

in the lower face of the valve-chest. The exhaust steam from the high-pressure cylinder is conducted in the ordinary way to the low-pressure cylinder, from which it is finally exhausted to the atmosphere.

The valves which control the admission of hot water to the motors are so constructed that water may be fed directly to both cylinders, when it is desired to exert an extra effort in starting the car, a by-pass arrangement being used which is somewhat similar to that adopted in compound locomotives of the usual type. The method of mounting the cylinders upon the trucks is clearly shown in the accompanying engravings. The Stephenson valve motion is used, and a common valve stem does duty for the piston slide valve of each cylinder.

The car may be operated from both the front and the rear platforms, the starting, stopping or reversing of the engines and putting on the brakes being performed by means of three superimposed hand-wheels, arranged just above the dashboard of the car. One of these wheels connects through a central shaft with a pair of miter wheels, one of which is keyed to the vertical shaft, and the other attached to the outer end of a length of flexible shafting. The other end of the flexible shaft is looped to a rod, on which is a worm that engages a segment of a worm wheel, which in its turn operates the reversing lever. A second hand wheel operates through a similar arrangement of miter wheels, flexible shafting, worm and worm wheel segment upon the throttle, the details of the throttle and worm wheel segment being shown in the accompanying sectional view of the cylinders. The third hand-wheel operates a brake and gear of usual pattern. Each truck is equipped with two compound engines which are coupled upon a common crankshaft, with the crank set at 90°. A pinion at the crankshaft engages a smaller pinion on the shaft of the driving wheel axle. It is estimated that with the three tanks charged with water at 700 pounds pressure, at a corresponding temperature of 500°, the car will be capable of running for forty miles at a speed of from thirty to forty miles an hour.

Telephone in Sweden.

Sweden is the country in which the use of the telephone is the most widely extended. The first long-distance line was established by the State in 1889, between Stockholm and Gothenburg, 300 miles distance. Since then the number of lines has been constantly increasing, and at the end of 1898 the longest distance covered was 2,000 miles, between Hoparando and Ystod. The progress is shown by the fact that in 1890 there were 7,680 miles of lines, 126 stations, and 4,950 instruments; in 1897 this had increased to 45,180 miles, 734 stations, and 32,890 instruments. The rapid development of the State telephone lines has not prevented the extension of the systems installed and maintained by private companies, as will be observed by the fact that in 1896 there were 25,200 miles of lines, 387 stations,

and 22,500 instruments. The subscription rates asked on the State lines rarely exceed \$14, but on some lines reach \$25; in other cases the rates are as low as \$2.80. The largest of the private companies is the General Telephone Company, of Stockholm, whose system in the city and suburbs covers a radius of 43 miles. The competition with the government lines

