SAND WAVES AND THEIR WORK.

BY DAY ALLEN WILLEY.

The formation of sand hills or sand dunes along the Atlantic seacoast of the United States is so frequent, that these eminences are common sights, especially on Cape Cod peninsula, the coast of New Jersey, as well as in the vicinity of Cape Henlopen, Cape Henry, and on the beaches of North and South Carolina. It is perhaps unnecessary to say that the dunes are created by the action of the wind upon the sand, which is washed up by the waves. They are termed fixed or wandering dunes according to their formation; for unless one is sufficiently covered with vegetation, the force of the wind currents continually changes the position of the sand to such an extent, that the hill travels in the direction of the prevailing breezes at a rate depending upon their force and constancy. Measurements which have been taken in southern New Jersey, as well as Massachusetts, show that in a year a wandering dune may move from 15 to 20 feet. Unfortunately, the sand is continually shifting to such an extent, that there is little opportunity for seed which may be deposited upon the surface to germinate; and even where shoots appear above the surface, unless protected in some manner they are soon killed by being covered over or cut off by the contact of the flying sand particles. Consequently, the movement of a shifting dune is seldom checked until it has changed its location to such a point that it is less exposed to the wind current, when it may become fixed by the growth of vegetation upon it. The formation of the coast dune has a parallel in the sand waves, as they are termed, which are found in various localities inland, since they are due entirely to the action of the wind currents on loose material of this kind; and where the topography is favorable, so many waves are formed that they have been termed sand seas, as one can see ridge after ridge reaching backward for miles, and bearing a striking resemblance to the waves of the ocean. Not only in the United States are to be noted examples of this kind, but in some portions of the Sahara in Africa, and especially in the Turkestan desert, although the valley of the Columbia River in Oregon and Washington probably contains as remarkable illustrations of the action of the wind as any part of the world. Picturesque as is the view along these sand ridges, unfortunately they afford a perplexing problem for residents in this vicinity to solve, as they frequently overwhelm the railroad tracks, and would engulf buildings if steps were not taken to prevent their encroachment. For a considerable distance the tracks of the railway owned by the Oregon Railroad and Navigation Company are built through this valley between the Dalles and Wallula. Such is the movement of the sand, that on a windy day it is literally impossible to keep the tracks clear of the drift by means of shovels, and unless extraordinary measures were taken, the railroad would soon become buried to a depth of many feet.

An excellent opportunity has been given in the Columbia Valley to study the exact effect of wind currents blowing in different directions, since the high bluffs cause eddies and miniature whirlwinds, which also act upon the sand, as well as what might be called the direct currents. The changes made in the sand waves by various forms of barriers have also been carefully studied, and as a result some valuable data have been secured. It has been found that when the wind sweeps over a free surface of drifting sand, it acts about equally throughout; but an obstruction of any kind, such as a log or a bunch of grass, at once modifies the action of the wind. A solid object increases the force of the wind around the sides, and hence the sand is excavated. In the lee of the object the sand will accumulate. If two such obstructions are near together, a channel is formed between them, and once formed deepens with astonishing rapidity.

