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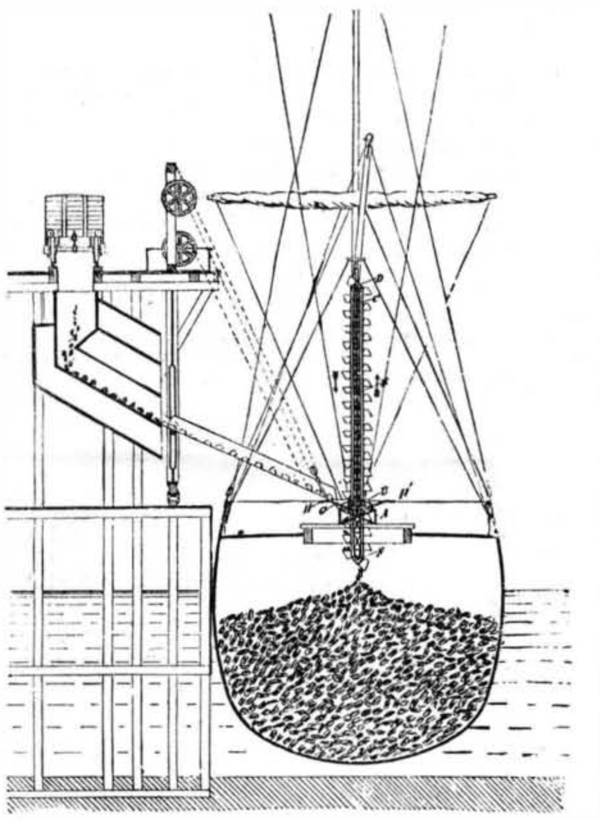
APPARATUS FOR COALING SHIPS.

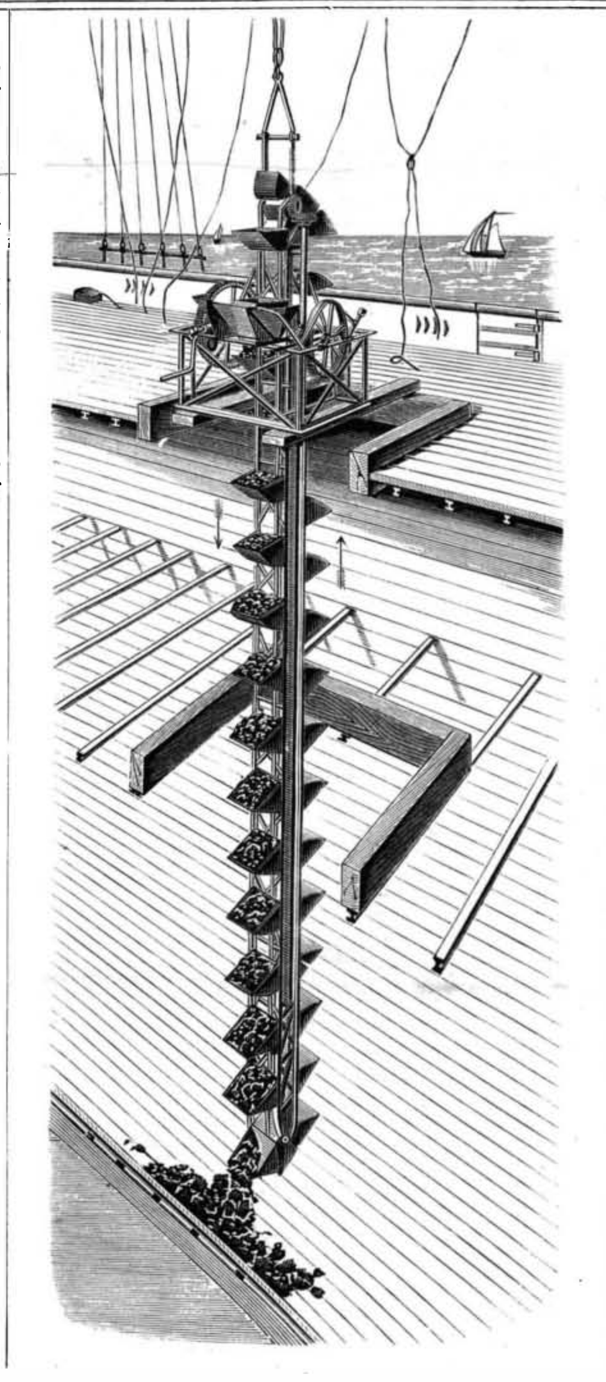
In the ports of England the loading of ships with coal is generally effected in the following manner: The car coming from the mines is hauled to the upper part of a trestle-work, the bottom of the car is opened, the coal falls into a hopper, follows an inclined chute as far as the hatchway, and from there is thrown into the hold. This mode of loading is very rapid and very economical, the only disadvantage that it presents being that large coal, on falling into the hold from the end of the chute, breaks into small fragments. To obviate such a disadvantage, Mr. James Rigg has invented and constructed, in his works at Chester, an apparatus which is shown in three annexed figures, and which constitutes a system that can be employed not only for the loading of coal, but also for letting down to the bottom of the hold bricks, stones, salt, etc.