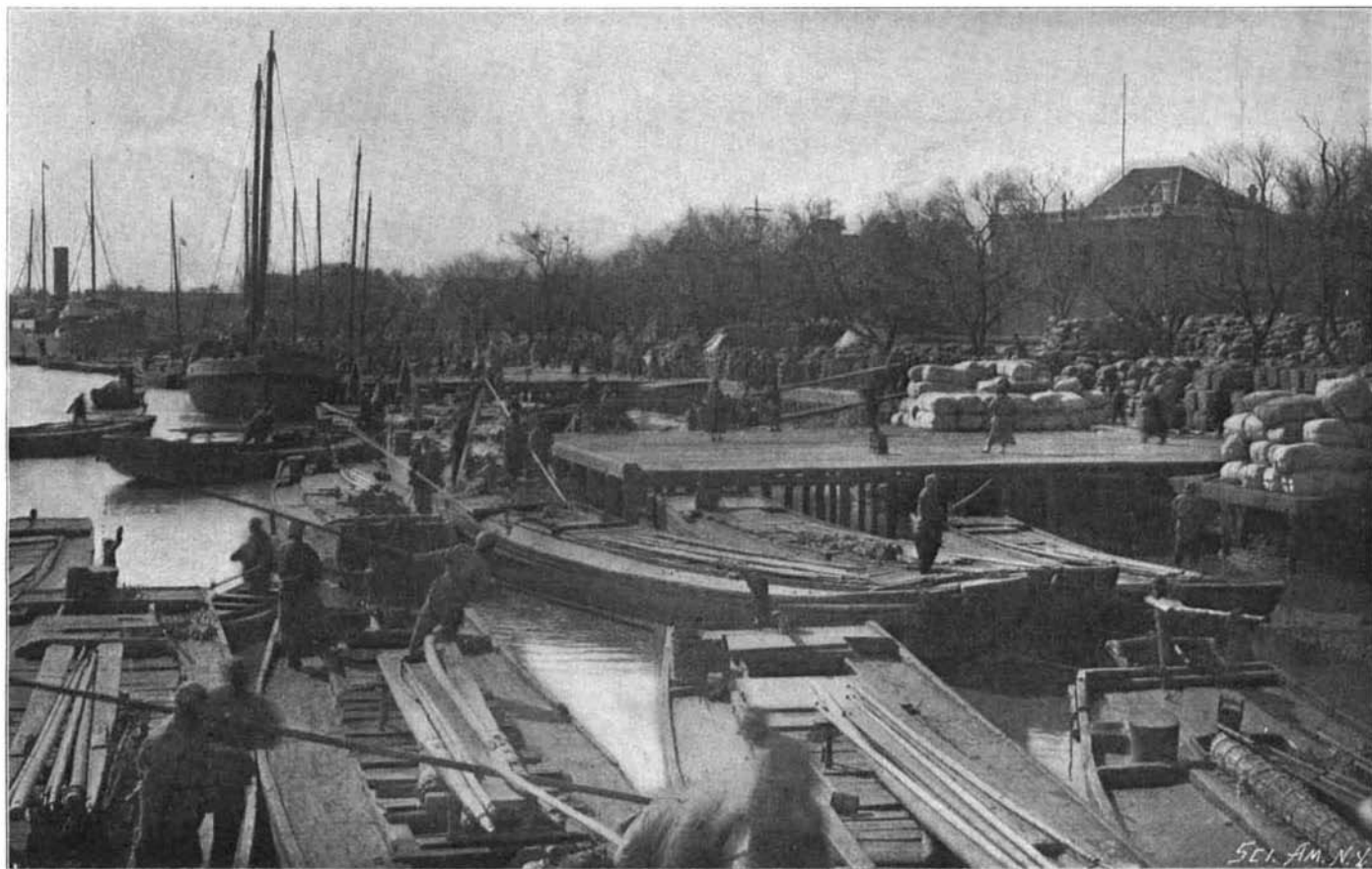


UNITED STATES LEGATION AT PEKING.

has brought about a reduction of rates, which accounts for the extensive use of the telephone in Stockholm, and the region has no less than 30,000 telephone posts.

A New Photographic Plate.

An invention has recently been patented in England for a photographic plate or film which has the developer, or the developer and fixer on the plate, so that it is only necessary to place it in water to obtain a developed, or a developed and fixed negative. The developer is applied to the plate in dry form and is then protected by an air-tight covering, the chemical not becoming active until the plate is put into a bath of water. The combined developing and fixing methods give the best results. The ingredients are mixed with a strong solution of sugar or dextrine. The solution may be applied to the back of the plate and then protected with paper or soluble gelatine, or it may be coated upon a paper backing sheath or envelop which protects the plate. The material can also be applied to the back of the film and can be cut up with



WHARVES AT TIEN-TSIN—BASE OF SUPPLIES OF AMERICAN ARMY.

the film for development. The process of development merely consists in placing the plate in water, which softens the covering and dissolves the developer. A similar process has been applied to printing papers by the inventors.

A Traveling Central Station.

According to the Technische Revue, there is in use on the French railroads a traveling central station consisting of a railway car bearing a dynamo and a petroleum motor, the latter serving for driving the former. One of the axles of the car is fitted with an electro-motor, which receives its current from the dynamo, so that the auto-car can go wherever there is work to be done. There the current generated by the dynamo is used either for running machines or for illumination. It suffices for feeding four to six arc lamps or thirty to forty incandescent lamps. This "electric power house" has been found especially valuable for working in railroad tunnels.

PROBLEMS OF THE CHINESE CAMPAIGN.

BY WALDON FAWCETT.

The military campaign in China will encounter graver engineering problems, particularly in connection with the maintenance of an adequate transport system, than have appeared in any similar operations in recent years.

In the first place, the water transportation of troops, animals, and supplies to the base of operations is a work considerably more arduous than was the corresponding task in either the Boer or the Spanish-American war. Russia, through the use of the new Trans-Siberian Railway, has perhaps the best means of access to the scene of conflict; but the United States, Great Britain, Germany, and all the other nations participating in the movement, find it necessary to transport nearly all of their troops and practically all supplies distances equal to from one-third to one-half the circumference of the earth.

