REPORT OF A COMMISSION

APPOINTED TO EXAMINE AND REPORT

ON THE RELATIVE VALUE

OF

KARRI AND JARRAH TIMBERS

FOR CONSTRUCTION OF WORKS,

PARTICULARLY FOR SUBMARINE OPERATIONS.

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EXTRACTED FROM THE MINUTES.

Friday, 5th August, 1887.

Papers.—The Honorable Sir M. Fraser laid upon the Table the following Papers:—

1. Report of the Commission appointed to examine and report on the relative values of Karri and Jarrah Timbers.
Report of a Commission appointed to examine and report on the relative value of Karri and Jarrah Timbers for construction of works, particularly for submarine operations.

WESTERN AUSTRALIA.

SIR,

Works and Railways Department,
Perth, August 4th, 1887.

I have the honor herewith to enclose the Report of the Commission appointed by Your Excellency, on my recommendation, to examine and report on the question of the relative values of Karri and Jarrah timbers for construction of works, particularly for submarine operations.

The Members of the Commission have gone very thoroughly into the question, and have examined those who are the best able to throw a light upon this much vexed subject, but I regret to say that it would appear to be as far from settled now as it was before. When I say regret, this is hardly the term I ought to apply, as it would appear to me rather that this Colony is to be congratulated on possessing two kinds of timber which, from all the evidences we can find, are so equal in goodness and quality as to make it a question, even with experienced men, which to prefer. From my own observations, I think the preference should be given to Karri, as, in my opinion, a considerably stronger and more reliable wood. As to its durability under water in comparison with Jarrah, time alone will prove, for which purpose I will have careful experiments and notes taken in all new works that we are about to undertake. At the Fremantle new Jetty Works we are driving both Jarrah and Karri piles side by side, which have been carefully marked and recorded, so that here we shall be able immediately to have a reliable comparison.

At Albany the new Jetty in course of construction for the Land Grant Railway Company is being solely built of Karri piles, while at the Vasse Jetty Jarrah is being used.

The attack of the *Teredo Navalis* and sea worm generally diminishes, as might be expected, with the temperature of the water, whereas at Port Darwin and in the tropical portion of this Colony no Jarrah or Karri will resist this, in the Southern or cooler portion it ceases to be of any great importance.

The South Australian Government in all their submarine works in the Northern portion of that Colony take the precaution of having the whole of the piles and timber below water sheathed with muntz metal; but as this is a very large additional expense, I doubt very much whether the use of wrought or cast iron screw piles would not be found cheaper in the end, the more especially when it be taken into consideration the high rates of freight and the difficulty of obtaining ships for such lengths of timbers and piles as are required for these places, owing to the great rise and fall of the tides.

I have to thank the Members of the Commission for the great care they have taken in procuring evidence and framing their report, which I now have the honor to enclose. More especially are my thanks due to Mr. H. C. Mais, M. Inst. C.E., the Engineer-in-Chief of South Australia, for the valuable information he has been good enough to afford us in his letter in reply to my inquiries. His great experience makes his testimony a most valuable one.

I have, &c.,

J. ARTHUR WRIGHT, M. Inst. C.E.,
Director of Public Works, and
Engineer-in-Chief.

To His Excellency the Governor of Western Australia,
WESTERN AUSTRALIA.

Works and Railways Department,

Perth, 22nd November, 1886.

SIR,

I have the honor to inform you that His Excellency the Governor has approved of my recommendation that a Commission of Engineers, &c., be appointed to examine thoroughly into, and report on, the relative merits of Karri and Jarrah Timber for works of construction, railways, &c., and especially as to the very moot question of the former timber resisting the action of salt water for the construction of jetties and marine works.

His Excellency has approved of the following gentlemen being appointed on the Commission:—

Clayton T. Mason, Esquire, M. Inst. C. E., General Manager and Maintenance Engineer for Railways.

William Rogers, Esquire, M. Inst. C. E., Chief Engineer to the Great Southern Railway.

Fred. Stafford, Esquire, M. Inst. C. E.


James Gardiner, Esquire, Assoc. M. Inst. C. E., Resident Engineer of the Southern Districts.

Joseph Harris, Esquire, J.P., Resident Magistrate at the Vasse, and Inspector of Forests.

Mr. Clayton T. Mason to act as Chairman.

I need not point out to you how important this subject is, not only for the Public Works now being carried out both by the Government and private enterprise, but for the timber industry of the Colony generally, and that it is necessary to go thoroughly into the question affecting it, so as to come to a definite decision, and to set at rest the many conflicting statements now being made.

I propose that the Commission shall proceed as soon as possible to the Vasse, to the Hamelin, and Augusta, to examine the works there, and the timber, both Jarrah and Karri.

I am writing to the Engineers-in-Chief in the other Colonies, for any information they may be able to give from their experience in the use of both.

I have, &c.,

C. T. Mason, Esq., M. Inst. C. E., &c., &c., &c., General Manager and Maintenance Engineer for Railways, Perth.

WESTERN AUSTRALIA.

REPORT.

Perth, 17th June, 1887.

SIR,

In compliance with the instructions contained in your letter of November 22nd, 1886, we have now the honor to forward the following report, appended evidence, and various tables.

The Commission proceeded to the Hamelin, and held their first meeting at Karridale on the 1st December, 1886, at which all the members were present.

On the 2nd of December the Commission took evidence and inspected instances of Karri timber, as shown by the various works connected with the forests, mills, &c., to which this timber had been applied; and also many instances where the timber had been subjected to exposure and action of severe tests. Tramways, which had been laid with cross sleepers, carrying longitudinal Karri rails, had been in use for over six years, were found to be in sound condition. This timber had all been previously condemned for shipment, and cannot, therefore, be regarded as a good example. Logs, also, which had been lying in swamps, exposed to all weathers, were cross-cut, and found perfectly sound throughout. Paling fences, which had been erected for seven years in similar ground, were opened out and found sound and generally perfect.

I have, &c.,

J. ARTHUR WRIGHT,

Director of Public Works, and Commissioner of Railways.
The mill buildings, which are constructed chiefly of Karri, subjected to severe strains from the vibration of machinery, were found perfectly sound; with the exception of a few instances, where small saplings had been used, which showed signs of decay.

