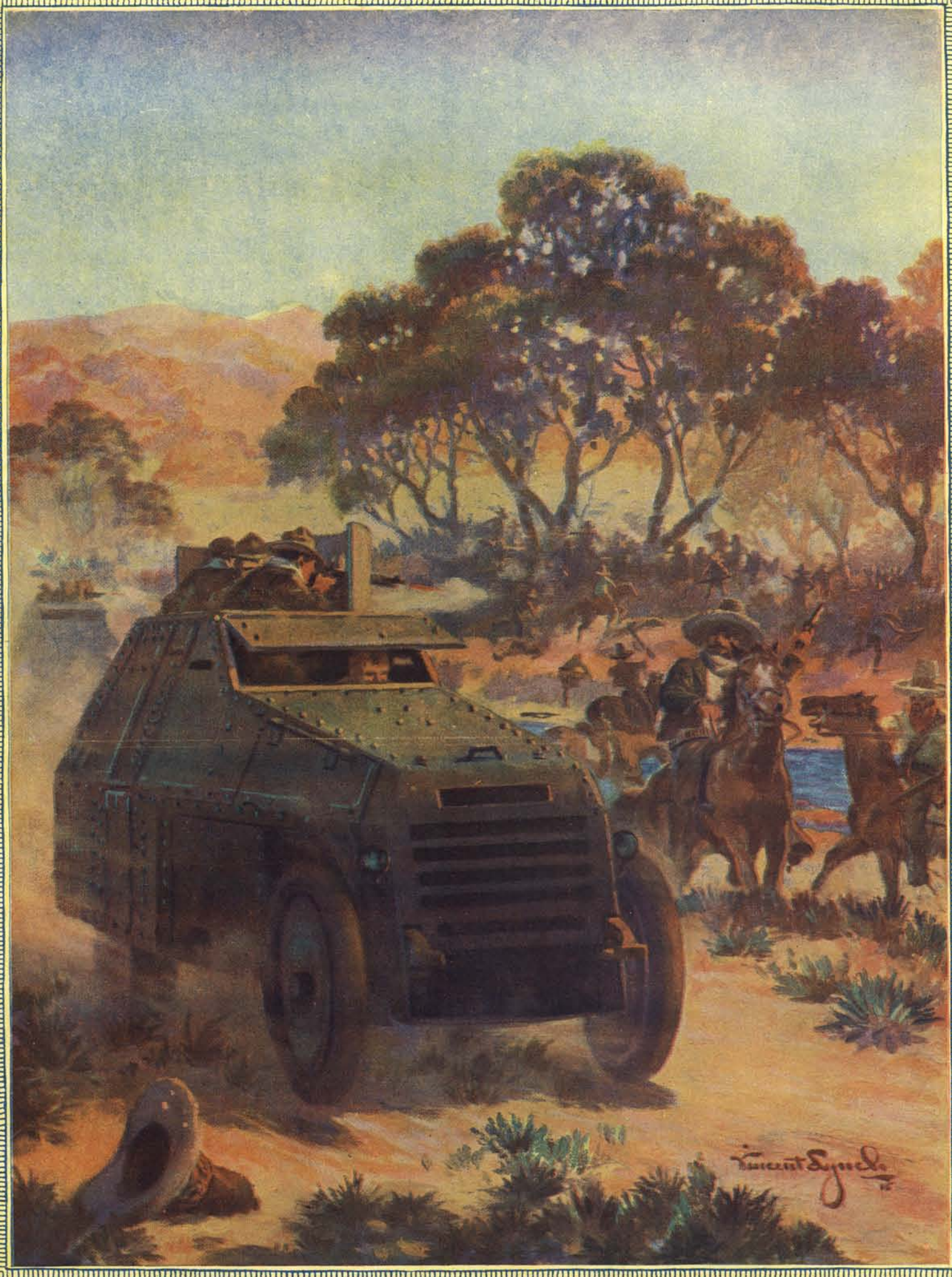
OUR ARMY

SCIENTIFIC AMERICAN



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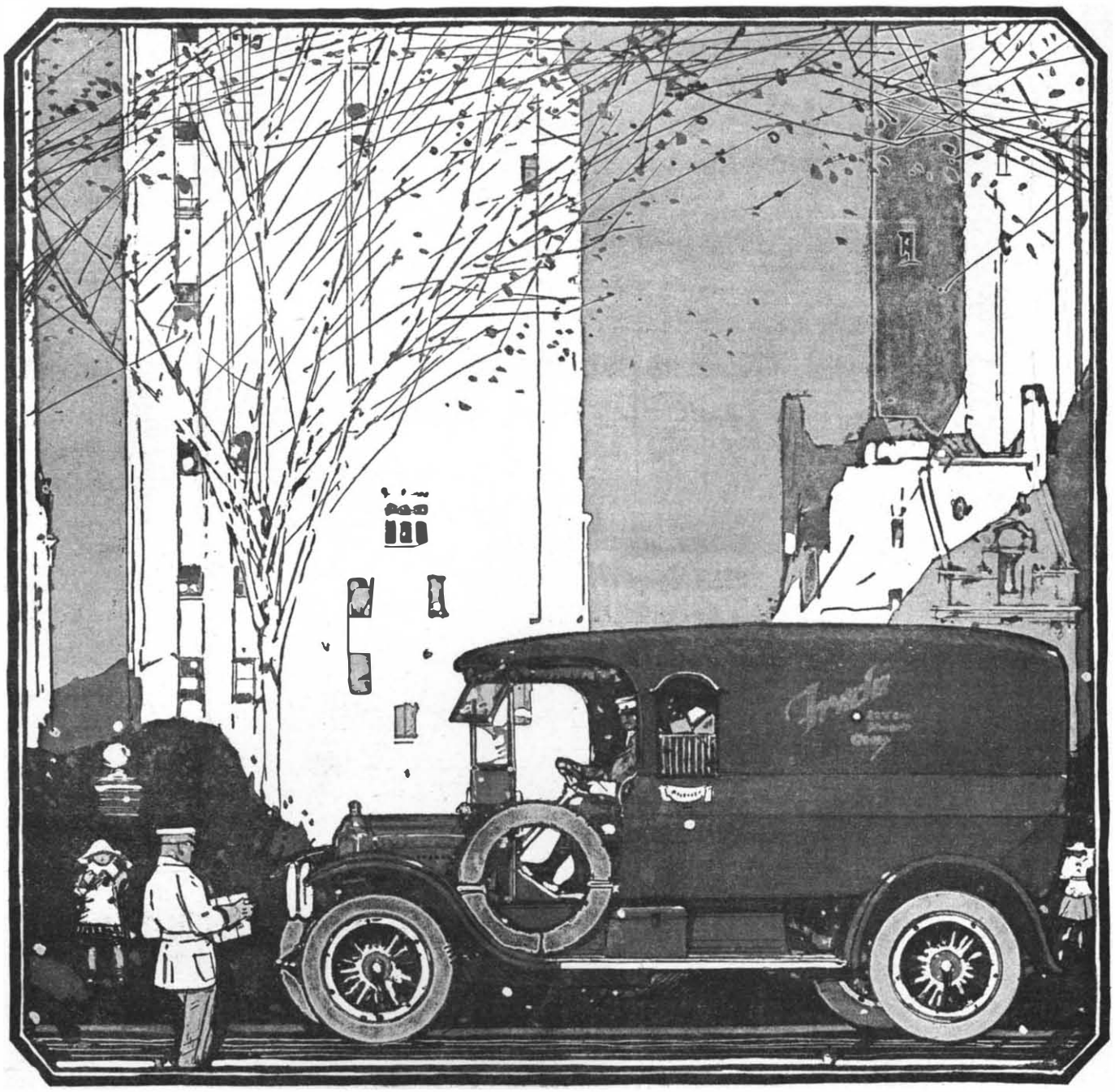

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SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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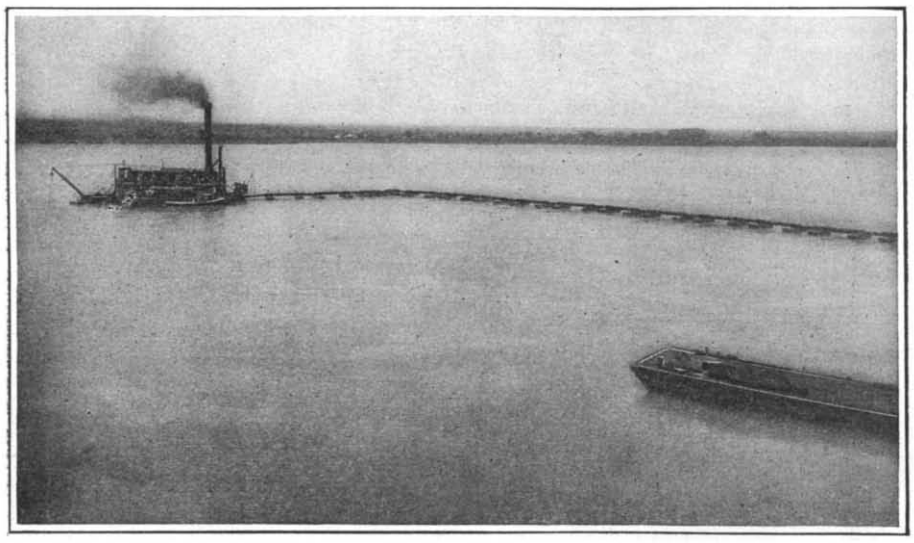


Panoramic view of New Orleans river front, showing pipe line dredge in operation

Development of the Port of New Orleans

By F. J. Springer

THE construction of the Panama Canal has turned the eyes of the world upon New Orleans. Always a port of great importance, the Crescent City now aspires to a position in American commerce second only to that held by New York. As a necessary first step toward the attainment of this ambition, a comprehensive scheme of water-front improvement has been laid down, and is now in process of realization.

In its general outlines this scheme involves the building up of the east bank of the river to a considerable height above its present elevation, and the construction thereon of a great cotton warehouse and grain elevator, with a complete marginal railway and truckway adequately connected with the rail and street systems of the city. The building up of the bank is being effected through the transfer of alluvial material from the river bottom to the desired points by a pipe-line dredge like that employed in the construction of the Gatun dam. This dredge takes up material from the bottom, together with a considerable amount of water, and forces the mixture through a transmission pipe line. The matter discharged from the pipe may consist for the most part of water. Nevertheless, the continued discharge results in the formation of a solid bank of sand, etc., the water passing off into the stream and the heavy particles remaining.

In view of the alluvial nature of the natural land, as well as that produced in this manner, the supports for the piers and other structures are necessarily provided by some type of pile. Apparently in the present construction there has been no necessity of guarding against the teredo. Wooden piles have accordingly been used, creosoted in order that the ends projecting out of the water might stand up under service. These piles have been used throughout, in water and made land alike, as foundations for the concrete warehouses as well as for the piers.

The choice of reinforced concrete for use above the piles was dictated by considerations of fire hazard. It was decided, moreover, to avoid the solid construction involved in brick supporting walls because of the expense and the inadequacy of such construction for the eccentric loads to be expected from the use of cranes for handling purposes. For the support of such loads a cantilever type of construction is demanded. The two requisites of fireproofness and cantilever framework are admirably met by the type of reinforced concrete finally chosen.

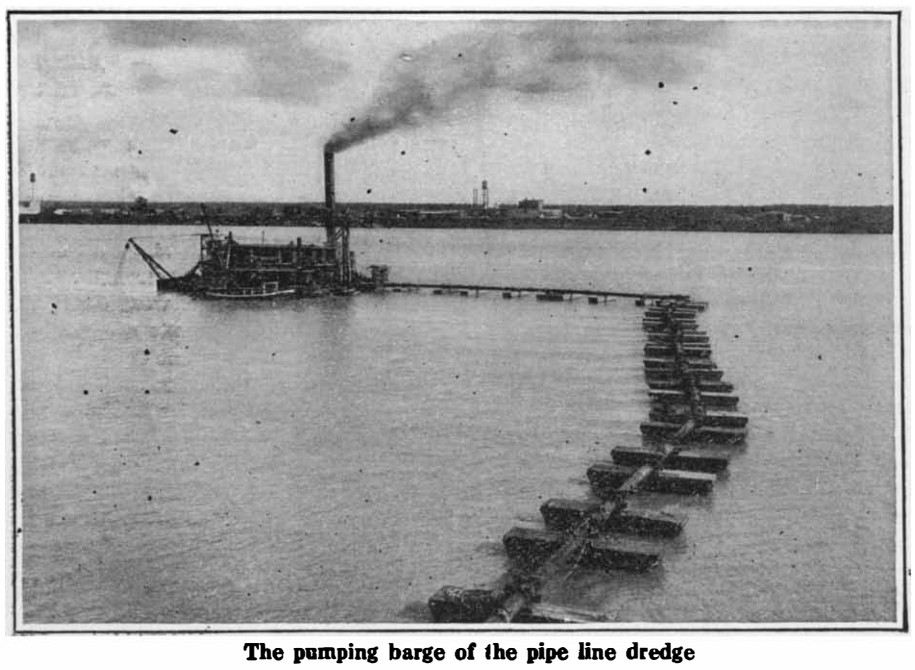
Where the reinforcing bars did not need to be bent, high carbon steel was employed; where bending was necessary, low carbon steel received the preference. Justification for this choice lies in the metallurgical fact that while the tensile strength of steel increases steadily with the carbon content up to a certain point, the act of bending high carbon steel while cold is very apt to result in fracture.

An important item that had to be taken into account in providing reinforcement was the expansion and contraction of concrete under temperature changes. Under a variation of 20 degrees Fahrenheit, a 100-inch section of concrete will expand .011 inch. While this seems insignificant, it is quite enough to start a crack, which will become a source of danger with any material further increase in temperature. The solution of this difficulty was to provide and suitably dispose enough reinforcement to distribute the total amount of cracking into a large number of small breaks. The amount of steel necessary to accomplish this is such that the tensile strength of the steel will equal that of the concrete in any interval. With this amount of steel, in case a small crack is formed at one place, there will be enough reinforcement passing through this crack to prevent its opening up, as well as enough to rupture the structure at other places under the pull of this crack, thus causing a multitude of small cracks instead of a few large ones.

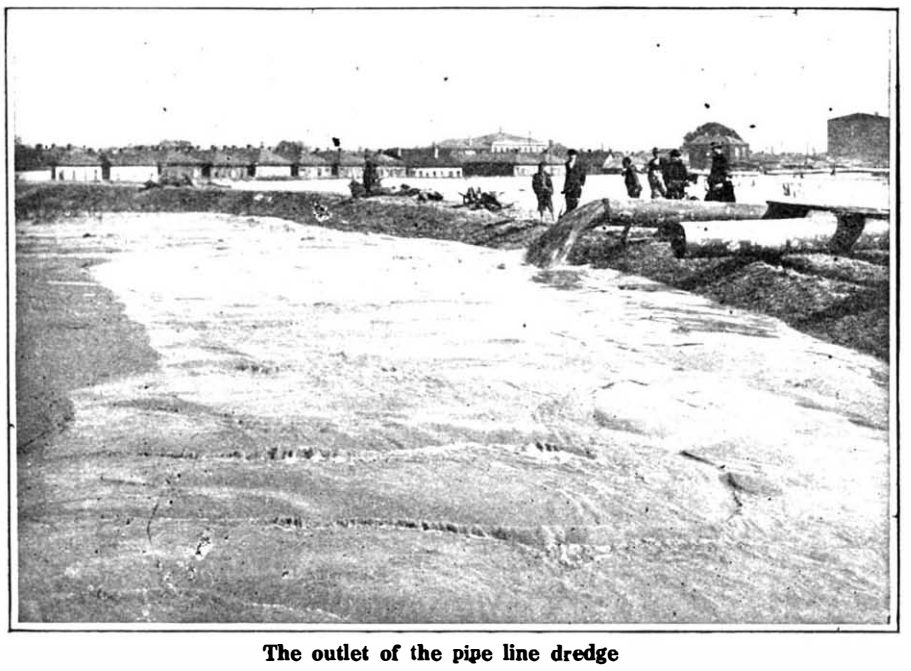
The floor plan of the cotton warehouses was regulated by the necessity of fire safeguard. Baled cotton is highly inflammable, frequently suffering from spontaneous combustion. Hence, to allow adequate inspection it is necessary to have one end of every stored bale on an aisle. So the entire interior of these giant warehouses is divided up into fireproof compartments 32 feet wide, 100 feet long, and 36 feet high. Such a compartment holds about 2,000 bales of cotton. It has not been possible to isolate these compartments completely, because of the necessity of running cranes into each. Hence the fire risk is considerable, even with the best of construction and inspection.

Some idea of the magnitude of the construction work involved may be drawn from the statement that there are four separate cotton warehouses, covering an aggregate ground area of 406,000 square feet—that is, a plot 203 feet wide and 2,000 feet, or more than three-eighths of a mile, long.