In so far as this phase of the case is concerned, the experience of the quartermasters' departments of the American and British armies in the recent wars is of great value. Not only has a knowledge of the economical conduct of a transport system been acquired, but the troopships, fitted up to meet the emergencies of the past few years and remaining in service, formed the nucleus of a fleet which, under less favorable circumstances, would have required months for assemblage. It early became apparent that, owing to the length of the voyage to be made, it would be necessary to provide a good sized fleet of transports; and the various nations, therefore, lost no time in chartering practically all the vessels on the Pacific available for such purposes.

Perhaps a word should be said with reference to the transport service of the United States War Department upon the Western ocean, since it would appear to be nearly model in almost all respects. The fleet now in use for service between this country, China, and the Philippines consists of thirty-four vessels, aggregating nearly 135,000 tons burden. Of this number fourteen vessels of 60,500 aggregate tonnage are owned outright by the government and are regularly in its service, the remaining score of steamers, the tonnage of which is in excess of 75,000 tons, are chartered from private firms and individuals, and more than half of them

have been secured since the outbreak of trouble in China. For these craft the Transportation Bureau of the Quartermaster-General's Department pays about \$11,000 per month, or in the neighborhood of \$550 per day. All of the transports which are owned by the government and which, between original purchase price and the outlay for refitting, have cost \$10,000,000, are employed in carrying troops; but all save two of the chartered steamers are used either as freight ships or for the transportation of animals.

The Navy Department in its preparations has been confronted with almost as many difficulties as have the army officers. There is no satisfactory naval base within a reasonable distance from the scene of operations. Manila is more than two thousand miles from Taku; and in case of a naval war the ordinary Chinese ports would be closed. About the only solution possible is a joint use of the coaling-station at Chefoo, with the British, or of the naval base at Port Arthur, with the Russians.

In a land campaign, much of which may have to be carried on in the dead of winter, with the thermometer below the zero mark, fuel will naturally be a primary requisite, but it is planned to resort to the scheme which proved successful in the Spanish-American war when the nation suffered from the same lack of coaling stations which now threatens to embarrass it. A fleet of colliers was then pressed into service to carry coal. Fortunately, a number of these vessels are still in the possession of the War and Navy Departments. The fierce competition for tonnage on the Pacific for war uses has, however, had its effect and the government is paying \$9 per ton for the transportation of fuel to the Orient, whereas a few months ago the service was performed for \$7 per ton.

In anticipation of a further advance in the freight rates to a practically prohibitive point the government has fitted out the colliers which were purchased during the Spanish-American war, and which have since been out of commission. The same plan has been followed with water-ships, disinfecting barges and other adjuncts of warfare upon the sea. There are about twenty vessels in the collier fleet.

All the reports thus far received by the government emphasize the difficulties of unloading pack and cavalry animals and supplies at Taku. The necessity for a change of the base of operations from Nagasaki to Taku consumed no little time; and some confusion has doubtless been induced by the strenuous effort to land every ton of fuel and supplies possible, owing to the fact that the rivers and bays in north China freeze as early as November 1.

Although the authorities at Washington early decided to make use of the Pei-Ho River for conveying supplies to the successive camps of the American forces on their march to Peking and authorized Gen. Chaffee to purchase all the steam launches, drawing three feet of water or less, for the transportation of both troops and supplies, the value of this waterway as an avenue of communication is at best uncertain. Above Tien-Tsin it is navigable only for light draught vessels; and the windings are so numerous and the bends so sharp that hawsers must be resorted to continually in order to facilitate the progress of the larger craft. Water transport via this river was, however, employed by the Anglo-French force in 1860, and the allies found at Taku and Tien-Tsin a large number of specially constructed junks and light draught tugs which have proven well adapted for the purpose at hand.

The roads of China vary greatly in character, and the eight-six mile stretch between Tien-Tsin and Peking which constitutes the pathway of the allies is in some respects one of the best in the land. It follows the Pei-Ho River closely, and during the rainy season, which does not end until well into September, is nearly impassible in places, a circumstance which is by no means strange when it is remembered that the rainfall frequently exceeds ten inches per day. With the rainy season past, travelers on the road have the terrific dust storms to bear. Much of the country is open; the soil is sandy, and the heavy traffic over the thoroughfare grinds the light soil into a fine dust that fills nose and eyes and mouth, and at times almost prevents travel.