The Hamelin Jetty was next examined, also Karri sleepers recovered from a wreck, mentioned in the evidence of Captain Hay and Mr. Tomb.

In the jetty, which has been erected for six years, Jarrah and Karri piles were used. Both timbers were destroyed, to a depth of about two and a half inches, by the effects of the sea worm ("Shelura"). The superstructure, which is chiefly of Karri, was found perfectly sound. The sleepers recovered from the wreck were found sound, after a lengthened exposure (vide evidence of Mr. Tomb and Captain Hay).

The Commission visited and inspected the Augusta Jetty, built of Karri timber, and erected between two and three years, which, as far as could be seen, appeared to be in good condition. Karri timber on the adjoining beach, which, from the evidence taken, had been lying there for forty years, was found to be sound, with the exception of the sap wood, which was slightly decayed.

Two small trestles of an old jetty were examined. The lower portions, subjected to the wash of the sea, were partially eaten and destroyed on one side only, the superstructure being perfectly sound. The Karri forests were inspected, and various measurements of standing trees taken, which were found to average 124 to 126 feet to the first branch, and 15 to 20 feet in circumference. Logs, which had been lying on the ground for many years, were cross-cut, and found to be perfectly sound.

The trunks of the Karri trees as a rule are sound, and free from gum shakes or pipes to the first branch, from whence the timber deteriorates.

As the Commission were unable further to continue their researches together, Mr. Gardiner was requested to make an examination of the Bunbury Jetti; and Messrs. Rogers and Stafford, who were to travel south, undertook to take evidence, and report thereon. These reports are printed with other evidence appended.

The Vasse Jetty, 1,660 feet long, stretching out into Geographe Bay, constructed of Jarrah, was inspected. The piles, which have been standing more than ten years, appeared in every instance perfectly sound, no trace of the sea worm being discovered. Vide Mr. Knapton's evidence.

Four members of the Commission inspected the Lockeville Jetty, five miles from the Vasse. This structure is built entirely of Jarrah, and has been erected fourteen years. The piles and superstructure showed no signs of decay or deterioration. Mr. J. A. Evans, the manager of the Lockeville Timber Station, gave evidence and stated his experience. A Karri flag-staff (a sapling which had been cut from the outskirts of the Jarrah forest, and therefore not a good example) was examined, and found to be decayed under the surface of the ground to the extent of one inch deep through the sap, the heart being quite sound. Mr. Yelverton's evidence was taken (Vide Appendix).

The Commission visited Fremantle, and examined the timber structures in that locality. The piles in the old road bridge over the River Swan, which have been in position 28 years, are of round Jarrah, and throughout show no signs of decay. The square hewn Jarrah piles of the railway bridge over the same river were next inspected, and found to be in every instance perfectly sound; they were charred and tarred before being driven. This bridge has been erected more than six years, is built entirely of Jarrah, and the superstructure is almost as good as the day it was finished.

The round Jarrah piles in the new Sea Jetty appear to be in good order throughout.

Some years ago the Government of Ceylon imported and used a considerable quantity of Jarrah for jetties, sleepers, &c., and in consequence of the unfavorable reports received from the Engineers in that Colony, the Colonial Secretary wrote as follows to the Government of Western Australia:—

"It will be seen from the reports that the use of Jarrah timber has not hitherto been such a success as, in His Excellency's opinion, to justify the cost in importing further supplies of this wood "instead of using Ceylon Satin-wood, which is both less expensive and more enduring in the sea."
There is no evidence to show if the Jarrah referred to was a fair sample, or if the ordinary conditions for selecting good timber had been complied with. On the other hand, the reports that have been furnished from the Governments of South Australia, New Zealand, Natal, Hong Kong, and the Cape all speak most highly of the valuable qualities of Jarrah.

**CONCLUSIONS ARRIVED AT BY THE COMMISSION.**

1. It is very certain that the usefulness and durability of both timbers depends very much upon the locality where grown, and the season of the year in which it is felled. The Commission consider that from November to May or June, or when the sap is down, is the best time to undertake this work; this applies equally to Jarrah and Karri.

2. From the lengthened tests and life in works to which Jarrah has been subjected, it appears to be a timber suitable for piles in Marine structures. Karri piles, as compared with Jarrah, can scarcely be regarded as having passed the experimental stage; and the Commission would suggest that a series of experiments be commenced and continued year by year with both timbers under exactly similar conditions, careful inspection being made from time to time, and true records kept.

3. From the evidence appended, it appears that the advantages of Karri over Jarrah are:—that piles can be obtained of greater lengths; straighter; they drive better, and resist a heavier strain. For the superstructure of bridges, jetties, &c., or where severe strains or crushing weight has to be considered, Karri, in consequence of its greater strength (see appended tables), should be preferred and used before Jarrah.

4. It does not appear from the evidence before the Commission that there is much to choose between the two timbers, as far as their ant-resisting properties are concerned.

5. From the evidence before the Commission, and the appended Tables of Tests, we are of opinion that Karri is most suitable for works of construction, railways, and public works generally; but as regards the timber resisting the action of salt water and sea-worms, in marine works, it has yet to be proved.

6. It appears, from structures that have been examined, and from the evidence taken, that, as a general rule, round piles should be used in preference to square, and they should be charred and tarred before being driven.

The results of tests made at different times appear in the appendix, together with the evidence taken by the Commission.

We have, &c.,

CLAYTON T. MASON, M. Inst. C. E., Chairman.
WILLIAM ROGERS, M. Inst. C. E.
FRED. STAFFORD, M. Inst. C. E.
H. ERNEST PARRY, Assoc. M. Inst. C. E.
JAMES GARDINER, Assoc. M. Inst. C. E.

The Hon. J. A. Wright, M. Inst. C. E., Engineer-in-Chief, &c., &c., &c.

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**Evidence received by the Commission.**

Mr. Hugh Tomb.

