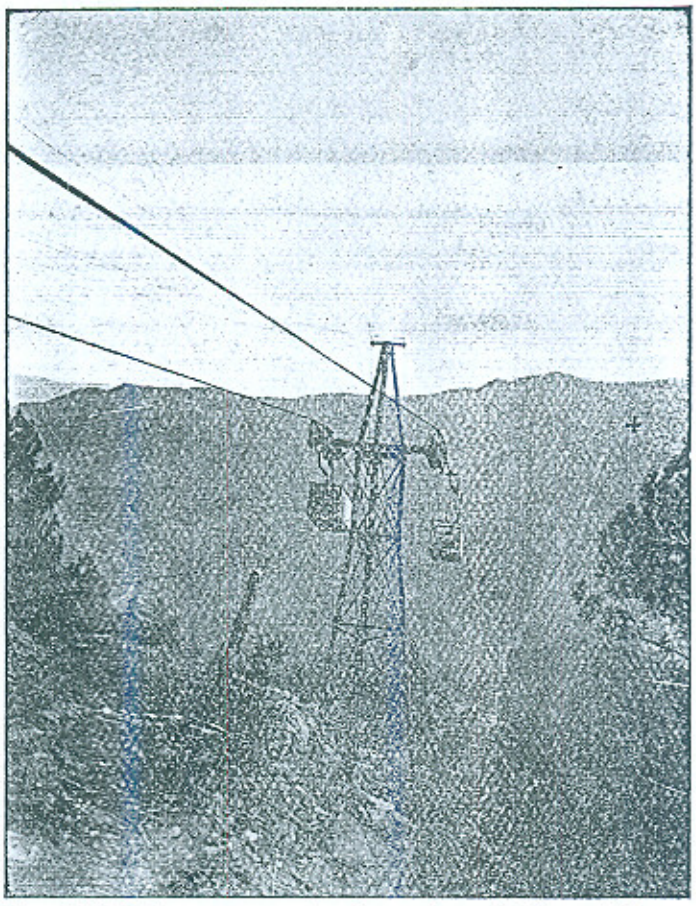


Logs on a rolling road, Ruhnang Forest, Bashahr.

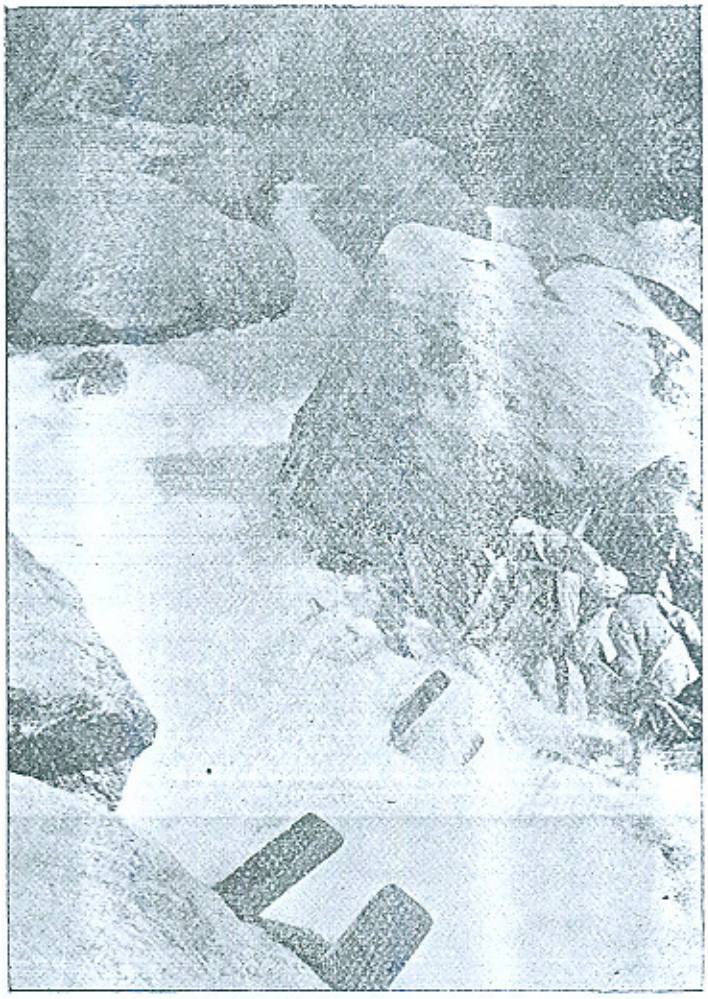
The Patriata ropeway, receiving station.