New Orleans is the natural outlet for the entire area comprised within the Mississippi drainage system. Coal from Pittsburgh, grain from Minneapolis, meat from Kansas City, can be gotten to tidewater far more cheaply at New Orleans than at any other point. Added to the natural advantage of rock bottom downstream water freight rates thus obtained, New Orleans has the further one of being directly connected by rail with the great manufacturing section of Alabama, and with the vast agricultural garden country of Texas. So there can be little doubt that the city will become a very important shipping point for South America, the Pacific Coast states, and even Europe, upon the completion of this development.



The pumping barge of the pipe line dredge



The outlet of the pipe line dredge

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Two Years of War in Europe

THE duration of the European war, the most stupendous conflict of nations the world bas ever witnessed, is about to extend from the second into the third year of strife. Before proceeding to discuss the changes of the year just past it may be well briefly to review the course of the war up to August, 1915.

On August 1st, 1914, Germany declared war on Russia, on account of the mobilization of the latter's forces in virtual support of Serbia's stand against Austria. It was a foregone conclusion that France would strike if Russia did, and German mobilization proceeded at both fronts. On August 2nd Germany occupied the neutral Duchy of Luxembourg, and on the following day the Kaiser's forces moved against Belgium as the most feasible and least defended highway into France. So well was it known by every general staff of Europe that this route would be taken that when the moment came it occasioned no surprise to military men. On the technical ground of supporting Belgium's neutrality, Great Britain, after the time expiration of an ultimatum to Germany, entered the war.

The German plans had been worked out years before, and the war machine moved on with the regularity of clockwork—except that Belgium "threw a monkey-wrench into the works" by springing to arms in far greater force than anticipated, with the result that ultimate strategic developments when the German armies were near Paris were delayed for a period just barely sufficient to permit France to mobilize in enough strength to stem the tide of invasion after the official capital had been moved from Paris to Bordeaux.

It was on August 14th that the first large body of French troops could reach supporting distance of the Belgian army, near Dinant. Two days later the comparatively small British contingent reached the lines. At the beginning of the last week of August the British were in position, joining up with the French centering on Namur. The Germans forced the latter contingent back and the British right flank was left up in the air, 24 hours elapsing before Field Marshal Sir John French discovered his perilous position. Immediate retirement was necessary, and a general retreat took place, a marvel of military accomplishment, ending only when the allied lines stiffened and held at the Marne.

This is a fitting place for a moment's digression. The war is not yet ended, and the end is not yet in sight; but every indication points to a growing superiority of Entente over Teuton in men and all-important guns. The perspective of two years, combined with the mathematical probabilities of the future, lead to a constantly expressed opinion by military observers that the decisive battle of the war will not be told in history as marking the close of the war; it will be known as the Battle of the Marne, when the German plan to eliminate France at once failed signally.

The German plan of campaign soon became evident. It called for the absolute defeat of the French armies —their elimination—first of all, while Austria and a skeleton army of Germans were to hold mighty Russia in check; the Germans, figuring on the proverbial slowness of Russian mobilization and the scarcity of railway lines, counted that at least two months were available for their mighty stroke on the west; after that they were to turn on Russia with full strength and wipe her out as a military factor. Their plan came very near to success.

September 1st found the Germans extended from the environs of Paris to the Swiss frontier, with von Kluck advancing against Paris proper, obliquely across the front of the fortress. The French center was the objective of the hardest attacks, and it barely managed to hold on. Von Kluck, attacked on his exposed flank, was forced back. French reinforcements, hurriedly recalled from the offensive which had been launched in Alsace for moral effect, were rushed to Gen. Foch's endangered center; and the entire German line pivoting on Verdun was forced back by von Kluck's retiremeut, until the line of the Aisne was reached and the lines settled into their deadlock which obtained for so long. Gradually the lines were extended in attempted flanking operations until they reached the North Sea.

Even then things might have prospered for the Teutonic cause had Russia not upset all calculations by mobilizing in strength with surprising speed. While Russia was not ready for an offensive movement, the peril of her allies on the west demanded that she take the initiative. Preparations for this movement became so evident that the Kaiser, instead of standing strictly on the defensive in the east, directed the Austrians to invade Poland. There was at first little resistance offered by the Russians, but before long the Austrians were checked and the Russians struck the Austrian right through Volhynia and Galicia, crumpling up the line until retreat became a rout, and on September 2 the Czar's troops occupied Lemberg, the forces north and east pressing on until the line of the Carpathians was reached. Russian armies also invaded East Prussia, making good progress until the Germans, in alarm, recalled troops from the western front and von Hindenburg struck his first masterful blow amid the Masurian lakes.

Seizing what seemed to be an inviting opportunity, Germany undertook the first movement against Warsaw, the strongest point in the Polish salient, hoping to sever connections between the defeated Russian forces to the northward and the forces in Galicia. Success nearly crowned the movement, but the Russians came up in time and forced an immediate retreat of the Germans to their own frontiers. Again the Russians resumed their activities in Galicia, besieged and isolated Przemysl, approached Cracow and raided into Hungary; and again Hindenburg was called to the rescue, almost succeeded in bagging a considerable portion of the Russian forces and brought Russian operations in Galicia to a standstill.

Russia readjusted her lines and made another effort to force the Carpathian passes. By this time the German Staff was aware of the stern character of the western deadlock, and in consequence it was determined to swing the hammer of war with all possible force against Russia, in hopes of not only defeating the Russians, but of destroying their military forces.

On May 1st the Teutonic offensive was launched across the Donajec, behind a stupendous massing of batteries. The object was to isolate the Russian armies in the Carpathians, and the attack was supported by general assault throughout the Carpathian line, if for nothing more than to retain in position the Russian units there. The attack succeeded in breaking the Russian line, which was repaired with the greatest difficulty—but a rout was avoided and the Russians retired to the line of the San. The isolation of the Carpathian armies was prevented by magnificent work, and these threatened forces were enabled to retire in touch with the forces farther northwest.

But the Teutonic pressure was not relaxed and the Russians were forced back by successive steps, past Przemysl and Lemberg, to the Sereth, the Vistula and the Bug. Then Hindenburg, who had seemed passive, waiting for the outcome of the southerly movement, descended from the northwest toward Warsaw. Mackensen was 125 miles in rear of the Warsaw position, striking northward; and the German hope was that the entire Russian force between the two would be cut off—bagged. So successful were the Kaiser's thrusts that the last of July found the great fortress base of Ivangorod surrounded and the Vistula crossing secured to the south of Warsaw; it seemed almost a foregone conclusion that the entire Russian center was doomed.

The Second Year of the War

But again Germany was frustrated. With extraordinary skill the Grand Duke Nicholas, fighting a terrific rear-guard action, managed to extricate his forces and, gladly paying the price of the evacuation of Warsaw, early August found him, with his lines sorely battered, munitions depleted to an unbelievable extent, yet practically intact; and Russia was saved.

The Germans pressed onward, disappointed at the escape of their prey, yet determined to trap him farther on. Vilna was practically surrounded; but again the Russians escaped through a very small gap which was held open by almost superhuman efforts, and the northern portion of the Russian line retired to the strong line of the Dvina. Mackensen bent every effort toward the elimination of the Russian forces in his own front, and he drove them back beyond the Pripet marshes, took Lutsk and Dubno—then his efforts could carry no farther and the eastern front settled down into a condition of deadlock similar to that in the west.

On the western front there occurred little change during this time. There were constant and sanguinary encounters, sorties, little local offensives launched here and there, but with no more effect than the gain or loss of some slight trench positions, which affected not at all the general situation. In September, 1915, the French opened an ineffective offensive in the Champagne and in Artois, attacking over a composite front of 26 miles. The Entente forces farther north sought to supplement the efforts of the Champagne offensive by attacking Lens. But preparations had been insufficient, and while a few miles of ground represented the gain, it had little effect on the situation.

The Gallipoli failure must go in the records of the second year of the war. In the effort to get in closer communication with Russia, to supply her crying needs for munitions, it was decided to attack Turkey at the Dardanelles and open the straits. The Entente naval forces instituted a heavy bombardment without material effect; there was much controversy at the time as to the propriety of the attack, and it now seems very evident that it was ill judged, for the naval attack was begun before the troop contingents were anywhere near ready to be landed, and Turkey—and Germany—were able to prepare for adequate defense.

Due to diplomacy, Bulgaria joined forces with the Central Empires in September, 1915, and in October moved upon Serbia. Mackensen, after the deadlock resulted on the Russian front, went to the Balkans to direct the Teutonic operations and, with a powerful Austro-German force, attacked Serbia from the north, while Bulgaria invaded from the east. Between the two, the Serbs were driven into Albania, and by the last of November every foot of Serbian soil was under the Kaiser's control. A belated effort was made to assist the Serbs by England and France, but as all communications with Saloniki, the landing place, were cut, it was of no assistance. A remnant of the Serbian army was able to reach the sea. This remnant has been reorganized on the island of Corfu and has been transferred to the lines of Saloniki, augmenting the forces under General Sarrail, until at the present time he has under his command a strong force of about 600,000 men, waiting for the propitious moment to strike northward against Bulgaria and the Teutons, in hopes of severing communications between Teutonia proper and Turkey.

Toward the latter part of May, 1915, Italy threw over her allegiance to the Triple Alliance and declared actively for the Entente. Her quarrel with Austria was hereditary, and to her it seemed to offer the only opportunity for the recovery of her lost lands and the establishment of strong geographical boundaries in case of success. The principal effort of Italy was directed toward the Izonzo, and the remainder of the Italian armies struck northward against the Trentino, more as a cover to the eastern operations than anything else. At no time since Italy's entrance into the war have her lines varied much from those of her frontier. Small gains have been made here and there, but not sufficient to bring any material advantage. In the late spring of this year Italy was surprised by a powerfully organized Austrian offensive against her northern front, directed evidently with the hopes of cutting off the Venetian plains from the Italian main territory. The offensive was proceeding with seeming success, when Russia, who had been preparing, startled the world by the assumption of the offensive on so grand a scale that the position of the entire eastern German line is imperilled.

This is a direct outcome of the great German attack upon Verdun, which opened in February. It was hoped that success at this point would so depress France that she might be willing to listen to peace talk. But with the exception of a French retirement from the advanced lines, no gains have accrued to Germany from this measure. As a matter of fact, it amounts to a substantial French victory, for the lines are unbroken and France has been stirred to her depths by her holding success against the ceaseless assaults of the Crown Prince. But Verdun seems now a past page, for the Russian and the long delayed Entente offensive on the western front are under way.

From the beginning of the war until a very few months ago it seemed as though there was scarcely a ghost of co-ordinated action between the elements of the Entente. Each country struck its isolated little blow at will, permitting Teutonia to hold on all other fronts and concentrate in overwhelming strength. But it seems at last as though co-operation were complete. East and west the strokes of the Entente are ringing. and no longer dares Germany deplete one front to bolster the other. Bulgaria crouches before the lines of Saloniki, waiting for the attack that is bound to be near. Turkey has her hands full and can help little elsewhere, for the Grand Duke is creeping across the Asia Minor peninsula from the Black Sea to well into Persia, the reports showing almost daily gains. The initiative seems at last to have passed from the hands of the Kaiser into those of his enemies; and perhaps the beginning of the end is nearer than one suspects.

Astronomy

Stellar Parallaxes.—In his recent presidential address before the Philosophical Society of Washington, on "The Distances of the Heavenly Bodies," Prof. W. A. Eichelberger traced the history of stellar parallax determinations from the first accurate measurements (relating to three stars) in 1838, down to the present year, when the parallaxes of from 200 to 300 stars are known. Photographic methods have greatly increased the accuracy of such determinations, while diminishing the labor involved. The average probable error of photographic determinations with the Mt. Wilson 60-inch reflector is less than .006 second, as compared with a probable error of .025 second in the measurements made visually at the beginning of such work. The speaker declared that "it appears that any star whose parallax is as much as 0.02 second, i.e., whose distance from the earth is less than ten million times that from the earth to the sun, should give a positive result when subjected to the treatment now employed in parallax investigations." As eight or ten observatories are engaged in this work, we should soon have a list of at least a few thousand stars whose parallaxes (and hence whose distances from our system) are known.

A Catalogue of the Meteorites of North America by Dr. Farrington, curator of geology at the Field Museum of Natural History, Chicago, has recently appeared. It is a work of 513 quarto pages of text, besides 36 maps, and treats of 247 objects or "falls," recognized by the author as undoubted meteorites, down to January 1, 1909. Of these meteorites 161 are classified as iron, 10 as iron-stone, and 76 as stony. Sixty were actually seen to fall. The distribution of meteorites over the continent is very uneven. Falls have been most common in the eastern United States and Mexico, while few meteorites are known from British North America or the western United States. A circle with a radius of 300 miles drawn about Mount Mitchell, N. C., as a center will include nearly half the known meteorites of North America. Dr. Farrington says there seems to be little doubt that some force tends to bring about their concentration in this area. "It is noteworthy that this region includes the highest summits of the Appalachians, and this suggests either the presence of extra-gravitational force, or that a purely obstructive effect has been exerted by the high peaks. Studies of the gravitational effects of mountain masses indicate no force seemingly sufficient to affect the fall of a meteorite, though some such force may exist. Magnetic influences may also be suggested." The three greatest meteorite showers of North America have all occurred within the state of Iowa, and two of them within 65 miles of each other.

Visibility of Stars in Daylight.—The belief that the stars may be seen in daylight from the bottom of a deep well, shaft or tall chimney is a very old one. Its wide currency is perhaps due to the fact that it is found in the works of Aristotle, whose authority was regarded as final on all subjects for so many centuries. One of the first scientific men to investigate the correctness of this idea was Humboldt, who spent a great deal of time in mines himself, and also questioned miners in various parts of the world, without finding the slightest evidence that the stars are ever visible by day from the bottom of mine-shafts. Rev. W. F. A. Ellison discusses this subject incidentally in a recent paper in the *Journal* of the British Astronomical Association, and declares the idea to be a myth. The invisibility of the stars in the daytime is due to the glare of the atmosphere illuminated by the sun's rays, and there is no reason why a shaft or chimney should sensibly diminish this glare. The author proceeds to consider the question of the visibility of stars and planets through the telescope in the daylight. This varies a good deal with color. Red or yellow stars are much more easily seen than white ones. The telescope needs to be very accurately focused; otherwise even a very bright star will lose itself hopelessly against a daylight field. Of the planets, Venus and Mercury are, as is well known, better observed in daylight than in darkness. In general, planets are much less visible in daylight than stars, as the telescope diminishes the brightness of the planet's disk as well as of the sky, and hence does not heighten the contrast, as in the case of a star. Saturn is hardly visible by day in a 5-inch telescope. W. H. Steavenson, in a note on Mr. Ellison's paper, states that the faintest star he has ever been able to see in sunshine with a 3-inch telescope was the companion of Epsilon Booties, magnitude 6.5, which was seen two hours before sunset. A Swiss astronomer has recently exhibited in Paris sketches of Saturn of considerable interest. The crepe ring is distinctly visible, and the equatorial band on the planet is badly slashed. The south pole, very dark, is outlined by a small shaded band. The shadow of the planet on the ring shows at one point a marked depression, indicating either a thinning of the rings or a difference between their planes.

Science

A Forgotten Cereal of Ancient America.—Old chronicles of Mexico record that among the articles of tribute paid to Montezuma by the Mexican pueblos, including maize, beans, cacao, etc., was a grain called *guautli*, or *huautli*, of which about 160,000 bushels was furnished annually. The identity of this plant has long been a mystery. The seed was described in 1629 by Hernando Ruiz de Alarcon as smaller than mustard seed. It was widely used for food, and also in various religious ceremonies. Mr. W. E. Safford, of the U. S. Department of Agriculture, has recently called attention to the fact that the economic collections of the department contain certain seeds from Sinaloa, Mexico, where they bear the vernacular name of *guaute*, and are used for food when maize is scarce. They have been identified as the seeds of *Amaranthus cruentus, L.* The late Dr. Edward Palmer found both wild and cultivated varieties, not only in Sinaloa, but also in more southerly states of Mexico. Apparently this is the ancient *guautli*, and it is interesting to note that closely allied, if not identical, species are cultivated for food in Peru and Bolivia, and also in Tibet and the mountains of India.

Tornadoes in Kansas.—A recent paper by Mr. S. D. Flora, of the U. S. Weather Bureau, aims to correct the popular impression that Kansas is the "tornado state" *par excellence*. The expression "Kansas cyclone" (*i. e.*, tornado) has become proverbial, mainly because of the undue publicity given to the spectacular features of such storms in the days of the early settlers. It is true that during the period for which tolerably accurate statistics are available—viz., 1889-1896—a somewhat greater number of tornadoes were recorded in Kansas than in any other state, but in proportion to its area Kansas had no more of these storms than Iowa, and only slightly more than Illinois. The area of the state is more than 80,000 square miles, while the whole track of an average tornado does not exceed 25 square miles, and many are a great deal smaller. More people are killed in Kansas by lightning than by tornadoes, while the property loss due to these storms is insignificant compared with that caused by floods or by hail. From the somewhat heterogeneous records available, the total number of Kansas tornadoes during the combined periods 1859-1887, 1889-1896, and 1914-1915, is given as 228.

