THE SUB-TARGET GUN MACHINE.

A most interesting exhibit at the recent meeting of the National Rifle Association, at Sea Girt, N. J., was the sub-target gun machine, an illustration of which appears herewith.

This machine is designed, primarily, to instruct recruits in the art of rifle shooting, although, as a matter of fact, it is in daily use by expert riflemen, who find it of great advantage in keeping in practice without the necessity of frequent visits to outdoor ranges. No ammunition is required, and the machine may be operated in the armory or at home.

By reference to the illustration, it will be noted that the apparatus consists of a sub-base or stand; a carriage base adjustable by locked vertical and horizontal screws; a ground-steel carriage rod, having at the target end a steel scoring-needle accurately spring-balanced on ground-steel ball-joints; a sub-target holder, which is released electro-magnetically by the trigger when the gun is fired, driving the sub-target against the scoring-needle, thus giving an absolute record of the aim or hold of the gun; a gun-holder proper, so designed and constructed that it is absolutely impossible to secure a point of rest with which to steady the gun when aiming, the complete holder so counterbalanced that only the weight of the firearm is supported by the marksman. The entire apparatus is scientifically correct and absolutely accurate. The machine may be quickly changed from the standing to either kneeling or prone position, as may be desired by the marksman.

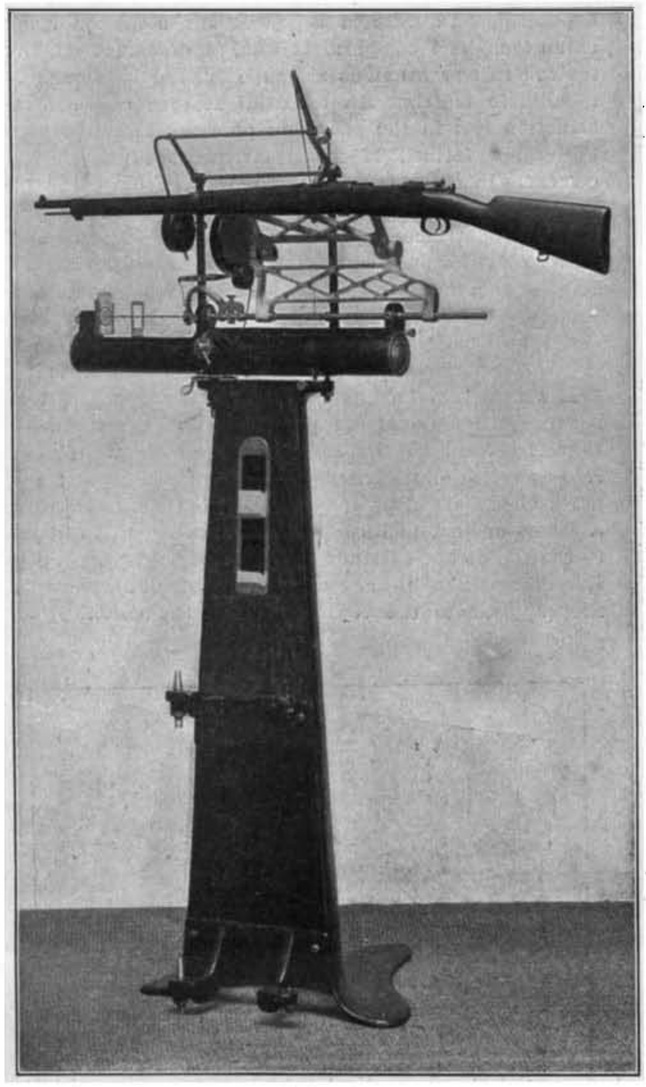
These machines are in daily use at United States army posts and in State guard armories, where they are proving invaluable in the training of recruits and, incidentally, the affording of otherwise unobtainable practice for qualified marksmen, and have already raised the standard of marksmanship in the United States and other countries, wherever used.

In one instance thirty men who had never had any rifle practice, were selected and divided into three teams of ten men each. The first team was put on an outdoor range with service rifles and ammunition; the second on a miniature range with miniature ammunition, and the third in the armory with the sub-target gun machine. After several weeks' practice, as above, the three teams were pitted against each other on an outdoor range, and the sub-target gun team, the members of which had had no practice with loaded rifles, defeated both the other teams. This was a natural consequence, because with this machine the recruit becomes thoroughly familiar with the holding, sighting, and firing of the rifle before he can acquire the gun-shyness usually accompanying the use of loaded firearms by beginners.

