MILITARY ASPECTS OF THE TRANS-SIBERIAN RAILWAY.

Although the Trans-Siberian Railroad is just now the most valuable asset of the Russian government in prosecuting its war with Japan, this vast system was not originally planned for military purposes—not, at least, if we are to believe the original proclamation or "rescript" of the Emperor Alexander in which the construction of the road was authorized. It is given herewith, and the reader may judge for himself. This rescript is dated the 14th of May, 1891, and was received by the Grand Duke Czarevitch on his landing in that year from an important tour of inspection of the Far Eastern countries. "Having given the order to build a continuous line of railway across Siberia, which is to unite the rich Siberian provinces with the railway system of the interior, I intrust to you to declare my will upon your entering the Russian dominions, after your inspection of the foreign countries of the Far East. At the same time I wish you to lay the first stone at Vladivostock for the construction of the Ussuri line forming part of the Siberian Railway. . . Your participation in the achievement of this work will be a testimony of my ardent desire to facilitate communications between Siberia and the other countries of the empire, and to manifest my extreme anxiety to secure the peaceful prosperity of this country."—Alexander.

Thus was inaugurated a railroad which, in point of continuous distance covered, is altogether without a parallel even among the large railroads of the United States. It had been under advisement and more or less an object of solicitude on the part of the Russian government for a third of a century past. Actual construction was commenced on the 19th of May, 1891, when the Grand Duke Czarevitch filled a barrow with soil and emptied it on the railroad embankment.

The longest continuous line on the North American continent is the Canadian Pacific Railway, whose main line from Montreal to Victoria has a total length of 2,990 miles. The line of the Siberian Railway from Cheliabinsk to Vladivostock measures 4,776 miles. The branch from Harbin to Port Arthur measures 1,273 miles, so that the main line system, independently of its feeders, covers over 6,000 miles of track. From Vladivostock to St. Petersburg is about 6,700 miles, and from Port Arthur to the various harbors of the North Sea is about 6,900 miles by the nearest route.