The New Flora and Fauna of Krakatoa.—Before the tremendous eruption of 1883, the three islands known collectively as Krakatoa, in the Strait of Sunda, were clothed with thick forest and tropical vegetation. The eruption buried the islands under from 6 to 200 feet of hot ash and pumice, and undoubtedly destroyed every germ of life. The gradual reconstitution of the flora and fauna has been studied in much detail by many naturalists, and a review of this subject has recently been published by Dr. E. Bordage. First a slimy covering of a simple algæ appeared on the surface and in the hollows of the pumice blocks. Wind-borne spores of mosses and ferns germinated upon this surface, and, in their turn, prepared a soil for flowering plants. The last complete botanical survey of the islands was made in 1906, when 114 species of plants were found. The new flora differs considerably from the old one. It is remarkable that no mangroves are found, as the fruits of this plant are thrown up on the beach in abundance. In 1908 an expedition found 263 animal species, of which 240 belonged to the Arthropoda (insects and their allies). No mammals were found.

Origin of the Earth's Electric Charge.—To solve the problem of the earth's negative electric charge it is necessary to find some means by which the earth may receive a constant supply of negative electricity without the corresponding positive charge being set free within the earth itself or in the lower atmosphere. This problem has hitherto proved baffling. Dr. George C. Simpson, one of the highest living authorities on atmospheric electricity, suggests tentatively, in a recent article, two solutions both of which, he admits, are "against the recognized principles of physics." The first is that the earth is constantly being bombarded from outer space by particles of negative electricity, having sufficient penetrating power to pass through the atmosphere in order to be absorbed in the earth. At present, however, we know of no kind of electrical particles capable of piercing the atmosphere, the absorbing power of which is equivalent to that of a layer of mercury 30 inches deep. The most penetrating electrical particles known—viz., the beta rays from radioactive substance—cannot pass even half an inch of mercury; but the ionization within closed vessels proves that more penetrating radiations exist. Dr. Simpson's other suggestion is that there is a spontaneous production of negative electricity within the mass of the earth, without the simultaneous production of positive electricity; a process hitherto regarded as impossible. In apology for this suggestion the writer points out that "our ideas of the axioms of physics are at present in such a state of flux that it would be difficult to state exactly what they are."

Automobile

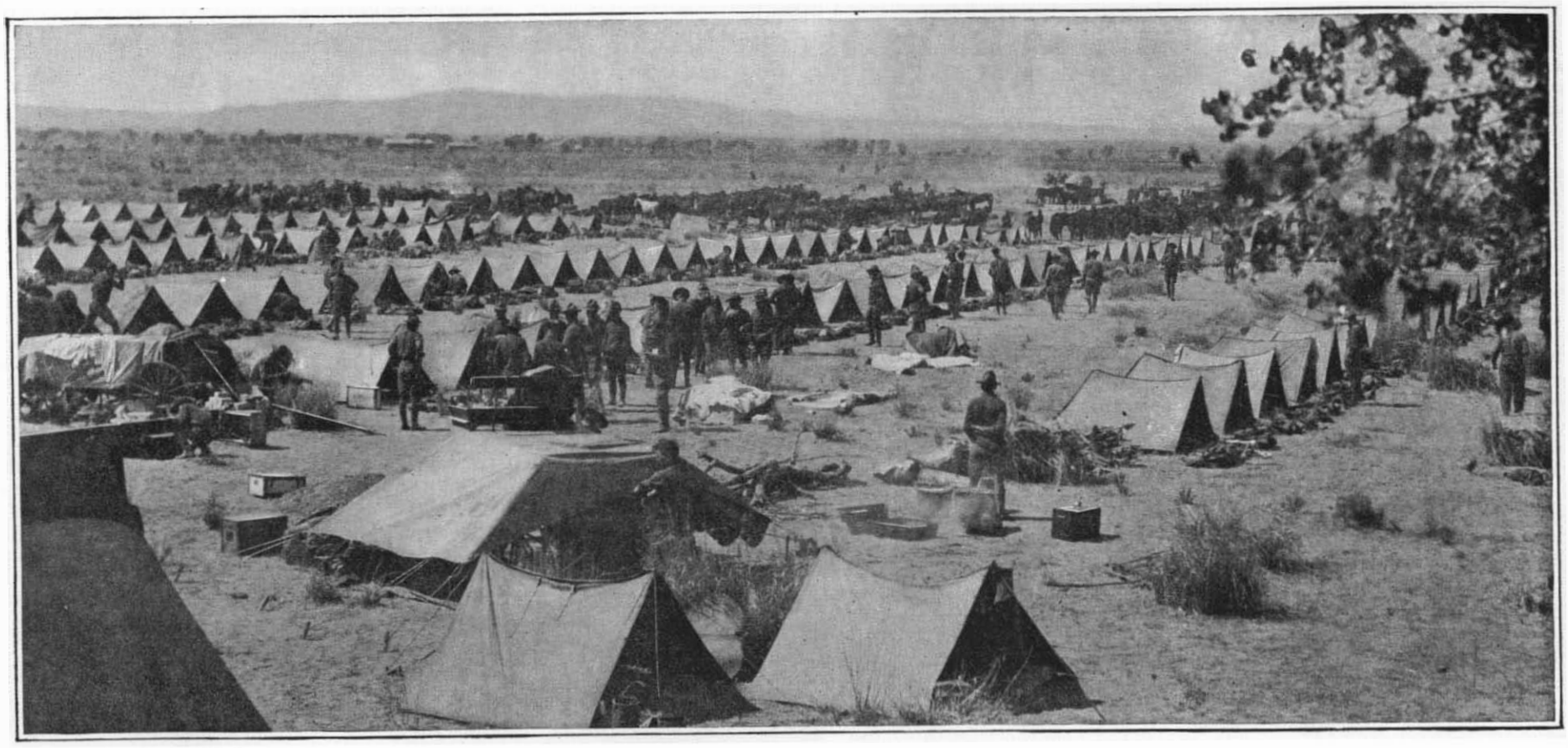
Trailers for Commercial Work.—One of the logical developments of the commercial vehicle is the trailer, for the fact is being rediscovered that a motor vehicle, even when fully loaded, can pull another loaded vehicle. Although this method of hauling goods may not be entirely desirable in cities, there are important possibilities in other localities, especially at manufacturing plants. Where goods are to be taken to different destinations, two lots may be separated, the truck taking one consignment, while the other is loaded upon a trailer, which is dropped at its destination, while the truck goes on to another point, picking up the trailer on its return trip. This avoids much delay in loading and unloading, and enables the truck to be kept in more continuous operation, with corresponding economy.

Making Motor Trucks Pay.—The average owner of a motor truck fails to get the full value of his investment on account of the hap-hazard manner in which he uses it. With modern equipment modern methods should be adopted, and the principle recognized that standing equipment is a dead investment. The loading and routing of the truck should be carefully studied to keep it moving as constantly as possible, but as a rule two thirds of the working day is wasted in loading and unloading, as a result of lack of foresight and system. Loads should be assembled and properly placed beforehand to insure quick handling, and ample space kept free for equally rapid discharge; and in this connection the extended use of detachable bodies, enabling entire loads to be handled by a single operation, and the truck started off again without delay, is worthy of more general consideration.

The Development of Kerosene Devices Desirable.—In a paper read before the Society of Automobile Engineers Prof. Lucke stated that kerosene utilizing appliances are more worthy of development than the new oil cracking processes for the following reasons, among others. Kerosene is now available in much larger quantities than gasoline, and no new refinery capital or patent rights are nedeed; it is sold at a much lower price and it can be bought at many more places, throughout the world. To utilize the cracking processes new plants will have to be erected, costing millions of dollars, and these must be paid for by the consumer; moreover there are the patent rights that must also be paid for, and the existence of such patents would preclude open competition between the various producers. It would seem, in view of this, and much other evidence, that in delaying the introduction of a practical oil engine, the builders of internal combustion motors are playing into the hands of the producers of gasoline.

An Important Improvement.—It has long been recognized that no matter how perfectly balanced the crankshaft of a multicylinder engine may be, as regards the distribution of its weights, still at high speeds the shaft will bend and "whip." This effect can also be found in a plain round shaft, machined as symmetrically as possible, the main element being the speed, as the speed of revolution at which this whip appears varies in different constructions. Of course, this bending or whipping is distortion, and all distortion in a piece of machinery means a misdirection, or loss of power. A prominent automobile company has given the question careful study, and has succeeded in producing what might be called a theoretical balance, or compensation, in their crankshafts by so placing weights on the cheeks of the cranks as to counteract the forces that would produce the distortion alluded to, and the result of this plan is that the engine runs with remarkable smoothness, and also there is a marked increase in power, as the power that previously was consumed in distorting the shaft had become available for driving the car.

Benzol in America.—Benzol is extensively used as a motor fuel abroad, and the question is often asked why it is not available in this country. This liquid, sometimes known as benzene, is a coal-tar product, and is largely used in the manufacture of carbolic acid, dyes and medicinal compounds, and as the manufacture of these articles was but slightly developed before the war little attention was given to the production of benzol in the distillation of coal, there being but a limited market for it. Of late more attention has been given to the producing and saving of the benzol resulting from the manufacture of gas, but the entire supply is now in demand for the making of carbolic acid, which is a step in the manufacture of explosives, and for the making of dyes, so there still is none available for motor fuel. *The Horseless Age* estimates that America will produce over 20.000.000 gallons of benzol in 1916, as against a possible 125,000,000 gallons if all our resources were utilized. If such a time arrives, the surplus may be put on the market as a motor fuel; but the question of price will depend on future developments.



United States troops in camp on the Mexican Border

The Organization of the United States Army

The Various Arms of the Regular Service, and the Functions of Each

By Martin Wells

IT is a very fine, compact regular army we have in this country to-day, a jewel of an army, in fact, very expensive, highly polished, well guarded—and small, as all real jewels are. But there have been grave as well as heated controversies from ocean to ocean and back again, regarding its adequacy for the defense of the vast land which owns it. As a result of these discussions, the irritating conditions which have existed for so long in Mexico, the belated influence of the great war in Europe with its colossal figures of men, munitions, casualties and operations and the glare of publicity which far-sighted citizens of America have caused to be focused upon our seeming indifference to national insurance against disaster, Congress and constituents have stirred from lethargy at last. Recent appropriations indicate that at least a certain amount of much-needed relief is in sight, if nothing more than the increase of army strength to a point from which necessary expansion may be easier in case of hostilities with a first class power.

Theoretically, the destinies of the United States army are in the hands of the general staff, a body of keen, studious and efficient officers, each one a specialist upon some branch of the war machine. But as a matter of fact, the general staff is but an analytical and advisory body, the duty of which is to consider all phases of army organization, and the prosecution of warfare, then devise the most effective means of meeting a given condition. A determination once reached, it is communicated to the Chief of Staff, whose influence and authority are great enough materially to alter the conclusion, and through him the recommendation is transmitted to the Secretary of War, in whose office is vested the final authority for putting in force such recommendations as are possible under existing legislation. But there his power ceases; for whenever the recommendations embodied in his own conclusions require the expenditure of public moneys not already provided by congressional appropriation, he can only appeal to Congress to authorize this expenditure. So the real head of the army is no head at all, only a glorified political hydra which, it is openly charged by editorialists and tacitly admitted by practically the entire body politic, feeds almost exclusively upon "Pork." If Congress sees fit, the recommendations are indorsed and appropriation is made for their inauguration; and if not—not.

United States troops entrenched near Vera Cruz

Rough marching over the Mexican sand-dunes

Until a few weeks ago, when Congress authorized the increase of the regular army by a few regiments of infantry, cavalry, artillery and certain auxiliaries, the army had a definite and standard paper strength, but with the proviso of the late legislation that increase to a strength of 208,000 men be spread out over a span of five years, the strength of the army has become an unknown quantity, dependent mainly upon the efforts of the recruiting officers to collect the necessary additional men required to pad out the old organizations, portions of which have been designated to constitute the nuclei of new regiments. The formation of the latter scarcely affects the old scheme of organization, so discussion of the subject may as well be restricted to the scheme of organization which has been in effect for some years.

Infantry is the backbone of any army, and by far the strongest numerically of any arm of the service. Under the old order of things, the United States boasted thirty-one regiments of infantry; the number now has been increased to sixty-five.

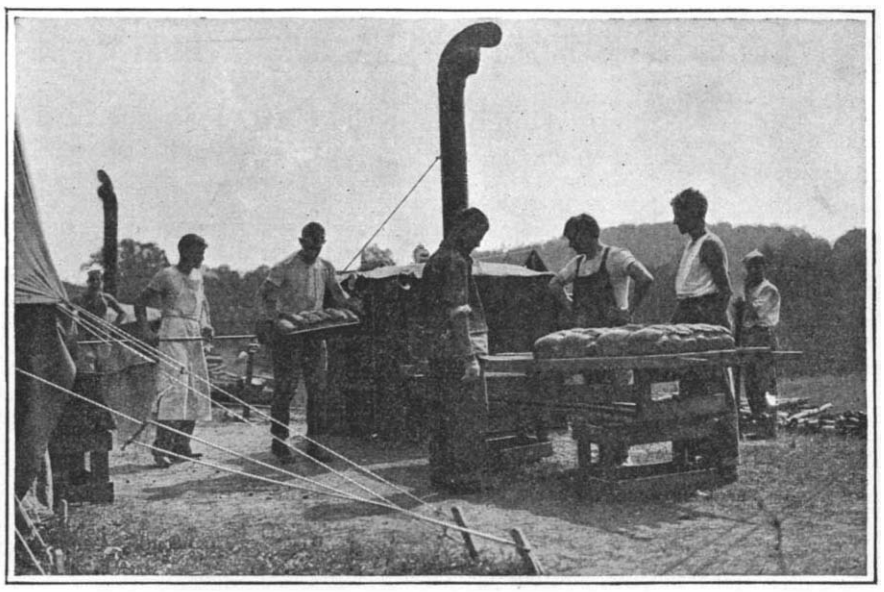
There were fifteen regiments of cavalry. Ten more regiments have been authorized, bringing the number up to twenty-five in all. Six field artillery regiments, each containing two battalions composed of three batteries, a total of twenty-four guns to the regiment, are now twenty-one placing at the disposal of the regular army 484 guns only. When the European war broke out, Germany placed 3,400 guns on the western front alone;—a suggestive comparison.

Auxiliary organizations of the line consist of engineers and signal troops. And while not usually counted as part of the fighting line, the corps which operate the services of field supply, ammunition and all-important food are so frequently called upon to come in direct contact with the leading elements of an embattled force that they should come under this head. The Medical Corps finds its function close to the firing line as well as throughout the line of communications, non-combatant but frequently exposed to the same danger as the firing line.

The Ordnance aud Quartermaster corps are mainly concerned with the providing

of materiel in the homeland and at the bases; but the various branches of the army are so absolutely dependent upon one another for the successful functioning of the whole and the proper prosecution of war, that no individual corps can justly be given a place of more importance in the public esteem than another.

Staff duty is distinctly that of administration and supply, and its system is extended as low in the scale of units as the battalion. The ramification begins with the Chief of Staff, who is, in effect, the general commanding all the forces of the United States. He has his personal staff, exclusively for the purpose of relieving his mind of all possible detail. It is separate and distinct from his administrative staff, which comprehends the head of each branch of the army, the highest possible centralization of authority and control for the various elements. The Quartermaster Corps which is charged with the manufacture, collection and distribution of clothing, food, transportation facilities and body comforts, as well as the disbursement of pay, is the largest staff unit. Its composition embraces, in a descending scale of authority and responsibility, (1) a corps of officers trained to their particular duties of supply, and (2) the minor personnel of the corps which consists of both enlisted men and civilians, such as clerks, teamsters, laborers, artisans and skilled workers.



A field bakery in active service

The Ordnance Corps is charged with the providing of artillery, rifles, ammunition and equipment. This last is a comprehensive term which includes everything not actually clothing, from canteens and haversacks, through tin spoons and cups, bayonets, gun-cleaning material, belts and sabers to machine-gun packs and tarpaulins to protect the heaviest siege guns from the elements. In time of peace as well as war, this corps provides the necessary ammunition, millions upon millions of rounds of small-arms cartridges, hand-grenades and explosives, and the shells, great and small, which go to feed the voracious artillery of many calibers.

The Coast Artillery is exactly what its name implies; that land force to which is entrusted the coast defense. It mans the sixteen inch guns---of which we have a very, very few—the disappearing guns and mortar groups which constitute the main strength of the coast defense system, the mine-field guns, rapid fire guns of position which form the lesser batteries of the coast defenses ,and has to do with the planting of mines in the fairways. This corps is almost an army in itself and is not counted as part of the mobile army, although the necessities of the service, due to the slenderness of force in the regular infantry establishment, have frequently required their utilization as infantry as, for instance, in the Philippine Islands and on the Mexican border at the present time.