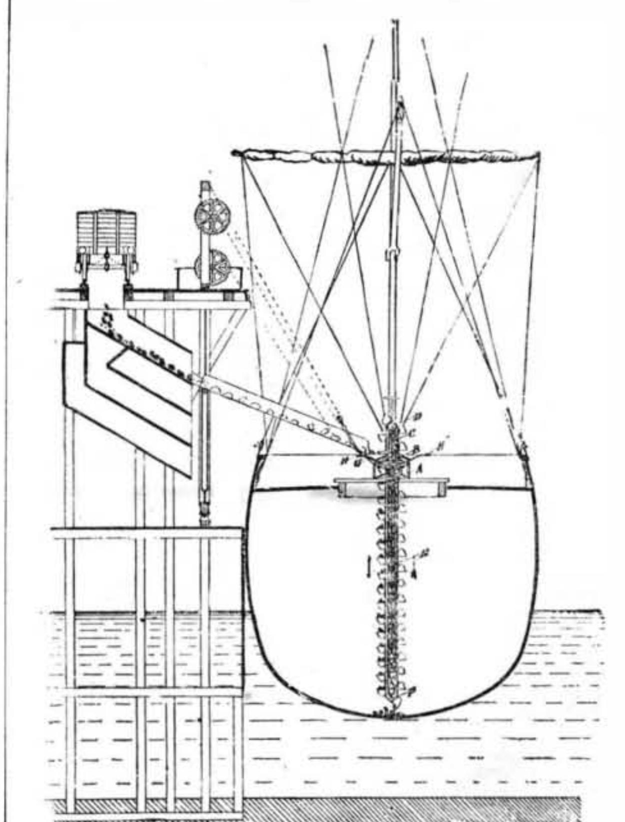
One of the figures gives a general view of the apparatus arranged in the interior of a ship's hull; and from the other two figures may be seen how it operates when the loading begins and the hull is still empty, and when, the hull being nearly filled, the operation is about ended. As may be easily seen from these cuts, the apparatus is exceedingly simple, consisting of an endless chain provided with buckets, and running around a vertical bucket frame. At the upper part there is a wooden frame, to which is fixed the head of the bucket frame, and which is laid across the hatchway. The weight alone of the materials is utilized to cause the working of the endless chain, without the necessity of having recourse to a motor. The bucket frame is raised or lowered according to needs, either by the aid of a pulley installed in the masting, or by means of a small windlass fixed upon the frame. The buckets, in their descent, pass in front of an open hopper, where they become filled, and empty themselves only at the moment at which they are revolving over the lower drum at the extremity of the bucket frame.

In order to regulate the descent and prevent its taking place too rapidly, a brake is fixed on the upper frame, and serves to actuate a vertical shaft that acts upon the axle of the upper drum by means of a cone wheel. The vertical shaft, which descends nearly to the base of the bucket frame, is provided with a groove throughout its entire length, in order that the action of the brake may occur, whatever be the position of the bucket frame. Mr. Rigg's apparatus is constructed almost wholly of steel, thus causing it to be very light, while having all the strength necessary.

It is very portable, and, in the different applications that have been made of it, its working has left nothing to be desired.







IMPROVED ELEVATORS FOR LOADING SHIPS WITH COAL BALLAST, ETC.

MACHINE FOR EXCAVATING THE CHANNEL TUNNEL.