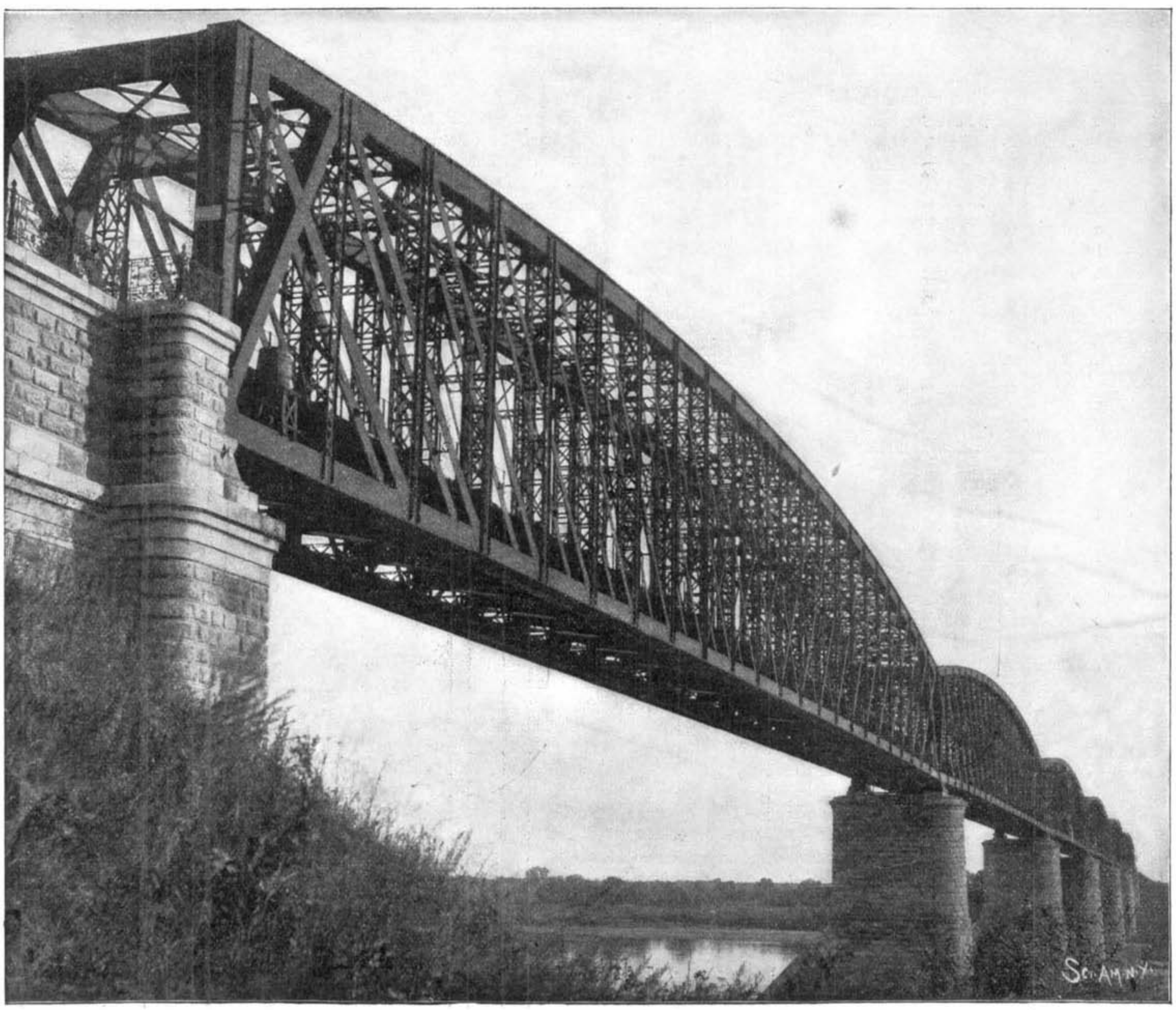
The road may be divided into six sections. The first or western section extends from Cheliabinsk, which is on the European frontier, to Pochitanka, a distance of 1,080 miles. It runs for about 900 miles over a highland plateau that is practically level. For over 600 miles it traverses an excellent agricultural country, while 300 miles west of Tomsk the line is laid through a good stock-raising district. The central division extends from Tomsk to Irkutsk, through upland country, whose climate and soil are both unsuitable for agricultural settlements. The third section includes Lake Baikal, and in this section the road reaches its utmost elevation, from which it drops to the Pacific slope, running through country rich in minerals, from which some $15,000,000 worth of gold is annually exported. The fourth section is that of the Amur, which extends toward the Pacific for a distance of 1,600 miles. This is the district which gives the greatest promise of future agricultural development. It is richly timbered and contains large sections of alluvial land and is favored with a more temperate climate. Then follows the Ussuri section, which extends to Vladivostock, on the Pacific, running through a hilly country suitable for agriculture and stock-raising, and containing an excellent bituminous coal. The branch through Manchuria from Harbin to Port Arthur is laid through a thickly-settled farming country. Although much of the country traveled by the Siberian road is inhospitable and barren, a competent authority has estimated that the valuable territory tributary to this great system that will be suitable for agriculture, is equal to the combined area of Germany, Austria, Belgium, the Netherlands, and Denmark, an area that, when once populated, will be fully capable of sustaining the railway out of local traffic alone. The only stretch of country which must be regarded, from the standpoint of railroad operation, as altogether unpromising is the 1,500 miles extending from Tomsk to the head waters of the Amur.

It is as a military road, however, that the great Siberian enterprise is just now vested with its chief interest. There is a popular belief, which seems to have grown by the relating thereof, that the road has been hastily and wretchedly built, and that under the severe strain of the war, it will be subject to continual breakdown, and probably fail to perform the military duties for which it was supposed to have been built. This impression we do not at all share, and the accompanying illustrations, most of which were furnished by Mr. Lodian, of this city, formerly for several years a resident of Siberia, show at a glance to any railroad man that in many respects the road is built in accordance with modern ideas and with structures that are well up to the very latest railroad practice. In the first place, the construction of the Siberian Railroad has been under the care of Prince Khilkoff, who was for several years a resident of the United States, and acquired a thoroughly practical knowledge of the construction and operation of American railroads. Consequently, it is fair to assume that the Siberian road has been built on carefully-considered and well-ordered plans, and that if there has been economy it has been of a judicious kind and exercised under the restraining hand of Prince Khilkoff, who is thoroughly familiar with roads of the same type in the United States, that have been built under the same restrictions of economy as this Siberian enterprise.