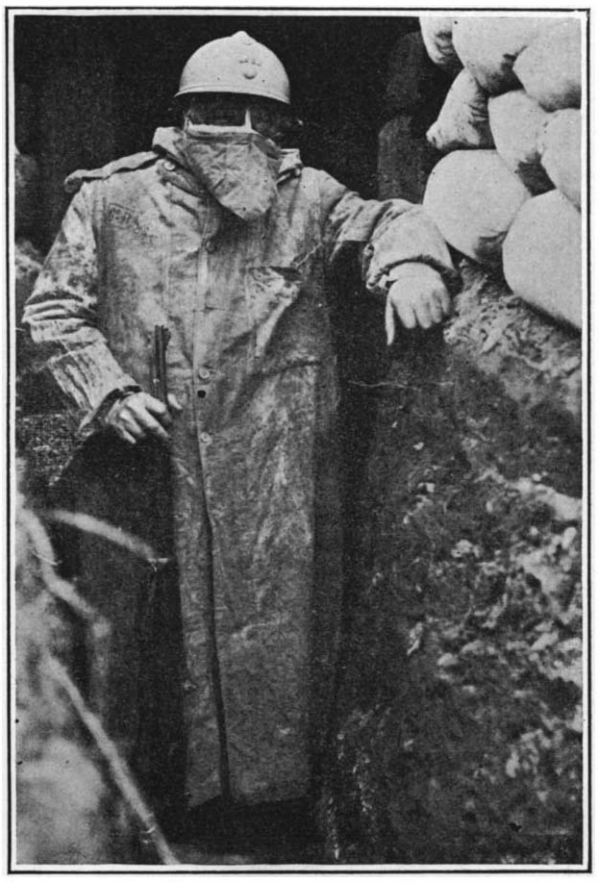
For field service and to facilitate the handling of the various troop bodies with greater ease and effectiveness, the land forces as a whole are divided into separate armies, usually designated by a territorial name, such as "The Army of the Potomac." Each army is composed of two or more field armies, each complete in itself. The old army corps has disappeared in favor of the later designation.

The field army consists of two or more infantry divisions; one or more brigades or divisions of cavalry and field army troops which may be attached as the best interests of the service dictate. Theoretically a lieutenant general commands such an organization, but in the United States army to-day there is no general officer above the lesser grade of major-general. The commander, of course, has his own headquarters and staff corps.

The infantry division comprises headquarters, three brigades of infantry, one regiment of cavalry, one brigade of light artillery, (48 guns), one pioneer battalion of engineers, one field battalion of signal troops and one each of the following trains (transportation); ammunition, supply, sanitary, engineer. The infantry division at war strength, the only strength considered in this article, numbers 736 officers of all grades and 21,929 men, a grand aggregate of 22,665 effectives.

The cavalry division is of about half the strength of an infantry division, numbering 458 officers and 9,703 men, an aggregate of 10,161. Its composition differs also. In it are three brigades of cavalry; one regiment of horse artillery (in the field artillery, the cannoneers ride on the guns, limbers and caissons while in the horse artillery these men are all mounted, making thereby a more mobile force); one pioneer battalion of mounted engineers, one field battalion of signal troops (mounted); an ammunition, a supply and a sanitary train.

The infantry brigade consists of three regiments of infantry, with attached sanitary troops, 168 officers and 5,581 men. The cavalry brigade contains but two regiments, and the necessary sanitary troops, 111 officers and 2,505 enlisted men.



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New York National Guardsman in full regalia

The infantry regiment is composed of twelve companies, divided into three battalions. In it are 51 officers and 1,836 men. The cavalry regiment has the same number of officers, but only 1,089 men.

These figures were arrived at by the gentlemen of the general staff after much arduous labor and deep study, as being those best fitted to proper organization. The scheme of organization is pronounced sound as a dollar by those in authority who know their profession. But theoretical—paper---organization is by no manner of means what we actually get in this country. The lessons of the Great War have pointed out innumerable deficiencies which must be rectified, not in the theoretical scheme, but actually. Reorganization and extension of the munitions and supply service to be prepared to meet a hostile eventuality is of paramount importance, yet the army can do nothing but recommend—Congress must provide. The flying service has proved one of the most important branches abroad, for it has constituted the eyes and ears of the opposing commanders; in trench warfare, ground reconnaissance is impossible deeper than the first trench. Yet we have scarcely the nucleus of two small aerial squadrons.

An army organized on a peace basis is, in itself, supposed to be capable of prompt expansion to dimensions adequate to the service of defense expected of it. If it cannot be expanded in the day of need, it is perfectly useless—has been merely a waste of money; and it may be added that the United States owns the most expensive army in proportion to its strength, in the whole world. Under the present system, then, it is not unbelievable that in the hour of need a "million men would spring to arms between sun-up and sun-down." But a distressing point is to be found in the fact that, although these untrained men might be expected to surge up in patriotic response to the call, there would be no arms to which they could spring. The proper proportion of guns to men seems to be something over three to the thousand; therefore the 192 guns which form our regular artillery should be sufficient to supplement the efforts of 64,000 men, not quite a field army and a half, about a third more than is to be found in a European army corps. When it is considered that in all the United States resources, regular army and national guard, there are less than 900 guns, sufficient for less than 300,000 men, it is rather appalling. It takes time to make guns—months, years; and it takes just as much time to provide the stupendous amount of ammunition required to feed them. England took almost two years to provide these things for her forces; and in the offensive recently launched in the Somme sector, more than 5,000,000 shells were expended in five days.

The United States has neither the rifles nor the equipment to supply an army of any size. It is estimated that there are about 700,000 Springfield rifles on hand. The European war has shown that there must be provided at least three rifles available for each man engaged, for they wear out rapidly under constant use.

The recent action of Congress has made things look far brighter than they have ever been before, in time of peace, or even threat, but provision is still inadequate; and it seems rather a humiliating commentary upon our proudly claimed business sagacity that this great country, with its little jewel of an army, is so penny-wise that it will not pay a comparatively trifling premium for comfortable national insurance of peace and prosperity.

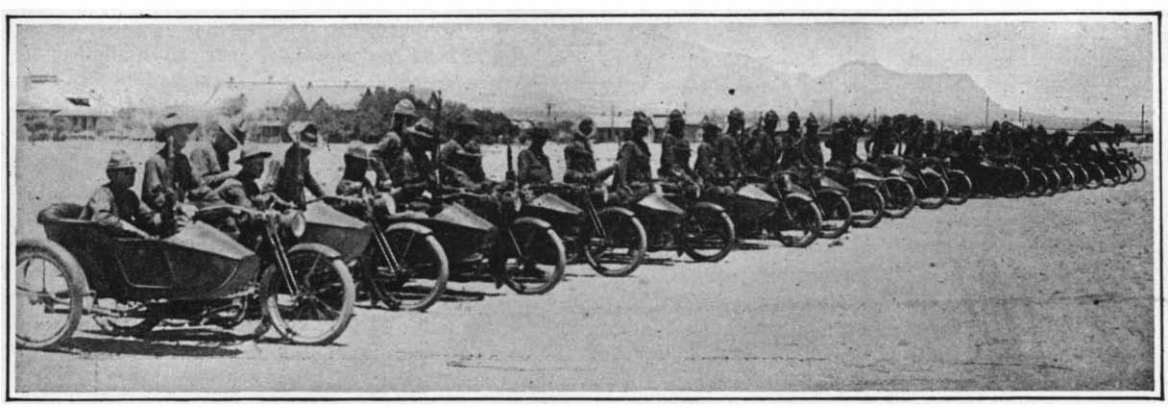
Death of Principal Examiner Maxson

LOUIS WILLIAM MAXSON, for many years principal Examiner of the Patent Office, died at the Johns Hopkins Hospital, Baltimore, July 2nd, on his sixty-first birthday, after an illness of several months.

Mr. Maxson was born in California, and graduated from Yale College in 1876, entering the Patent Office a few years later.

At the time of his death, Mr. Maxson was one of the oldest, in point of service, as a principal Examiner of the examining corps of the Patent Office.

Mr. Maxson was a churchman, a good man, a man whose fine ability in his profession was universally recognized and whose industry and clear insight won the respect of all associated with him, but to the writer it seems that the kindly helpful side of the man was pre-eminent. He had the ability to help and a spirit that denied no one, humble or exalted. He will ever be remembered for the good he has done, and there is hardly a man or boy associated in patent soliciting in Washington, and practically throughout the United States, who has not come under the kindly influence of Examiner Maxson in his service in the examining corps.



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The "Gasoline Cavalry" at Fort Bliss, Texas

Strategic Moves of the War, July 27th, 1916

By Our Military Expert

A SUCCESSION of sanguinary grinds against the German positions in the Somme sector; the gradual creeping of the Russian wings about Brody, along the boundary line of Galicia and Volhynia, gains to the crest of the Carpathians, and an offensive launched by Gen. Kuropatkin in the Riga district; the victorious drive of Grand Duke Nicholas against Erzingan in Asia Minor—these are the principal developments of the current week in the war zone.

Pozieres, about the middle of the east and west side of the British salient, extending from Orvillers to Longueval, north of the Somme, has been the center of conflict in the attempt to establish the Entente lines firmly on the Bapaume plateau. It may be a trifle premature, but as every indication points toward it, it may not be amiss to mention the fact that the Germans practically have ceased their attacks at Verdun, an eventuality suggested by the SCIENTIFIC AMERICAN soon after the beginning of the allied offensive. It must be obvious that, with the enormous resources of men and munitions necessary to the prosecution of the Verdun attack, not enough force would be left to meet adequately the Somme thrust if it were continued. This statement does not mean to imply that there may not be further activity at Verdun; they will at least attempt a show of force; but for all practical purposes the battle of Verdun is over, accruing as an undoubted moral victory for France.

It is believed by many persons who have studied the situation earnestly that when a final decision is reached, it will come about on the western front. This may well be; but, without intending any disrespectful comparison, a herd of horses is driven into a corral and penned only because there is nowhere else to go; wing fences, representing strong neutral boundaries, form a barrier and the herdsmen's incessant work in the gorge completes the round-up. Therefore, while the finishing battle may be fought on the western front, it could never be accomplished unless the forces in the other theaters of war are so active that all fronts must be strongly defended—and the most important one requires the greatest defense.

With this in mind, it is rather apparent that the elements of the Entente have got together at last for concerted action. Russia has swept forward from her deadlocked line in two huge bulges, south of the Pripet, threatening Kovel and Lemberg, while the Russian left is now able almost to peer down into Hungary from the crests of the Carpathians. It is acknowledged by all that Russia is in far greater numerical strength than her adversaries, and the extension of the line beyond Czernovitz and Kolomea has so increased the length of the Austrian front that it must be held in less force than desirable for strength; and Russia's broad front represents the main line of the herders.

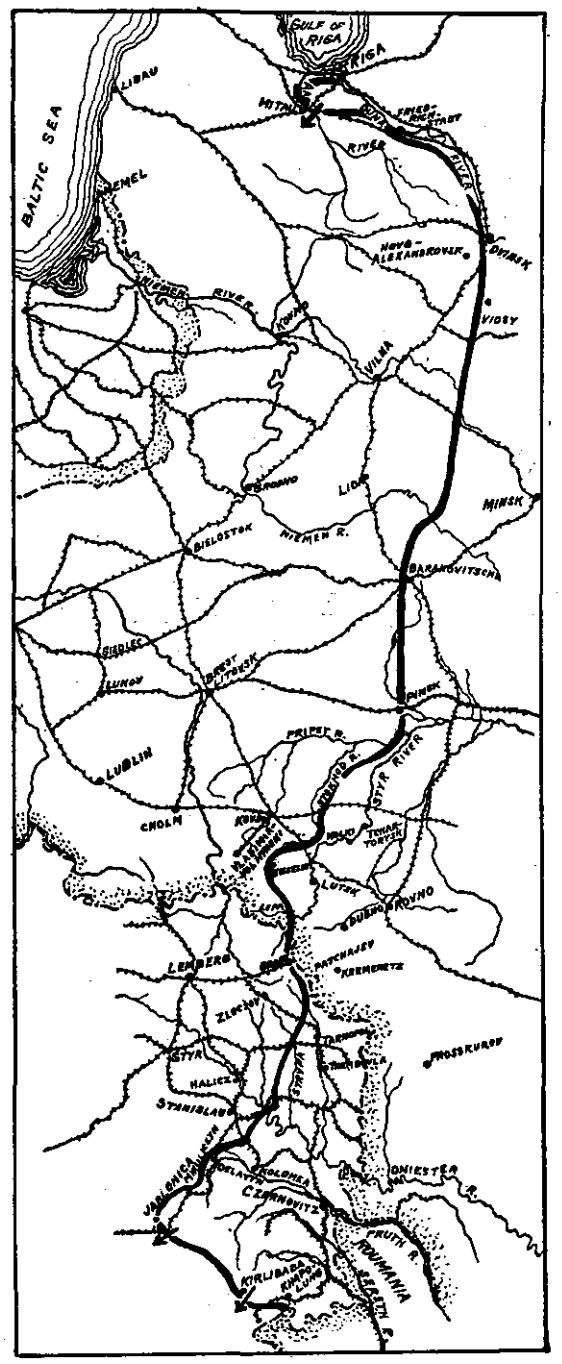
But there is still another front to be heard from—Saloniki. The offensives east and west are being prosecuted with great vigor, so great that neither front can be weakened to help the other. General reserves have been called upon to bolster up these lines, for they must be defended; there are undoubtedly other general reserves available for use, probably from 600,000 to 800,000 men, but one may be sure that they will be fed into the battle fronts most grudgingly; a country without reserves is already lost, as the great Napoleon said.

Now, as to this other front—Saloniki. Austria and Germany have taken many of their troops away from the Macedonian line; they were urgently needed elsewhere, and it is reported that Turkey has sent a contingent to aid Austria. This is bound to weaken the Balkan line materially, for Bulgaria could not at the most extravagant estimate place more than 300,000 men afield. These, assisted by the remaining Teutonic troops, are face to face with Sarrail's 600,000 men—and they are held practically inactive.

Why? Either there is a well-founded hope that Roumania will come into the struggle, force the extension of the Austrian line along the Roumanian frontier and pinch Bulgaria between her upper millstone and the Saloniki nether one; or—Roumania will not come into the fight, in which case it sems sound strategy to hold the Balkan attack until the Teutonic defense of the great eastern and western fronts becomes so intimately involved that there is no opportunity to detach troops to stiffen the Balkan line without forcing the Kaiser to call upon his general reserves when Sarrail strikes.

Austria's perils would be great, overwhelming, should Roumania come in. This latter country, with forces about equal to those of Bulgaria, is squarely on the Austrian flank; and if Roumania and Russia should join hands atop the Carpathians, it appears as though it would be a death blow to Austria. Suppose, however, that Roumania does stay out of it all; Sarrail will, at some time, move forward with his 600,000—and it will probably be soon. It is to be doubted whether more than 400,000 can be secured immediately to oppose him—and as there is no line in position with extremities resting upon impassable obstacles, there is ample lateral room for maneuver, for flanking operations. If, then, the Bulgar front should be hurled back through Serbia, the Turkish communications would be threatened greatly, and Germany would have to decide whether to abandon Turkey to her fate or to call upon the rapidly diminishing general reserve to come to her assistance. The Entente knows well that when Sarrail moves such a problem will have to be decided. To support the Saloniki force will be a paramount duty of the Entente, and one may rest assured that when this time comes, activities on the other fronts will be increased to a point of desperate endeavor.

To complicate matters for Turkey, the Grand Duke



Russia's great battle line, stretching from the Gulf of Riga to the borders of Hungary

seems to have taken a new lease on life and is pressing forward, and is now in possession of Erzingan, the next strongly fortified point beyond Erzerum and before the Sivas line. The delay of the past few months in the Caucasus is easily to be accounted for; communications are more difficult in this section than in any other theater of war, and to collect the vast supplies of ammunition and food necessary to a stern campaign takes considerable time. Russia has given up attacking without adequate preparations, and so it is believed that the renewed activity in the Asia Minor peninsula presages a powerful advance which is aimed ultimately to block the neck of the peninsula from west of Trebizond, through Sivas, to the Gulf of Alexandretta. To each country its own defense is of far greater importance than the mere support of an ally. The threat to Turkey in Asia is becoming so much greater with each mile of Russian advance that it is believed Turkey will not permit detachment of much of her force for service farther west. Why Turkey came into the war at all is hard to see. If Teutonia loses the war, Turkey is doomed—will likely cease to exist; she knows that. And if Teutonia wins, then Turkey becomes but a vassal of Germany, lining the way to her "place in the sun." And Turkey knows that, too. As it is, Turkey is playing a game where the cards are stacked against her; flipping a coin, it is the old game of "Heads I win, tails you lose." German dominance of Turkey must have been so unbelievably great before the war that Turkey had no choice save to obey the behest of Berlin.

The situation regarding the position of Russia to-day is highly reminiscent of that which obtained during the early days of the war, as far as position and opportunity goes. From Kirlibaba to Jablonica Pass, Russia is practically at the crest of the Carpathians; from Jablonica to southeast of Brody, the Russian line extends over the eastern face of Galicia. Russia has two choices; she may either endeavor to force the mountain barrier and ride down into Hungary, or she may center her efforts upon a push through Galicia. It was from this direction that Russia upset the Austrians in the early days of the war—with the difference that Austria had thrust northward into Poland at the orders of the Germans, and when the Russian drive rolled through Galicia it took them in rear and caused a precipitate retirement. If Russia drives again into Galicia, it will be an operation directed toward forcing back the Austrian right flank, not striking at communications. But should Russia attempt the thrust into Hungary, it would call for tremendous armies, for her own left flank would be rather up in the air unless sufficient men were available to form a strong refused angle—and unless Roumania should cover the left flank for her. The thrust through Galicia, however, if successful, would have the effect of getting in rear of the Austrian-German lines and the occupation of Lemberg, should cause immediate Teutonic retirement to the Kovel-Vladimir Volynski line farther north—possibly retirement to the Bug. It therefore seems more reasonable to assume that unless Roumania declares herself actively, Russia will confine her southern major operations to the Galicia section without doing more than attempt to control the Carpathian barrier as a strong point of rest for her left flank.