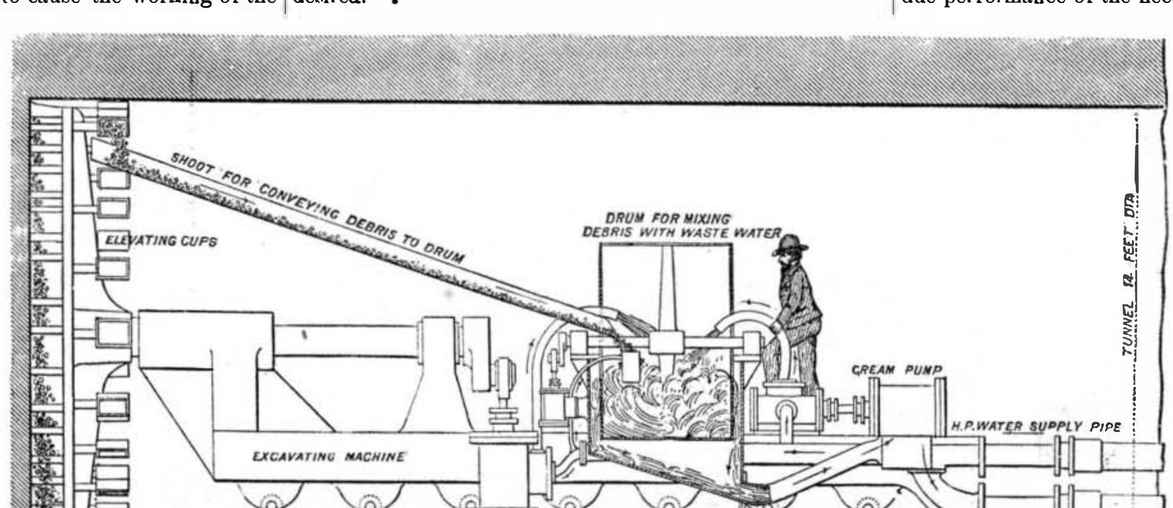
An interesting lecture was lately delivered at the *conversazione* held at Leeds during the meeting of the Institution of Mechanical Engineers, by Mr. Crampton, in which he described his proposed method of executing the work of boring the Channel tunnel. We condense the following from the lecture:

The tunnel is assumed to be twenty miles long, independent of approaches on either side, to be excavated 36 feet in diameter in one operation, which, with an internal lining of 3 feet all round, will leave a clear tunnel 30 feet in diameter; and that the work will be commenced simultaneously at both ends. It follows, therefore, since the approaches may be made at the same time as the main tunnel, that we need only consider here a length of ten miles of excavation worked from one face.

Practical trials in chalk made with machines many years since, established the fact that a rate of advance may be easily maintained of one yard per hour, or twenty-four yards per day, at which rate the work of excavating ten miles of tunnel would take two and a half years to accomplish, taking the year at 300 working days. With the simple apparatus on the table, as much as five yards forward per hour has been cut 12 inches in diameter. The advance of one yard forward per hour in a 36 foot tunnel will necessitate the removal of 113 cubic yards of chalk per hour. In order to insure the due performance of the necessary work, I will add fifty per cent to the figures here given, and shall henceforth deal with other items in the same proportion. We have to provide, then, for the removal of 170 cubic yards of *débris* per hour, equal in weight to 250 tons, a greater quantity than is lifted in two of our greatest collieries together in the same time.

Near the mouth of the upright shaft powerful machinery will be erected to pump water from the sea, to press it up, and hold it under compression by means of force pumps and accumulators. The water will be compressed on the top to 512 pounds per square inch, the fall through 400 feet from the sea will add another 188 pounds per square inch, producing thus at the bottom of the shaft 700

(*Continued on page* 116.)



AUTOMATIC MACHINE FOR THE SUBMARINE TUNNEL BETWEEN FRANCE AND ENGLAND.

MACHINE FOR EXCAVATING THE CHANNEL TUNNEL.

(*Continued from first page.*)

pounds per square inch, a pressure commonly employed. The cutting machinery at the face will be driven by an ordinary hydraulic motor direct without the intervention of gearing. The *débris* of chalk cut down will be taken up by a series of cups and thrown into a chute, at the top of which the waste water from the hydraulic motors is conducted. The water flowing down carries with it the *débris* of chalk, and both pass into an ordinary cylindrical revolving drum, where it is reduced to sludge. The quantity of water used by the hydraulic motors will be so calculated that it will amount to about three times the quantity of chalk *débris* by weight. When mixed with the water in the revolving drum, the very small *débris* almost instantly dissolves, and the result is a cream or sludge, which is taken up by ordinary pumps, worked by hydraulic motors, and forced into the main outlet pipe to the bottom of the shaft, or direct up the shaft to the sea if required. The pumps are placed upon the main frame of the boring machine, and driven by high pressure water taken from the main inlet pipe.