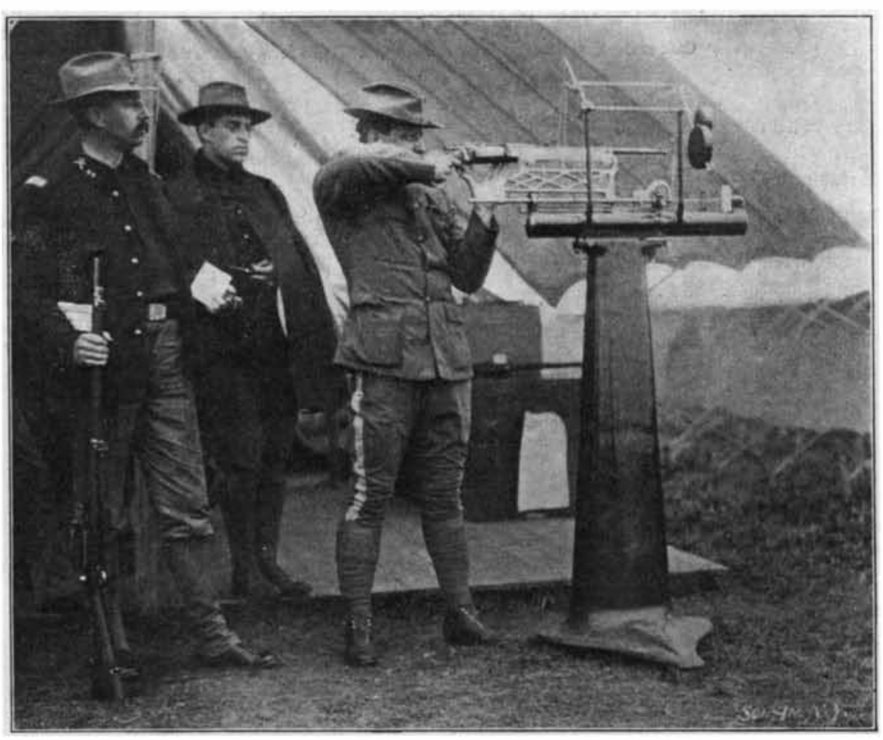
Referring to the use of the sub-target gun machine, the inspector of small arms practice of the 71st Regiment, N. G., N. Y., writes: "By personal observation and instruction, I practised and qualified nearly 650 men. The result of that indoor practice demonstrated itself when the regiment was ordered down to Creedmoor for actual work. We qualified as marksmen 538 men out of a total of 539 turnout. The elimination of ammunition for this past winter has been a saving of several hundred dollars, which was principally brought about through the use of the sub-target gun machine."

At the International Rifle Meeting recently held at Bisley, England, the machine attracted great attention and was daily used by members of the American team, which won and brought back to the United States the Palma trophy.

At this time, when every military power finds itself with very powerful rifles, but with a very small percentage of men who can effectually use them, the advent of these machines is very timely, as by their use any number of men may be rapidly qualified as marksmen.



THE SUB-TARGET GUN MACHINE.



TARGET PRACTICE WITHOUT AMMUNITION.

Becquerel Rays and Water.

In a paper recently read before the German Physical Society Mr. F. Kohlrausch resumes some interesting observations relative to the influence exerted by Becquerel rays on water. Having passed the rays given off from a mixture of radium and barium bromides through an aluminium plate 0.1 mm. in thickness, and a layer of water of about 18 mm., the author failed to note any immediate effects of the radiation. Under the influence, however, of a prolonged radiation, Mr. Kohlrausch noticed a considerable acceleration in the increase of the electrical conductivity.

As regards the interpretation of the above phenomenon, the author is not able to decide between two hypotheses, viz., that of a direct development of ions in the water, and that of an accelerated disaggregation of the walls of the glass tube. As to a third equally admissible hypothesis, i. e., that the surrounding air should have absorbed some substance, such as, for instance, bromine, introduced besides the stopper, the author does not think it to be true, as a special experiment made with a view to confirm it has given negative results. With this experiment an air current having passed through the radio-active substance was led through water provided with electrodes.

The Bactericidal Effect of the Arc Light.

The bactericidal effects of the arc light are much superior to those of sunlight, says M. K. Walsham, in Röntgen Ray Archives; the very rapid ultraviolet is absorbed by the atmosphere. A rapid oscillation high-tension arc, particularly between iron points, gives off an abundance of ultraviolet rays of extremely small wave length, with a fair proportion of lower refrangibility; to these ultraviolet rays quartz is transparent, transmitting 60 per cent through 4.4 millimeters, gelatine is quite opaque, ice is as transparent as air, and a film of iron oxide quite opaque. For use, as blood is opaque to the rays, they are passed through ice made to press upon the region affected, so as to make it anæmic.