The whole tract of country between the seacoast and the Chinese capital is usually flooded during the autumn, and this year the usual inundations were greatly increased by the breaking of dikes on the Pei-Ho River by natives who sought to impede the progress of the invading army. This circumstance has entailed no little inconvenience upon the allied forces, since it not only obliterated many roads and destroyed bridges, but destroyed a considerable portion of the crops in the territory between Tien-Tsin and Peking, a tract which has been denominated one vast truck garden, and which, under ordinary conditions, would have afforded ample sustenance for an army of almost any size.

It was, unquestionably, the wretched Chinese roads which forced Admiral Seymour, the British commander, to abandon his effort to relieve Peking before the middle of the summer. His soldiers might have overcome the resistance which they encountered had

they not been compelled to put the road along which they were advancing in passable condition. The first sections of the roads, moreover, are much the best, being nearly level; whereas the highway, as it approaches Peking, winds among hills and is frequently cut between banks from ten to twenty feet high. Here careful scouting is necessary, owing to the excellent opportunities presented for ambushes.

According to the best informed military authorities who have visited the Chinese capital, the defenses of Peking have been greatly overestimated. The famous wall which surrounds the city is of great height and thickness; but it is composed mainly of earth dug from the adjacent moat, and this mass, although faced with brick and stone, would prove by no means impregnable to modern engines of war. The defenses of the sixteen gateways are inadequate, and at some places painted cannon have been utilized to give a semblance of strength.

The great danger to the health of the foreign troops is found in the radical changes in temperature. From the intense heat of the summer there is a quick transition to the dampness of the rainy season. This, too, is followed by a period of cold nights, and finally by the winter season of bitter cold days and nights. Had not precautions been taken the drinking water would have constituted a source of great danger to the health of the soldiery; but the United States government at the outset expended the sum of \$14,000 in the purchase of a distilling and sterilizing plant especially for use in China, which plant has a capacity of 32,000 gallons of pure water per day, so that the wants of the soldiers of this nation at least are well provided for.

The arrangements are the best possible under the circumstances. Owing to the fact that China has never signed the Geneva treaty guaranteeing the consideration of Red Cross nurses as non-combatants, it is unlikely that any female nurses will be detailed for duty in the interior; but the United States hospital ships "Solace" and "Relief," the hospital ship "Maine" fitted out in England for use in South Africa, and other similar craft are stationed at Taku and other ports to care for the wounded. Each of these vessels can accommodate from three hundred to four hundred patients at a time.

The railway and telegraph systems of China are not likely to play a very important part in the present campaign. If hostilities are prolonged to any extent they will almost certainly be destroyed beyond all hope of speedy repair. There are only 350 miles of railroad in the Empire.

Prior to their destruction during the past summer, telegraph lines connected Peking with the capitals of practically all of the provinces and extended far into the dependencies, connecting also with the ocean cables and with the Russian Trans-Siberian telegraph lines. The total length of the lines, according to statistics that were compiled but a few months ago, exceeded four thousand miles.

The Present Position of Roentgen-Ray Work.

At the recent meeting of the Roentgen Society, Mr. Wilson Noble, in the course of his presidential address, said no very striking discovery with regard to the rays had to be recorded, but a steady improvement had taken place in general practice. It was now possible to shorten exposures and to get far better definition, both in sciagrams and on the screen. In the latter case there was much greater clearness, and, what was of even more importance, an absolutely steady image. It was also possible to localize foreign bodies with certainty, and the importance of stereoscopic radiography, seeing objects in relief on the screen, was an accomplished fact. There were many things difficult to see, or, at all events, to distinguish with certainty, when seen as a flat surface, but which came out with wonderful clearness when seen in relief. One had only to look at an ordinary stereoscopic slide, first without and then with a stereoscope, to appreciate this. More particularly was this the case with objects showing but little contrast and ill-defined; such, for instance, as the early patches of tuberculosis in the lung. He could not but think that the diagnosis of this disease would be enormously facilitated when stereoscopic radiography became general. Many minor improvements had been brought before the society during the past year. One noticeable feature of the present practice was the adoption of the influence machine by many workers. It was too soon to say whether that machine would ever supersede the coil. In South Africa the rays had rendered admirable service. It was a fortunate circumstance that the work for which they were most wanted on the battlefield—i. e., for the localization of foreign bodies—was the easiest to perform, for the employment of the rays anywhere than at a well appointed base hospital was accompanied with enormous difficulty. The number of cases constantly coming in, the necessity for hurrying through them, and the constant impossibility of keeping the tube in good working condition, the difficulty of charging the accumulators, and many other serious inconveniences, made it a marvel how any satisfactory work could be done.—British Journal of Photography.