I am Manager of the Karridale Timber Works. I have held that position from the starting of the mill, eight years ago, and my experience in the Karri timber dates from then. Before that date I was connected with the Jarrah trade for three years, as Manager of the Collie Timber Station. I consider the Karri equal to Jarrah. Karri in jetty works is stronger than Jarrah, and this has been proved by official tests.

I have had experience also in driving Karri piles, and consider they drive better than the Jarrah, not being so liable to split. I am also of opinion that piles for jetty works should be square, and prefer using the Karri. My reasons are because the squared timber of the sizes required are obtained from trees of an older growth. I do not consider the sap of Karri as good as that of Jarrah. My opinion as regards Jarrah for jetty works applies the same as to Karri.

The longest time I have known Karri piles to be in a sea jetty is six years, and they are now in the Hamelin Jetty, and in good condition. In this jetty there are also some Jarrah piles, and the reason for
using them was to save haulage. Provided the expense were the same, I prefer to use Karri to Jarrah. Between wind and water the sap is eaten by the sea worm "Shelura," and this applies also to the Jarrah piles. For jetty purposes the smallest round pile, in my opinion, that should be used is fourteen inches diameter at the smallest end.

We have shipped from Karridale piles of this dimension up to 88 feet in length, for the Port Darwin Jetty, and the specification stated that these piles were to be coppered.

The sea worm, as before stated, has only penetrated the piles at the Hamelin Jetty as far as the sap, and I am now, in the present extension, trying the effect of charring and tarring.

The first piles in the Augusta Jetty have been down three years, and some of them were charred and tarred. All the piles used in this jetty are round Karri. I used the round in preference to square piles to save expense, and our jetties, for the most part, for the sake of economy, are constructed of condemned timber, unsuitable for the market. All other things being equal, I consider Karri and Jarrah piles for jetties to be of equal value, but for the superstructure prefer using the Karri. I am inclined to think that the "Teredo Navalis" will attack the Karri in the same manner as the Jarrah.

Re Sleepers.—I have known Karri sleepers to be used for six years at this Station, being laid quite green, and of all sizes. They are at the present time in very fair condition, and I know of no single instance where they have been attacked by the white ant; but I have seen both Karri and Jarrah lying down in the bush attacked by them. I have not observed any dry rot in Karri sleepers. My own experience of the Karri and the Jarrah for sleepers is that they are equal, but I prefer the Karri as being the stronger of the two.

With reference to the ship "Shaudrie" containing Karri sleepers, and wrecked three years ago at the Hamelin, I got about 4,000 out of her at different intervals; some, eighteen months ago. They were the last recovered, were in good condition, and many of them forwarded to South Australia.

There is no truth whatever in the report circulated that these sleepers were rotten, and I hold an affidavit from two gentlemen to this effect. There is also no truth in the other report that Jarrah was condemned timber, unsuitable for the market. All other things being equal, I consider Karri and Jarrah piles for jetties to be of equal value, but for the superstructure prefer using the Karri. I am inclined to think that the "Teredo Navalis" will attack the Karri in the same manner as the Jarrah.

I consider the best time to cut Karri is from January to May, when the sap is down.

CAPTAIN W. B. HAY.

I was master of the "Shaudrie." On 4th July, 1888, she was wrecked with a cargo of Karri sleepers on board. I conveyed the first cargo of Karri sleepers and some round and hewn timber to South Australia in 1879, which was used for the Port Dock, Adelaide. The next cargo I took in 1880 consisted of round piles for the Wallaroo Jetty. I have seen them since the jetty was constructed (which is partly of Jarrah and Karri, the former having been obtained from the Jarradale Timber Company). The piles in this jetty are all round and were quite green when shipped. The jetty was completed about 1880, and I made a personal inspection of it about May, 1885. It appeared perfect throughout, and I took particular notice of the piles between wind and water. They were not coppered but I believe were tarred, and I could distinguish no difference between the Karri and Jarrah piles.

I have also carried piles for the Largs Bay Jetty, South Australia. It was completed in 1888, and is at the present time perfectly sound.

I consider the Karri piles preferable to Jarrah for driving as they can be driven without shoes, and my experience is that Karri timber is heavier than Jarrah when green.

The Karri sleepers I have carried weigh 124 lbs. each. The Jarrah sleepers I have carried weigh 112 lbs. each.

Mr. C. HOWES (examined at the Hamelin).

I am a Foreman Carpenter, and was on the Largs Bay Jetty works, S.A., until nearly completed. It is constructed mostly of Karri timber, and was completed in 1882. I last saw it seven months ago, and it appeared to be in as good condition then as when finished. I was Foreman Carpenter also at a bridge over the Oakaparinga River, at Burra Burra, South Australia (about two chains in length). The piles were thirty and forty feet long, two feet butt and round; being some of the first Karri sent from W. A. about 1878. I crossed this Railway Bridge last, six months ago, and am informed it is perfectly sound.

Mr. WM. ELLIS (examined at Augusta).

I have resided over 40 years in the district, and have known the Karri timber to be used for the same period. The ship "John Panter" was loaded with baulk Karri, which was forwarded to England about 40 years ago. Several pieces of this timber were left on the beach, the vessel being too full to take them; they are still there, and I can point them out.
A stockyard of the same timber was erected about 40 years ago, and I examined some of the posts last December and found them perfectly sound. This yard is on dry sandy ground.

I have been working amongst Jarrah since I have been in the Colony, and consider the Karri the stronger wood of the two, and tougher; but for buildings on dry ground do not consider one better than the other.

I have seen Karri logs buried in swamps, that have lain there since I can remember; they are still perfectly sound. I am confident that I can distinguish Karri from Jarrah. The first Jarrah I saw used on jetty works was at Augusta, in a small boat jetty about five miles from the mouth of the Blackwood River. The tide there flows about twenty miles up the river, and this jetty was constructed before I came to the Colony. A considerable quantity of fresh water comes down this river during a portion of the year, and as far as I know the piles are in perfect condition at the present time.

I recollect a trestle jetty being erected at Augusta about seven years ago; it was constructed of mixed timbers, including Karri, Jarrah, and Red Gum, and a portion of it is still standing; the remainder having been washed away in consequence of the longitudinal and superstructure having been removed. This jetty was only intended in the first instance as a temporary structure.