Abraham Lincoln's genius as an inventor will be exploited at the World's Fair. His famous device for lifting steamboats off the shoals will be shown in the transportation department.

THE TRANSPORTATION OF LUMBER.

BY WALDON FAWCETT.

Few industries can compare with lumbering operations in the variety of the methods of transportation employed to convey the product to market. From the time the woodland monarch is felled in the heart of the forest until the material has passed from the sawmill into one of the various avenues of utilization open to it, the problem of speedy and economical transportation is well-nigh a foremost consideration, and is accomplished by means of a variety of facilities, prominent among which are steam railroads, natural and artificial waterways, and ice-paved highways. The transportation phase of the industry may almost be said to be in a state of transition. The latest approved practice can scarcely be designated as the perfect practice, inasmuch as improvements are being made constantly.

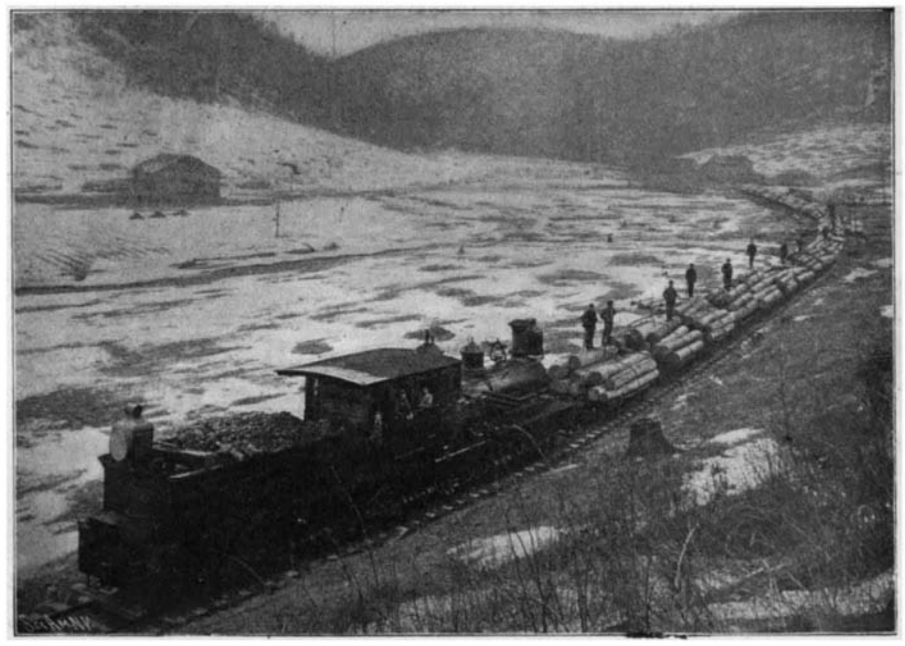
Nowhere, however, has recent progress been more remarkable than in the methods attending the first stages of lumbering. Logging by steam is now an accomplished fact. The first steam log-skidding system was devised in 1886, and was introduced in the pine forests of Michigan. By gradual and almost continuous improvement there has been evolved from this nucleus the steam skidder of the present day. This consists of a main cable suspended from two trees about 750 feet apart, upon which the skidding engine travels, and also a short cable used for loading the logs, which is attached to a third tree. The carriage supports a hoisting rope, to the end of which are attached one or more pair of tongs for grappling the logs. In operation the tongs are fixed to the ends of one or more logs, which are hoisted well into the air, and then the hoisting rope is drawn in, the logs being thereby dragged or skidded to the end of the cableway and deposited ready for loading.

A loading cable spans the railroad track, the block being located directly over the track, and carries the loading line, to the end of which is fastened a pair of tongs. When the tongs have been attached to a log, it is dragged from under the main cable up to the car, and then hoisted clear and landed on the car. The two operations of skidding and loading are carried on at the same time. In localities where, as in the swampy districts of the South, logs find their outlet to market through canals in which they are towed by tugboats, a steam skidder is often installed on a scow, where are located the engine, boiler, mast, and rigging. Skidders of this type handle logs six feet in diameter and weighing six tons each.

In the cypress swamps of Louisiana there are employed what are known as pull-boats, an evolution from the plan of placing a hoisting engine upon a scow and snaking the logs out of the swamp. By this plan the logs, which are drawn in at the rate of 600 feet a minute, are capped with steel cones, which prevent them from imbedding in the soft ground or catching against obstructions. The endless-rope pull-boat engines have 44-inch winding drums, and each weighs 33,000 pounds. Another up-to-date apparatus is the log gatherer, which is similar in construction and operation to the steam skidder previously described, but which is designed for lighter work than the skidder, being especially applicable to conditions in the low flat pine regions upon the Atlantic coast.