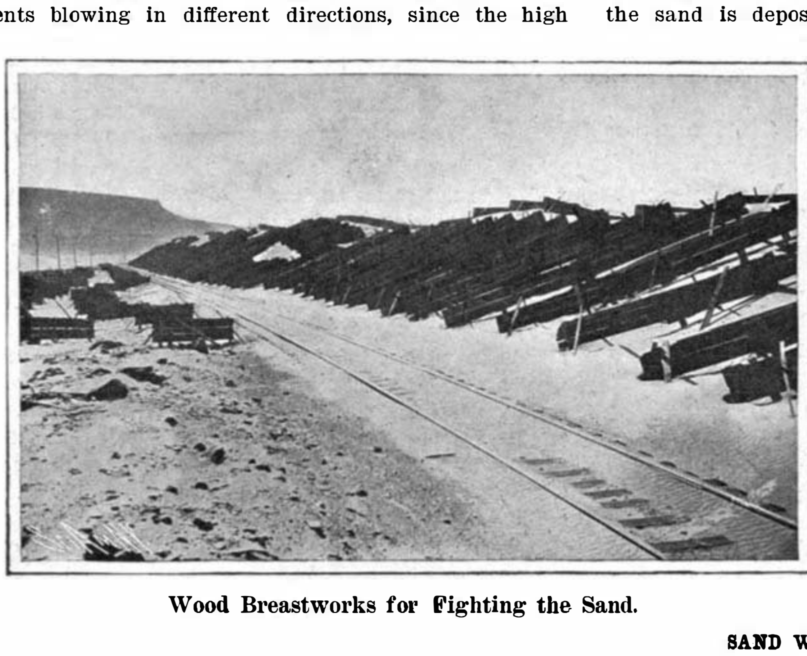
Railroad Men Fighting the Sand Sea in Oregon. The Track Can Be Seen to the Left Partly Buried.

The carrying power of the wind increases much more rapidly than the increase in the velocity. Consequently, any increase in the velocity is immediately noticeable in the increased erosive power. The erosive power of the wind is not identical with the carrying power, for in the first case the wind overcomes cohesion, and in the second case it overcomes weight. If the velocity of the wind decreases, the sand previously held in suspension is deposited. Thus if a solid fence is placed upon the sand at right angles to the wind, the sand is excavated in front. The wind, unable to proceed, is divided into currents in all directions. Those going downward scoop out the sand, thus forming a drift a short distance in front. This increases until its height equals that of the fence, when the wind, no longer meeting with the obstruction, allows sand to be deposited in this channel, and it fills up, covering the fence. Similarly, at the ends of the fence the wind currents are increased, and the sand is scooped out. If the fence is raised so as to allow a space beneath, the sand is rapidly scooped out below. The same result occurs beneath buildings, trestles, or other works which allow a space beneath, through which the wind rushes with increased force. If, however, the obstruction is not solid, but more or less open, as a pile of brush or a bunch of grass, the action is entirely different. The wind passes through the obstruction, but with decreased velocity; hence sand is deposited within the obstruction. No excavation takes place in front or around the sides. If the obstruction is stiff and inflexible like a sand fence, the sand is deposited on both sides, the windward slope being gradual and the lee slope more abrupt. If the obstruction is flexible like a bunch of grass, most of the sand is deposited in the lee. Of course, there are all gradations between the two classes, and various circumstances may modify the usual action.

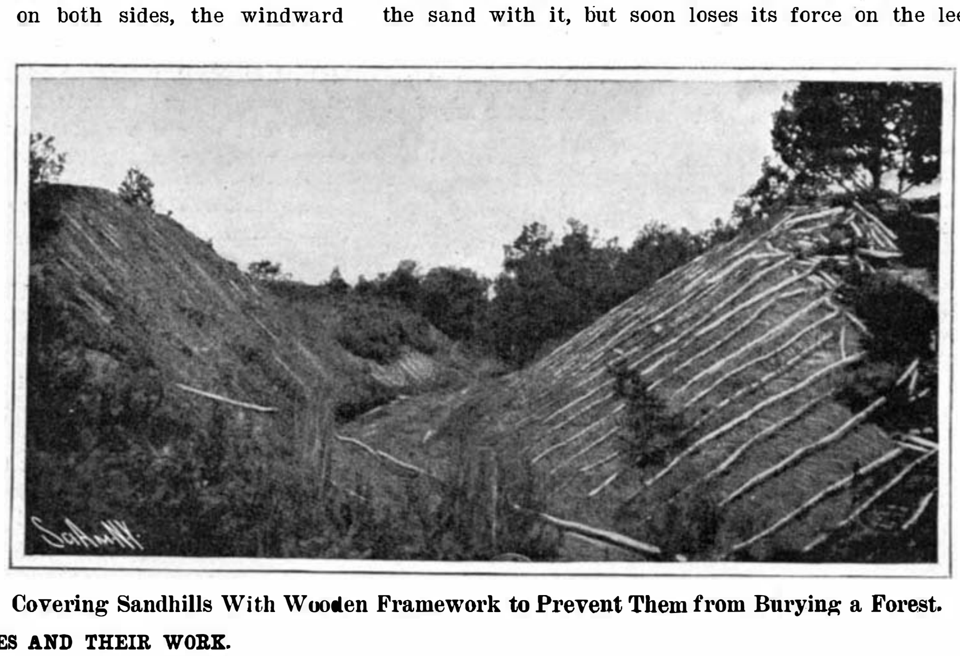
It has also been ascertained, that when the wind is blowing up an incline, the surface velocity increases with the steepness, but when the wind blows down a slope, eddies form, which usually produce a current uphill at the surface. Thus it happens that while small bodies can be blown uphill easily, it is not often that they are blown downhill, but must fall from their own weight when the slope is steep. The fact that the velocity of the wind at the surface on the windward side of a dune increases with the slope results in producing a normal incline, which represents a balancing of forces. Usually this incline is quite gradual compared with the lee side of the dune, where the slope is the greatest at which the sand will remain in place—about 30 deg.