As a matter of fact, the road corresponds very closely to a pioneer American transcontinental system. It is single-track, and built for the comparatively light loads and engines which characterize a new railroad through an undeveloped country. In some respects it is considerably better built than were our own early Western railroads, as witness the invariable use of stone piers and abutments, masonry culverts, and steel superstructures.

The weakest point in the construction of the line is, or rather was, the very light rail that was used. The first 600 miles from Cheliabinsk was laid with rail that weighed but 54 pounds to the yard. This was found to be too light for the trains, and a heavier section, more suited to modern rolling stock, was adopted and has been laid over a majority of the road. The gage is the standard 5-foot gage of all Russian roads. The road is hampered by want of sufficient sidings at the stations. On the stretch of road from the European frontier to Lake Baikal, the track is laid over country that permits of long tangents. Thus for a continuous stretch of 880 miles in the western section, from Cheliabinsk to Pochitanka, the road is so straight that its total distance exceeds an air line by merely 2½ per cent, and in this division there are three stretches of absolutely straight line, one of which is 50, another 62, and another 86 miles in length.

The most troublesome portion of the line is the section that includes Lake Baikal, which lies in an exceedingly mountainous and rough country. For the present, freight and passengers are disembarked at the western end of Lake Baikal and ferried across to the terminus of the railroad at the eastern end. When the location of the line was made, it was found that the work of constructing the road around the lake would be of such magnitude and would consume so much time that it would be impossible to await its completion. In about eighteen months' or two years' time from now it is expected that this circum-Baikal route, as it is called, will be finished. The country is extremely difficult, and we are assured by one who has been over the route and is very familiar with it, that it is even more difficult of construction than the heaviest stretches of work on our own Colorado Midland road. This location is laid through a country which is so mountainous and precipitous that it is called by the Russians themselves the Switzerland of Siberia.

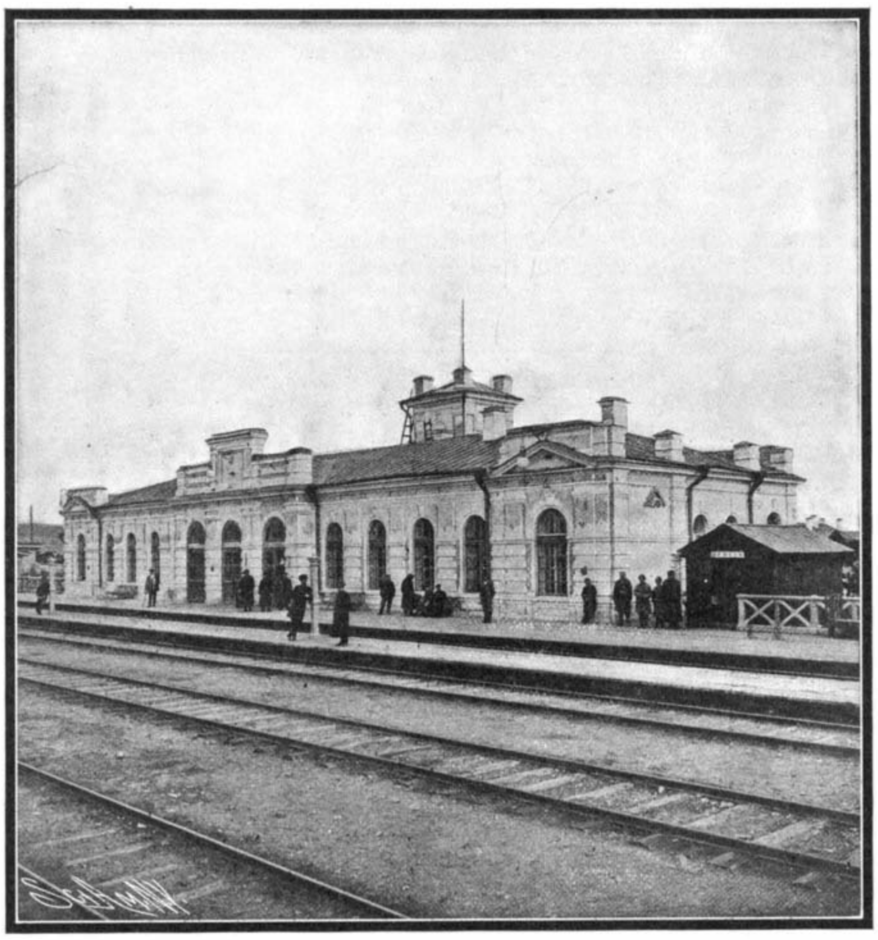


THE TRANS-SIBERIAN RAILWAY—STEEL BRIDGE AT OUFA, OVER THE BIELAIA RIVER.