The cream is forced by the pumps through the excavated portion of the tunnel to the bottom of the shaft, and thence may be raised by pumps or other suitable means to the top and discharged into the sea, or disposed of in other ways.

It will now be perceived that the space lying between the boring machinery and up to the top of the shaft is left entirely free, excepting so small a portion of it as is occupied by the two pipes—the high pressure water inlet pipe and the cream outlet pipe.

The operation of lining the tunnel may therefore be carried on with the greatest facility, there being no traffic upon the rails, no hoisting up or lowering in the shaft except that necessary to transport the workmen and the building materials for lining the tunnel, amounting to only one-quarter that required on the ordinary system, or in other words, three-quarters of the whole weight to be disposed of is carried through pipes instead of by locomotives and trucks.

The cutting machine is of a most simple construction, designed for the purpose of excavating the chalk. It consists of a number of small disks attached to a large boring head made to revolve at any given speed. The disks turn freely on their spindles, and as they cut only a width about one-quarter of their diameter, they turn in an opposite direction to that in which the large disk is turning, and thus act by rolling into the chalk and changing the cutting edge continually, whereby the wear and tear of the edges is reduced to a minimum; at the same time the cutting edges do not require sharpening, a most material feature.

By trials I have ascertained that two horse power per cubic yard of chalk excavated would be more than ample; and if in piercing a tunnel 36 feet in diameter 170 cubic yards of chalk will have to be cut down, 340 horse power will have to be provided for this part of the work.

In the real machine the pressure of the incoming water upon the area of the telescopic joint, in the one case, and the back pressure of the cream, forced toward the exit, on the other, will push the machine forward automatically, and it becomes necessary to provide an arrangement to control this speed and allow the machine to advance only at a certain desired rate forward. There are various simple means of effecting this object.

To cut a clear face 36 feet in diameter will require seventy-two 12 inch cutting disks upon the arms or cross-beam—each cutter in one revolution of the machine taking off a concentric ring 3 inches in width and one-sixteenth of an inch thick—supposing the cross beam or head to turn at the rate of ten revolutions per minute. This would give the cutter on the extreme outside a periphery speed of 1,130 feet per minute, which has been found to be well within practical limits. It will be understood that the cutters turn at different speeds, those near the outer periphery doing considerably more work than those near the center, the revolving cutters being equally effective at all speeds.

The apparatus for the reduction of the chalk *débris* to sludge or cream is a plain cylindrical drum. One face of this drum is made of a strong wire grating except in the center, where a hole is left. Through this central aperture the *débris* of chalk and the water in whatever quantities required are introduced, and as the drum revolves, the particles of chalk, saturated and softened by contact with the water, are quickly dissolved, and a cream or sludge of more or less consistency is produced, which escapes through the meshes of the wire grating and collects in a reservoir, whence it is taken up by a pump and forced to the place where required.

As a matter of fact, two drums, 7 feet in diameter and 7 feet in length, will be amply sufficient for the purpose with 85 horse power.

The conveyance of the cream through ten miles of pipe on a level, back to the bottom of the shaft, will be done by a 12 inch main pipe with a pressure of 700 pounds per square inch; the water passing through this pipe at a velocity of 6½ miles per hour, or 9·5 feet per second. The total horsepower developed by this quantity of water amounts to 1,377 horse power at our disposal at the face. The sludge being composed of chalk, 76 cubic feet per minute; water, 459 cubic feet per minute; cream, 535 cubic feet per minute.

A main outlet pipe, 20 inches in diameter, will be required to convey the cream back to the bottom of the shaft through ten miles of level tunnel, and the cream will have to flow through it at a velocity of 245 feet per minute or 4 feet per second. The total head required to force the cream to the bottom of the shaft is 214 feet, or 21½ feet per mile. This represents a force of 224 horse power, the pressure in the pipe being 96 pounds per square inch.

