THE STRENGTH OF LOCOMOTIVE BOILERS.

The following article is from the *Railway Gazette* of Dec. 20th: Of late years, owing partly to the increase in the size of locomotive boilers, and partly to the numerous explosions that have occured, the thickness of boiler plates has been materially increased. Twenty-five years ago there were few, if any, used thicker than 5-16 in. Now, for the larger sizes of locomotives, plates are always ½ and in some cases 7-16 in. thick. Double-riveted seams were seldom found in the older boilers, whereas, now, it is the rule for horizontal seams, and in some cases for all others; and in the larger engines now in process of construction on the Louisville & Nashville railroad the former are treble-riveted. The object of this increase in the thickness of the material and in the method of fasteni ng it together is to increase the strength of the structures; but a boiler is like a chain, the strength of which is only equal to that of the weakest link, and the misfortune has been that in attempting to increase in resisting capacitv of boilers, some of the links have been very much neglected. A house painter who should fall from a scaffolding by the breaking of a rope would quite naturally get a stronger one if the survived the fall; but the strong rope would be of little service unless it were securely fastened. Without knowing any confirmatory facts it is safe to venture the opinion that many more accidents of persons falling from scaffolds are caused by insecure *fastenings* than by insufficient strength in the members of the structure. The unfortunate man who undertook to lower his wife from the window of an upper story of the Southern hotel at the time it was burned was not mistaken about the strength of the pieces of bedding which he tied together, but he had not the knowledge nor the skill to fasten them, and his knots slipped and his wife was killed.

The weakness of boilers arises generally not from insufficient material, and perhaps not as often from inferior quality, as it does from the weakness of the attachments of the various parts. Unless there is some reason for a contrary opinion, it may be assumed that riveted work will always be done badly. The chief defects of such work are out of sight, and to a great extent undiscoverable after it is finished. Mismatched and unfilled holes cannot be seen after the heads of the rivets are formed, and therefore such work is less subject to criticism and inspection, and consequently there is little rivalry or pride of excellence in doing it among mechanics. Without the very closest inspection it is always possible for a workman to hide his blunders and his carelessness. Then, too, there is no strong sense of the necessity of good work of this kind. There is generally a lack of what might be called mechanical moral sense in this respect, and an engineer who should insist upon having first-rate work would find it no easy task to have his orders executed.

In the construction and attachment of the braces, there is more carelessness and ignorance displayed than in any other part of boiler construction. These are seldom carefully designed, and are nearly always left to workmen to arrange. They are seldom deficient in the amount of material of which they are made, but very often in the methods of attachment to the shell of the boiler.

In the attachment of steam domes there is more disregard of the laws which govern the strength of locomotive boilers than anywhere else. In order to give access to the inside of the boiler a hole from 24 to 30 in. in diameter must be cut into the shell. To make up for this there is the flange which is formed on the base of the dome, and, in some cases, another flange which is turned up on the plate which forms the shell of the boiler. Both of these are cut away by the rivets so that their sectional area is diminished thereby. What is needed here, and what is used in Europe, is a heavy wrought-iron ring around the hole at the base of the dome. This can be riveted either to the boiler shell or to the dome, and in this way it will reinforce the strength of the boiler which has been diminished at this point.

Broken stay-bolts we have always with us. Our present knowledge of the subject has not thus far supplied a remedy for the evil. All we can do is to supply such means as will enable us to discover the breakage as soon as it occurs. Hollow stay-bolts plugged on one side are the surest safeguard.

It is a little singular that more effort has not been made to overcome the effects of unequal expansion in locomotive boilers. If we reflect for a moment on what occurs when a fire is built in a locomotive boiler filled with cold water, it will be seen that there must be enormous strain exerted on it before the whole of it becomes heated. The first effect of the fire is to heat the fire-box plates and tubes. These must expand before the outside shell is even warmed. The expansion due to a rise of temperature from say 70° to 400° is about 0.002 of the length of the tube, which if 10 feet long would therefore be increased in length nearly a quarter of an inch. This pressure must be exerted against the front and back tube-sheets and transferred to the shell of the boiler. The front tube-sheet cannot yield excepting to an almost inappreciable amount. The outside shell will be stretched and the tubes compressed somewhat under the strain, but after making allowance for these effects it will be seen that the greater part of the strain, due to the elongation of the tubes, must be exerted on the back tube-sheet, and this in turn is transmitted to the side-sheets and stay-bolt of the fire-box. It is no wonder they are broken.

It is remarkable that no one has devised any method of compensating or permitting this expansion of the tubes without subjecting the other parts of the boiler to excessive strains.