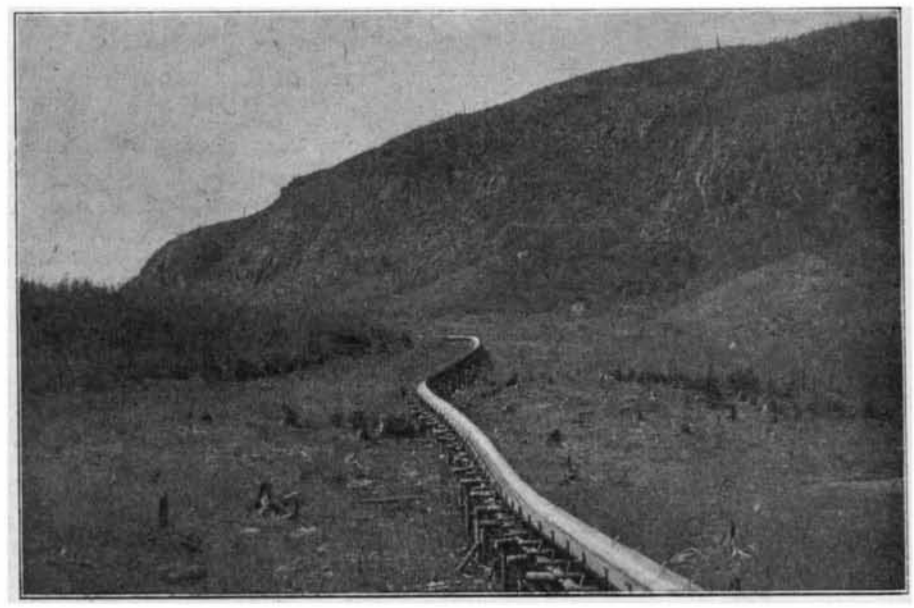
On the Pacific coast log-hauling engines with cylinders 10 by 12 inches and drums capable of holding 3,000 feet of wire rope are in use and in mountainous districts there are utilized what are known as mountain loggers. The logging railroad is run up the valley or cove between the ridges, and the logs are gathered by means of conveying cableways, and, clearing the rocks and creek in the bottom of the gorge, are deposited along the railroad, where they can be loaded upon cars by a steam loader, or even by the same engine which has moved them to the loading point. This system is in extensive use in the pine regions of Maine and the hemlock regions of Pennsylvania as well as on the Pacific slope. In the northern lumber districts, embracing all sections of the country from the Adirondacks to the extreme Northwest, where logs must be taken out during protracted periods of cold weather *via* ordinary highways, remarkable achievements have been made in the operation of ice logging-roads. Such a road is laid out and graded in the autumn, and upon the advent of cold weather is flooded by any one of a variety of methods. In many localities the water is hauled in eighty-barrel tanks mounted on sleds, and with an arrangement of pipes which directs the flow over the roadway as the sled progresses. During the season of activity many teams must be kept busy hauling water night and day, in order to keep the roads in condition. A rut-cutting

Hauling Logs on Sled.

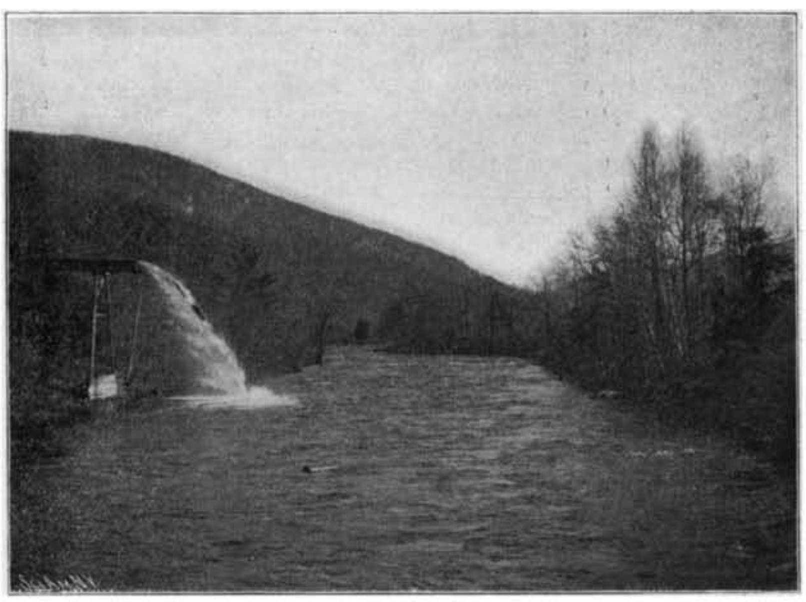


A Logging Railroad.