To lift the cream from the bottom of the shaft to the surface will require a total of 525 horse power.

The cubic foot of cream of the above admixture weighs 72·06 pounds. If we now add up the powers required for the several operations, we find:

	Horse power.
(1) For cutting the chalk	340
(2) Reduction of chalk to cream	55
(3) Conveyance of cream to bottom of shaft through 10 miles,	224
Total required at the face	619

As we have provided 1,377 horse power, there will be no deficiency, even if the hydraulic motor should only yield 50 per cent duty, which is a very low estimate.

The 525 horse power required for lifting the cream to top will, of course, have to be provided for at the top of the shaft, and will be in addition to the power necessary for the compression of the water.

To compress 459 cubic feet of water per minute to a pressure of 512 pounds per square inch, or about 1,200 feet head, would require a force of 1,040 horse power.

We have, therefore, to provide on top of shaft—

	Horse power.
For compression of water	1,040
For pumping up the cream	525
Total	1,565

to carry out the entire operation of cutting required, 172 cubic yards per hour, reducing it to cream, and conveying it to the surface in pipes and into the sea.

This power is independent of that required to transport the material necessary for lining the tunnel, which will be done by locomotive or other means, the same as that employed in the ordinary system.

The Preservative Treatment of Timber for Railway Cross Ties.

The *National Car Builder* estimates the yearly consumption for cross ties for new roads, and for replacing worn out ties on old tracks, roughly at thirty millions, assuming the average life of the ties now in use to be about seven years. The annual increase in track mileage, if it is to continue at a rate approximating that of the past year, with a corresponding increase in the great volume of traffic, points to a continuous yearly increase in the consumption of timber for ties for an indefinite period in the future—a home consumption strictly, and not including timber exported for like uses on the roads of foreign countries. How to meet this prospective demand with our annual increase in track mileage without causing such an excessive draught on our forests gives the problem of future supply a greater importance every year.

With respect to cross ties more particularly, attention has of late years been directed to three methods to check the excessive consumption of timber material, namely, preservative treatment, tree planting, and the substitution of iron ties for wooden ones. What is wanted, so far as wood is concerned, is a material that will have twice the durability of the ties now in use, and at the same time cost less, or at all events not any more, for a given period. If the average life could be doubled, it would save a vast quantity of growing timber, and also the cost of one renewal for the total track mileage. This would go far to compensate for the cost of treatment, or the cultivation of timber of exceptional durability and capacity of service, like the catalpa, for example. Tree planting and the use of iron will avert the impending evil to some extent, no doubt, but the main reliance must be upon methods which will make the various kinds of timber now in general use for ties more lasting, by subjecting it to some kind of preservative treatment that is both effective and cheap. Many processes for accomplishing this have been tried and recommended, some of which are reported as having been very successful in Europe, but as yet they have scarcely passed the experimental stage even there, while in this country none of them are in general use, and very few have been put to a satisfactory preliminary test even. These methods, although various, all aim to render the timber less perishable by expelling the sap and all humidity, and then filling the pores or cells with creosote oil, or with a solution of certain metallic salts, both of which have the quality of arresting fermentation and preventing decay—a treatment somewhat analogous to embalming as practiced upon human bodies to arrest decomposition. These processes are known under many names, the more noted of which are the Kyan, Burnett, Bethell, Hayford, and Boucherie methods. The most effective agents appear to be chloride of zinc and creosote, the preservative effect on the timber being about the same for each, but the creosote treatment being twice as expensive as the zinc, the latter is mostly used on foreign railways, and to these we must at present look for the best information extant upon the subject.

The preservation of timber by artificial means has been resorted to more or less in this country for many years in cases where it was to be used for the foundations of heavy masonry and structures of great weight and durability, but for railway ties, telegraph poles, driven piles, and a host of other uses to which timber is applied, its preservative treatment has been little thought of, and nothing very definite has been realized in practice. In practice one thing is quite certain, and that is that soft, porous timbers, such as pine, fir, hemlock, spruce, and the like, can be rendered vastly more serviceable and lasting for cross ties by creosoting or by impregnation with solutions of zinc than if used in the natural state or with ordinary seasoning, especially upon roads with light or medium traffic and with tolerably good ballasting.