It seems as if there were some grave defects in the principles of constructing locomotive boilers. Whether they can be remedied it is too early to answer, but it is certain that much of the workmanship and the design of the details could be immensely improved without any increase of knowledge on the part of those who have charge of their construction, excepting that which every good mechanic should have, and which can be found in elementary books.

CELLULOID.—This substance, though prepared by Mr. Hyatt, an American, as long ago as 1869, has only lately been turned to much practical account. It is prepared by subjecting ordinary paper to the action of a mixture of nitric and sulphuric acids; washing this till all trace of acid disappears; drying the product, powdering the same, and mixing it with camphor; drying and repeatedly pressing this mixture, at last applying heat, when the celluloid appears in the form of transparent, elastic rods or slabs. As it is hard and not easily broken or slabs. As it is hard and not easily broken at ordinary temperatures, susceptible of high polish, and capable of being cut into extremely thin plates, yet elastic, and, at high temperatures, malleable, plastic and even fusible, it has become extensively used in the manufacture of the rims of eye-glasses, cheap ornaments, cigar cases, etc., and, when colored, as a means of imitating ebony, lapis lazuli and malachite. It has also been employed in making elastic belts, trusses, etc., and some of its applications in dentistry were patented as early as the year of its discovery.—*Moniteur des Produits Chim.*

SINGULAR OCCURRENCE.—The fishing smacks along the coast of Florida, report a stream of fresh or poisonous water along the coast, that kills all the fish in its range. They report sailing for 200 miles through dead fish, covering the sea as far as the eye could reach with all the varieties. Immediately on the shore the water is salt and natural, while less than a mile off it appears of a red brick color.

THE gay season of visiting and entertainments at Washington has begun.

WHY THE SIERRA NEVADA IS LARGER THAN THE COAST RANGE.

A LEGEND OF THE YOKUTS.

Stephen Powers, in his "Indian Tribes of California," relates occasional legends of the strange peoples he visited. Many of these traditions are in themselves silly, child's fables, but viewed from the standpoint of ethnology they possess peculiar interest. The tribe of the Yokuts lived, or rather their remnants still live, about the northern half of Tulare lake, reaching as far north as the bend to the eastward of the San Joaquin, and extending to the east and west as far as the Sierras and the Coast Range respectively. The following legend belongs to this tribe. Powers entitled it the

ORIGIN OF THE MOUNTAINS.

Once there was a time when there was nothing in the world but water. About the place where Tulare lake is now there was a pole standing far up out of the water, and on this pole perched a hawk and a crow. First one of them would sit on the pole awhile, then the other would knock him off and sit on it himself. Thus they sat on top of the pole above the waters for many ages. At length they wearied of the lonesomeness and they created the birds which prey on fish, such as the kingfisher, eagle, pelican, and others. Among them was a very small duck, which dived down to the bottom of the water, picked its beak full of mud, came up, died, and lay floating on the water. The hawk and the crow then fell to work and gathered from the duck's beak the earth which it had brought up, and commenced making the mountains. They commenced at the place now known as Ta-hi-cha-pa pass, and the hawk made the east range, while the crow made the west one. Little by little, as they dropped in the earth, these great mountains grew athwart the face of the waters, pushing north. It was a work of many years, but finally they met together at Mount Shasta, and their labors were ended. But, behold, when they compared their mountains, it was found that the crow's was a great deal the larger. Then the hawk said to the crow: "How did this happen, you rascal! I warrant you have been stealing some of the earth from my bill, and that is why your mountains are the biggest." It was a fact, and the crow laughed in his claws. Then the hawk went and got some Indian tobacco and chewed it, and it made him exceedingly wise. So he took hold of the mountains and turned them round in a circle, putting his range in place of the crow's; and that is why the Sierra Nevada is larger than the Coast Range.

This legend is of value, says Powers, as showing the aboriginal notions of geography. In explaining the story, the Indian drew in the sand a long ellipse, representing quite accurately, the shape of the two ranges; and he had never traveled away from King's river,

Further, it may be added, this legend and all of similar origin, are of value in correcting the ideas of "city folks" with regard to the California Indians. Those who have seen only the "Digger" in his debauched indolence, as he hangs about some stage station, have no right to form an opinion, based upon their own experience, of those unfortunate people. They do not deserve the approbrium attached to the term "Digger." They are interesting tribes, that have a history. They are falling before the advance of a people far better than themselves; but not so much better, that the uncivilized cannot point to the civilized as the hasteners of the Indian's destruction. "We shall all die soon," wails the Yokuts Indian in his dance for the dead. "We were a great people once. We are weak and little now. Be sorrowful in your hearts. O, let sorrow melt your hearts. Let your tears flow fast. We are all one people. We are all friends. All our hearts are one heart."