At the risk of appearing to be possessed of but one idea, attention is again invited to the Saloniki front. Keep on the lookout for movements there; put two and two together and figure on the possibilities when that front bursts into the flame of assault. If one is inclined to bet, it may be well worth the risk to wager that when General Sarrail at last moves forward monumental results will follow that will have a distinct bearing upon the outcome of the war to such an extent that the war will pass into another distinct phase—perhaps well along toward the end of the conflict.

The Current Supplement

THE scourge of Infantile Paralysis that has visited New York and its vicinity recently is a matter of interest to the entire country, as it is liable to appear anywhere. Although it cannot be said that any definite information in relation to the disease exists, the facts of present knowledge concerning certain highly pertinent aspects of the malady, together with deductions of practical importance derived from them are given in a statement by the greatest authority on the subject in this country, which appears in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2118, for August 5th. It is very complete and exhaustive. *An Electrically Operated Marble Quarry* is an interesting story of how this valuable and convenient power is utilized for a great variety of operations. It is illustrated by a number of excellent photographs. *The Cyclo-Harmonograph* describes and illustrates an ingenious scientific instrument for drawing large classes of important higher plane curves. The valuable article in *Automobiles in the Great War* is concluded. *Rapid Nickel Plating* tells of investigations with a view to improving present methods of procedure. *Nightblindness* gives interesting information relating to a little understood defect, to which the war has called attention. The *Restoration of the Dynosaur Podokesaurus Holyokensis* is a valuable paper by one of the leading paleontologists in the country that should be of great interest to all students of ancient life on the earth. It is illustrated by reproductions of the author's original drawings. *Ore Flotation* deals with an important process that has yet not progressed beyond the first stages of development, and which offers a wide field for investigation. Other articles are *Experimental Biology* and *Materials Used in Casehardening.*

Sir William Ramsay

The Father of the New Physical Chemistry

FEW of those conversant with the details of the services of Sir William Ramsay to the cause of science can have failed, when their morning papers of July 24th made known to them the passing of England's foremost chemist, to draw a mental parallel between the positions held in the lay mind by him and by the distinguished decedent of the previous week, the Russian bacteriologist, Metchnikoff. Each man possessed an extraordinarily complete grasp of the general field in which he had chosen to put forth his labors, each had made contributions of extreme value in all quarters of that field. Yet each is known to the world at large almost entirely through a single performance which chanced to possess that touch of the bizarre and the spectacular needed to rivet the attention of press and public upon a scientific effort. Just as Metchnikoff was last week pointed out to be the man who makes us live to unexampled old age by feeding us sour milk, so is Ramsay no less the modern alchemist who has realized the dreams of centuries of pseudo-science, and at one stroke elevated the medieval notion of transmutation from the rank of a childish phantasy to that of a scientific *fait accompli*. In the case of the chemist no less than in that of the biologist is the fame of all other achievements lost in the fanfare of popular clamor greeting the one exploit.

To Ramsay even more than to Metchnikoff is grave injustice thereby done. For Ramsay belonged to the romantic type of investigator, working with unusual speed of reaction, marked by rapid and varied production, leaping with sure scientific insight and imagination to correct conclusions where a less gifted worker is forced to plod wearily through a maze of facts to reach the same result by a long process of reasoning. Hence a catalogue of his activities comes close to being a complete review of the modern chemistry.

Obtaining his early education from a scientifically inclined father, he later attended the universities at Glasgow, Heidelberg and Tübingen. His first efforts were in the field of organic chemistry. It is very interesting to observe from his many communications how he gradually found his way out of organic work into that other region which has since found an independent place as physical chemistry. It was at first certain practical problems, such as the determination of vapor densities, which introduced to his attention the more physical aspects of his science. Here we find the first marks of growing genius in his extraordinary independence in the choice of means of attack. Thus he used the pitches of pipes of fixed dimensions for the determination of vapor densities, thereby utilizing his own musical abilities.

This process was successful, but he was less fortunate in an attempt to measure the electric conductivity of substances by means of the telephone. The problem of vapor densities, however, gave rise to further investigation, in the course of which the habit of expressing experimental results by mathematical formulæ, learned from Sir William Thomson while an undergraduate at Glasgow, turned out to be of extraordinary value. In this connection originated the fundamental works on evaporation and dissociation, which first drew the attention of the larger circles of the scientific world upon him. While not appreciated at their full value at the time, their investigations nevertheless led to Ramsay's appointment to the chair at the University of London which he filled for over thirty years, to the day of his death.

With this appointment began the rapid succession of works which brought Ramsay to the scientific eminence which he deserved. The measurement of surface tensions up to the critical temperature led to the well-known law which allows us to determine the molecular weights of liquids. An occasional lecture experiment, during which magnesium nitride was produced, suggested to him to coöperate with Lord Rayleigh in the solution of the problem proposed by the latter concerning the difference in density between nitrogen derived from the air and that obtained from other sources. By heating atmospheric nitrogen repeatedly with metallic magnesium he succeeded in producing a gas that became denser as the operation proceeded, and turned out to be quite different from nitrogen itself. At the same time Lord Rayleigh solved the problem of separating nitrogen from possible impurities by a repetition of an experiment devised by Cavendish a hundred years earlier, which had failed at that date because of inefficient apparatus. The joint continuation of the work by these two investigators led to the discovery of argon, first of a new class of elements.

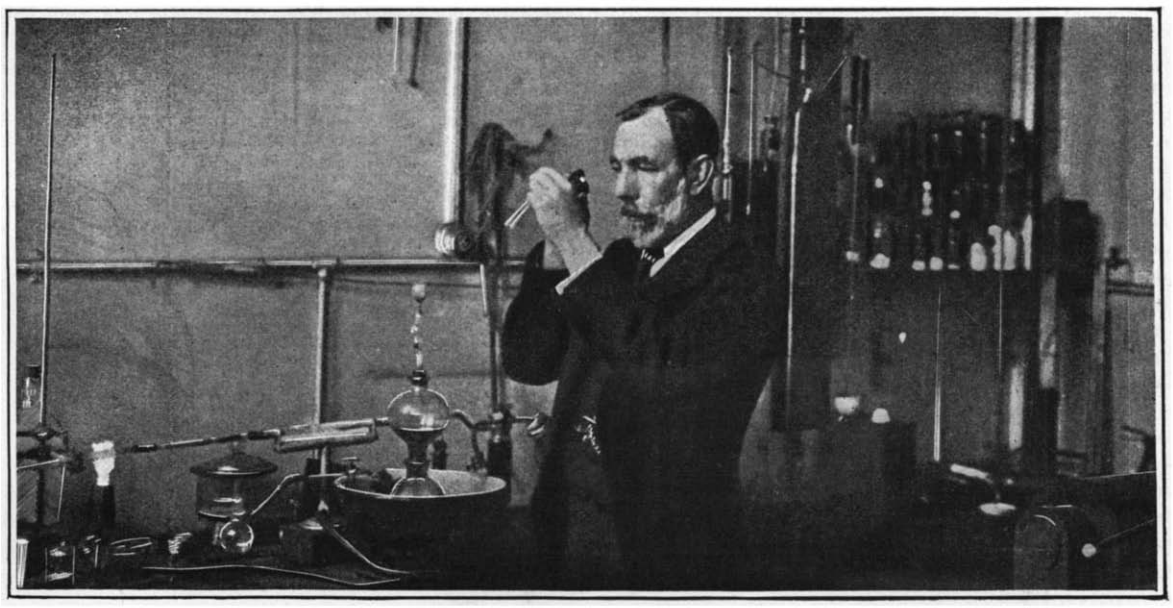
But when an element of a new type had been found, the periodic law at once suggested the existence of a number of other elements of the same type. Following this lead, Ramsay succeeded in a short time in isolating the element helium from certain rare minerals, and identifying it with an element already found spectroscopically in the sun—whence its name. An incidental occupation with a liter of liquid air, then first made in London by Hampson, led to the discovery of three further elements of this same type—neon, krypton and xenon. These were separated from each other and described, in many cases by the use of entirely novel methods of determination. Then when the dark rays of uranium were found—from which later followed the discovery of radium—Ramsay showed the keenest interest, and undertook in his own laboratory an investigation of the phenomenon.

It will be noted from the above brief outline that Ramsay's work always moved in orderly sequence from one thing to another. It was this faculty of pressing each point to its ultimate limit, of discovering all its connections, of seizing upon its logical corollaries and sifting these out to their conclusions, of extracting the last ounce of profit from everything he undertook, which characterized Ramsay's work at all times. This is undoubtedly to be attributed to his membership in the romantic type, already mentioned; he was able to see connections which no one else would ever have imagined to exist. It was the final step in this process of continuous passage from point to point that brought Ramsay to the study of possible transmutations of the elements. We may here well allow him to speak for himself, in the words of his presidential address of 1911 before the British Association.

"The discovery of radioactivity by Henri Becquerel," he said, "of radium by the Curies, and the theory of the distintegration of the radioactive elements, which we owe to Rutherford and Soddy, have indicated the existence of no fewer than twenty-six elements hitherto unknown. To what places in the periodic table can they be assigned? What proof have we that these substances are elementary? Let us take them in order.

"Beginning with radium, its salts were first studied by Mme. Curie; they closely resemble those of barium; the metal, recently prepared by Mme. Curie, is white, attacked by water, and evidently of the type of barium. The atomic weight, too, falls into its place; it is 89.5 units higher than that of barium; in short, there can be no doubt that radium fits the periodic table, with an atomic weight of about 226.5. It is an undoubted element. But it is a very curious one. For it is unstable. Now stability was believed to be the essential characteristic of an element. Radium, however, disintegrates—that is, changes into other bodies, and at a constant rate. If a gram of radium is kept for 1,760 years, only half a gram will be left at the end of that time; half of it will have given other products. What are they? We can answer that question. It gives a condensable gas, 'radium-emanation'; in addition, it evolves helium, one of the inactive series of gases, like argon. Helium is an undoubted element, with a well-defined spectrum; it belongs to a well-defined series. The atomic weight of 'radium-emanation' can be calculated, and it corresponds to a congener of argon, the whole series being: helium, 4; neon, 20; argon, 40; krypton, 83; xenon, 130; unknown, about 178; niton (the name proposed for 'radium-emanation'), about 222.4. The formation of niton from radium would then be represented by the equation: radium (226.4) = helium (4) + niton (222.4)."

Sir William then went on to describe a whole series of products of radium in a descending scale, each resulting from the disintegration of the preceding substance in the scale, by means of an equation entirely similar to the one above. The "half-periods" of these substances, that is to say, the times during which they lose by emanation half their mass, vary from three minutes to sixteen and a half years. The series ends with the disintegration represented by the equation: polonium (210.4) = helium (4) + lead? (206.4). But the atomic weight of lead is 207.1. However, it is possible that that of radium is 227.1 instead of 226.4, and there are other hypotheses upon which the variation can be explained away. The significant feature is the passing of one element into another, according to a definite law of procednre that can be embodied in the form of an equation. And it is this which is seized upon by the popular mind and made the basis of Ramsay's reputation.



Sir William Ramsay in his laboratory

That the thing is indeed of far-reaching consequences appears at once. We pass over the possibility, which makes such immediate appeal, of the manufacture of valuable metals from base ones; for it is quite clear that in anything resembling the present state of science this could not be done upon a commercial scale, or even at a profit on any scale at all. The immediate possibilities lie rather in the direction of utilization of energy. As Sir William puts it:

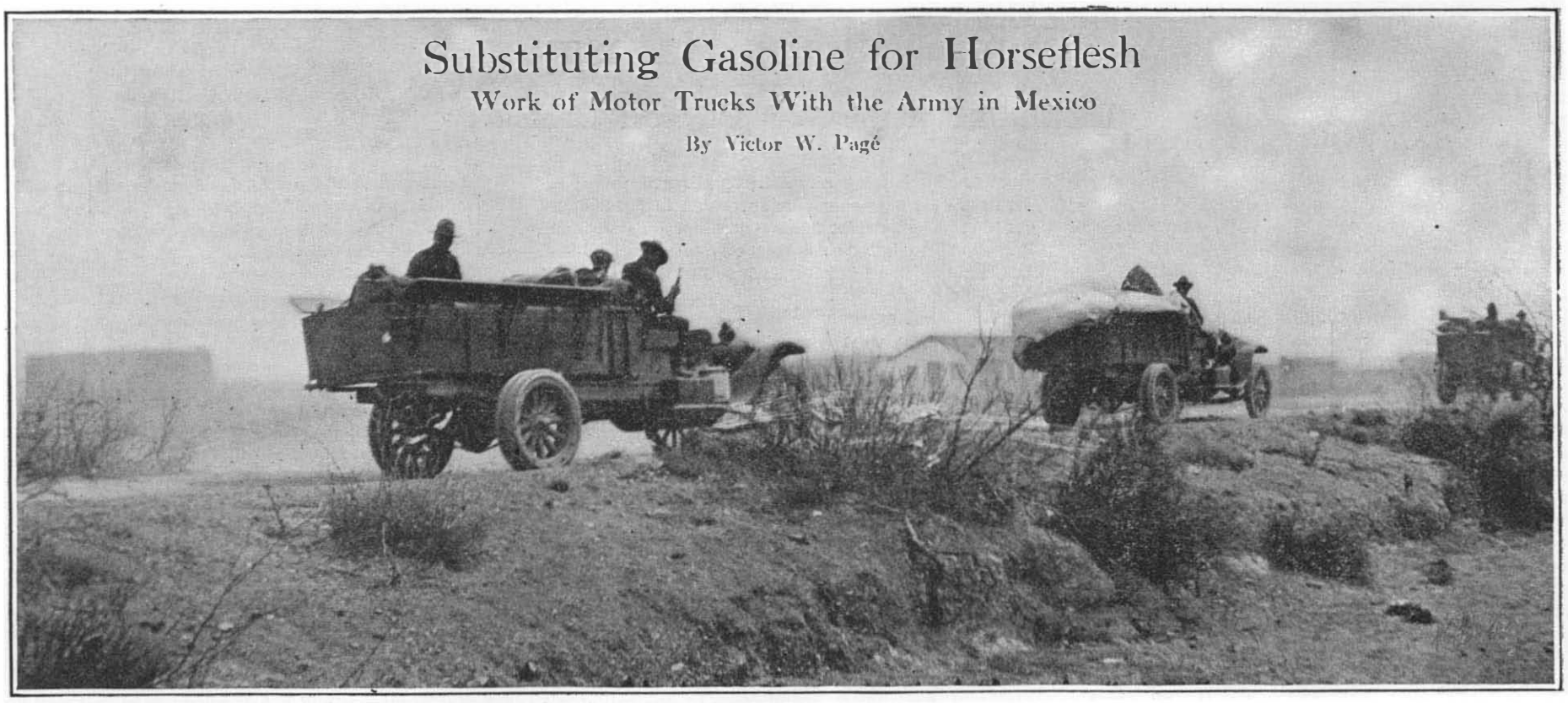
"Attention has repeatedly been drawn to the enormous quantity of energy stored up in radium and its descendants. That in niton is such that if what it parts with in heat during its disintegration were available, it would be equal to three and a half million times the energy available by the explosion of an equal volume of detonating gas. If the energy in a ton of radium could be utilized in thirty years, instead of being evolved at its invariable slow rate of 1,760 years for half-disintegration, it would propel a ship of 15,000 tons at the rate of fifteen knots per hour for thirty years. If we could control the rate at which radium evolves its stored up energy, we should have a useful and potent source of energy. But the supply is a very limited one. If, however, the elements which we have been used to consider as permanent are capable of changing with evolution of energy, if some form of catalyzer could be discovered which would usefully increase their almost inconceivably slow rate of change, then it is not too much to say that the whole future of our race would be altered."

So it is seen that the popular mind is not entirely wrong in its estimate of Ramsay's last discovery. It has a wrong perspective. It emphasizes the aspect of matter at the expense of that of energy, it fails to grasp the true scientific import of transmutation as a material process; it ignores the significance of Ramsay's previous work which led directly to this achievement. We may, with Ramsay, deplore the emphasis put upon the spectacular side of his labors, upon his efforts to produce copper from lead, etc.; but, after all, while we agree that it seems quite likely that posterity will look back to him as the harbinger of a new civilization, we are not so far out of accord with the snap estimate of the man in the street.

