

privacy is secured. Private rooms and lavatories form part of the sleeping cars, while in each there is also contained a small room with a stove for warming the car by means of hot air pipes.

The minor details of the cars are too numerous to mention, though their neatness and ingenuity deserve notice. The windows, with convenient blinds and plated bolts to regulate their opening, are a pleasant contrast to those we usually see. The lamps—six in each car—are extremely elegant, as is also the metal work—that which is decorative being bronze, and that which is plain nickel-plated. The black walnut woodwork, carved and gilded, and the neat Brussels carpet on the floor, cause the crimson velvet cushions and chairs to stand out perhaps a trifle too prominently, but with excellent effect, while the bright plated metal fittings, occasional looking glass, and the sides (almost all windows) give the interior of the cars not only a luxurious but a comfortable appearance.

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THE EFFECTIVE POWER OF STEAM ENGINES.

It is rather the exception than the rule that manufacturing establishments have abundance of motive power. In those using steam power, a false economy in first cost is almost universally practised in purchasing insufficient boilers. An increased consumption of fuel is the result, which, for various reasons, becomes greater from year to year, until the losses from this cause aggregate a fearful rate of interest on the amount intended to be saved. In many instances, from one fourth to one half of the fuel would be economized by the introduction of boilers of proper proportions for the power required. From how many smokestacks throughout the land can great volumes of smoke, as black as midnight, be seen, at almost all times, rolling upward, carrying with them the most valuable portions of the fuel! Each one of these advertises a great waste, which is generally produced by the boilers being too small. The amount thus lost on an average coal-burning Mississippi river steamer would be abundantly sufficient to furnish gas lights for a city of ten thousand inhabitants. When steam boilers are of suitable proportions and furnaces properly constructed, this waste should not occur. A genuine fear of loss of fuel from too much boiler surface is quite common with proprietors, but it is very rarely that such actually occurs. It is safe to provide twenty per cent more boiler than cylinder horse power, while equal power in each will often serve the purpose; and yet it will, in most instances, be found that the cylinder considerably exceeds the boilers in measurement.

Of equal importance is the size and construction of the steam engine cylinder. The naked rule that a certain pressure upon the number of square inches surface of the piston head will give the definite horse power, if followed out, will always cause failure. Omitting, for the present, the amount of friction, let us point out the principal reasons why this is so: It is well established that the economical use of steam forbids that the cylinder should be entirely filled at each half revolution with steam at the full boiler pressure. For this reason the flow of steam into the cylinder should be cut off at some portion of the stroke, and be allowed to exert itself expansively. There are two systems of accomplishing this: In the ordinary engine, by means of the slide or other

valve, closing the steam supply port at a fixed point; the other, as in the Corliss type, through a governor acting upon the steam supply valve, cutting off steam when sufficient has been admitted to accomplish the number of revolutions per minute required. With the first-named engines, that regular speed may be had, it is necessary to use a governor. The principle upon which this governor always acts is that of securing less than boiler pressure in the cylinder by throttling the steam pipe, and rendering it impossible for the full pressure to reach the piston head. If a pressure gage be connected with the cylinder of an engine using a governor, less pressure will be registered than that shown by the boiler steam gage. When the pressure of steam in the boiler and cylinder becomes the same throughout the stroke, the governor is no longer of service, regularity of speed ceases, and the revolutions become less than those required.

With the Corliss type of engines, the full boiler pressure enters the cylinder at the commencement of the stroke, and the motion of the governor determines at each half revolution where steam is to be cut off, that proper speed may be maintained. When the full pressure is necessary for the whole stroke, this engine fails the same as the other, a considerable margin of power being always essential. Very little additional power is gained in any engine by allowing the steam valve to be open at over half stroke, and much less is lost in the crank and by dead centers than is generally supposed. From the above suggestion, the necessary failure of engines, when expected to yield the full boiler pressure power, in actual use is made quite apparent. If, besides allowing amply for friction, a further allowance of twenty-five or thirty per cent is made for the governor and for a reserve, sufficient power in engines will generally be provided. The omission to do this has caused many advertisements of "a good second hand engine for sale, having been replaced by a larger one." Some engine builders practice deception by claiming to secure, by patented improvements, great accessions in results. These pretensions are usually unfounded, and should not be allowed to reduce the sizes of cylinders.