The Columbia River, which deposits the sand along the valley it traverses, often rises to a height of fully 60 feet during the freshet season, carrying down stream an immense quantity of fine silt, which is more mobile than the ordinary sea sand, as it consists of very fine rounded grains, easily combined into drifts by the strong winds which sweep through the valley. The movement of the wave is of course caused by the movement of the sand grains over its crest. As the direction of the winds is generally upstream, the waves have a notable uniformity, and at times attain such a height that actually trees 40 feet in height are sometimes buried to the tops. An analysis of the sand shows that it is very fertile when sufficiently irrigated, but the high winds absorb so much moisture that it is impossible for vegetation to take root in the dry season.

In fighting the sand sea, Mr. J. P. Newell, engineer of the railroad company referred to, has had the assistance of Mr. J. W. Westgate, of the Department of Agriculture, who has made an exhaustive investigation of the conditions. As a result several methods of checking the movement of the sand have been tried, some of them with notable success. The first and most extensively used is the "sand panel." A panel consists of two boards, 1 inch thick by 12 inches wide, and about 20 feet long, nailed to sharp stakes at each end. The stakes are driven into the sand, so as to make the panel stand up with its length oblique to the wind, and the leeward end away from the track. The wind is thus made to carry the sand along the face of the boards and away from the track. While the wind is blowing hard, the panels must be closely watched, as they soon become undermined and fall down, or if not properly placed, are covered up. The second method can be used only where there is a considerable level space on the leeward side of the track. A vertical wall of inch boards from 10 feet to 20 feet high is built a few feet to windward of the track, with an opening of 3 feet or 4 feet at the bottom. The wind striking the wall is turned down, and passes with increased velocity through the opening at the bottom, carrying the sand with it, but soon loses its force on the lee



Wood Breastworks for Fighting the Sand.



Covering Sandhills With Wooden Framework to Prevent Them from Burying a Forest.

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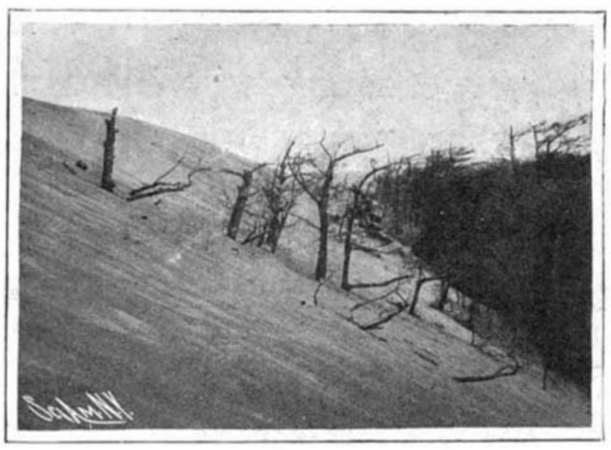
side of the wall, and deposits the sand just across the track. From there it must be occasionally removed by teams or some other means.