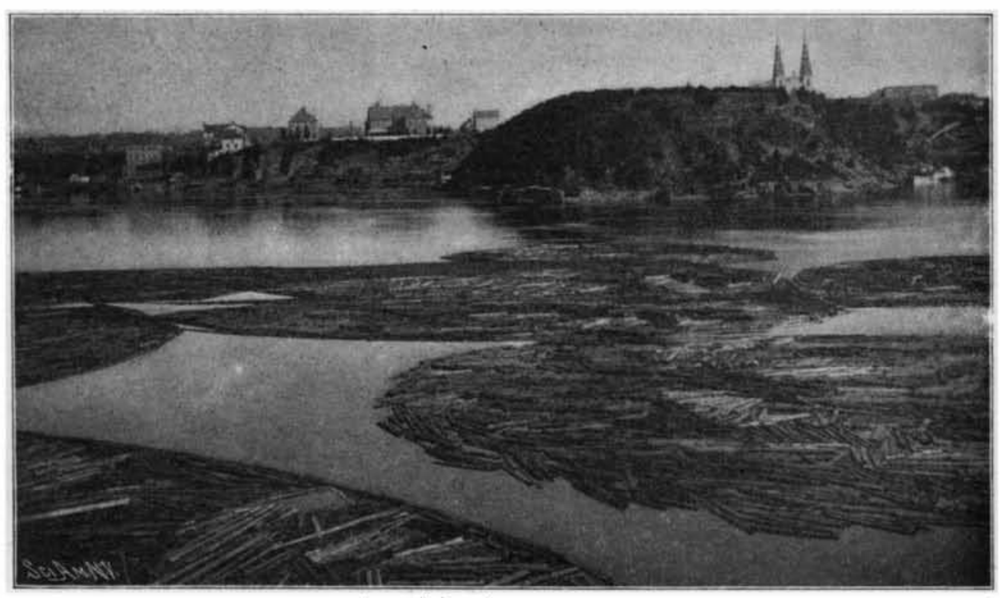
A Lumber Slide, Showing a Feeder.



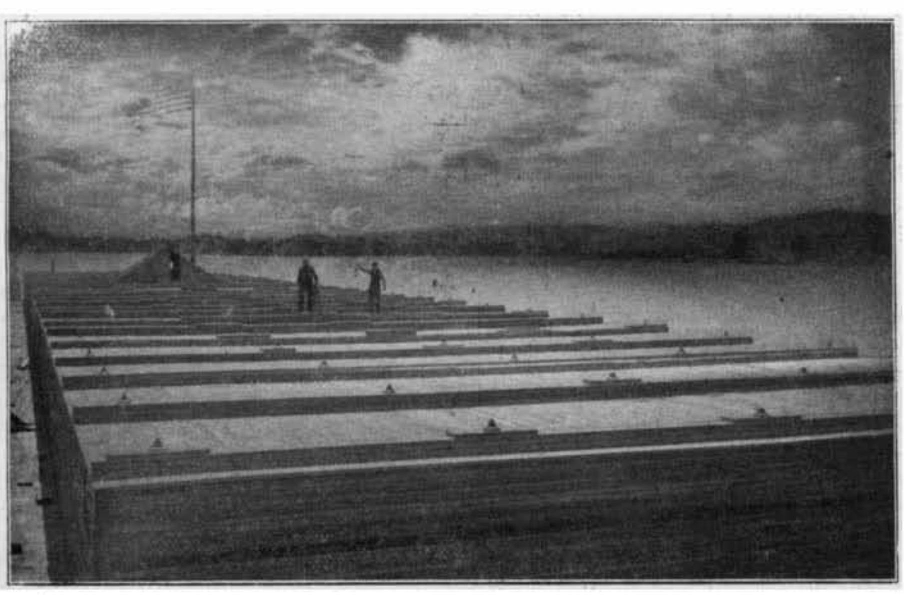
A Typical Lumber Slide or Flume.