CAPTAIN HAY (re-examined).

The temporary trestle jetty at Augusta was constructed in 1879, under my direction. The timber used was what could most easily be procured on the spot, and consisted of different descriptions.

Mr. G. H. Knapp (examined at the Vasse).

I was the Contractor for the 3rd Section or extension of the Vasse Jetty. It was completed in 1876. I procured the piles, which are Jarrah, from Mr. H. Yelverton's timber station. They were neither charred nor tarred, and were put in perfectly green. They were cut on high land and in an ironstone locality.

Mr. J. A. Evans (examined).

I have had 15 years experience in timbers, in Canada, New Zealand, Newfoundland, etc., and am now Manager of the West Australian Timber Company. I assumed office in 1882, since which time I have had considerable experience in Jarrah; I have had no experience whatever in Karri, and cannot express an opinion as to the relative merits of the two timbers.

For sleepers my opinion is that Jarrah is as good a timber that I know of, and for Marine Works consider it really good, and better than any other timber I have had to deal with.

The best Jarrah in my opinion is obtained from the back of Bunbury, i.e., between Vasse and Bunbury. I account for this owing to the height of land above the sea level and the nature of the soil (ironstone formation) and being near the centre of the forest, as it is a well known fact in all parts of the world that the finest timber is found in the centre of a forest.

I have not visited all the timber stations of the Colony, having only been at Karridale, Yelverton's (Quindalup), and the one I am at present the Manager of. After inspecting the Karridale forests, I came to the conclusion it was the finest grown timber in the world as far as I have seen, although I have travelled through Gipps Land (Victoria), the Yosemite Valley (California), and the Douglas Firs in British Columbia.

The jetty at this station (Lockeville) has been erected fourteen years. A portion of it was carried away by a schooner drifting ashore, but the shore and sea ends are as originally constructed.

I have not tried any artificial means to preserve the Jarrah from the attacks of the sea worms.

I believe the soundness of the piles in the Vasse and Lockeville jetties is attributable to the very best description of Jarrah having been used, and possibly in consequence of the season of the year in which it was cut. My opinion is, that this timber should be cut from November to May, when the sap is down.

I have no doubt whatever that for Marine or other works round piles of Jarrah are preferable to square, and my reason for this assertion is, that the finest quality of the wood exists nearest the sap, which if squared would be cut away.

Mr. Henry John Yelverton (examined).

I am the proprietor of the Quindalup Timber Station. Have been engaged in the Jarrah timber trade 14 years. Have had very little experience in Karri, though I know the timber. I consider myself competent to make a comparison of these timbers, and consider, for marine works, that Jarrah in piles is preferable to Karri. My reason for stating so is, I know Jarrah piles from 20 to 30 years in the sea now sound, and they are in the Vasse and Quindalup Jetties. The piles in the present jetty at Quindalup have been driven 18 years, and are nearly as sound as when first put down. With the exception of the
sap, all the timber is perfectly sound. For superstructure I consider Karri equal to Jarrah. Personally I know nothing of Karri for piles, but consider from authentic information that they are not as good as Jarrah piles.

For Marine works I prefer round Jarrah piles, and consider no timber for piles should be used of less than 12 inches diameter at the smallest end. That portion of the timber between the heart and sap I consider the most durable.

I have examined the Jarrah piles of the old sea jetty at Fremantle, and attribute the bad condition of this jetty to the fact that many of them were cut out of large trees, two, three, and four out of each log, consequently a portion of the heart in each was left exposed. They were all square, and should have been round piles. The timber was supplied by my father in the rough, and obtained from the nearest locality to Fremantle and cut up by convict labor. Had the piles been round, in my opinion they would have lasted much longer.

I am not aware of any instance of Jarrah piles having been artificially treated.

The sea worm, in my opinion, will not attack Jarrah piles in tidal rivers the same way as in the sea. I consider Karri tougher than Jarrah and of greater strength, and that like Jarrah the best portion of the wood is between the heart and sap.

Mr. JAS. GARDINER (in writing to the Chairman) says —

I am Resident Engineer at Bunbury, and have made a minute examination of the jetty at Bunbury, and found many of the squared Jarrah piles considerably decayed and riddled by sea worms at surface of water.

Perhaps it may be proper for me to mention that the timber employed for those piles appears to have been of an inferior description, and owing to the sap wood having been removed in the squaring of each pile nothing has been left but the heart of the tree.

From what information I can obtain from the settlers at Bunbury, I am led to understand this portion of the Jetty has been erected about 22 years.

Referring to the extension erected during 1875, when round piles were employed, I may say I am unable to detect any signs of decay or ravages from sea worms.

Mr. JOHN WISHART (examined).

I am a contractor, and have been engaged in the colonies for the past 25 years, especially on Harbor Works and Jetties; am now a member of the firm of Baillie, Davis, and Wishart; and during that time I have had constant experience with the timbers of the colonies, and especially the Karri and Jarrah, and have constructed from these timbers numerous wharves, jetties, and bridges in South Australia and Victoria.

I have used Jarrah for the last 20 years in South Australia, and Karri for the last 8 years in wharves and jetties from the time of its introduction into the public works there, about 1878.

I have constantly, up to the present time, examined these structures; and, as far as my experience has gone, the Karri timber, both above and below water, is now perfectly sound, and shows no signs of being eaten by sea worm between wind and water; this refers to the Adelaide River and open sea. I have taken out piles of Jarrah which have been 25 years in the ground and found 3 out of 4 to be sound, the remaining proportion showing signs of decay from the sea worm—the piles referred to were always tarred before driving.

All timber referred to in timber wharves, jetties, and bridges in South Australia are coated with two coats of gas tar.

I believe, for the superstructure, Karri is far superior to Jarrah; for piles I am not prepared to give an opinion, my experience of Karri not having been over a sufficient length of time; but I am confident that Karri is the strongest timber for pile work, and will stand over twice the strain of Jarrah.