A third method, invented by Mr. Newell, is a modification of the panel plan, but is intended to be of permanent construction. A tight wall from 10 feet to 16 feet high, composed of two planes, the upper inclined toward the wind and the lower away from it, is built between the track and the approaching sand drift. The upper plane deflects the air current strongly downward, and the lower one throws it out so it cannot undermine the walls, but is turned against the sand bank. The wind is thus made to carry the sand along the wall to the end, which is located at some point where the natural features will prevent the sand from doing any harm. Such a wall has protected one of the worst places on the road for three years. The movement of the sand has also been partly obstructed by the planting of trees at right angles to the direction of the waves. The trees, which are of a variety which will take root in the formation, are usually set out in two rows separated by a bank of sand, but the formation about them must be artificially moistened to keep them from dying.

As the photographs show, however, there are places where apparently no protection is sufficient to keep the sand from covering the right-of-way. At one point where the track passes close to the wall of rock forming one side of the valley, a force of men and teams is almost constantly employed with shovels and scrapers as illustrated.

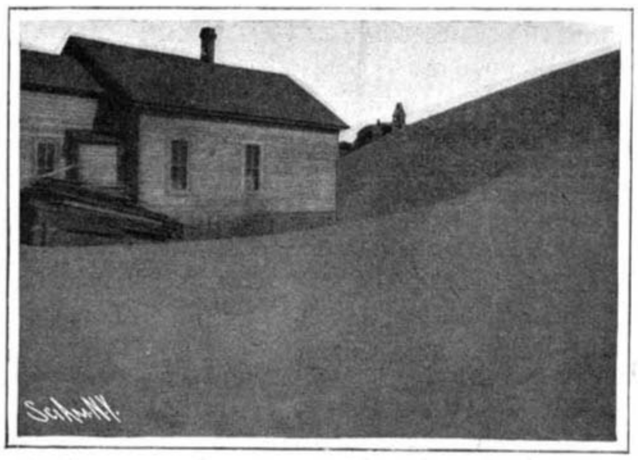
As far back as 1832 the people of Massachusetts realized the necessity of preventing the movement of sand dunes near some of the coast towns, to prevent the latter from being literally overwhelmed. The principal form of protection has been the planting of beach grass in places where the wind currents are not too violent to check its growth, keeping the dunes from forming. Some of the dunes have also been "fixed" after formation by planting the grass, then protecting it from the wind by covering the windward side of the hill with brushwood. On a fixed dune certain kinds of trees will grow to maturity. This is illustrated by the forests in New Jersey and Virginia, some of which extend almost to the water's edge. In these States, however, are places where the dunes have reached a height of over 100 feet, and have literally buried growths of large timber to such an extent, that only a few feet of the trees can be seen projecting from the sand here and there.



Shifting Dunes Burying a Forest.

Woodland Destroyed by Sand.

Near Cape Henry there are shifting dunes, which are gradually engulfing pine woodland in their rear, since this section of the coast is exposed to the severest gales, which sweep over the Atlantic in winter. One of the most notable illustrations of shifting dunes, however, is to be seen at Cape Henlopen, Delaware. Here the lighthouse, one of the highest towers on the seaboard, is nearly surrounded by a ridge of sand, which already reaches more than half way to the top. The resistance to the wind, however, has caused eddies, which have prevented the sand from closing in around the structure, except on one side. From Delaware Bay the size and height of the building can be appreciated, but looking at it from the southeast, from which come the principal winds, the tower appears to be only about 20 or 25 feet above the shore.



House Buried in the Sand Sea.

Water as a Preservative of Milk.

