

### Three Concrete Bridges.

Without entering upon the relative merits of different structural materials we refer here to three railway bridges with spans of 187 feet, 211 feet, and 211 feet, respectively which have lately been erected in plain concrete on the three-hinged principle. All of the structures were designed by Mr. Beutel, chief engineer to the Bavarian State railways. One of them at Lautrach crosses the river Iller with a main arch span of 187 feet and two smaller arches at the abutments. As the rise of the main arch is only about one sixth of the span, the three-hinged system is particularly advantageous. The arch rib in this instance carries across walls connected by small arches surmounted by the road upon which the permanent way is laid. The other two bridges cross the river Iller close to Kempten station, where there is a network of several branch lines. One of these bridges carries four railway tracks, and the other only two, but their structural features are practically identical, the main arch of each bridge having a clear span of 211 feet, with a rise of about four-ninths of the span. We are glad to say that all three bridges were finished without the casting of stone or other veneer which some engineers seem to imagine is necessary for decorative effect. It is stated that the cost of the Lautrach Bridge was 17% less, and the cost of the two Kempten bridges was nearly twenty per cent less than the estimated cost of steel bridges. The ultimate saving should be considerably more owing to the fact that practically no maintenance is necessary in the case of concrete structures.

### Lubricate the Outer Rail on Curves.

As everyone is interested in the safety of railroad travel, it behoves the public in general to give this matter all the thought possible. The friction of the wheels on outer rails of curves is well known. During rain there is little trouble; in dry weather the wheels "climb." They now have pipes so arranged that they would throw a jet of water or cheap oil against the side of the outer rail when the locomotive struck the curve thereby lubricating same and reducing the tendency the wheels have to climb. It would be a very simple matter to arrange the feed valves for the control of lubricant so that they would open only when the engine struck the curve, closing again when straight track was reached. By a system of this kind and a practice of bolting the two rails together in curves so that they could not spread, the public would hear less of wrecks in such places. The above suggestions of a correspondent are sound. The practice of directing a fine stream of water against the outer rail was tried in Western America some years ago with good results.

### The Panama Canal.

It will be remembered that the estimated area of the great storage lake, which is to be formed by the construction of the Gatun dam, was 110 square miles. This calculation was based upon the preliminary reconnaissances of the area to be flooded, and was understood to be only approximate. The detailed surveys of the Isthmus, which have now been completed, show that the area of the lake will be more than double the original estimate, or 225 square miles. The larger lake represents some very material advantages in favour of the 85-foot high level canal as now being constructed, advantages which will be felt both in the wet and the dry season. In the first place, the lake will have sufficient capacity to receive and retain all the flood waters, even those of such heavy floods as occurred in December of last year; and secondly, it will be possible to handle this water with considerably less fluctuation in the canal level. It is estimated that the increased lake area will double the amount of water that will be impounded in the lake at the commencement of the dry season. The statistics of past years show that, even in years of extremely small rainfall, the run-off from the area draining into the lake amounts, during the rainy season, to 7200 cubic feet per second; and this will be sufficient to raise the level of the lake the 4 feet which it will be lowered during the dry season. It is true that because of the increased area of the lake, the evaporation will be double what it would have been from a lake of only 110 square miles area, but since the total supply impounded will also be doubled it is estimated that, after deducting the loss by evaporation, there will be sufficient water available for fifty-six lockages a day, instead of twenty-six, which was the number estimated as available with the smaller lake.

### Strange, if True.

#### A CURIOUS ACCIDENTAL WELDING OF STEEL SHAFTING.

Mr. P. N. Bockaroff, M.E., of Mockba, Russia, tells in a valued publication, an interesting story of a very curious accident which occurred recently in a large cotton mill near Moscow. From a steam engine of nearly 1500 horse power, 350 horse power is transmitted by ropes to one of the stories of the mill. The driven shaft makes 320 revolutions per minute.

The main shafting in the rope drive is arranged so that the power from the flywheel is transmitted by ten ropes to the rope pulley on the first shaft, then by a pair of bevel wheels to the second shaft, and then by a Wullfel's friction clutch to the third shaft, and from the rope pulley on this shaft to the rope pulley on the line shaft in the mill.

By some mistake of the fitter, the second shaft was put too close to the third shaft, so that it touched the latter, and all the pressure from the bevel wheel was transmitted directly to the end of the third shaft.

One morning the first bearing on the third shaft became warm. The engineer, wishing to cool it, loosened the clutch and thus stopped the third shaft. Thus all the pressure from the rotating second shaft became applied to the end of the third shaft. Both shafts have the same diameter, 170 millimeters (6 3/4 inches).