With respect to economic results, the reports from the German and Austro-Hungarian roads are the most definite. The ties used are mostly of oak, pine, fir, and beech, and nearly one-half of the total number in use have been subjected to antiseptic treatment according to various systems, with a reported increase in their average life over and above the average life of untreated ties, as follows: Oak six years, fir seven years, pine nine years, and beech nine years.

If preservative treatment is profitable on European roads, where the scarcity and cost of timber naturally lead to close and careful investigation in order to get at the truth, the *Car Builder* inquires why the same thing cannot be made profitable here, irrespective of any threatened exhaustion of our existing timber resources? There is no very obvious reason why it cannot, except that it is a new economic rut to get into after being so long accustomed to plentiful supply and wasteful profusion, and everybody knows how difficult it is to introduce innovations in the face of long established usage and the prejudices thereby engendered.

The Ready Made House Industry.

The Canadians are making such a considerable and profitable business of ready made house manufacture that the *Northwestern Lumberman* (Chicago) thinks it strange that Americans, who have the reputation for seizing new opportunities for money getting, do not branch out in this direction more extensively.

Illustrative of the manner this industry is progressing, it is mentioned in the London, Ont., *Advertiser* that the Truaxes planing mills at Walkerton, are turning out material for ready made houses at a rapid rate. Orders for a whole row of houses can be filled in a few days, and it is not uncommon to see an entire street for Brandon or a block for Winnipeg sent out on a train twenty or thirty days after the order has been received. During the past season Messrs. Truax shipped 219 cars of knock down house material to the Northwest. One of the partners in the concern accompanies each train, and superintends the putting up of the houses. Sometimes houses are ordered by telegraph in this fashion: "What can you furnish me a tidy cottage for, 22x40 feet, with bay window and veranda?" Next spring the enthusiastic house builders expect to receive orders for entire villages, something after this style: "What is your lowest figure for five stores, two wagon and two blacksmith shops, one Methodist and one Presbyterian church, twenty-five cottages, a town hall, and a lock-up, to be delivered on or before July 1?" Orders have been received for twenty-one houses to be put up in Brandon next spring. The freight rate on these houses from Walkerton to Chicago is $40 a car; from Chicago to Minneapolis $20 a car. The charge the balance of the way is enormous, owing to the lack of competition, the cost of a medium car through from the start to Winnipeg being $361. The large ones used by the Truaxes cost more. Considering the fact that Chicago is nearer Winnipeg than Walkerton, Ont., why cannot, adds the *Lumberman*, the knock down house business be made profitable here, and still more so at Minneapolis, Duluth, or any other lumber point in the Northwest?

An Electromotive Torch.

Dr. Brard, of La Rochelle, some time since announced his discovery of a method of preparing blocks of combustible matter, capable of being used as fuel, which at the same time developed a current of electricity. See engravings in SCIENTIFIC AMERICAN, October 28, 1882. Proceeding on the same lines, Dr. Brard has succeeded in making a kind of torch which yields a current of electricity in burning. He makes first of all an inflammable wick of coal dust and molasses, moulded into a rod. A thin sheet of asbestos is then wrapped round this wick, and the whole is dipped into fused nitrate of potash until a good thickness of the material adheres. When the wick of the torch thus made is ignited, a current of electricity may be detected in a circuit of wire connecting the coal paste and the nitrate of potash. It does not appear that such a torch is at all a good one for giving light, and, indeed, the contrary might be inferred from the materials used in its construction. Neither does it develop a useful current of electricity, for the electromotive force produced is insignificant. Still the discovery is regarded as important, because it proves the possibility of electro-generative fuels. It also affords a starting point for the imagination of sanguine individuals, who have already begun to speculate on the time when the fireplaces of living rooms will be made available for supplying electricity—not only for ringing bells, but also for charging accumulators, and thus giving light also. It is reported that Dr. Brard has this latter object in view.

Hemlock Bark.

There are produced annually in North America 100,000 barrels of hemlock bark extract, of which a single Boston firm produces 72,000 barrels. They own nine extract works and operate twenty-three tanneries. All the tanneries of the United States consume annually 1,250,000 cords of hemlock bark, produced in nine States. As the yield of bark is about seven cords to an acre of hemlock timber, the yearly consumption implies the clearing of 178,000 acres. In the main, the bark is stripped from trees cut for timber; and as the demand for this timber exceeds the supply, the supply of both timber and bark is threatened with speedy exhaustion