Inattention to the temperature of feed water for boilers is entirely too common. When the escape steam of the engine can be brought into water heaters, no water should be supplied to boilers at much less than boiling heat. A heater that does not furnish it and a pump that fails to force it in at that heat should be thrown out at once.

We shall next week comment on the effective power of turbine water wheels.

COMPARTMENT SHIPS.

It will be remembered that last year a large and splendid French steamer, plying between New York and Havre, the Ville du Havre, was sunk in mid ocean, in the night time, by collision with a sailing vessel. A large number of lives were lost. The side of the ship was torn open, and the water poured in so rapidly that, in twelve minutes, the vessel went down. It was alleged that the doors in the dividing compartments of the ship were open at the time of the collision, and that influx of water was so rapid and unexpected as to prevent the closing of the doors, otherwise the ship would have floated much longer, and might finally have been saved.

We have now to record the loss of another French steamer, belonging to the same line, the Europe. Happily no lives were lost. This vessel sailed from Brest for New York, March 28, encountering rough weather and leaking a little from the start. It was alleged that she scraped her bottom in passing the bar.

On the fifth day out, a thousand miles from land, the leak had increased so much that the commander decided to leave the vessel, and all on board, four hundred in number, were transferred to a passing steamer, the Greece, and brought to New York. When finally abandoned, the Europe had 17 feet of water in her hold. Her cargo was valued at two millions of dollars.

The Europe was an iron ship: Length, 410 feet; breadth of beam, 44 feet; depth of hold, 37 feet; tonnage, 4,585; her engines were of 1,000 horse power, and she was divided into seven compartments.

It is now common in the construction of iron ocean steamers to subdivide the hull into compartments, each of which is intended to be watertight, so that, if leakage occurs in one, the others will not necessarily be affected.

It is obvious that, if the vessel were divided into a sufficient number of strong independent compartments, the chances of sinking by leakage or collision would be very much reduced. In fact there are many examples on record of vessels saved by means of compartments. On the other hand, large numbers of compartment ships have gone down, but of these it has too often appeared that the partition; were weak or leaky, or ports between them were left open or the compartments were too large. In a 400 foot ship, it is not customary to have more than seven compartments. But experience seems to show that this is too small a number. The engine and boiler space now required is much smaller than formerly, and there seems to be no good reason why an increased number of compartments should not hereafter be provided.

As an example in this direction, we may refer to the new British war steamer Inflexible, which is to have 127 watertight compartments.

For mercantile service, it would be unnecessary to employ so many compartments as this, but it is plain that the number might be considerably increased and the risks of disaster correspondently diminished.

After the above was written, the sad tidings came of the loss of another ship belonging to the same line, the Amélique. This vessel was almost similar, in size, power, and construc-

tion, to the Europe. The Amélique sailed from New York, April 4, and encountered a hurricane, near Brest, April 14, when the captain, acting under the impression that his ship was a leak, signaled another vessel, transferred passengers and crew, and abandoned the Amélique. The next day (April 15) she was found floating in the trough of the sea, by the captain of another steamer, who, on boarding, found 6 feet of water in the middle compartments, all the others being free. The Amélique's pumps were started, and she was then towed to Plymouth, England, vessel and cargo saved in good condition. The value of compartments is well illustrated in this instance. It is now believed that the abandonment of the Europe was unwarranted, and, as in the case of the Amélique, was an act of bad seamanship.

A TREE THAT KEEPS A STANDING ARMY.