The impression that the Siberian road is poorly built and is liable to break down under the stress of military service is based upon the early condition of the line, before the heavier steel was laid and time had been given for ballasting and bringing up to standard such portions of the lines as were hastily laid in the endeavor to get the line pushed through to completion. We understand that an enormous amount of filling in and ballasting has been accomplished during the past year, and to-day the road is equal to taking care of trains and locomotives of the kind that have been supplied to the line. One advantage which this line has over some of our pioneer Western roads, is that the Russians have made very free use of embankments, preferring these to the more-hastily-built and less permanent pile trestles, which form such a conspicuous feature of our own Western roads. The earth or rock embankment, once made, requires very little subsequent care, and consequently the great amount of time spent in maintaining ordinary trestle construction will be saved on the trans-Siberian road. The same is true of the culverts and piers which, as we have said, are practically all of good masonry.

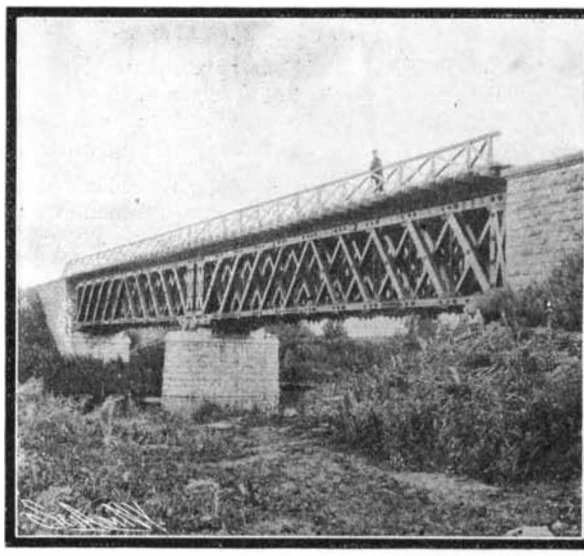
We think, however, that it would have been a wiser policy if the engineers had adopted a better class of track tie. As will be seen from our engraving, many of the ties consist merely of soft-wood trees cut to length and split in two. These are laid with the flat face down and a notch is adzed in each to receive the rails. The weak features of this type of tie are that it presents but small bearing surface for the base of the rail, which quickly cuts down into the tie, and also it is liable to rot out quicker than the square tie that is hewed on opposite faces. In one of our illustrations, showing the laying of the track, the latter form of tie is used, in another the half-round split tie, and the difference in stability and in bearing surface will be readily appreciated by comparing these two pictures.

Probably it will be found, as the war proceeds, that one of the elements of weakness in the line, for operation purposes, is that the sidings are not of sufficient length. These, however, can readily be lengthened so as to accommodate several trains at a time, and with ample provision of this kind, the road should be able to land at the seat of war a minimum of 800 troops a day with their supplies of food, ammunition, etc., and it might be able by excellent management and good luck in the matter of breakdowns to place as many as 1,200 troops a day at the front. We are informed by an eyewitness, who has just arrived from Lake Baikal, that 1,000 troops a day were being transported during the latter part of February, and it is likely that the lengthening of the sidings that is now going on, coupled with the experience that is being gained, will enable Russia to place troops at the front during the summer months at the rate of from 30,000 to 40,000 a month.