Substituting Gasoline for Horseflesh

Work of Motor Trucks With the Army in Mexico

By Victor W. Pagé



An example of good roads in Mexico

WHEN the history of the punitive expedition into Mexico is written the important part that motor transportation played will be fully realized. In fact, it is safe to say tbat without the aid of the motor truck the rapid movement of General Pershing's forces from the border far into the interior of Mexico would have been impossible. If power wagons had not been available it would have been necessary to purchase hundreds of mule-drawn wagons and thousands of animals, which in the present depleted condition of the market due to the demands of the European war, would have been difficult to accomplish promptly. If automobile transport had not been available, it would have been necessary to seize the railroads, which in itself would have been an act that might have precipitated a war. The army equipment of trucks was small indeed, but this was not the fault of the military men who are in charge and who realize the importance of mechanical transport, but to the meagre funds allotted the army in peace times by our legislators. Fortunately, the United States is the home of the most progressive motor truck manufacturers and the largest producers of these vehicles in the world. The weekly output of a number of our American plants is almost as great as the yearly output of many of the European makers whose vehicles have an enviable reputation.

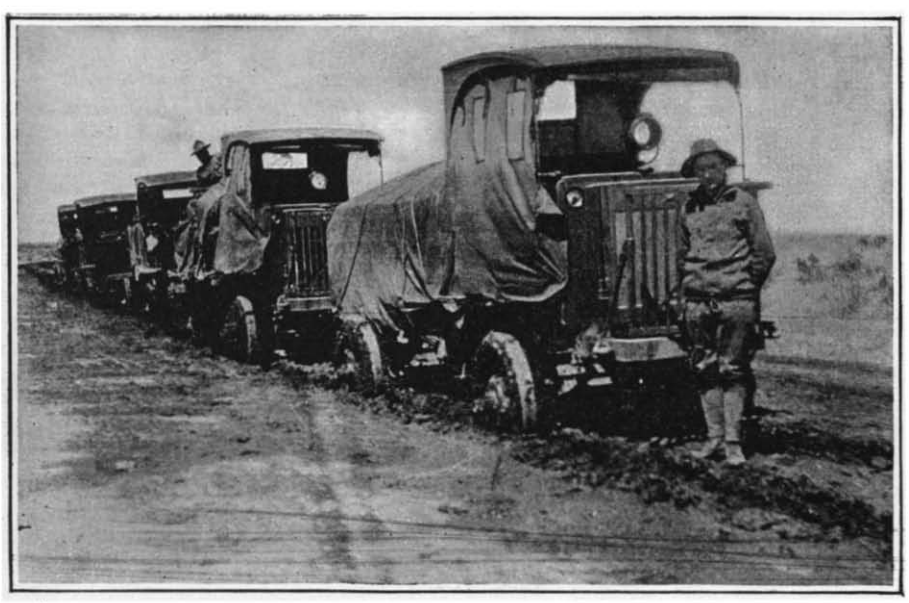
Loading a convoy preparatory to a start for an advanced army base

Considering first the marked superiority of motor-propelled army supply wagons to the animal-drawn conveyances, it will be evident that there is much in favor of the gasoline power plant. At the inception of the European war there were not enough horses in existence in the world to have handled that large problem of transporting over twenty million men and of feeding them and keeping them supplied with arms and ammunitiou. It takes about three years to produce a draft horse, or mule, suitable for army use, and the work that can be accomplished by a horse is only about one sixth of that which can be done by a motor truck of 1½-ton capacity. We know that there are limits to the endurance of living things. A man, horse or mule can do only a definite amount of work without rest. A motor truck can go twenty-four hours, and after a few minutes' attention, such as greasing up the mechanism and perhaps making a few minor adjustments, it is capable of repeating this term of service almost indefinitely, as long as the mechanism is maintained in good condition. The motor truck not only transports more material than the corresponding type of animal-drawn vehicle, but it can be handled more easily and is quicker. One important thing gained by the use of the truck is that it is not necessary to carry forage for animals, and the large space formerly taken up by this bulky material can be utilized in bringing the all important supply of men, ammunition and food to the fighting line.

At the inception of the European war our American manufacturers did not have a very good idea of what constituted the design features of a successful motor truck. The foreign purchasing agents, however, who placed orders for several thousand trucks of various makes suggested features that should be incorporated to make the trucks more practical for army service, though many strictly commercial chassis were sent abroad to fill the urgent demand. The lesson taught in Europe was soon learned by the United States military authorities, and automobile engineers who had been following very carefully the reports sent from abroad decided that certain features should be incorporated in trucks intended for army use that were not always essential when the chassis was to be applied to every day service. The conditions in Mexico are radically different from those obtaining in Europe. Instead of the very good roads that were available there, the Mexican highways are worse than our country byroads, and in some cases are merely trails through sandy wastes, furrowed with numerous small gullies.

The modifications that were necessary to adapt the regular commercial chassis were not many, nor did they involve radical changes in design. The only thing that could be considered a radical departure from current practice was the use of trucks in which the power was applied to all four wheels, and in some cases in which all wheels were dirigible for steering purposes. Four-wheel drive trucks were found capable of negotiating any road or field where the animal-drawn army wagon could be driven. It was found that a good ground clearance or plenty of room between the mechanism and the ground and absolutely reliable power plants were essential. The frames had to be stronger, the turning radius had to be shorter, and the standard vehicle tread was found preferable to the variety of treads that are noticed on vehicles intended for operation over city streets or good roads. Powerful brakes were an important requirement, and in some cases the provision of sprags, which have been practically forgotten in business vehicles, was insisted on.

A truck with trailers crossing a ford that is more than hub deep



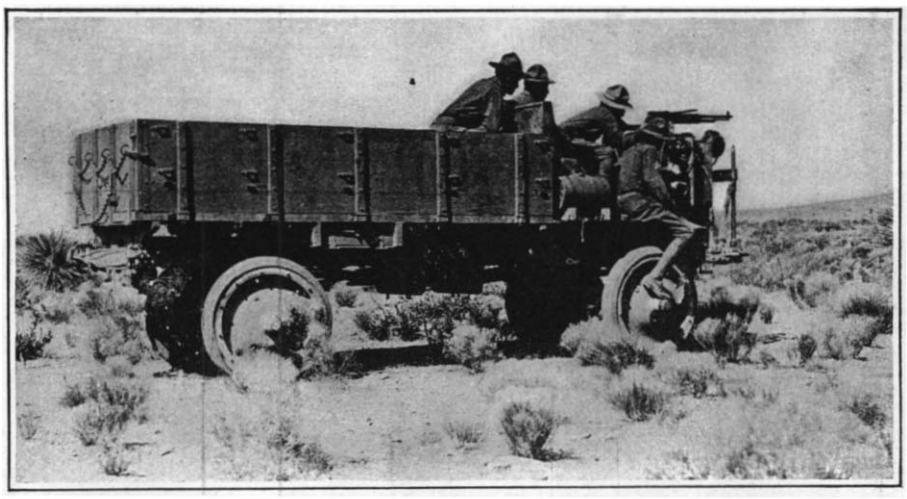
Mexican roads after a rainstorm are far from ideal for motor transport

The gasoline tank capacity was increased in order to enlarge the touring radius, force feed water circulation was pronounced essential, as was the standardization of such parts as spark plugs, magnetos, carbureters and other accessories, to make them interchangeable on trucks of different makes.

Naturally the call for trucks for munitions transport purposes automatically developed a demand for other types. Among these may be mentioned water, gasoline and oil tank carrying autos, traveling repair shops, trucks equipped with powerful wireless or searchlight equipment, other forms intended for wrecking service and for the use of the engineers, armored cars carrying armament suitable for offense and defense, and other vehicles intended for transportation of troops. There is also the need of vehicles of the tractor type for hauling heavy artillery and special motor trucks for carrying supplies and machines for the aeronautical division.

Nearly all of the truck manufacturers in the United States that may be ranked as leaders have contributed to the recent demand for trucks to be used in Mexico. Some makes are represented by nearly 300 cars, of others there are a lesser number. The trucks in use may be divided into two main chassis types, the conventional rear drive and the type that drives, steers and brakes by all four wheels. There are a number of trucks in use, however, that drive by the four wheels but which steer only with the front wheels. The war department and the commanding officers are particularly pleased with the work done by the four-wheel drive form where poor roads have to be negotiated. After a heavy rainstorm, such as always occurs in warm countries, or in the deep desert sands, which are also a common feature of Mexico, it is sometimes difficult for a two-wheel drive truck to obtain enough traction to surmount unusual obstacles. Under these conditions it was possible for the four-wheel drive trucks to make some progress. The test of war service, of course, cannot be accepted as final in its bearing upon the operation of vehicles in regular commercial service. There are too many rear-wheel drive trucks in use to question their practicability under the operating conditions they were designed to meet. Modern warfare, however, has introduced an entirely different set of conditions, which are best met by trucks specially designed to cope with the unusual.

To show the high state of efficiency and preparedness obtaining in our motor truck factories it is necessary to cite but one instance. A prominent company, which has about two hundred of its trucks in active service on the border, was able to fill an order for 56 three-ton trucks, which were valued at $186,000, in eight hours after the order was received. Other prominent makers made records almost as good as this in supplying the rush orders received from the war department. It has been the endeavor of the army authorities to organize the trucks into convoys or trains of twenty-eight trucks each. There are about twenty of these truck companies now in service, and orders are expected for a large addition to this number.



Rapid-fire gun mounted on a motor truck dash-board to repel attacks

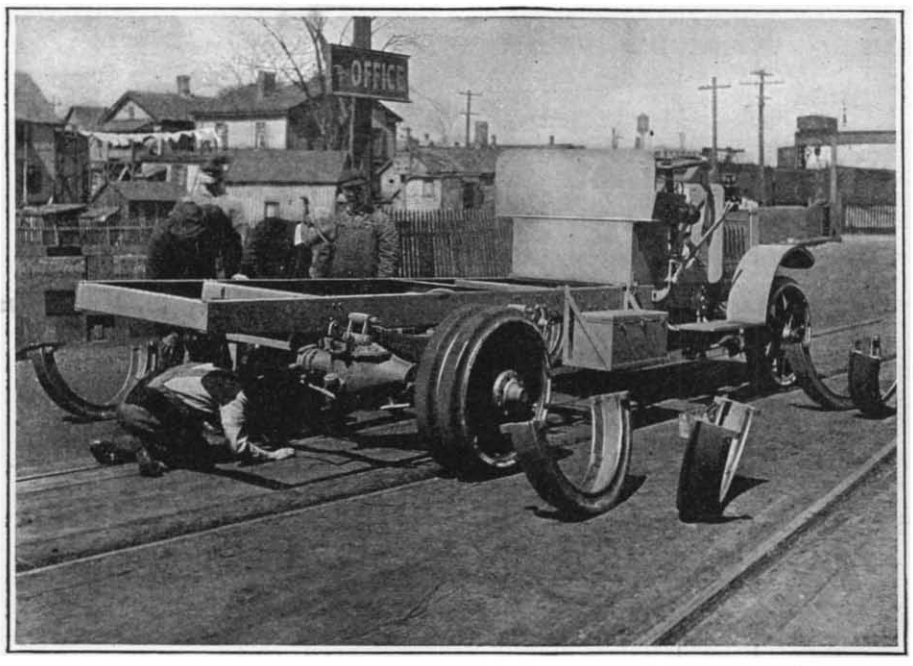
Very little has been done at the present time in the equipment of special vehicles such as used abroad. There are practically no motor ambulances, self-propelling kitchens, or autos offering bathing facilities such as are used in Europe. As these are types that can be readily fitted to standard chassis forms, they can be quickly extemporized should there be actual need of their services. There is likewise a paucity of armored trucks and anti-aircraft carriers. There has also been a scarcity in self-propelled repair shops, but this need is now being supplied. The lack of armored trucks has been met in an ingenious manner by fitting rapid-fire guns to some of the four-wheel drive trucks which have steel bodies. The quick-firers are mounted on special swivel fittings that can be moved at will to sweep all four sides of the machine and also to be pointed up in the air. In fact, on some of the regular supply trains rapid-fire guns are mounted on the steel dashboards of the trucks to give added protection to that afforded by the guards accompanying each train.

In spite of the bad road conditions, some very good records have been made by the different motor truck companies, and a spirit of rivalry between the different commands exists at all times. Truck company No. 3, which is composed of rear-wheel, worm-drive trucks, recently lowered the record between Casas Grandes, Mexico, and Columbus, New Mexico, by an hour, making the 104 miles in ten hours actual running time. On this trip this truck company had been away from its base for fourteen days, having traveled about 1,000 miles in that period.

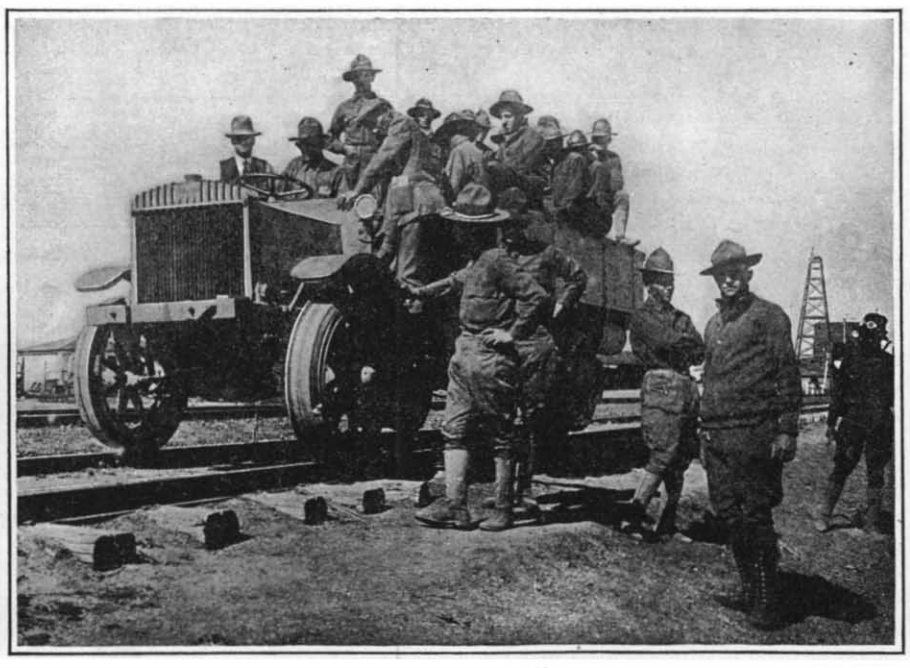
When operating trucks in a country that is practically roadless much can be learned, and manufacturers are not only correcting the minor defects that practical service has shown to exist in their product, but the Government is also realizing the importance of good roads, and the resulting stimulation of the propaganda for suitable military roads cannot fail to be of value.

The drivers that have been recruited for service in Mexico are practically all civilians, many of them having volunteered from the truck factories to accompany the shipments of trucks to the borders. Others are taxicab drivers and motor truck operators having metropolitan experience. Then, again, college students of an adventurous turn of mind have been interested in the work, and, finally, many enlisted men have been trained to drive the trucks since these have arrived on the border. As a rule, the enlisted drivers have proved the most satisfactory, and on several occasions civilian chauffeurs have not taken kindly to the orders given by army officers. Most of the drivers, however, have performed excellently, and in some cases, heroic service.

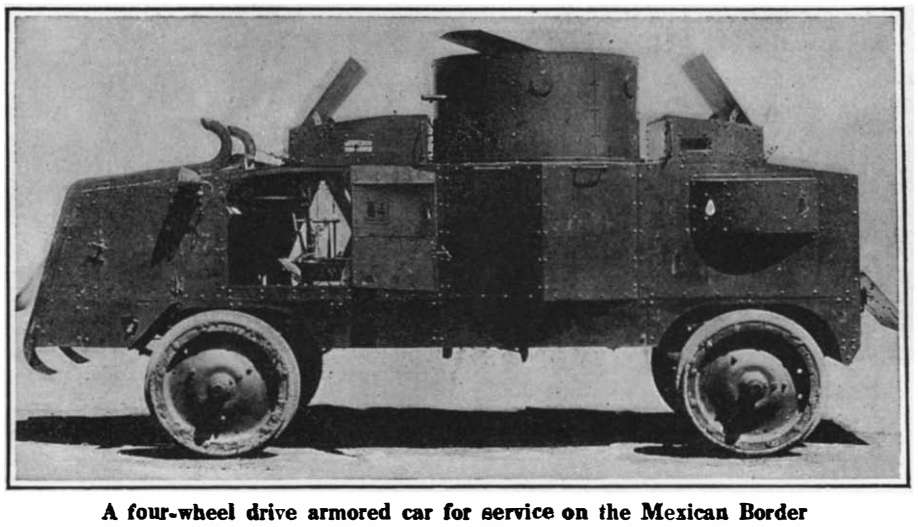
Much is expected of an equipment consisting of special flanged rims that may be secured to the ordinary truck wheels to make the truck suitable for operation on regulation railroad tracks. A machine equipped in this manner was placed on the rails at Columbus and made the trip to El Paso, Texas, a distance of 93 miles, at an average of 19 miles per hour. When it arrived at its destination it was removed from the tracks and driven over the roads. It made its return trip to Columbus the same day.



