CONSTRUCTION OF THE ASPEN TUNNEL.

One of the most important sections in the work of reconstructing the Union Pacific Railroad in Wyoming was the excavation of what is known as the Aspen Tunnel. The Leroy-to-Bear River cut-off location crosses the Aspen ridge, one of the foothills of the Wasatch ridge, which it was necessary to tunnel. By making open cuttings at each side of the ridge, the actual length of the tunnel was brought down to 5,900 feet. The approach to the eastern end of the tunnel is through a heavy cut 2,200 feet in length, and at the western approach is another cut 2,600 feet long. The work commenced late in 1899 by the sinking of a shaft about 3,000 feet from the eastern end, which was carried down to a depth of 331 feet, where it reached the level of the tunnel floor. Headings were then pushed out in each direction to meet the headings driven from the ends of the tunnel. Shortly after a start had been made with the headings from the central shaft, there was a heavy inflow of water which rose to a height of 70 feet above the bottom of the shaft. After being flooded for eight or nine months, the shaft was pumped clear of water and the driving of the headings resumed. The material from the eastern approach cut totaled 260,000 cubic yards, while 185,000 yards were taken out of the western approach. The drilling in the tunnel was done by compressed air machinery, and one of our illustrations shows a steam shovel at work in the tunnel, operated, however, not by steam, but by compressed air. These shovels were used for loading material blasted out of the benches in the rear of the headings into dump carts. The dipper has a capacity of three-fourths of a cubic yard and the height of the boom is 16 feet.

West End Shovel Taking up Muck from Bench.

The greater part of the length of the tunnel was lined with timber, the walls consisting of vertical 12 x 12 posts, spaced from 20 to 6 inches or less in the clear, according to the nature of the material encountered. The roof was timbered with arched ribs built up of three pieces of 4 x 12-inch plank in segmental form, as shown in the accompanying illustration of the steam shovel. In some parts of the tunnel, where the material was particularly soft, the built-up ribs were placed solid, or touching one another. After the timber lining had been used for a distance of 600 feet from the western entrance, there began to be a sliding movement of the material both from above and from the side. Huge masses of rock moved at the rate of about 1 foot per week, and the pressure was so great that the heavy timbers and ribs were crushed and broken. For a distance of over 700 feet all the timbering had to be removed, and a lining of concrete and steel put in its place. This construction was made up of steel framework and concrete filling; the frames consisting of 12-inch I-beams, weighing 55 pounds per foot, spaced from 24 inches to 12 inches center to center. They were built in three sections, the top being bent to a circular curve and the side members to a curve of a longer radius. The three sections were spliced together and each formed a complete horseshoe. The space between the steel ribs and for a depth of 6 inches outside the ribs was filled in with concrete, lagging being placed at the back.

The accompanying photograph shows the steel ribs in place and the concrete filling built up to a height of 5 or 6 feet above the floor of the tunnel. Another of our illustrations shows the effect of the side and roof pressure of the sliding rock on the steel ribs. In this particular case the movement of the rock was too rapid to allow of the concrete to be set in place, and distortion of the steel ribs occurred. The upward pressure against the floor of the tunnel was resisted by laying a bed of concrete, 5½ feet in depth, which was stiffened by a layer of rails imbedded in the concrete with their axis crosswise to the axis of the tunnel. The cause of the heavy pressure and the movement of the rock is ascribed to different causes, one authority considering it to be caused by swelling of the soft shale rock due to oxidation on its being exposed to the atmosphere, and another authority considering that it is due to the direct pressure of the overlying material.

Heavy Steel I-Beams Yielding Under Pressure of Slacking Material.

CONSTRUCTION OF THE ASPEN TUNNEL.

The History of the Spur.

Not many horsemen are aware of the fact that the spur which they attach to their heels is an instrument the origin of which is lost in the most remote antiquity. The Romans were familiar with the use of the spur; they called it Calcar (cock's spur). No doubt this name was derived from the original shape of the spur, which was probably nothing more or less than a long point.

During the middle ages, the wearing of the spur was regarded as a sign of freedom. The vassal to whose heel it was fastened swore fidelity to his suzerain. The wearing of spurs soon spread to such an extent that even the clergy followed the fashion set by the knights. But this custom did not long endure; at a council of nobles and bishops held in 816, the clergy were forbidden to wear spurs. The spurs of knights were of gold, to distinguish them from the spurs of esquires, which were of silver.

At the beginning of the XI. century when a man, for some noble deed, was dubbed a knight, the ceremony of knighting him began by giving him a pair of spurs. The over-lord in conferring the title attached the spurs himself to the heels of the newly created noble and then gave him his helmet, his horse, his sword and his lance.