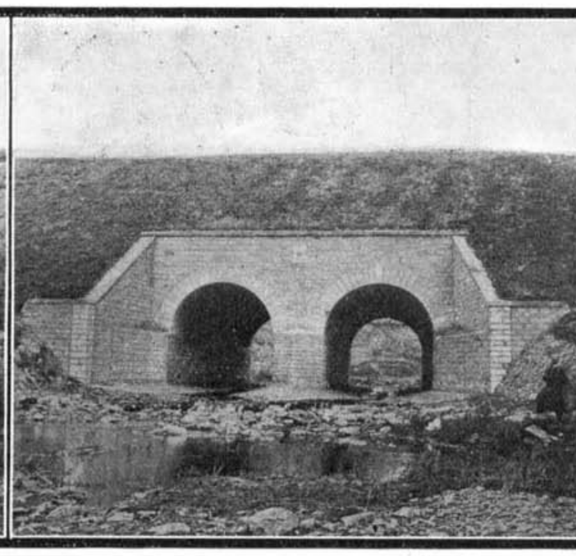


The Depot at Kraknoiarck, Central Siberia—A Most Important Mobilizing and Forwarding Station at the Present Juncture. Showing Substantial Character of the Buildings.

An instance of where brute strength triumphs with the modern wire-drawer as a wage-earning factor, as compared with the skill of the old-time wire-drawer, who had to make his own dies as well as draw his wire, is shown in the case of the champion of the Worcester works of the American Steel and Wire Company, who, according to the Iron Age, draws 10,000 pounds of three-draft wire a day. This man is a Finlander of enormous strength and endurance. To draw 10,000 pounds of wire means a lift of 40,000 pounds a day, 200 pounds at a time. The wire is drawn from No. 5 to No. 12½. He must lift the rod on the reel, then lift the coil off the block on the reel, for the second draft; repeat this operation, and finally lift the coil off the block on a barrow.

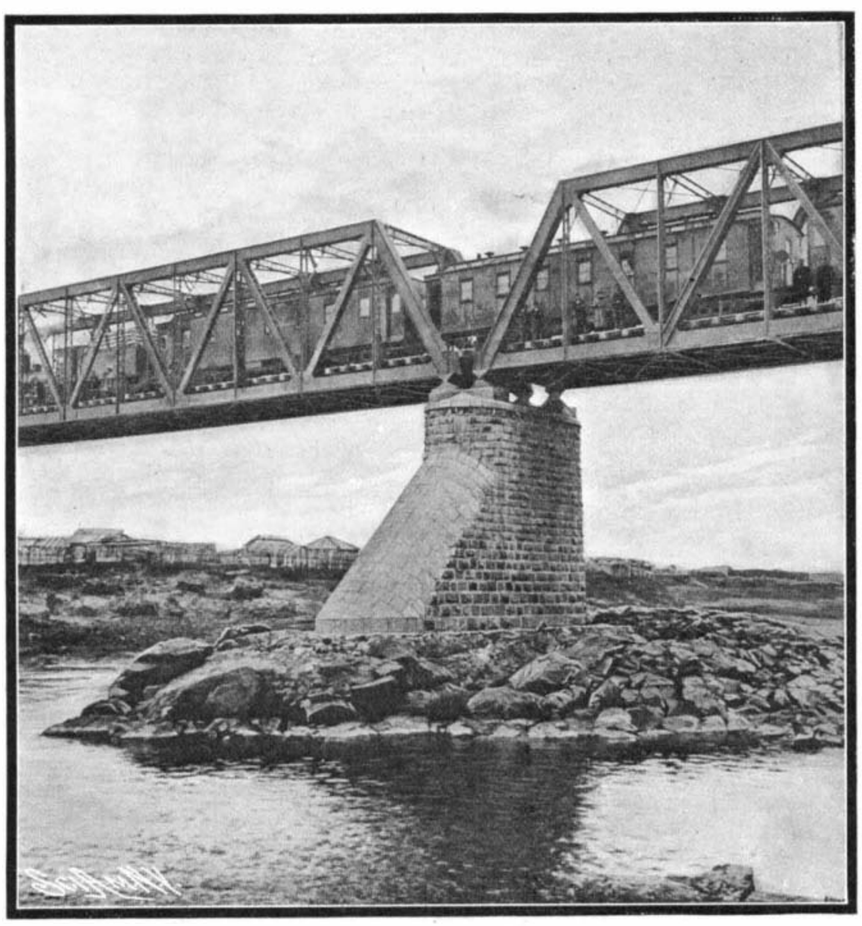


Howe Truss Bridge on the Central Siberian Section.



Type of Masonry Culvert.

Grooving the Ties for Rails.