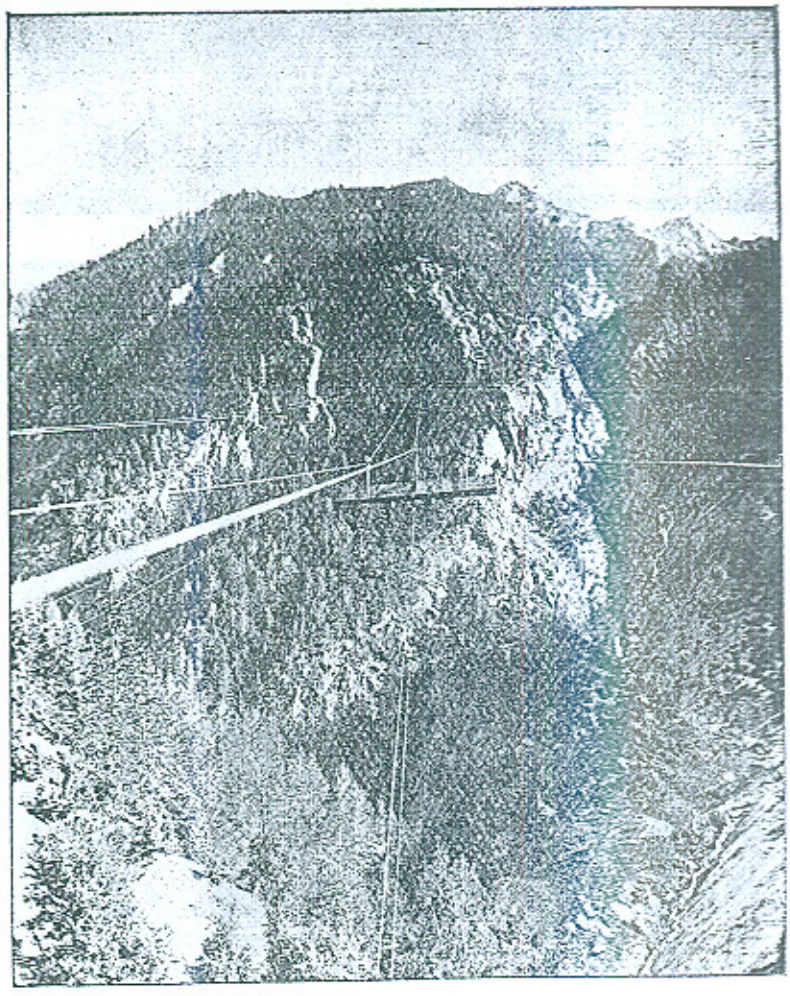
Launching sleepers showing construction of a telescopic slide.



The Patriata ropeway + shows despatching station.



The Katholu gorge, Sutlej river.



A sleeper ropeway, the Barang Forest, Bashahr.

A sleeper ropeway, lower station.

DISCUSSION.

MR. GLOVER, in his introductory remarks, first drew attention to certain corrections which have since been incorporated in the paper printed in the record of the Congress proceedings, and then said a few words about the position as regards world supplies of coniferous timber.

Col. Walton, in his opening address had laid stress on the immense development in the past hundred years of means of transport and of all branches of engineering, and Mr. Glover pointed out that the improvement in communications had rendered the forests more accessible and that the perfecting of mechanical means of conversion and extraction had led to the felling of vast tracts of virgin forest. This was most marked in America where there had been a race to harvest the accumulated timber wealth of centuries and no one had taken care to restock the areas cut over. The U. S. A. was already feeling the effects of the timber shortage and now possessed extensive forests only on the Pacific coast and was importing timber in ever increasing quantities from Canada: the eastern states had almost exhausted local supplies and in 1924 when Mr. Glover was in Central Europe he had seen the first consignment of planking despatched from Austria to New York.

Europe was divided into various nations who had no means of importing timber cheaply from abroad and had long ago learnt to be more or less self-supporting as regards timber supplies or at any rate had already taken care to conserve their forest resources to the utmost extent.

Great Britain had occupied a peculiarly favourable position astride the great ocean trade routes of the world, and since the days of wooden ships had taken no care of home grown supplies, but had been accustomed to indent on foreign nations. That position had changed during the war when thousands of tons of shipping had to be diverted to importing timber for home use and for the Armies in France. Vast quantities of timber are still imported from the Pacific coast of America, from Canada, from Northern Europe and from Russia, but these supplies are not inexhaustible and those from Russia are limited by the cost of rail transport. and by the fact that the ports are frozen throughout the winter.

The British Empire still possessed large tracts of coniferous forest in Canada, New Zealand and the Himalaya and Great Britain had already taken steps to plant up its waste lands so as to guard against a shortage of soft woods in the future. In the last few years there had been a great development in the production of substitutes for timber but in spite of the use of substitutes the consumption of timber, both per head and gross had increased: in fact satistics showed that the greater the stage of economic development reached by a country the greater was its consumption of timber.

Mr. Glover referred to the larger esources of timber in the Himalaya where the forests are being carefully preserved, but where the supply of the more valuable timbers is not greater than the demand. There are still vast supplies of fir timber but the forests are remote from the market and the cost of extraction is great and it is unlikely that fir timber will be exported from the Punjab until world prices for timber have advanced. He wished to call special attention to the Forest Research Institute at Dehra Dun which was far better equipped than any other Institute in the British Empire for testing timber, and would readily furnish engineers with authoritative information on the strength and durability of timbers, would advise as to the best species of timber to be used, and would test samples submitted. Also that at Lahore was a Utilisation Circle ready to advise eingineers as to what timber to use, where to obtain it and the most recent market price.

MR. LYSTER said that in the early days of his service he was posted on the Hindustan-Tibet Road, which runs through Bushahr State. There he witnessed the extraction of timber of which Mr. Glover was in charge. He referred to the water shoot and the dry shoot devices. The water shoot arrangement he said was constructed entirely of the sleepers that were to be extracted. Then he referred to the dry shoot arrangement and said that in his opinion timber from the dry shoot was no use afterwards, and he wondered to see that Mr. Glover said in his paper that it was more suitable.

MR. NICHOLSON referred to the methods of extraction in other countries and said that railways in America were close by the hills where large tracts of forest lay. The hills were not so high in elevation as the forests of the Himalayas, hence the Americans could extract their timber more easily than the Punjab Forest Department, and said that the Forest Department were up against many more difficulties than an average man realised.

MR. GLOVER in reply to the discussion said that as regards the point raised by Mr. Lyster concerning the cost of extraction, said that they built a permanent dry Chute when they had to extract timber from one block for a couple of years or so.