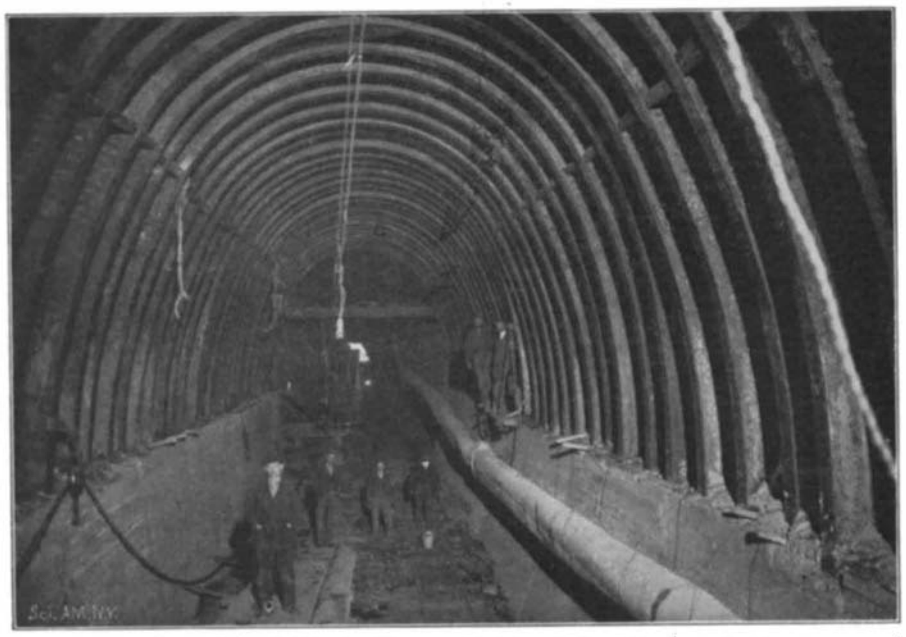
The oldest known form of the spur is that of a long pin or needle. This early specimen was found at Autun, in the tomb of Queen Brunehaut, murdered by her rival Fredegonde in 613.

In the 13th century spurs received the form of rosettes or stars. The wheel-form did not appear until the 15th century. Most of the young noblemen of that day wore spurs of most curious pattern, comprising primarily a rod half a foot long, at the end of which an enormous star-wheel was carried. In the middle ages, when a cavalier almost stood in his stirrups and horses were caparisoned, very long spur-shanks were necessary in order to reach the flanks of the mount. A specimen of this type of spur has been preserved, and its ownership ascribed to Godefroy de Bouillon, who died in 1110.

In the 18th century, when the knight of old had practically disappeared, M. François Robicon de la Guermière, Equerry to His Majesty Louis XIV., was the first to cut down the length of the shank and give the spur its modern form (1768).

Balloon Outfit of the Sultan of Morocco.

The Sultan of Morocco, Muley Abdel Azis, is having a captive balloon and its accessories constructed by Schneider and Company, of Creusot. The outfit includes all the material necessary for furnishing the new aerostatic park which the Sultan has in project, and M. Edouard Surcouf, the well-known Paris aeronaut, is to superintend its installation. The outfit is of the first quality, and has a number of improvements. The balloon is made of a specially prepared silk tissue and is claimed to be absolutely tight. It has a volume of 1,000 cubic yards and is kept swelled out by a small air balloon in the interior gaging 90 cubic yards.



Arched Steel Ribs in Place, with First Lift of Concrete Laid.

When filled with hydrogen the balloon will lift three persons to the extremity of its cable, which is about 2,000 feet long. The car, built on the Hervé system, is a model of elegance and comfort; it has a telephone post which communicates with the ground. The steam windlass has been well designed and the cable is unrolled in a uniform manner. It is operated by two controlling levers. A ventilating fan is used to keep the interior air-bag filled out. The retaining cable is attached to the car by a pulley mounted upon a flexible joint to give it the proper direction. A hydrogen generator has not been provided, as the balloon will be filled from tubes of compressed gas. It is estimated that it will take 120 tubes of a capacity of 25 gallons, charged at 1,900 pounds per square inch. The hydrogen is produced by electrolysis at the Montbard works and is thus chemically pure. Every time the balloon is filled the tubes will have to be returned to France, where they will be re-charged and sent back to Morocco. This process is quite expensive, but no doubt the Sultan can afford it.

In response to Sir Harry Johnston's appeal for the protection of the okapi, to prevent its extermination by big game hunters, the British government has placed this animal on the list of wholly protected animals in the Game Regulations of the Uganda Protectorate. By this decree, any person shooting or trapping the okapi in British territory, except by the written permission of the commissioner of the Uganda Protectorate, commits an illegal act. It is hoped that the Belgian authorities will co-operate with the British authorities in preserving this newly discovered and rare animal by passing a similar law in connection with the Congo forests.