Bridge Over the Jaia River, Central Siberia. Showing Excellent Character of Masonry Pier and Steel Superstructure.

Track Laying on the Trans-Siberian Railroad; Note the Cheap, Half-Round Ties.

THE TRANS-SIBERIAN RAILWAY.

Purification of Potable Water by Means of Ozone.

The purification of potable water by means of ozone formed the subject of an interesting lecture delivered by Dr. G. Erlwein, of Berlin, at the forty-third annual meeting of the German association of specialists in gas and water technology at Zurich, the essential points of which are given below.

The lecturer first discussed the practicability of the use of ozone in the purification of various kinds of water (surface and underground water) in municipal or central water-works, and the advantage of this method over the various proposed methods of purifying water by chemical means. He then gave a description, illustrated by diagrams and models, of Siemens' ozone works at Paderborn and Wiesbaden, which have been described by him in the Scientific American. The lecturer then pointed to what had been accomplished by the method as regards the destruction of bacteria, and showed results obtained by the Imperial Health Bureau (Ohlmuller) and by Koch's institute for infectious diseases (Proskauer-Schuder), also by Siemens & Halske in experimenting on ordinary and pathogenic bacteria in their experimental works at Martinikenfelde, and in the water-works at Wiesbaden. Special attention was directed to the main result arrived at, viz., that ozone practically reduces the ordinary water-bacteria to a minimum, and may be absolutely relied upon to destroy pathogenic bacteria of every nature, even in the most contaminated water.

Dr. Erlwein then tried to give his audience an idea of the expense attending the working of the system, and submitted a statement showing in detail the cost of treating one cubic meter of water in establishments of different working capacity and working under different conditions. Figures were given showing the comparative cost of working in establishments (*a*) of different working capacity (2,000 and 200 cubic meters per hour respectively), (*b*) working different hours (12 and 18 hours daily), and (*c*) with different kinds of motive power (gas and steam).

Before concluding his lecture, Dr. Erlwein described the systems of sterilization in vogue in other countries, using drawings, illustrating the principles of construction of the sterilization tower and of the ozone apparatus. The following systems were mentioned:

1. Siemens & Halske's older type of 1890 had an iron tower about 3 meters high, filled with water, through which ozone air is forced.

1a. Scrubber's tower was 4 meters high, filled with pebbles.

2. Tindal's tower was 8 to 10 meters high, with a series of rainfalls through which ozone air is passed. Another type of Tindal's tower consists of three to four wide earthenware pipes joined together in a row for the passage of water, into which ozone air is forced.

3. Abraham-Marmier's scrubber, about 4 meters high, the interior construction and contents of which are not known.

4. Otto's tower, in the upper division of which the ozone is mixed with water by means of an injector. The lower division is fitted with a scrubber, with a view to utilizing the unconsumed ozone.

5. Vosmaer's tower; an iron cylinder with a water column, through which a counter-current of ozone-air is forced.

Other systems mentioned were:

1a. Siemens & Halske's latest type, as used at Paderborn and Wiesbaden, with a discharge surface consisting of eight cylindrical pipes; outer positive electrode cooled by water; it carries a current of about 8,000 volts, one pole being grounded.

2a. Tindal's ozone apparatus with discharge surface of metal resistant to ozone. A Schneller glycerine-alcohol resistance is inserted into the high-tension circuit to produce a sparkless short-circuit-proof ozone discharge without insulation. The discharging surfaces of one electrode are the inner walls of a cooled double-walled metal box resting on the ground, the corresponding surfaces of the other being formed by insulated metal plates placed in the box. Current: 40,000 to 50,000 volts.

3a. Abraham-Marmier's box, with a series of glass plates, one square meter in size, as discharging surfaces. Both electrodes are cooled by water, and the cold water current is provided with two rainfall interrupters for the insulation of the high-tension pole. Current: 40,000 volts. A spark gap is inserted into the high-tension circuit for generating currents of high frequency.