As the pressure from the bevel wheel on the shaft was considerable, and the shaft was making 320 revolutions, in a few moments the touching ends of the two shafts between the two halves of the clutch were heated, not only to a red heat, but to the welding point as well, so that the liquid iron spurted to the walls. The engineer became very much frightened, and signalled to stop the engine, and thus both shafts became completely welded together.

After the shafts were cooled, the engine was started again, but both shafts revolved together, notwithstanding that the friction clutch was open. The bearings did not become heated, thanks to the fact that both shafts were welded in exact alignment. So the mill was run till night, and all the usual machinery working from this shaft and taking 350 horse-power.

Next day the shafts were lifted by their free ends, together with the bevel wheel, the clutch and the pulley, and though they weighed some tons, the welded joint did not separate. So it was decided to leave them in the welded state till the new shafting is ready.

Since that time, for more than a month, the shaft has been working satisfactorily with opened clutch, transmitting all the power without difficulty.

### Factors of Safety in Mechanics in Animal Structure and in Animal Economy.

Dr. S. J. Meltzer recently addressed a lecture on the above subject to the Harvey Society of New York.

Meltzer borrows the term "factor of safety" from the mechanical engineer who thus designates the margin of safety required in constructing engines, bridges, houses, and the like. If for instance, the tensile strength of boiler steel plates and stay bolts is 60,000 pounds to the square inch, the actual stress which is allowed for the work of the boiler should not be more than 10,000 pounds per square inch for the plate and not more than 6000 pounds per square inch for the stay bolts—which means that the stress to which the plates may be exposed in the boiler should be only one-sixth or one-tenth of the actual strength of the steel. The factors of safety are here said to be six for the plate and ten for the bolts. In mechanics, then, it is calculated that the structures should be capable of withstanding not only the stresses of reasonably expected maximum loads, but also those of six or seven times such loads. The factor of safety is founded upon finite human ignorance of what might happen, and upon a wise and very praiseworthy desire to provide against such contingencies. Wherefore these factors are oftentimes termed factors of ignorance. And, with regard to the human machine, the latter term would seem rather the preferable one. For this machine is, by comparison with those constructed out of inorganic materials and worked by men, of complexity quite infinite. It is, of course, much more difficult to foretell the possible strain, the stress of environment, accidents, the attacks of parasitic organisms, and the myriad other agencies hurtful to the human machine, many of which we are powerless to prevent, concerning many of which we are in ignorance—ignorance, we are however proud to say, which is yearly becoming more and more dissipated.

### Building Railway Coaches with Side Doors.

President Harriman, of the Southern Pacific, a short time ago gave orders to have a number of new fine passenger coaches built at the company's car shops at Sacramento with side doors instead of end doors.

Harriman believes that cars thus constructed will be much stronger and more durable than the style now used, and also that in case of wreck, there will be little danger of the coaches telescoping each other. These new cars will have a small passageway by which passengers may go from one coach to another, but this will be so arranged that it will not weaken the end walls of the cars.

Another feature of these coaches is the use of round instead of square windows. New patent ventilators now being used by the Union Pacific on its motor cars will be placed on the new coaches, and the cars will present an appearance so little in common with the ordinary coach that they will at first hardly be recognised as passenger vehicles. Some of these cars will soon be completed and placed in commission on the Southern Pacific western roads.

### The Railroads of the World.

The statistics of the railroads of the world, published in the June number of the Archiv fur Eisenbahnwesen gives the mileage of the several continents as follows—

	Miles.		Miles.
Europe	192,251	North America	252,098
Asia	50,593	South America	32,859
Africa	16,538	Australasia	17,441
	259,392		303,398

making a grand total of 562,780 miles in the whole world at the end of 1905, or the nearest date for which reports are made. This is an increase of 12,525 miles or 2.3 per cent. over the previous year, and is the smallest increase since 1900, it having varied since 1898 from 10,800 miles in 1900 to 16,754 in 1904 while the total additions to the world's mileage since 1898 have been 95,816 miles, an average of 13,688 miles yearly.

Of the increase in 1905 a little more than one-half was in America, 5,891 miles in North America and 426 in South America (including the West Indies). Canada is credited with 990 miles, against 533 in the year before but in Mexico the additions were but 150 miles in 1905, against 1,720 in 1904. In South America, Argentina opened 337 miles, Peru 39, Brazil 36 and the other additions were 12 miles in the West Indies.

The experiment of growing tobacco under cover is being tried in Porto Rico. The cost of production—about £100 per acre—is more than repaid in the increased yield and finer quality of leaf.

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In a laboratory of the Pasteur Institute two months ago a well-known surgeon broke a glass tube containing virulent tuberculosis bacilli, and a fragment of the glass cut his neck. He immediately began a treatment, but the disease, which in a few days had seized him, has not yet been got under, and it is a question whether he will overcome it.

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