Fitting a truck with flanged wheels for travel on rails



Motor truck equipped to travel on railroad tracks



A four-wheel drive armored car for service on the Mexican Border

Linking up Greece with Other Continental Railroads

IT is interesting to note the completion of the remaining strip of unconstructed road necessary to the final linking up of Greece with the rest of Europe. This gap of some 56 miles has at last been closed, and the stretch of roadway is most likely in use at the present writing.

The result of the completion of this work to Greece can hardly be overestimated. As soon as the war is ended, through trains will be run from Paris and other European capitals to Athens and its port, Piræus.

Time from Paris will be shortened 60 hours, it is thought, and through dining and sleeping cars of the Compagnie Internationale des Wagons Lits et des Grands Express Européen will run over the lines.

This hitherto missing link in communication lay between Gilda, on the Salonlki-Monastir line, and Pappapuli, on the Thessalian frontier. Temporary bridges of wood span streams and valleys until permanent steel and concrete structures can replace them when peace is established.

Twenty powerful engines, now ready at Athens, will draw these trains at high speed through the picturesque Vistritza Valley and along the Ægean coast to their destination.

Three-inch field gun battery on the march

The Field Artillery of the United States Army

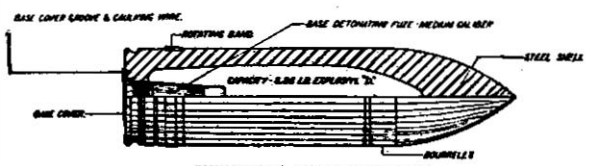
The Field Gun Has Become the Dominant Element in Modern Warfare

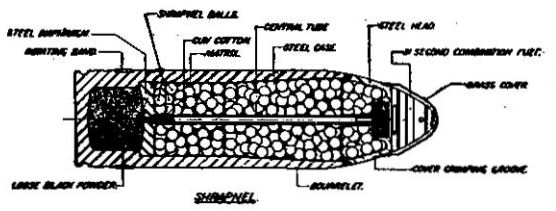
IT is not going too far to say that the growth in power and numbers of field artillery and its dominating influence on the field of battle is the most striking development of the European War. Prior to the war field artillery consisted of direct-fire guns of the 3″ to 4″ calibre and high-angle fire guns or howitzers, which ran from 4.7″ to 7″ caliber in our own army, with a few pieces of larger caliber, say 8 to 9.5″ caliber in some of the European armies.

Germany and Austria, having in view the destruction of the steel and concrete fortifications of the nations which they were preparing to attack, set themselves to develop new artillery of such enormous destructive power that it would have the fortifications completely at its mercy. As the result of extensive experiments carried out at their various proving grounds, the German and Austrian authorities developed certain mobile howitzers of unprecedented size and power, capable, where the roads were favorable, of transportation with the armies, and of being quickly brought into action, either upon the carriages on which they were transported or upon hastily-prepared foundations of concrete. Best known of these great pieces are the Skoda, 12″ Austrian howitzer and the German 11.2″ and 16.5″ howitzers. How these guns quickly reduced the fortifications of Liege, Namur and Maubeuge is now an old story familiar to every student of the war.

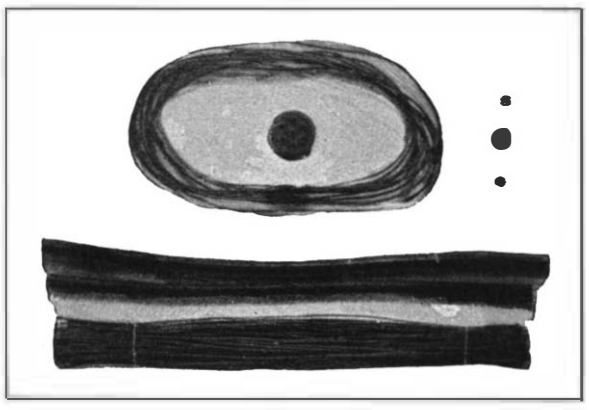
When the contending armies on the various fronts had settled down to trench wafare and reliance had come to be placed upon earth fortifications, it was found that these heavy pieces, together with the lighter howitzers of from 6 to 9.5″ caliber were equally efficient for tearing the trenches and the various forms of field earthworks to pieces and opening the way for infantry assault. The smashing and leveling effect of the big howitzers has been well illustrated in the assault on Verdun, and in the present great offensive of the Allies at the River Somme. Thus it has come about that there has been a great increase in the types of new guns and it is now certain that the big howitzers of from 9.5″ to 12″ caliber and over have come to stay.

The field artillery of the United States Army, as at present constituted, consists of seven or eight types of gun. First the guns of minor caliber, namely, the standard 3″ field-gun, the older 3.2″ field gun, and the 2.95″ mountain gun; the guns of mid caliber, including the 4.7″ direct-fire gun, the 5″ siege gun, the 4.7″ howitzer and the 7″ howitzer, this last named being an early type and now considered obsolete; of the major caliber guns of from 8″ to 16.5″ caliber our army at present possesses none.





Sectional views of schrapnel and common steel shell



Samples of smokeless powder

The complete field gun consists of two parts—the gun and its limber or caisson, the latter containing the ammunition. Each part is mounted on a pair of wheels and when the gun is in battery the gun and its limber are placed side by side, the caisson abreast of and to the left hand side of the gun. The rapidity of fire of the field gun is due to the method (first adopted in the Navy) of mounting the gun in a sleeve in which it recoils and placing the telescopic gun-sights on the carriage, where they remain stationery during the recoil. This makes it possible for the gun to be maintained continually on the target. One of our illustrations shows the gun-pointer with his eye at a panoramic telescope. It is his duty to maintain the gun at the correct elevation by means of an elevating hand wheel. The latest field pieces of this model are provided with a traversing mechanism which allows the gun to be traversed to a limited number of degrees independently of any movement of the gun carriage. The carriage is prevented from recoiling by means of a spade at the end of the trail, the spade being driven firmly into the ground. The recoil of the gun is taken up and controlled by means of a cylinder, filled with oil and water. During the recoil, the movement of the gun compresses a coiled spring which serves to bring the gun back into battery.

The operation of these 3″ field pieces is very rapid; and it is claimed that, under favorable conditions, the French 75 centimeter (approximately 3″) gun has fired as many as 20 rounds in a minute. Our 3″ field piece fires three kinds of shell, each of which weighs 15 pounds. They include a common steel shell containing 13 oz. of explosives "D"; a common shrapnel shell filled with 252 balls, the interstices being filled with a smoke-producing matrix; and a high-explosive shrapnel in which the interstices around the 285 balls are filled with a matrix of high explosive. In the case of the shrapnel, the bursting charge of loose black powder is carried in the base and the time fuse at the nose of the shell. The fuse is so set with reference to the range and the time of flight, that the black powder will be ignited and the balls driven from the case just above the body of troops to be attacked, the balls scattering and falling in a cone-shaped mass upon the enemy. The balls are shot out of the

The 4-inch field gun, limbered up, ready for transport

case with an added velocity of from 250 to 300 feet per second. The high-explosive shrapnel will eventually replace all types of shell for the 3" field gun. The maximum range of this gun on a level platform is about 8,000 yds. with the gun at maximum elevation. If the trail be sunk in the ground the range is increased to about 9,500 yds. This gun is used entirely against personnel. The older 3.2" gun has a range on a level platform 4,500 yds. and with a sunk trail of 6,000 yds.

The 2.95" mountain gun is designed to be carried on pack animals. It is so built as to be quickly dismounted from and assembled on its carriage. The gun, weighing only 236 pounds, is in one piece, its total length being only 3 ft. It fires a 12.5 pound or 18 pound projectile with 920 and 750 ft. per second velocity.

The 4.7" gun like the 3", uses fixed ammunition, the shell and the powder charge being contained in a common case; and it fires either shrapnel or high-explosive common steel shell. The projectile weighs 50 pounds and the maximum range with an elevation of 15" is about 7,000 yds. and the maximum with the trail sunk below level is 11,000 yds. This gun is used for breaching earthworks and also against personnel in the open. The 3" gun is our only absolutely first-class fieldpiece; the 4.7" gun would be a most excellent piece if it were provided with a better carriage. As it is, the amount of elevation on a level platform is limited; indeed the 3" gun, having 9 deg. more elevation, has a greater range than the much more powerful 4.7" gun. The latest model of 3" gun bears date 1905 and the 4.7" gun is the model of 1906.

Our 4.7" howitzer is a shorter gun of lower velocity designed for use against overhead cover, dug outs, and intrenched personnel. Upon a level platform it has a maximum range of something over 6,500 yds.

We also have a 5" siege gun of obsolete pattern, designed in 1898 and 1890. Its weight is 3,660 lbs. and it fires a 45-lb. shell with a muzzle velocity of 1,830 ft. per second. Its maximum range firing from a level platform is 5,400 yds. and with a sunk tail it has a maximum range of 6,500 yds. The recoil is checked by a hydraulic buffer, which consists of a steel cylinder, 5" in bore and 42" in length. The piston rod of the gear is attached to the trail and the cylinder is connected to a pintle secured in the platform.

The 6" howitzer is a more modern piece being of the model of 1908. Its weight is 1,925 lbs. and it fires a 120-lb. projectile with a muzzle velocity of 900 ft. per second and a maximum range from a level platform of about 6,700 yds. The gun is built up of nickel steel and consists of a body and a breech hoop. It fires common-steel shell and shrapnel. The carriage carries a cradle in which the howitzer is mounted. The recoil is controlled hydraulically and when the howitzer recoils it carries with it the cylinder, the piston of which, being fastened to the cradle head, remains stationary. The end of the trail is provided with a large spade, which serves to keep the carriage stationary, the howitzer being permitted to have a sufficient length of recoil on the carriage at low angle of elevation to render the carriage stationary under firing stresses. At high angles of elevation the length of the recoil is reduced in order to maintain clearance from the ground. The 6" howitzer is intended for use against overhead cover, dug-outs and intrenched troops.

The largest field piece that we possess is the 7" siege howitzer, model of 1898 and 1890. Like the 5" gun it is too old in design to render it serviceable under modern war conditions. The weight of the gun is 3,710 lbs. and it fires a 105-lb. shell with a muzzle velocity of 1,100 ft. per second. Its range when firing from a level platform is 7,000 yds. It was intended for breaking down overhead cover and reaching intrenched troops. Its carriage and recoil mechanism are generally similar to those of the 5" gun above described. The 7" howitzer is considered by our Ordnance Authorities to be obsolete; in fact, Brig. Gen. William Crozier, Chief of Ordnance, ignoring the 7" piece, stated that the heaviest piece of field artillery which is now in our service is the 6" howitzer above described.

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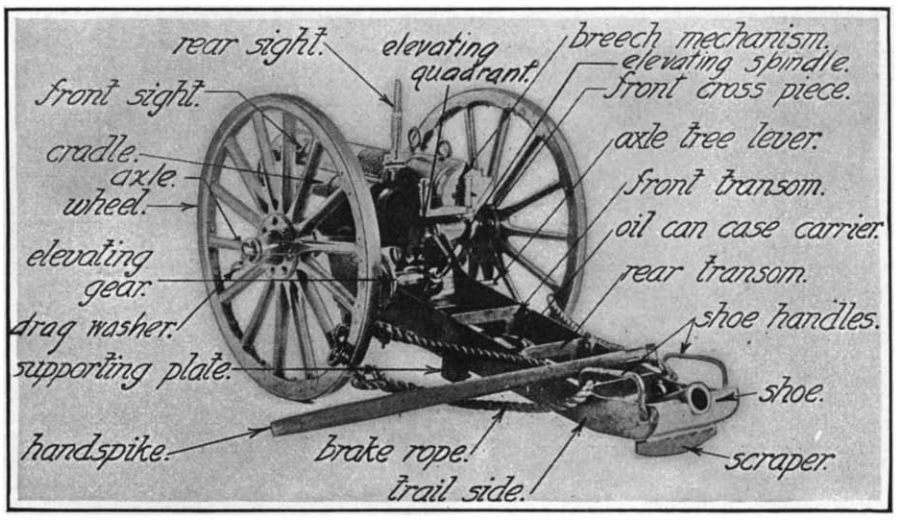
Three-inch field gun in action, with limber ranged alongside



The details of the 2.95-inch mountain gun

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Assembling a mountain gun. Note the one-piece gun in foreground

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Using the panoramic telescope gun sight on a 3-inch field gun

It is very evident to any one who has followed the development of artillery in the European war, that in this branch of the service, so far as our equipment is concerned, we are sadly deficient. Not only do we possess altogether too few of the types of gun above enumerated, but we are entirely without field artillery of the major calibres from 8" to 16.5". The fault is due, primarily, to the parsimony of Congress in refusing to grant the increase in personnel necessary to enable the Ordnance Department to do the experimental work, draft out the plans, and build some of the heavier types of guns. Gen. Crozier, in his recent hearing before the House of Representatives on Military Affairs, stated that he had been trying for several years to experiment with two calibers of field piece heavier than the 6" howitzer. With a totally insufficient force, the Ordnance Bureau has been trying to find time and the expert men to get out a design for a howitzer of about 7.6" caliber and for another one of about 9.5" caliber. The 7.6" howitzer would fire a projectile weighing 240 lbs., which is twice the weight of the projectile fired by the 6" howitzer, at present the heaviest field piece we have.

The 9.5" howitzer would fire a projectile weighing something like 400 lbs. It was originally intended to fire a projectile weighing 480 lbs., which is twice the weight of the projectile fired by the 7.6" howitzers. The Ordnance Bureau wished to go up by steps of 100 per cent in the weight of each projectile; that is, the weight of the succeeding projectile was to be twice the weight of the projectile fired by guns of the next smaller size.

The Bureau has had these two pieces in mind for a number of years, always hoping to get them out pretty soon. The 7.6" howitzer has been designed, and an experimental one has been just about completed. It is nearly ready to go to the proving ground at Sandy Hook for a test.

The 9.5" howitzer has never got beyond the stage of the preliminary drawing. If the Bureau had a sufficient force of officers to put at the subject, and if they had a sufficient force of draftsmen to carry out the ideas of the officers, they could have had the 9.5" howitzer on the proving ground now, and by the beginning of this year they would have had the 7.6" howitzer pretty nearly through with its tests.

As a result of the increased importance given to artillery by the European war, and as soon as reliable information on the subject was available, our War Department appointed a Board known as the Treat Board, which made three important changes in the principles governing the supply of artillery. It increased the proportion of guns to troops from 3.6 per 1,000 of infantry and cavalry to 4.9 guns per 1,000. It increased the size of the largest piece from a 6" howitzer to an 11" howitzer; and it increased the amount of ammunition supplied per gun from 1,800 rounds for the 3" field gun to 5,000 rounds. This increase is due to the enormous rate at which ammunition has been used up in the present war. General Crozier stated that he had heard reports coming directly from French officers to the effect that for a certain period of very intense action batteries of the 75 c.m. gun had fired as much as 1,000 rounds per piece.

With regard to our supply of field guns, the General stated that we had at the opening of the year about 900 field guns of all calibers, and that we actually require 2,040 guns. Furthermore, the question of the number of guns now required is intimately bound up with the question of the life of the guns. There is an enormous wastage of guns due to erosion now taking place in Europe. The 3" field gun is

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How an Army Hears

Every Resource of Modern Science Employed to Tell the Modern Warrior What His Enemy is Doing

AN army without an up-to-date signal corps would be blind and deaf. Should it be called upon to give battle to an enemy modernly equipped in this respect it would be as much handicapped as though its fighting units were armed with old-fashioned muskets and guns and employed black powder with disclosing clouds of white smoke.

The battle fronts of Europe furnish the most comprehensive picture of the functioning of this important service. On the western front, extending from a point between Ostende and Nieuport, on the North Sea, to the Swiss frontier in the vicinity of Belfort, there are something like 7,000,000 men, Teutons and Allies, in the various successive lines of trenchwork. These men are divided, for tactical and administrative purposes, into units of various strength, from the huge army corps of 40,000 men, to the infantry squad of eight. Yet it is not only possible, but an accomplished fact, that the squad at the very northernmost extremity of the line is in direct communication, if it should be necessary, with the squad whose right touches Switzerland.

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Field telephone in use near Vera Cruz

What is probably the most intricate system of telephonic communication in the world is to be found here. The wires extend at intervals of a few feet from the first line trenches and dugouts, back through the system of communication works to the second, third and all the reserve lines. At each military subdivision headquarters is an elaborate switchboard with tireless, lightning-quick operators on the job every minute of the 24 hours.

In turn, these centralization points are linked with others at the headquarters of larger units, and the ramifications extend not only to general headquarters but all over the country. Then the battle-front system is doubled, in some places trebled and quadrupled, for fear of a single line being shot away. And the whole system is coupled up by cable so that, for instance, a man in an English trench may talk with his own home. This is merely to show what may be done; there is too much press of official business to permit social chatter.

All this is the work of the signal corps. Electrical communication has come into such general use, has rendered all information so promptly available, that it has practically superseded all other methods. These other methods, however, visual signaling, etc., are by no means forgotten. The signal troops are as carefully trained in these essentials as in any others.

In general efficiency and organization the United States is fortunate in its signal corps. While it is far too small at the present time to render adequate service in time of war, what there is of it is highly trained and up to the minute in its theoretical and practical knowledge, although it has undoubtedly been seriously handicapped by lack of appropriations with which to purchase an ample supply of the most approved and latest apparatus.