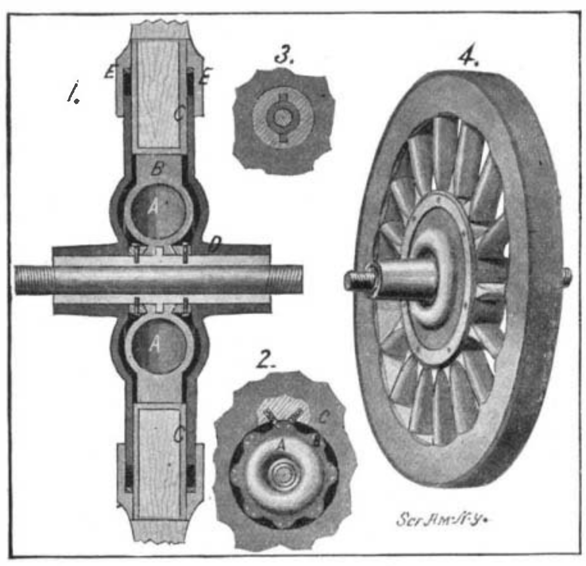
4a. Otto's apparatus. One pole is formed by the iron cylinder, resting on the ground, and the other by a concentric rotating metal axis with vertical aluminium disks. Current: About 12,000 to 20,000 volts. The discharges take place between the inner surface of the iron cylinder and the edges of the rotating aluminium disks without fixed insulation.

Vosmaer's ozone apparatus, with a grounded pole, has not been drawn, as the details of its construction are not known. It is said to consist of a system of combined iron tubes, between which the discharges take place without a fixed insulator. Current: 10,000 volts.

In conclusion, the lecturer discussed the prospects of the use of ozone in municipal or central water-works, and pointed out that the practical application of the treatment would be limited to the purification of surface water, the purification of underground water being only necessary in certain special cases, and appealed to water technicians to co-operate in insuring the success of the new process by developing its technical side as thoroughly as hygienists had developed the scientific idea. In the Scientific American Supplement Dr. Erlwein's lecture will be published in full with drawings.

RESILIENT WHEEL FOR VEHICLES.

It has occurred to Mr. Brenton B. Weaver, of Glace Bay, Cape Breton, Nova Scotia, that by placing a resilient tire in the hub of an automobile wheel instead of on the tread where it is subjected to constant wear, the difficulties which now attend the use of pneumatic tires on automobiles would be entirely avoided. The construction of this wheel is shown in the accompanying illustration, in which Fig. 1 shows a section through the center of the wheel hub. The resilient member is indicated at *A*, and consists of a hollow tube of rubber provided along its periphery with a series of ears *B*, as best shown in Fig. 2. The tube lies in a recess formed in the hub casing and is separated from the axle by a bushing. Two metal rings are bolted to this bushing and they are formed with inclined walls to fit over a bead formed on the inner surface of the tube, thus holding the tube firmly in place. The bushing is also provided with two lugs which fit into sockets formed in the tube, thus preventing the latter from creeping. The hub, it will be observed, is formed of two flanges or circular plates, between which the ring *C* is held. Two flanges *E* are



RESILIENT WHEEL FOR VEHICLES.

secured to the ring and these fit over the flanges of the hub *D*. The ring rests along its inner edge on the ears *B* of the rubber tube which is held from moving circumferentially thereon by coil springs. The ring *C* is formed at intervals with sockets to receive the spokes of the wheel. When the wheel is in use any jolting caused by unevenness in the road will be taken up by the cushion tube *A*, the ring *C* being permitted to move between the confining flanges of the hub. As an extra precaution a rubber ring is placed in the bottom of the trough formed between the flange *E* and ring *C*, so as to prevent undue jarring of the parts should the edge or flange *D* be brought into contact therewith.

The Current Supplement.

Mr. Emile Guarini opens the current Supplement, No. 1476, with an interesting article on "Automobile Fire Engines." The excellent discussion of radium begun in the last Supplement is continued. The recently announced discovery of a new substance called by its discoverer, Prof. W. Marckwald, "Radio-Tellurium," has been made the subject of some interesting letters in Nature by Mr. Soddy and Prof. Marckwald. These letters on radio-tellurium are published in the Supplement. "Our Flood Warning Service" is the title of an article by Charles A. Byers. Mr. I. C. Russell writes instructively on the recent volcanoes of southwestern Idaho and southeastern Oregon. His paper is accompanied by striking illustrations. Mr. Herbert C. Fyfe writes on a "New Invention for Rendering Vessels Unsinkable." Mr. E. O. Hovey discusses the "Crystal Cave of South Dakota."