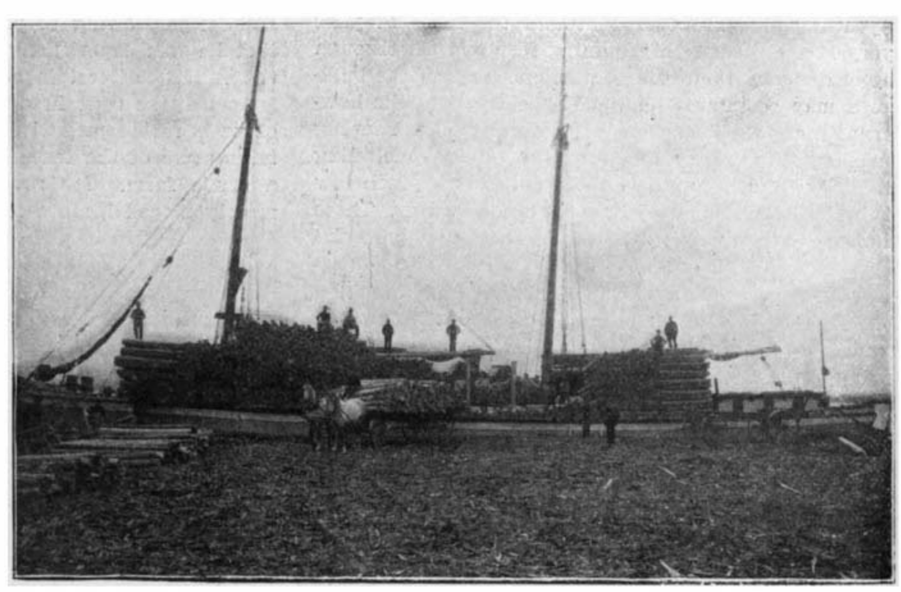
The End of a Seven-Mile Lumber Slide.



Lumber Booms at Ottawa.



Lumber Raft on Puget Sound.



Loading Lumber on a Lake Schooner.

THE TRANSPORTATION OF LUMBER.

machine cuts out the ice where the runners of the log sleds run. A team of horses will haul surprising loads over these ice-paved highways. Fifteen tons of logs is accounted only an average load, and in some districts there has been adopted a system known as trailing—hitching three sleds one behind the other and pulling them with the same horse power. In this manner loads aggregating seventy-two tons have been moved successfully.

The redwood forest belt of California, which extends along the coast range of mountains from the vicinity of the Oregon line southward three hundred miles to the bay of Monterey, affords most striking exemplifications of the possibilities of machinery and power applications to transportation in the lumber industry. Power appliances are utilized almost exclusively in getting out and loading the logs, and bull teams, each consisting of seven or eight yoke of oxen, are employed for ordinary highway transportation. At the mouth of the Noyo River and other points, where the seacoast is bold and where wharves cannot be maintained, an ingenious method is employed for loading deep-sea ships. A steel-wire cable is stretched from the high bank to the vessel, and on this is operated a traveler from which depends a sling of chains carrying the load of lumber. The force of gravity carries the load to the ship, and the traveler is hauled back by a donkey engine. About one hundred and fifty thousand feet of lumber is the daily loading record with this apparatus at Noyo River. At many points along the Mendocino coast this plan of loading lumber is employed where there is no harbor at all, and where the cable is run directly out to the open sea.

In California also the employment of the traction engine as a transportation agent in the lumber industry has reached its highest development. Loads too large to be hauled easily by six and eight horse freight teams, and yet forming a traffic scarcely large enough to justify the construction of a railroad, are hauled expeditiously and economically by the traction engine freighting outfits. The engines in use in the lumber districts of the Pacific coast will haul a load of from 40 to 60 tons at a speed of two to three miles an hour, and will ascend, with full load, grades of 10 per cent. A traction engine freighting train consisting of the engine and five lumber trucks is capable of turning in a circle the diameter of which is only 49 feet.

The traction engine is also employed to load the logs on the trucks. The engines travel through forests without having the roads previously prepared, and under such conditions a traction engine has hauled 15,000 feet of logs on two trucks down a 17 per cent grade. An aggregate of 30,000 feet of lumber has been hauled up a 10 per cent grade by a single engine, and a 60-horsepower engine on one occasion unloaded 50,000 feet of lumber from six trucks and took on water and fuel for the return trip in the total elapsed time of only 55 minutes.

The water transportation of lumber partakes of its most picturesque form in the construction and management of the giant rafts, which are used to convey logs and lumber from Puget Sound to San Francisco. A lumber raft of the type constructed on the Pacific coast is about 400 feet in length, and contains approximately 5,000,000 feet of lumber. The log or pile rafts are usually made up of logs averaging about 60 feet in length. From 12,000 to 15,000 piles are embodied in such a raft, which thus contains about 800,000 feet of piling. One of the log rafts constructed at Astoria a short time since was 625 feet in length, 60 feet beam, 32 feet deep, and had a draft of 20 feet. Some of the piles had a length of 120 feet and a diameter at the butt of 22 inches. A large force of men worked for eight months in the construction of the raft, which cost $30,000 to build.