The rapidity with which microbes increase in certain liquids, and especially in milk, is almost incredible; this is the reason why milk is so difficult to keep. Messrs. Nicolle and Petit, two French scientists, have found that milk, fresh from the cow and taken under test conditions of cleanliness at nine o'clock in the morning, contained one hour later 6,250 microbes per cubic centimeter, 25,000 four hours later, 310,000 after eight hours, and 11,250,000 after a lapse of twenty-four hours. Microbes absolutely swarm in milk after a short time, especially if its temperature be slightly increased. These gentlemen recently examined some samples of milk at Tunis; one of them, which had reached the market at eight o'clock in the morning, was found to contain already 2,387,000 microbes per cubic centimeter. In some instances specimens of the bacterium coli were found. Refrigeration has so far been found to be the only certain means of checking the growth of bacteria, and milk placed in a refrigerator will keep well; in practice, however, this is not within the means of everybody. However, a gentleman, Mons. A. Renard, has now secured highly satisfactory results by means of a very simple method, which is not intended to check the operations of bacteria for very long periods, but merely for two or three days or so. The interesting point about this method is that the milk is left in its natural state, no formol, salicylic acid, borax, or other antiseptic being put into it. M. Renard uses oxygenized water, which decomposes slowly in the liquid without changing it in any way. The experiments were made recently at Rouen, when the inventor of the process merely poured two per cent of water, oxygenized at twelve volumes, into the milk. It is not advisable to use more than three per cent, as the decomposition of the oxygenized water might give rise to certain drawbacks. The milk thus treated did not differ in any way from perfectly fresh milk; when an addition of three per cent was made at a temperature of 11 deg. C., it kept fresh, without the least trace of acidity, for a period of 95 hours, but only for 32 hours when the temperature mentioned was increased to 20 deg. In order to determine whether milk thus treated could be safely given to children, Dr. Debout (of Rouen) experimented with it at one of the dispensaries, giving it to some 57 infants with good results.

Further experiments regarding the preservation of milk have also recently been made by Messrs. G. Nicolle and E. Duclaux, at the Pasteur Institute at Tunis; they have obtained very good results with the refrigeration method, but they are greatly in favor of M. Renard's oxygenized-water process, as its antiseptic action lasts long enough to prevent any alteration in the milk—provided, of course, that it be added directly the milk is drawn from the cow. If added to boiled milk, the oxygenized water, instead of rapidly disappearing, forms certain combinations with the constituents of the milk (which have been altered by boiling) and is only eliminated very slowly. Messrs. Nicolle and Duclaux have carefully studied the effect of oxygenized water upon such pathogenic microbes as the comma bacillus, the bacillus of cholera, bacterium coli, the pyocyanic bacillus, etc., and also upon certain microbes which cause diseases in milk; among these latter we may mention the cyanogenic bacillus which produces the phenomenon of blue milk, and the micro-bacillus prodigiosus, which is one of the chief agents in the putrefaction causing what is termed "red milk." Without going into details, it may be said that oxygenized water does not destroy pathogenic and other germs with certainty—much less the bacillus of tuberculosis, which is the most capable of all in resisting microbicide influences. In this respect the new method does not come up to the pasteurization of milk, which kills all pathogenic microbes, excepting the microbe of tuberculosis; but this latter process does not insure preservation,

The Sand Seas of the West Which Overwhelm Houses and Railroads.

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while it changes the properties of the product in such a way as to diminish its nutritive qualities. M. Renard's method of only adding a few drops of oxygenized water is much simpler, and quite as efficient as refrigeration, the milk—without being altered in any way—being kept fresh for at least 30 hours after it is taken from the cow.