Science Notes.

Formosa produces by far the greatest quantity of camphor. The annual output amounts to between six million and seven million pounds, while the Japanese annual production is about three hundred thousand, and that of China two hundred and twenty thousand pounds.

Dr. S. Adolph Knopf has won a prize of 4,000 marks offered by the Tuberculosis Congress for the best essay on the subject "How to Fight Tuberculosis as a Disease of the Masses." Eighty-one essays were offered in competition. The award was made by a committee composed of several of the leading German physicians and two or three State dignitaries.

A letter has been published in Moscow from Sven Anders Hedin, a traveler, in which he mentions an excursion into Thibet in a direction never before attempted by Europeans. He succeeded in reaching Lake Lobnor, on the shores of which he discovered the remains of an ancient city. The ruins were magnificent and were intersected by broad roads.

The ice habit is making rapid progress in Great Britain largely owing to the calls of Americans. To-day all first class establishments put ice upon the tables in small tubs and guests pick out as much as they desire with ice tongs. Though few saloons and restaurants have refrigerators, many private houses are now provided with them. The consumption of ice would be much greater if regular companies distributed it, but the business is now largely in the hands of fish-mongers. The yearly consumption of ice in England is 450,000 tons and in London 160,000 tons. Much of the ice is brought from Norway and a considerable quantity is manufactured.

London is at last to have a complete ambulance service. There is no place in the world where it is so much needed. The Metropolitan corps of the St. John Ambulance Brigade does excellent work, but their chief surgeon, Mr. S. Osborn, recommends that the service should be under the control of the London County Council. His idea is to graft an ambulance system for London on to the Metropolitan Fire Brigade, by whom it can be easily horsed, housed and supplied with alarm calls. The London Fire Department does not have any too many horses now for prompt responding to calls, and it would necessitate an increase of the number of houses if the new scheme is adopted.

It has for a long time been supposed that the mongoose was immune to snake bite, but an official report of R. H. Elliot states that the creature is not immune in the fullest sense of the expression, as it may succumb to a snake bite, if sufficiently severe, the same as any other animal. His researches show, however, that the mongoose enjoys a partial and comparative immunity from snake poison. That is to say, a mongoose requires from ten to twenty-five times as much cobra venom to kill it as a rabbit does, and from five to ten times as much as a dog. The mongoose was introduced into Guadeloupe and Barbadoes twenty-five years ago, and in this period there has been a very appreciable reduction of the animal's resistance to snake venom.

M. Pietro Pellegrini, an Italian scientist, has lately published the results of his researches upon mushrooms of the poisonous variety, of which the following resumé may be given: The poison of mushrooms dissolves easily in water and the aqueous extract keeps its toxic properties for a long time, these having been strongly marked at the end of eleven months. The poisonous action is not diminished by the drying of the mushrooms by heat. Mammals and birds show a great sensibility to the poison, even in feeble doses, but on the contrary it is without effect upon cold-blooded animals. The action is shown very clearly when it is injected under the skin; animals, when subjected to frequent injections of this kind, acquire a certain immunity, and the serum of these animals may be used as a remedy in cases of poisoning.

Mr. Joseph Jaubert has addressed the following note to the Académie des Sciences, relating to a halo of extraordinary appearance observed on the 22d of June at 10h. 45m., at the Observatory of Montsouris, Paris. Messrs. Besson and Dutheil observed an irised arc at the interior of the ordinary halo of 22° radius, of which the upper half was then visible. This arc appeared to belong to a circumference having the sun as a center; about three-eighths of the circumference was represented. The two observers made drawings separately, which were found to be concordant. According to one of these, the radius of the exterior halo was 17°; the second gave 17.5°. The duration of the phenomenon was about 10 minutes. From 18h. to sunset were also observed, besides the two ordinary parhelia, brilliantly colored; the summit of the halo of 22° radius crowned by a mass of white light; the halo of 46° radius, of which the whole of the upper half was visible at 18h. 20m.; and finally a luminous column which was already perceptible at 19h. and which acquired at 19h. 30m. a length of nearly 20°. It disappeared before sunset, on account of the thickening and alteration of the layer of cirro-stratus to which it was due.