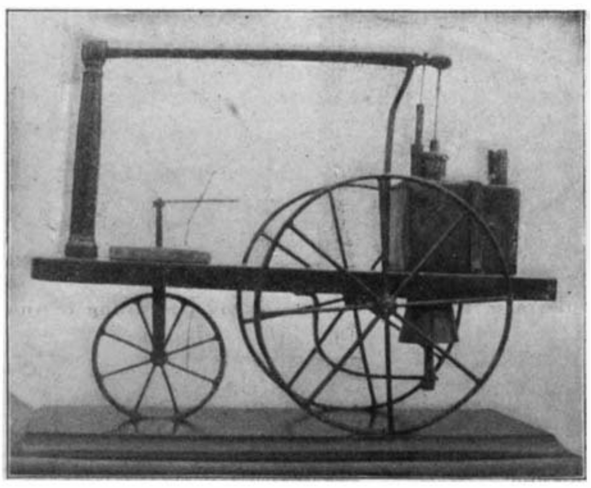
In order to hold the logs forming the raft in place, 1½-inch chains are passed around the mass of piles every 12 feet of length. Running fore and aft through the center are two 2-inch chains, one holding the bulkheads at each end and the other attached to the hawser. From this tow chain are lateral chains running out from the center to connect with the encircling chains. There is provided 75 fathoms of 1¾-inch tow chain and 150 fathoms of 14-inch manila hawser. These immense rafts are towed to San Francisco by powerful tugs. Some idea of the saving in cost effected by the rafting method may be imagined, when it is stated that in the case of the annual consumption at San Francisco alone, amounting to 30,000 piles a year, the saving over the cost of material prior to the introduction of rafting amounts to $150,000 per year. The rafting method has been employed to some extent on the Atlantic coast, and on one occasion a raft of 645 feet in length, containing 1,000,000 feet of piling, was towed from Nova Scotia to New York.

Almost every phase of lumber transportation is characterized by an element of the picturesque, but the spectacular features of the industry reach their climax in the "drive," whereby advantage is taken of the spring thaw to float the winter's accumulation of logs down streams and rivers to the sawmills. When a "jam" results, the lumbermen are called upon to perform some of the most arduous and most hazardous work known to the world of industry, and very frequently it is found necessary to employ dynamite to break the jam. The logging railroad has to a considerable extent displaced this old-fashioned method of bringing the logs to the sawmill, and even in localities, such as some parts of the Adirondacks, where water transportation is still adhered to exclusively, the lumber companies have constructed great flume systems, often many miles in length and with "feeders" similar to those of an irrigating canal. By means of these narrow artificial waterways, logs are conveyed from remote lumber camps to the rivers or streams, down which they float to the sawmills.

AN EARLY ROAD LOCOMOTIVE.

The early miniature road locomotive which we illustrate was the ingenious mechanical creation of William Murdoch, the well-known assistant to James Watt, and the first to discover the illuminating properties of coal gas and to reduce his discovery to practical application.

The machine should, perhaps, be more strictly termed an automobile, since it was essentially a road machine. Murdoch, as is well known, while co-operating with Watt, invented several devices in connection with steam engines, the most important of which, no doubt, were the "D" slide valve and the eccentric. The precise date at which Murdoch made his first attempt at the construction of this workable locomotive is not known. According to the testimony of Murdoch's son, it was invented and constructed in 1781, but another reliable source places it at 1784. Certain it is, however, that it was built some time between 1781 and 1786. During these years, Murdoch was working at Redruth, in Cornwall, upon the erection of some pumping engines for Messrs. Boulton & Watt, and in August of 1786 the firm's agent at Redruth wrote to his principals: "William Murdoch desires me to inform you that he has made a small engine of ¾-inch diameter and 1½-inch stroke, that he has applied to a small carriage which answers amazingly." Upon the receipt of this intelligence, Boulton inspected Murdoch's creation, and described to Watt, in a letter the next month, that Murdoch "had made his steam carriage run a mile or two in River's great room, making it carry the fire shovel, poker, and tongs. William uses no separate valves, but uses the valve piston."



MURDOCH'S ENGINE.
Length, 19 inches; height, 14 inches; extreme width, 7 inches; piston, ¾ inch diameter; stroke about 2 inches.

James Watt, however, had long before devoted his attention to the question of steam propulsion upon roads, but although he took out a patent describing a locomotive in 1769, he did not build an engine upon his designs, owing to pressure of work, and trouble that he was experiencing in establishing and proving the validity of certain of his previous patents.

As may be seen in our illustration, Murdoch's machine is rather primitive in its design, but yet it contains some of the features of the engine of to-day in a crude form. It is very small, and is in reality merely a model, since it is only 19 inches in length, by 14 inches in height, and 7 inches in extreme width over the driving wheels. The frame of the locomotive consists of a rectangular piece of wood mounted upon three wheels—two driving wheels at the rear mounted on an axle with a crank, and a single steering wheel in front, placed in the center underneath the board, and running in a fork. Steering was accomplished by moving the little handle above, to which the fork was attached, in the desired direction.