The first work I constructed in Karri was a large dockyard wharf at Port Adelaide, in 1878; this was built partly of Jarrah and partly of Karri; the reason for this being that at the time the supply of Jarrah was scarce, and the Jarrah sheeting would not stand driving through the limestone, whereas Karri was driven without difficulty. The Government allowed my firm to use Karri, on the condition that if the Karri showed signs of decay or damage from the sea worm during the following 5 or 6 years it would have to be replaced at our cost. This wharf has been carefully examined annually by the Marine Board, and shows no signs of decay or damage from any cause.
If I were building on my own capital I should consider generally that for piles both are about equal; but for superstructures I consider Karri the best.

It is always a difficult matter to obtain Jarrah piles over 50 feet, whereas Karri can be obtained up to 90 feet lengths.

At Port Darwin, in a large jetty 1200 feet long by 60 feet which we have built, only Karri has been used, and about 300 piles were from 75 to 90 feet long. These piles have been coppered from four feet below ground to the cross heads, also the walings and bracings. About twelve months before this jetty was built, the Government drove down six test piles—3 Jarrah and 3 Karri. When these piles were cut, twelve months after being driven, both were equally eaten by the sea worm between wind and water, and with a rise and fall of 25 feet; the sea worms are notoriously bad and destructive on the North coast, where the tide rises and falls 20 feet and over.

I consider that piles should be always tarred and charred before driving, and that it increases the life at least 5 years.

I have had considerable experience in both timbers for sleepers, and I do not think there is much choice between them; if anything, it is in favor of Karri, which holds the fastenings better and is not so liable to split.

Mr. J. W. Hutchinson (examined).

I have had 30 years constant experience amongst the Gum and other timbers in the Australian Colonies, my attention having been called to the Karri and Jarrah timbers of Western Australia during the past nine years. I am specially a timber man, and have devoted the whole of my time to the management of sawmills and timber work in the Colonies.

I consider Jarrah is not so strong nor so tough as Karri for piles, the Jarrah will not stand hard driving but the Karri will. I refer to round or square piles for longitudinal girders or bearing powers. I consider the Karri far superior to any other Australian timber (except Iron Bark of New South Wales) that I know.

I have lately examined a number of fences and shedding near Torbay which have been constructed from Karri timber, and these structures have existed for over 22 years; they are now perfectly sound and show no signs of decay between air and ground or otherwise.

In cutting Karri at the large sawmills I am now working at Torbay, I find it much harder than Jarrah; it is as hard as the Iron Bark of New South Wales. I think Karri will stand sun and weather far better than the Jarrah or Red Gum of the other Colonies.

I consider that for public works generally Karri is far better than Jarrah, and superior to the timbers of the other Colonies excepting Iron Bark, both on account of its strength and endurance.

For sleeper purposes on Railways I have known the Karri timber from the time of its introduction for this purpose, and I have not known any instance where it has been necessary to replace it.

Mr. James Manning, Fremantle, W.A. (examined).

I am a retired Clerk of Works of the Royal Engineer Department. My experience of Jarrah has been very extensive. I superintended the construction of all the sea jetties in this Colony up to 1875; also the road bridge over the Swan at Fremantle and the road bridges in the Southern Districts. These structures are all of Jarrah, with the exception of the approach of the Warren Bridge, which is of Karri.

The old South Jetty at Fremantle was the first constructed in the Colony of square piles (four cut out of a baulk). The consequence was they were attacked by the "Teredo Navalis" on the heart side, and had to be removed during the course of the next ten years. Since then I have not used square piles in any structure except the Geraldton Jetty, which were of 9" x 9" Jarrah.

The mean diameter of piles I should recommend being used would be about 14 inches when barked.

At the time I retired from the service—in 1875—all the bridges referred to, as far as I know, were in good condition. Jarrah was also used in the superstructure of these bridges, and was in good condition.

I account for the difference in the quality of Jarrah in this way. Jarrah grown on sandy soil is soft and short grained, but that grown on ironstone or granite ranges is much harder and very much stronger. Jarrah cut when the sap is at its lowest ebb is more durable than when cut with the sap in full flow. From December to May is the best season for cutting Jarrah, in my opinion. About 1882 or 1883 I made experiments as to the strength of Jarrah.

I have had very little practical experience of Karri. I used in the approach to the Warren Bridge stringers of Karri; and on visiting this bridge about four years afterwards they were found decayed with
dry rot. They were round timber about thirteen inches diameter. These stringers were cut at the Warren River on chocolate colored loamy soil. This is the only instance in which I have used the Karri timber.

**Mosses, Rogers and Stafford, in writing to the Chairman, reported as follows:**

"The Government or Town Jetty, King George's Sound, has been constructed at two different periods. The shore portion of about 570 feet has been in use for nearly 26 years, and is built of hewn square Jarrah of small trees; the remaining portion of 583 feet has round piles of an average diameter of 12 inches, and has been used for about 18 years. In both cases the timber has been used in its natural state, neither tarring nor charring having been applied. This jetty was carefully examined, both above and to four feet below water; the piles generally were perfectly sound, and the waddings, bracings, and deckings in good condition. Several of the hewn square piles showed defects of decay, but not of a serious nature, and, as far as information could be gained, had not been renewed for 26 years. The round piles were perfectly sound, and although only 18 years in the construction against 26 years of the squared timber, seemed in every way more preserved than those hewn square. The waddings were in good condition and sound, and no trace could be found in any part of the attack of the sea worm.

"The smaller jetty, built by the P. & O. Steam Navigation Company, and situated nearer the entrance of the harbor, has been constructed for about 17 years, and is carried out to a depth of about 11 feet of water. The piles are small Jarrah trees hewn square to about 9 inches, and all other timber seems to have been cut from small trees. This jetty was examined in all parts to a depth of about 3 feet below water, and although in fair condition for a temporary structure (which purpose it was doubtless intended to serve) it still retains a state of preservation which could hardly be expected from most timbers of repute. In some portions decay appears to have commenced from the timber being badly selected at first, and, where it extended into the heart of the timber, has been very damaging; in the round piles a general wearing away has gradually taken place to a depth of about a quarter of an inch, but as a rule, in both jetties, the timber seems in a fairly sound condition, although used without being charred or tarred, a precaution which without doubt greatly adds to the life of Jarrah and Karri timbers. These jetties have been subjected to only light traffic, and, as far as we have observed, the effects of the sea worm, or 'Teredo,' are much less in the bays than in the open sea.