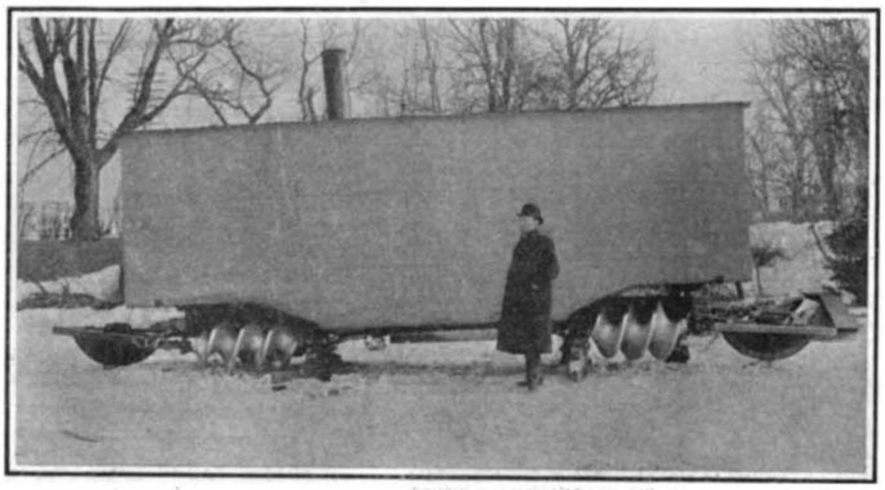
AN ICE AUTOMOBILE.

BY G. LUXTON.

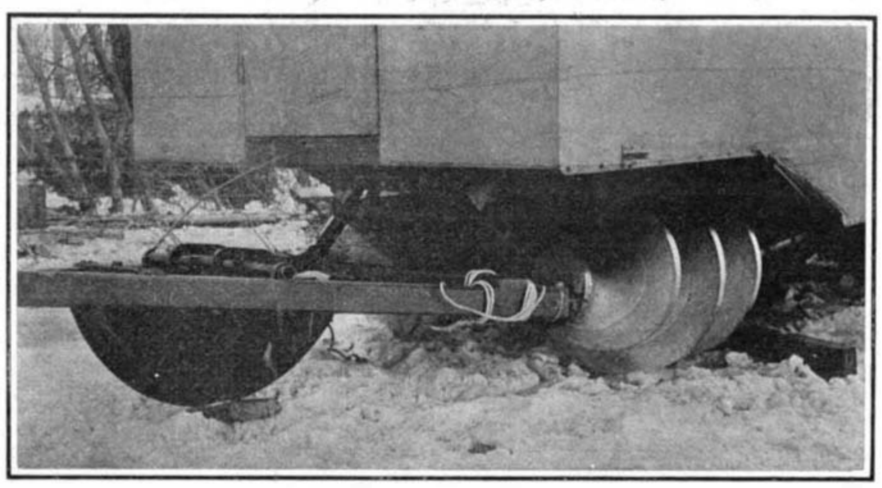
The development of the steamship, the locomotive and the automobile, and the still later conception of the dirigible airship, would seem to have exhausted the field of novel means of transportation. Yet a machine which is in its basic principle a decided innovation, has been designed and constructed by a Minneapolis man, Charles E. S. Burch, who has experimented for years in practical demonstration of his idea. The machine in question, illustrated in the accompanying engravings, is now resting on the ice of Lake Calhoun, where it has been tested, for, it must be understood, the machine is intended to travel on a frozen surface. The object which the inventor has had in view is the revolutionizing of the means of winter transportation in Alaska, where he is heavily interested in mining properties difficult to develop because of their inaccessibility. At present, in certain parts of Alaska, freight transportation during the winter is accomplished entirely by dog-teams and sleds, and in consequence the charges are from $100 to $1,000 a ton. It is the inventor's plan to use in place of dog-teams his "ice locomotive" drawing a train of sleds, and in this way to reduce the expense of freighting to a minimum. It is hoped that the invention will prove a boon to winter commerce in Alaska, and should it succeed will doubtless be received with enthusiasm by the thousands in that frozen country, who in winter are practically shut out from the civilized world.