The boiler is placed behind the driving wheels. It is a small rectangular vessel, made of brazed copper, 4¼ inches long, by 3⅛ inches wide, and 3⅝ inches high. A flue is fitted obliquely into the boiler, contracting from a circular chamber, forming the firebox, to a small funnel in the top of the boiler. Murdoch used a small spirit lamp to generate the necessary heat, arranging it to burn within the firebox, and the gases of combustion were carried off by the flue. The steam cylinder is mounted above the boiler, with the lower part thereof passing into it, so that part of the cylinder is surrounded by steam. The piston rod passes out of the cylinder upward, and is connected to one end of the vibrating beam, which passes to the front of the carriage, where it is pivoted into the upper end of an upright stout pillar. The diameter of the piston is only ¾ inch, and the stroke is approximately 2 inches. The piston rod is actuated simply by the expansive force of the steam alternately raising and depressing the piston, after which the exhaust passes out into the atmosphere. The piston rod, in moving up and down, causes the beam to turn the driving wheels, by means of a connecting rod attached to the crank of the axle, and the carriage then moves either forward or backward. The arrangement of the steam valve is ingenious, as it is driven from the beam by a projecting rod, in such a way that the valve is moved at the finish of every up and down stroke by the last portion of the upward or downward movement of the beam. The valve piston has two pistons, ground to work easily, yet pressure proof, in the valve cylinder. The space between the two pistons is in constant communication with the boiler, and the steam enters through two orifices—one at the top and the other at the bottom of the cylinder—arranged in such a manner that when the piston valve is up, the steam enters the upper orifice, and forces down the piston, while the exhaust steam from the under side escapes through the lower orifice into the air through a tube connecting the two pistons of the valve. Thus this valve is virtually a double piston slide valve, with a hollow piston rod for the exhaust.

The safety valve is placed near the steam cylinder, being let into the boiler and held down in position by a small tongue of metal. To preserve the balance of the engine, and to prevent its tipping up through the extra weight thrown on the back by the admittance of water into the boiler, a compensating leaden weight is placed above the steering wheel. The wheels are built of brass tubing brazed at the joints.

When Murdoch had convinced himself of the practical working of his engine in running round his room, he submitted it to a severe trial on the high road, where it gave a very conclusive evidence of its traveling powers by outrunning its designer. It was on one of these trials that Murdoch threw the unsophisticated village vicar into a terrible paroxysm of fear. Murdoch had taken his engine, one night, out on the high road near Redruth, lighted the lamp, got up steam, and started the engine, he himself following it. The vicar was walking along the road, when he espied the light of the lamp, heard the steam hissing, and the rumbling of the wheels. As it was too dark for him to perceive the object, he gave vent to terrific shrieks of terror and fled for his life, thinking His Satanic Majesty was after him.

When the possibility of Murdoch's engine was shown to Watt, the latter advised the inventor to discontinue his experiments, as he feared they might seriously interfere with the inventor's regular work. Subsequently, however, Watt offered to advance Murdoch $500 to found a locomotive business, with the latter as partner, if the inventor could build, within a year, an engine capable of hauling a carriage carrying two persons, in addition to the driver, together with two hours' supply of fuel and water, to travel at four miles an hour. It is said that Murdoch built three locomotives in all, the last of which was a large one, but of this there is no conclusive evidence. Certain it is, however, that in 1786, Murdoch abandoned his experiments. The inventor never again attempted to solve the problem of steam locomotion, and only kept his first engine to exhibit as a curious toy to his intimate friends. The engine remained in the hands of the Murdoch family until a few years ago, when it was secured by Sir Richard and Mr. George Tangye, the eminent English engineers, to whom we are indebted for permission to publish the photo of what is indubitably the most historical relic in the annals of steam locomotion.

Rotary converters operated six-phase will give from 35 to 45 per cent greater output than when operated three-phase, according to an article by Mr. A. S. M. Allister in the American Electrician. Hence economy dictates three-phase transmission, with transformation to six-phase at the converters. The simplest method is to use three transformers, the primaries being either star or delta connected, and the secondaries star connected. A delta connection on the low-tension side, as well as on the high-tension side has, however, the advantage that the breakdown of one transformer does not render the plant useless, as the two remaining transformers take the load of the missing one.

The United States Steel Corporation will make an exhibit at the World's Fair that will cover two acres of floor space in the Palace of Mines and Metallurgy. It will be the first exhibit of so wide a scope ever attempted, and will cover every branch of the industry.