"As regards Karri timber, a most interesting example was pointed out by the older inhabitants of Albany, especially Mr. Sherratt, who has a keen recollection of Albany for over 50 years, and has resided there the whole of that time. A baulk of Karri was unearthed, which had been buried within a distance of twenty feet of the tide mark, and with a covering of three feet of moist earth. This baulk was twenty feet long and thirteen inches square, and had lain more or less buried for 46 years. At the spot, being subjected to winter floods and occasionally the soakage of the sea water. It had originally been used as a stay for launching boats, and with three or four other pieces had remained in its present position for 46 years. This specimen was in every way perfectly sound, and showed no signs of decay, the color only having changed to a dark neutral tint. Various other examples, such as mooring posts and beacons of Jarrah, were examined, and after an exposure of from twelve to fifteen years appeared to be fairly sound. The example of the Karri baulk being most decided."

H. C. Mays, Esq., M. Inst. C.E. (Engineer-in-Chief and Engineer of Harbors and Jetties in South Australia), in writing to the Engineer-in-Chief of this Colony, says:—

"Since 1867 I have been engaged more or less in the erection of Jetties, Wharves, and other Marine Works, and have used Jarrah extensively in conjunction with the Red Gum of our own colony since 1868, having driven upwards of 3000 piles in sea-water; but my experience with Karri for Marine purposes is not sufficiently extensive to warrant me in expressing any opinion upon it for that purpose, it having only been introduced here in 1879, and has not been much used for jetty work except at Port Darwin, where the whole of the timber work of the jetty has been sheathed up to 2 feet above high water level, as it was found that when trial Jarrah piles (6) were driven to mark out the line of the jetty, the sea worms attacked them to such an extent that they were riddled in about eight months. This jetty was built of Karri, and as before stated not only the piles, 320 in number, but all the waddings and braces were sheathed with Munts metal and all timbers fastened with metal bolts. The fender pieces against which the vessels lay are of Singapore timber, which is said to successfully resist the ravages of the 'Teredo.' The only other instances where Karri has been designedly used for piles is in the Robinson Swing Bridge foundations and wharf at Adelaide. This bridge was built in 1882-3, and I allowed Karri to be used in the foundations which are removed from the face of the dock and out of the reach of the salt water, but the face piles connecting the bridge abutments with the adjoining wharves are also of Karri, and it having been rumored lately that some of these piles were being badly eaten by the sea worm I sent an Inspector down to examine them, and he reports as follows:—'I find a few piles are beginning to show signs of decay between the rise and fall of the tide. I cannot see that there is any difference between the Jarrah and Karri timber, as you will see by the pieces I have sent to your office cut from the two piles most affected.'"

"I think the cause of these few piles showing signs of decay is owing to some fault in the timber before it was put into the work and not to any fault of Jarrah or Karri timber as a whole, for I
find a pile here and there in the South Australian Company's wharves affected in the same way, and
five (5) or six (6) of the Red Gum piles in the Semaphore jetty had to be replaced eight years since for
the same reason.

"I find that Karri was used in building a temporary ship jetty at Port Augusta in 1879, and as it
was necessary to remove a portion of this work to build a new wharf, I took the opportunity of inspecting
the drawn piles and found them, comparatively speaking, uninjured, certainly not more damaged than
Jarrah would have been if exposed for the same period.

"The three instances above cited are the only cases where Karri has been exclusively used for
Marine work, but it is quite possible that this timber may have been imported here as Jarrah and used
where the latter timber has been specified, owing to the difficulty experienced in detecting the difference
between the two timbers by Clerks of Works who are not well acquainted with them. My experience is
therefore limited and would not warrant any opinion worth having.

"I have, however, used Karri extensively for Bridge piles and other purposes on land, as well as
for Railway sleepers, and find that for the former purpose it is tougher and drives better in piles than
Jarrah. With regard to the use of Karri for sleepers, although I have used a very much larger number of
Jarrah than of Karri, I don’t find much difference in the ant-resisting qualities of either timber, both are
very good when the timber is sound and grown on high ground and fully matured, but a great quantity
of timber finds its way here that is cut from small trees not of matured growth and felled the wrong
season of the year, so that when laid down as sleepers it is readily attacked by the white ants, which eat the
sap, the soft parts, and the heartwood. I am quite safe in stating that neither Jarrah nor Karri will stand
for many months the ravages of the ‘Teredo’ at Port Darwin and on the land in the Northern Territory;
the white ants will attack and speedily destroy any timber whether native or other Southern or Western
timbers, except the cypress-pine grown in the locality and in the South-Western district of New South
Wales. So certain was I of this fact that I determined to use steel sleepers for the Railway now under
construction, as there is a scarcity of cypress-pine fitted for sleepers.

"As an illustration of the durability of Jarrah I may mention that the Jarrah piles supporting the
keeper’s quarters at the Port Adelaide Light-house, 26 in number and about 14” x 14” hewn timber, were
driven in 1868, and are to-day as sound as when they were driven.

"Jarrah has been extensively used at Port Adelaide in the docks and wharves belonging to the
South Australian Company, in fact as they now stand they are built entirely from that timber, with the
exception of 500 feet at the West end of the dock, where Singapore timber was used. Karri has never been
used by the Company, as the manager has, I am informed, never been satisfied by the evidence produced
that it was equal to Jarrah in resisting the ravages of the sea worm, and even with regard to the Jarrah
used in their extensive works it is only too evident that after a time it ceases to resist their attacks; in fact
my experience is, that it is only a question of time when the worm-resisting properties of Jarrah which
it possesses when recently felled ceases to be of much value as far as the surface of the timber is
concerned, because the worms attack all the softer portions, entirely riddling the exterior of the
timber, penetrating more or less, but not extensively, into the harder portions, and the pile becomes so
much weakened that it must be removed.