The Atchison, Topeka & Santa Fe Railroad has purchased the Cane Belt Railroad, running from Sealy, Texas, to Matagorda, 90 miles. The building of a line to be called the Eastern Railway of Mexico, which will be about 500 miles long, and cost $13,000,000 to $14,000,000, is contemplated; also a line north from San Francisco.

Engineering Notes.

The Midland Railway Company is introducing a number of steel wagons of a novel pattern, which have been designed for either coal or ordinary merchandise traffic. Some of these trucks have been erected at the Derby works, while others have been built by the Leeds Forge Company. The wagons are 17 feet 6 inches in length (inside), 4 feet 6 inches in depth (inside), 7 feet 9 inches in width (inside), 8 feet 4¼ inches high from the rails, with a carrying capacity of 15 tons. Considerable economies will, it is claimed, be effected by having wagons which can be used for either coal or goods traffic.

North of the Thames the railways of London serve an area of 433 square miles, with a population of more than 4¼ millions. On the south the area served is 259 square miles, with a population of over 2¼ millions. In the former case there is just over three-quarters of a mile of railway for every square mile, and in the latter case just over one mile, the number of passenger stations per unit area being approximately the same in both cases, but in the northern district nearly 13,000 inhabitants have to be served per station, in the latter case 1,200 less. The inward trains on the northern section per week-day are 2,582 and on the southern 2,115, altogether 4,697. An examination of these figures shows that the south side of the Thames is better served than the north.

A pneumatic sanding device has been devised by an American company for electric street cars fitted with air brakes. It is simple, and consists of two traps placed beneath the sand-box. From each trap a rubber hose connects with a 1-inch iron pipe. The air supply is taken from the main reservoir, from which it passes through the motorman's valve with the warning port of the traps. The sand is then lifted from the traps and blown between the tread of the wheel and the rail. The operating valve in the cab is fitted with a warning port, and is so constructed that when the sander is in operation the warning port keeps up a continuous whistle. Should, however, the motorman wish to stop the whistle and still desire to keep the sander in operation, he can do so by simply pressing on the valve placed in the end of the operating valve handle.

A note presented to the French Academy describes an "electro-mechanical" coupling which allows a continuous change of speed from zero to maximum speed, and which is specially suitable when the prime-mover is near the axle to be driven. It consists of a combination of the prime-mover with two dynamos, one running as generator, the other as motor, and both being of a much smaller capacity than the prime-mover, say 1-3 or ¼. The prime-mover transmits always a certain part of its power directly to the main axle to be driven, while the rest of its power is absorbed by the electrical machine which runs as generator. A train of epicyclic gearing is used in such a way that the main axle is acted upon simultaneously by both the prime-mover and the dynamo which runs as motor. These two machines are separate, and may consequently have different speeds. For instance, an epicyclic gearing may be composed of a central toothed wheel and an external wheel with inside teeth, with toothed wheels between the two. The axles of the latter are fixed on a support. The desired result is obtained by connecting each of the three parts (internal wheel, external wheel, and support of the middle wheels) with one of the three axles—that of the prime-mover, that of the electric motor, and the main shaft respectively.

There is no doubt that one of the most important matters awaiting attention in the present day is the improvement of the existing canal systems, which might be reorganized to the great benefit of trade and commerce. A complaint frequently made by manufacturers is that they are seriously handicapped in competition with foreign rivals by excessive railway rates. Agitation sometimes results in the granting of small reductions, but still no substantial relief is given, nor can it be expected. The liberation of the canals from the stifling control of the great railway companies would be the first step toward affording the necessary relief, but considerable alterations in the existing waterways would be necessary before they could be of much use. An excellent scheme for the reconstitution of the canals has recently been submitted to the members of the Liverpool Chamber of Commerce, and there really seem to be no engineering difficulties to prevent its realization. The proposal is to make the canals at least 6 feet deep, with an average width of 80 feet, and to provide them with locks 235 feet long by 32 feet wide, large enough for a tug and five barges to pass at one time. The scheme in question relates to the improvement of 240 miles of canals connecting the most important manufacturing and mercantile districts of Great Britain. The cost would be no doubt heavy, but the benefit to be reaped in the reduction of freight charges would probably be sufficient to justify the necessary expenditure.