The ice locomotive is propelled by steam engines, but instead of resting on wheels or runners is supported by four great steel spirals, one at each corner of the body, in the places usually occupied by the wheels or runners of ordinary vehicles. The spirals lie with their vertical axes horizontal, and are of opposite pitch. The edges of the blades are fashioned like skate blades in order that they may grip the ice well. Each of the spirals is directly connected to a separate steam engine and consequently the spirals may be operated independently, this method giving unusual control over the car. It can be driven forward, backward, sideways or at any oblique angle desired, and it can even be made to spin around like a top. The model now at Lake Calhoun is 22 feet long, weighs 4½ tons, has engines of 42 horse-power and steel screws 27 inches in diameter. It is easily seen that the greater the diameter of the spirals the greater will be the ability of the ice locomotive to travel over rough surfaces and to surmount obstacles. Accordingly, a machine which the inventor is having built in Canada, to protect patent rights in that country, will have spirals six feet in height. The ice locomotive is steered by means of two semi-circular steel disks at each end of the body operated by compressed air. The disks work in unison and are weighted in order better to grip the ice. The bottom of the body is made watertight so that in the event of the machine breaking through the ice it will float upon the surface of the water. In that case it would be possible easily to propel the machine, for the spiral method of navigation, as is well known, operates successfully.

The Lake Calhoun machine, which is unfinished and rough in appearance, was constructed to make an estimated speed of 9 miles an hour, but on its trial trip it easily traveled at the rate of 18 miles an hour. Obstacles and rough places were passed with surprising ease. A toboggan slide course of ice and snow several feet above the level of the lake ice was surmounted without difficulty while traveling at full speed. The inventor intends to use alcohol boilers in the machines constructed for practical service in Alaska, thus avoiding the danger of the freezing of the boilers, and furthermore, considerably reducing the size of the latter. He plans to have a condenser to condense the alcoholic steam and use it over and over again. Wood, coal, or oil may be used for fuel under the boilers.



The Most Recent of the Ice Automobiles.



One of the Spiral Runners and a Steering Disk.

AN ICE AUTOMOBILE.

A record feat in shipbuilding on the Great Lakes was marked by the recent launching of the 10,000-ton ore carrier "Jos. G. Butler, Jr.," after a period of only fifty-five days following the laying of the keel.

Accidents Due to the Foreign Chauffeur.—The American Coachman is Said to Be More Cautious.

"American coachmen with a little training make more efficient chauffeurs than the majority of Frenchmen out of employment, who come over here with a smattering knowledge of motors and are employed without question as expert drivers of automobiles." This statement was made recently by a gentleman who has owned automobiles for nearly ten years, is prominent in the affairs of the Automobile Club of America, and has had a wide range of experience in the employment of chauffeurs.

"A majority of the fatal automobile accidents that occur in this country," he continued, "are due entirely to the reckless driving or the absolute ignorance of imported chauffeurs. I have no hesitation in saying that the sad accidents that resulted in the deaths of Mrs. Francis Burton Harrison and Mr. James E. Martin were caused by reckless driving. They probably would not have happened had the drivers been graduated from the ranks of coachmen.

"Bursting tires are usually blamed for fatal accidents, but I know that there is nothing about a tire explosion to force a car off its course before being brought to a stop. This was proved by a series of demonstrations given by S. F. Edge in London with tires purposely deflated. A chauffeur naturally will blame an accident to a tire to screen his own recklessness or ignorance.

"Many foreign chauffeurs are capable drivers. Many others come to this country to seek employment as automobile experts because they cannot obtain work at home. Some have previously been waiters and a great many have had no experience in handling automobiles before landing in America.

"Not sufficient effort is made by owners to find out the capabilities of men who apply for jobs as automobile drivers. If an applicant speaks a foreign language he goes a long way toward qualifying for the position. The owner is probably ignorant of the mechanism of his car, and so is unable to question the applicant. He takes it for granted that the latter is all he claims to be, and then intrusts his own life, the lives of his family and those of his friends to a man who possibly knows no more of the machine he is to handle than does his employer.