"I do not, however, consider that there is any better timber known in these Colonies for Marine
work than Jarrah, although we have native timber quite equal to it in worm-resisting qualities. I may
illustrate this by informing you that during some recent repairs to the older portions of the South
Australian Company’s wharves at Port Adelaide, some Sugar Gum (Eucalyptus corynocalyx) piles were
taken out, which although never very large were much worm-eaten on the surface, still upon examination
it was found that the worms had not penetrated far into the piles, confining their depredations entirely to
the exterior. The piles I now allude to were driven 32 years ago, and formed the face of McLaren’s wharf.

"I regret that the time at my disposal does not admit of an exhaustive reply to your request, but
until I have had a much longer experience in the use of Karri for Marine work, I shall prefer to use Jarrah
for this purpose; but for land purposes I would rather use Karri for piling than Jarrah, because it is a
tougher wood, and as far as my experience goes I do not find any difference in the resistance of either
timber to the attacks of white ants."
Extract from a Report by A. Ransome & Co., of London, on the practical tests of Colonial Timbers, in connection with the Colonial and Indian Exhibition, on 8th October, 1886.

With a view to forming some idea as to how the different timbers would be affected by seasoning, pieces of the various woods included in the schedules on pages 474 and 475 were planed to the uniform size of 18 inches by 4½ inches by 1½ inches; and, after being carefully weighed, were submitted to the Cool Air Drying Process for 144 hours, with the results given below. It should, however, be mentioned that this experiment can hardly be regarded as complete, in consequence of some of the samples being very much more seasoned than others when placed in the drying chamber.

For seasoning the woods the Cool Air Drying Process was selected, as being the most like natural seasoning of any of the artificial means at present known; and it is noticeable that though the test was very severe (the woods in some cases losing as much as 22 per cent. in weight) they have, with few exceptions, stood most excellently.

Western Australia.

Karri (Eucalyptus diversicolor). Like all the Eucalypti, this is a hard timber. In colour, it is of a light red tint. A log 3 feet in diameter, planted in the yard at Stanley Works to represent a growing tree, was cut down by the Steam Tree Feller; and another log of the same size was cross-cut, as it lay on the ground, by a similar machine. In each case the operation was completed in about three minutes. The wood was operated on in the following ways:-The rail-seatings were adzed on a sleeper and the spike-holes bored, giving satisfactory results. A plank passed through the vertical frame produced clean sawn boards; spokeshaves and hammer-handles were also turned out satisfactorily. The tree, which is abundant in the Colony, attains colossal proportions; stems having been measured to a height of 300 feet without a branch, and with a girth of 60 feet at the base. This timber has been quite recently imported into London, and can be purchased at from £7 to £8 a load at the Docks.

Jarrah (Eucalyptus marginata). This, the most plentiful of Western Australian timbers, is beautifully marked, and somewhat resembles mahogany in colour. Railway sleepers, joinery, casks, spokes, and hammer-handles were made from it. The planed and moulded specimens, unlike the Karri, which does not finish well, left the machines with a remarkably fine surface. The wood is largely used in Western Australia for railway sleepers, furniture, and joinery, and is especially adapted for piles, as it resists the teredo. The best jarrah is found on the hill ranges about twenty miles from the sea-coast, and being easily accessible can be delivered in London for £7 a load.

List of Woods dried by the Cool-air Process.

<table>
<thead>
<tr>
<th>Name of Wood</th>
<th>Colony</th>
<th>Average weight of pieces, 3&quot; x 2&quot; x 1½&quot;</th>
<th>No. of Tests</th>
<th>Average breaking strain.</th>
<th>Average Deflections.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karri</td>
<td>Western Australia</td>
<td>3 lbs., 1 oz.</td>
<td>3</td>
<td>19 lbs.</td>
<td>1:12</td>
</tr>
<tr>
<td>Moutimeen Teak</td>
<td></td>
<td>4 lbs., 1½ oz.</td>
<td>3</td>
<td>19 lbs.</td>
<td>1:08</td>
</tr>
<tr>
<td>English Beech</td>
<td></td>
<td>4 lbs., 2½ oz.</td>
<td>3</td>
<td>18 lbs.</td>
<td>1:02</td>
</tr>
<tr>
<td>Eucalyptus</td>
<td></td>
<td>4 lbs., 3½ oz.</td>
<td>3</td>
<td>18 lbs.</td>
<td>1:02</td>
</tr>
<tr>
<td>English Oak</td>
<td></td>
<td>5 lbs., ½ oz.</td>
<td>4</td>
<td>17 lb.</td>
<td>1:37</td>
</tr>
<tr>
<td>Jarrah</td>
<td></td>
<td>4 lbs., 1½ oz.</td>
<td>2</td>
<td>17 lbs.</td>
<td>.98</td>
</tr>
<tr>
<td>English Ash</td>
<td></td>
<td>4 lbs., 8½ oz.</td>
<td>3</td>
<td>16 lbs.</td>
<td>1:08</td>
</tr>
<tr>
<td>Red Deal</td>
<td></td>
<td>3 lbs., 4 oz.</td>
<td>2</td>
<td>11 lbs.</td>
<td>.92</td>
</tr>
</tbody>
</table>

Shrinkage:

<table>
<thead>
<tr>
<th>Name of Wood</th>
<th>Colony</th>
<th>Weight when put in.</th>
<th>Weight when taken out.</th>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karri</td>
<td></td>
<td>lbs.</td>
<td>oz.</td>
<td>lbs.</td>
<td>oz.</td>
</tr>
<tr>
<td>Jerrah</td>
<td>Western Australia</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Tuart</td>
<td></td>
<td>5</td>
<td>7½</td>
<td>5</td>
<td>1½</td>
</tr>
</tbody>
</table>

Width. | Thickness. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3½&quot;</td>
<td>3½&quot;</td>
</tr>
<tr>
<td>3½&quot;</td>
<td>3½&quot;</td>
</tr>
<tr>
<td>3½&quot;</td>
<td>3½&quot;</td>
</tr>
</tbody>
</table>
Results of Tests of Jarrah and Karri Timbers made at the Government Dockyards by Thomas Laslett, Esq., Timber Inspector to the Admiralty, in 1873.