Among the varied means of defense developed by plants in their ceaseless struggle for existence, there is perhaps none more wonderful or effective than that of a species of acacia which abounds on the dry savannahs of Central America. It is called the bull's horn thorn, from the strong curved thorns like bulls' horns, set in pairs all over the trunk and branches. These no doubt help to protect the tree from the attacks of browsing animals; but it has more dangerous enemies in the leaf-cutting ants and other insects. Against these the tree maintains a numerous standing army, for which it provides snug houses stored with food, nectar to drink, and abundance of luscious fruit for dessert.

When first developed, the thorns are soft and filled with a sweetish pulp, much relished by a species of small springing ants, never found except on these trees. Making a hole near the point of one of each pair of thorns, these ants eat out the interior, then burrow through the thin partition at the base into the other thorn, and treat it in the same manner. The hollow shells thus formed make admirable dwellings, none of which are left untenanted, as any one may discover by disturbing the plant, when the little warriors swarm out in force and attack the aggressor with jaws and stings.

The leaves of the plant are two-winged, and at the base of each pair of leaflets, on the mid rib, is a gland which, when the leaf is young, secretes a honey-like liquid, of which the ants are very fond. This ensures their constant presence on the young leaves, and their most zealous service in driving off other insects.

A still more wonderful provision of solid food is made for a similar purpose. At the end of each of the small divisions of the compound leaflet, there grows a small fruit-like body, which, under the microscope, looks like a golden pear. When the leaf first unfolds, the little pears are not quite ripe, and the ants are continually employed going from one to another to see how they come on. As these fruit-like bodies—which appear to have no other use than as ant food—do not all ripen at once, the ants are kept about the young leaves for a considerable time. When an ant finds one sufficiently advanced, it bites the point of attachment, then, bending down the prize, breaks it off and bears it away in triumph to the nest.

These ants, a species of *pseudomyrma*, are found, as already noticed, only on these trees; and that the trees really keep them as a body guard seems evident from the fact that, when planted in localities where their little protectors do not exist, they are speedily defoliated by leaf cutters, which let them severely alone on the savannahs, while their honey glands and golden pears offer no attractions to the ants of the forest.

Apparently both acacias and *pseudomyrmas* have been mutually modified in the course of time, until they are now quite dependent on each other for support and protection.

PROGRESS OF UNDERGROUND RAILWAYS IN LONDON.

The length of underground railways now in operation in London is about twenty miles, and they are being extended in various directions. From a recent number of *Iron* we learn that the extension of the Metropolitan Railway from Moorgate street under Finsbury circus is proceeding with rapidity. The Metropolitan Inner Circle Railway is to be completed from Aldgate. One new branch is to extend from the Metropolitan Railway, Queen Victoria street, under Friday street, Cheapside, curving northeasterly under Philpot and Road lanes, by Cullum street, under Fenchurch street to Aidgate, under that street, Whitechapel, Mile End, and Bow Road, to the North London Railway station at Bow. Another branch is from the line just described under Duke street, Houndsditch, to Roper's Building, to the Metropolitan extension, to Meeting house yard, under Petticoat lane, Middlesex street, with a curved junction to unite with the Metropolitan proper. Two more junctions will be made with the East London line at Stepney and the North London at Bow. All of these lines will be underground, the tracks being from 25 to 40 feet below the surface. The total length of the new lines is about five miles.

A NEW COMET.

The discovery of a new bright comet is announced by the Academy of Sciences, Vienna, in 21 hours 23 minutes right ascension south, 6 degrees 56 minutes declension. An observer at Yonkers, N. Y., states that it is nearly globular, about two minutes in diameter, with a decided condensation toward the center. In brightness it is above the average, but it does not in other respects present any notable difference from objects of its class. Its position at 4 o'clock A. M., of April 14, was approximately: Right ascension, 21 hours, 16 minutes, 31 seconds; south declination, 5 degrees, 15 minutes. Its motion is toward the north and east.

An observer in this city states, April 17, that it rises at 2 A. M., east one half south. Half an hour earlier on April 24. It is a telescopic object.