"In my experience I have found that the most capable and trustworthy driver of an automobile is a man who has been schooled in the driving of horses. The most reliable chauffeur is a good, level-headed coachman. He knows the rules and courtesies of the road; he understands that danger is likely to be met in getting the car off the road; he has a proper respect for the care of the varnish on a vehicle, and if given a little instruction he becomes better able to care for a car, to keep it clean and to turn it out smartly than a so-called expert foreign chauffeur.

"Lessons necessary to evolve a good chauffeur from a good coachman are, first, the theory on which the gas engine works; second the theory of ignition; third, the necessity for perfect lubrication, and, fourth, the danger of fire from gasoline.

"A chauffeur to take care of a car does not need to be a mechanic. If gears are stripped, crank shaft broken or axle bent no chauffeur, however expert, can repair the damage without a machine shop. Therefore it is not necessary to travel with a mechanic, for in case of a serious breakdown the car has to go to a shop anyway.

"If proper care were exercised in the selection of chauffeurs fewer lives would be lost in automobiling. Ignorant foreign drivers, who think more of speed than of saving their cars, slam them over rough roads until they become strained. This may not be noticed until weeks afterward, when, because of the strain, a piece of metal snaps and an accident results.

"Examinations for chauffeurs will not remedy the situation to any great extent. A reckless driver might pass a perfect examination. A revocable license would be more effective, for if a chauffeur finds he is liable to lose the chance of earning his living in driving automobiles, he will be more inclined to exercise care. But to my mind the best solution of the problem is the employment of steady-going coachmen as chauffeurs."—N. Y. Herald.

The Coloring Matter of the Blood.

The properties and composition of the coloring matter of the blood have been investigated by Messrs. Piettre and Vila, of Paris. One of the interesting reactions of toxicology is that which enables us to obtain upon the microscope plate the crystals known as *Teichmann's crystals*, and thus according to this classic experiment we find that the coloring principle of the blood is capable of crystallizing. This remarkable property was studied by different experimenters and was soon applied in blood researches in legal medicine. As it is only a question here of a microscopic reaction, we could not find out the composition of the crystals, but later on Nencki by using the powerful resources at his disposal succeeded in preparing about 500 grammes of this matter, by using enormous quantities of glacial acetic acid. The crystallized substance, which represents the total amount of the ferruginous pigment contained in the blood, he designated by the name of *acethemine*. The process which is used in obtaining it is simple, although expensive, and it gives an excellent yield of fine black crystals having a steel-like luster. The crystals have the form of very long rhombs and can reach a length of 0.12 inch. Microscopic examination shows that the Teichmann crystals which come from a saline solution, and Nencki's compound which comes from the same solution and in an acetic medium, are identical as to form, spectrum and properties. The authors have also prepared a quantity of the body according to Nencki's method. They find about the same analysis which he gave, namely, carbon 62.58, hydrogen 5.14, nitrogen 8.65, chlorine 5.64, iron 8.66. However, they do not consider that it is a definite chemical compound. They wished to produce the crystals which should be free from chlorine, and succeeded in obtaining such crystals, thus finding that the chlorine is not essential, nor is it constant in other cases. The proportion of iron can also vary. The authors are making further researches as to the nature of this body and state at present that there seems no doubt that the crystals in question can be separated into different principles, among which they have already isolated a solid and colorless substance containing no iron.

Certain wooden cylinders, usually from 30 to 50 inches long and from 6 to 7 inches in diameter, have become quite common in some places in Florida. They are called veneer cores, and are the waste lumber from the cutting of material for the sides of orange boxes and for other crates. This veneering, most of which is pine, is cut by clamping the ends of sections of the log to spindles, and revolving the logs rapidly under sharp heavy knives. After the bark is off the knives are sunk into the wood and thin sheets are pared off, unrolling somewhat as paper does from a roll. These are conveyed on runners under drop-knives which fall at regular intervals, and cut the veneer pieces of the right size for the crates. The cores are the heart pieces that are left after all the log that is available for crate material is cut for veneering. These cores are used for various purposes, to some extent for fence posts, but most of them for fuel, and are found at many Florida wood-piles. There are several veneer cutting mills in Florida.