**TRANSVERSE EXPERIMENTS.**

<table>
<thead>
<tr>
<th>Name of Timber</th>
<th>Dimensions (inches)</th>
<th>Specific Gravity</th>
<th>Weight at which piece broke (lbs.)</th>
<th>Direct cohesion on one square inch (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karri</td>
<td>1.91 - 3.31</td>
<td>0.54 - 0.64</td>
<td>6.08 - 4.71</td>
<td>1.10 - 1.90</td>
</tr>
<tr>
<td>Jarrat</td>
<td>0.84 - 0.78</td>
<td>1.13 - 1.11</td>
<td>8.02 - 6.66</td>
<td>1.08 - 0.91</td>
</tr>
</tbody>
</table>

Six specimens of each wood were tried, and the results given are average.

**TENSILE EXPERIMENTS.**

<table>
<thead>
<tr>
<th>Name of Timber</th>
<th>Dimensions of specimens</th>
<th>Specific Gravity</th>
<th>Weight at which piece broke (lbs.)</th>
<th>Direct cohesion on one square inch (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karri (six specimens)</td>
<td>2 x 3 x 30</td>
<td>1.14</td>
<td>981</td>
<td>789</td>
</tr>
<tr>
<td>Jarrat (two specimens)</td>
<td>2 x 3 x 30</td>
<td>1.18</td>
<td>996</td>
<td>790</td>
</tr>
</tbody>
</table>

These results are average.

**VERTICAL OR CRUSHING.**

<table>
<thead>
<tr>
<th>Name of Timber</th>
<th>Weight at break (tons)</th>
<th>Average on one square inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karri</td>
<td>5.14</td>
<td>7079</td>
</tr>
<tr>
<td>Jarrat</td>
<td>3.10</td>
<td>2940</td>
</tr>
</tbody>
</table>

*Extracted from the Western Australian Catalogue of the Melbourne International Exhibition, 1880-81.*

**Table showing Comparative Tests of Indian Teak and English Oak compared with Western Australian Jarrah and Karri Timber.**

<table>
<thead>
<tr>
<th>Name of Wood</th>
<th>Weight per Cube foot</th>
<th>Specific Gravity</th>
<th>Transverse Strength per square inch</th>
<th>Average Tensile Experiments</th>
<th>Vertical or crushing strains on cubes of 2 inches</th>
<th>No. of Years assigned by English Lloyd's for shipbuilding purposes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karri</td>
<td>63.13</td>
<td>981</td>
<td>2204</td>
<td>12</td>
<td>12 Years</td>
<td></td>
</tr>
<tr>
<td>Indian Teak</td>
<td>40.47</td>
<td>807</td>
<td>2303</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English Oak</td>
<td>83.51</td>
<td>885</td>
<td>2117</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jarrat</td>
<td>63.13</td>
<td>1010</td>
<td>1800</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tabulated Statement of the Transverse Strength and other Particulars of Karri and Jarrah Timber experimented upon by the Timber Board at the Victorian Railway Workshops, Newport, January to April, 1884.

The Samples tested were each 7' 0' in length by 1½'' square; the distance between the bearings was 6' 0' ; and the weight was gradually applied in the centre till the sample broke.

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Locality</th>
<th>Botanical Name</th>
<th>Locality where Grown</th>
<th>By whom sent</th>
<th>Approximate Date of Test</th>
<th>Dimensions of Specimen</th>
<th>Weight of Specimen in lbs.</th>
<th>Breaking Strength of Sample in lbs.</th>
<th>Average specific gravity</th>
<th>Average density in lbs. per cu. ft.</th>
<th>Average density in lbs. per cu. ft. in 6 months</th>
<th>Average density in lbs. per cu. ft. in 12 months</th>
<th>Average density in lbs. per cu. ft. in 18 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Karri</td>
<td>Eucalyptus diversicolor</td>
<td>Western Australia</td>
<td>N. Levi</td>
<td>31/1/84</td>
<td>10'60 61'44 0'988</td>
<td>0'968</td>
<td>8 2 16</td>
<td>900 0</td>
<td>960 0</td>
<td>4 54</td>
<td>4 54</td>
<td>2 821</td>
</tr>
<tr>
<td>2</td>
<td>Jarrah</td>
<td>Eucalyptus Marginata</td>
<td>Western Australia</td>
<td>N. Levi</td>
<td>31/1/84</td>
<td>9'33 0'875</td>
<td>0'877</td>
<td>7 0 10</td>
<td>857 3</td>
<td>3 71</td>
<td>3 71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>4/3/84</td>
<td>8'92 0'837</td>
<td>0'837</td>
<td>7 1 14</td>
<td>825 7</td>
<td>4 00</td>
<td>4 00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>7/2/84</td>
<td>8'30 0'218</td>
<td>0'218</td>
<td>6 2 25</td>
<td>744 8</td>
<td>4 35</td>
<td>4 35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>Jarrabahle Timber Company</td>
<td>26/3/84</td>
<td>6'22 0'222</td>
<td>0'222</td>
<td>6 1 22</td>
<td>646 7</td>
<td>3 38</td>
<td>3 38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>30/1/84</td>
<td>9'16 0'858</td>
<td>0'858</td>
<td>5 1 22</td>
<td>612 6</td>
<td>4 44</td>
<td>4 44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>31/1/84</td>
<td>9'16 0'885</td>
<td>0'885</td>
<td>5 2 0</td>
<td>662 7</td>
<td>3 38</td>
<td>3 38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>6/2/84</td>
<td>9'50 0'891</td>
<td>0'891</td>
<td>6 3 12</td>
<td>751 3</td>
<td>4 75</td>
<td>4 75</td>
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<tr>
<td>9</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>Do.</td>
<td>30/1/84</td>
<td>9'16 0'858</td>
<td>0'858</td>
<td>5 1 4</td>
<td>600 7</td>
<td>3 63</td>
<td>3 63</td>
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<td></td>
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