In the Signal Corps they catch them young and train them. Being counted among the technical branch of the service, the average bright young American who applies for enlistment in the signal corps is naturally attracted by the opportunities which this service presents. In addition to learning the rudiments of pure and simple soldiering, he here finds a variety of interesting things which break the sometimes monotony of service with troops of the line. And as the average young American is also ambitious, the opportunities furnished him by a "hitch" in the signal corps for learning not only the grounding, but a broad technical knowledge of many branches of electrical science, are great, in some respects far greater than those offered by technical training schools, as everything he learns theoretically is given immediate practical application in a school where nothing less than perfection is tolerated.

In the days of the Civil War visual signaling was that most generally in use, and while certain elements of this valuable branch of the service were engaged in telegraphic work, the principal reliance of inter-communication between troop elements was placed in the orderly, the courier, the flag by day and the torch by night.

To-day the flag and the lamp are used only for short distances and during an actual advance or a retirement and between the smaller troop units. But even during actual advance or retreat, reel carts handled by the signal corps spin off glistening strands of copper wire which is either left to lie on the ground or is hastily looped from convenient branches and posts for mile after mile. And in default of more of such wire being available, these scientists can "make talk" along an ordinary barbed wire fence by the simple expedient of attaching their instrument to each end.

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Signal corps on duty at Columbus, N. M.

A reel cart detachment going into action resembles a battery taking hasty position. The horses—when they use horses—are at a swinging gallop behind which the spidery apparatus rocks from side to side with each encountered inequality of the ground. A mounted member of the detachment bears in hand a low-carried lance through the tip of which the copper wire is threaded, and it is his duty to guide the laying of the line to best advantage. At the desired point the cart is stopped and within a few seconds communication is established. It is not only the duty of the signal corps, but its pride as well, to keep the extremities of its sensitive antennae directly on the firing line. This pride has frequently cost dear, but the mere fact that it is no part of their duty to fire an offensive shot seems to have inculcated within each and every member of this organization a beautiful indifference to such material things as bullet and shell.

There are many methods of signaling used by this corps. First and foremost come the telegraph, the telephone and the wireless. The International Morse code is the one in general use by the army and between the army and navy of the United States. This code, of course, is available for all cipher work which, by the way, it is part

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Wireless set ready for mules

U. S. Infantry setting up searchlight

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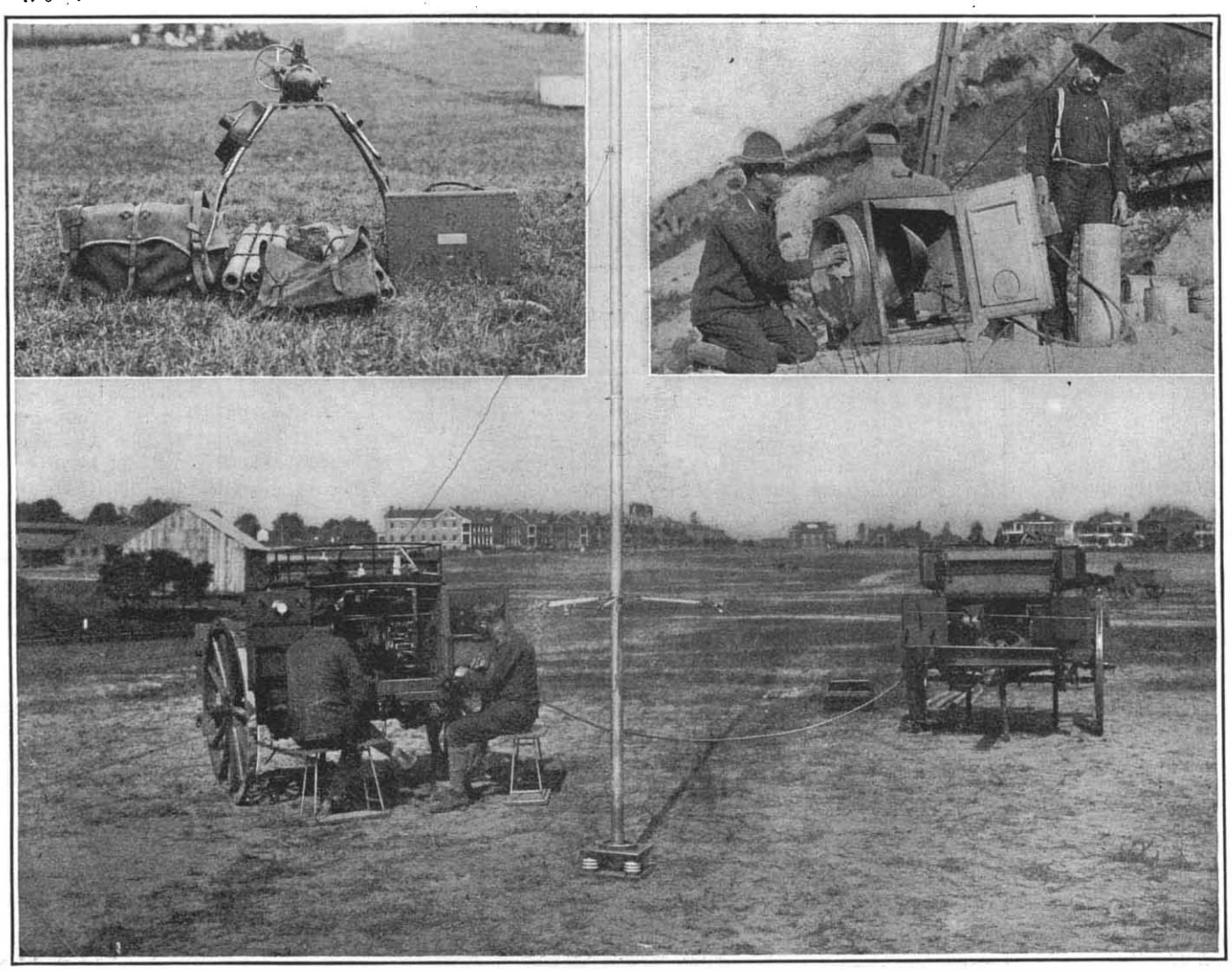


Wagon wireless set. The receiving and transmitting units are coupled together for hauling, giving a normal four-wheeled wagon

The Italian Cargo Steamer Milazzo

Ingeniously Constructed Freighter Which Unloads Cargo at Minimum Cost

WITH the arrival in New York on July 1st of the Italian steamship Milazzo is revealed an interesting departure from standard lines of ship construction. We have had many ingenious plans for increasing carrying capacity and facilitating the discharge of cargo, but never anything which went quite so far off the beaten track of naval architecture.

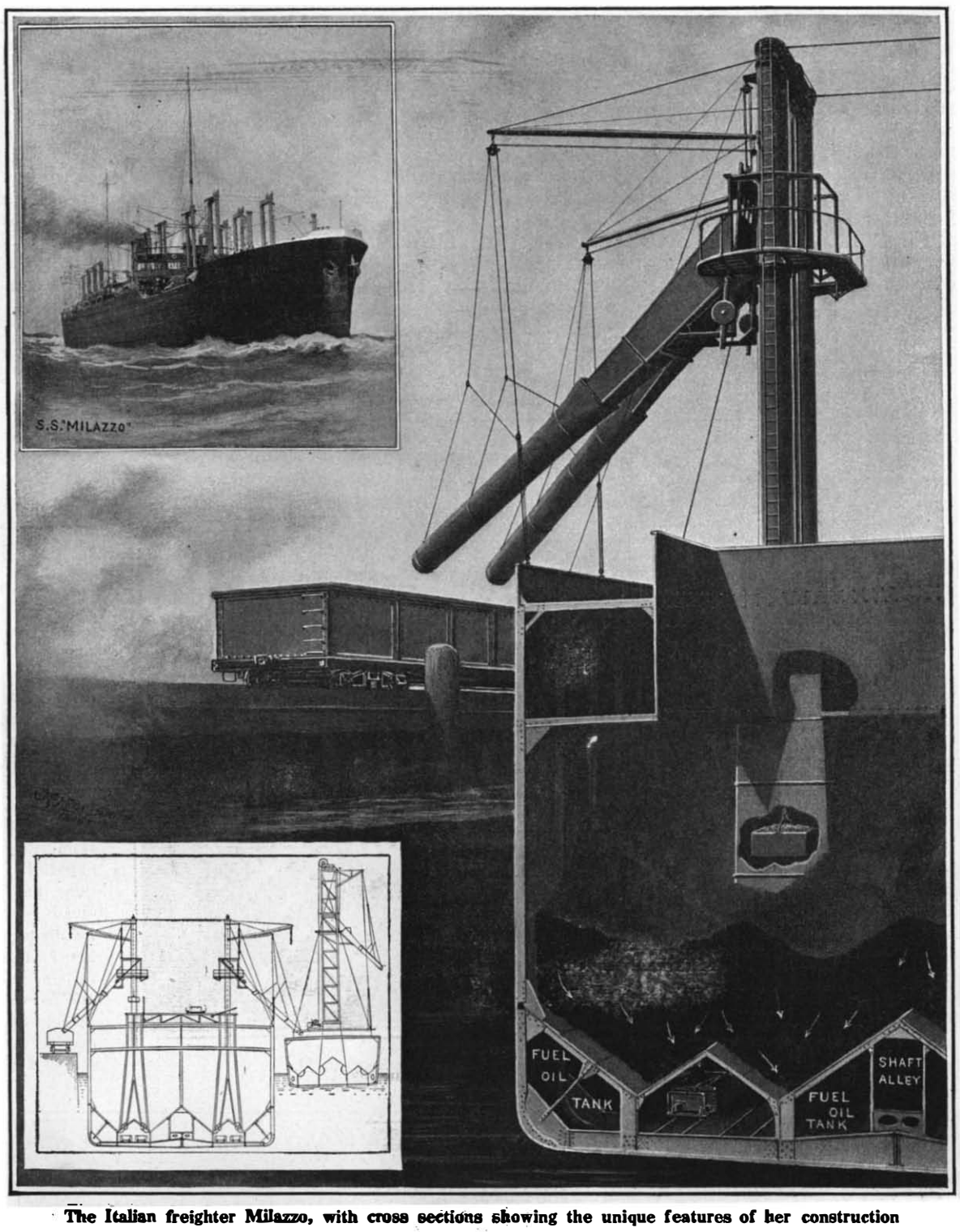
In the lateral division of her hull the Milazzo is quite normal. She possesses eight watertight bulkheads of the usual type, extending clear up to the main deck. The extreme forward and after compartments, of capacity 250 and 70 metric tons, respectively, are used for water ballast to insure longitudinal stability. The central compartment contains all the ship's vitals—engines, boilers, pumps, dynamos, lighting plant, etc. The remaining six compartments, of a combined capacity of 14,000 metric tons, are given over to cargo. In each of these the loading space is entirely free of all obstructions, right up to the main deck.

The radical structural features are found in the arrangements for discharging cargo, and are best seen in the cross-section plan herewith. On each side of the vessel, right down on her very bottom, is laid a miniature double-track railroad, roofed over by an inverted V to form a veritable tunnel running the entire length of the ship. At regular intervals these roofs are pierced by cargo hatches, with chutes for loading the cars that run beneath; and it will be seen that the arrangement of sloping roofs over the tunnels themselves and over the adjoining spaces is such that the pull of gravity will carry the cargo from every part of the hull into these hatches.

Ranged along each side of the ship is a series of tall discharging towers. Beneath each of these is a well extending clear down through the cargo hold to the tracks below. As fast as a car is loaded at one of the hatches, it is run to the nearest of these wells, where the hoisting apparatus snatches the body off the trucks and lifts it up the well and up the tower to the platforms shown in the illustration. It is here tripped over, and its contents dumped down the big chutes into a waiting truck or gondola. So effective is this process of discharge that the entire 14,000 tons capacity of the boat can be got out in about 48 hours, with no manual labor at all.

No space is allowed to go to waste in this ship. The roofed-over areas between the track tunnels, themselves forming larger tunnels, are plainly unavailable for cargo, since they could not be discharged by gravity. So they are used for fuel storage—for this craft burns oil. This, of course, is put in by gravity and taken out by pumps. Little deck-room is available, the hoisting towers and the hatches occupying most of the room ordinarily to be found on vessels of this class.

In length 512 feet overall, of 65 feet extreme beam and 26 feet draft amidships under full load, the Milazzo is a large ship, even as ships go. When fully loaded she displaces 20,040 tons. In addition to the 14,000 tons of cargo mentioned, she has room for over 4,000 tons of fuel. Her engines, under a fuel consumption of 54 tons per day, develop a speed of about 11 knots. So well satisfied are her owners with her that they have under construction a sister ship. Altogether she must be classed as by all means one of the most efficient and economical cargo carriers now afloat.



The Italian freighter Milazzo, with cross sections showing the unique features of her construction

Abderhalden's New Studies of the Ductless Glands

THE famous German physiologist, Abderhalden, whose studies of digestion, of the complex albuminoids of food and their breaking up into simpler elements, or "building stones" as he calls them, and of the possibility of supporting life by synthetic food, are well known to our readers, has recently published some interesting reports of his investigation of the ductless glands. His especial object of research, as set forth in the "Archives for General Physiology" has been the effect of these glands on the development and condition of certain tissues. Tadpoles were the animals experimented upon.

Physiologists agree that functional disturbances of these glands influence the organic growth. For example where disease of the thyroid is present the growth of the whole body is checked, as a result of anamalis in the secretion of the gland. In order to get at the precise manner of operation of such effects Abderhalden sought to discover whether the effective secretion products were high molecular colloidal compounds or simpler dialysable bodies, such as adrenalin. His experiments included the thymus, the hypophysis, the ovaries, and the thyroid. These organs were finely chopped and digested to such a degree that they were practically reduced to the separate "building stones," or amino-acids. The tadpoles were then placed in a fluid containing a definite proportion of the dried substance from one or more of the glands in question.

Various important conclusions were deduced by Abderhalden from the modifications of growth and development which resulted.

For example, it was proved that the thymus and thyroid contain one or more compound constituents which specifically influence the growth of certain tissues, and which are not destroyed by the pancreatic juice nor the digestive juices of stomach and intestines. It is therefore certain that these substances belong neither to the group of albuminous bodies nor to that of the peptones.

Abderhalden, indeed, holds it as very probable that the so-called internal secretions in general are of relatively simple nature and cannot be destroyed by the digestive ferments. Perhaps, however, the cells upon which the secretions act contain ferments which can prepare the effective agent from the secretion-substance which enters the lymph or the blood in ineffective form. As far as the thymus is concerned it does not matter whether the gland is used as it is, or in the disintegrated form described above.

Combinations of two or more of the glands produced various modifications of technical interest. When the solution contained the active substances from all four glands, the little creatures developed with extraordinary rapidity into very lively little frogs.

The eminent experimenter hopes to obtain definite reactions on the higher animals by similar combinations of one or more of these glandular secretions, in which case it may be possible to construct valuable therapeutic agents. By the definite determination that the substances which affect the tadpoles are dialysable, *i. e.*, that they are capable of penetrating membranes, it is made possible to undertake a systematic experimental investigation of these effective agents. This was not possible while it continued to be supposed that these were colloidal in character.

But perhaps the most interesting deduction made is that it is in this direction that we may look for an explanation of the origin and growth of cancer. This was suggested to Abderhalden by the circumstances that he twice observed the formation of a sort of tumor in "toadfrogs" which had been developed under the simultaneous action of the ovarian and the thymus dialysates.

This would seem to indicate that cancerous tumor and sarcoma may be due to disturbances of internal secretion glands. The abnormal cellular growth characteristic of such diseases seems to give a certain plausibility to this theory, which will doubtless be given due consideration by the many eminent physiologists engaged throughout the world in cancer research.

Picking Artificial Flowers Out of Chesapeake Bay

A RECENT trip on Chesapeake Bay made by the *Fish Hawk* of the United States Bureau of Fisheries was fruitful of unusual results. By the invitation of the bureau, a Baltimore manufacturer of artificial flowers accompanied the party aboard the vessel in order to ascertain the sources of supply of a form of hybroid which had been discovered on previous trips, and had been found to be of special value for decorative purposes.

The manufacturer was reported as very enthusiastic regarding the quality of the material and the opportunity for establishing the industry. The material appears to be abundant, but patience and persistent effort will undoubtedly be required to induce the fishermen to develop a new form of fishery. The raw material is valued at $250 a ton.

Our Cavalry

The Tactics of the Mounted Service of the World's Armies Are Governed by Principles Established on Our Western Plains

By Charles M. Maigne

WISEACRES, veterans of former wars who cling to tradition, and casual readers and observers, the latter basing their deductions upon the fact that infrequent mention is contained in *communiqués* regarding this branch of military force, are prone to voice the opinion that the day of cavalry is past and gone, vanished with the days of the Empire and the Civil War. They recite with glowing recollection of stirring personal experience—or of the ardor of slashing literature—tales of masses of horsemen sweeping over field and through woodland in the hurly-burly of pounding hoof, flashing sabre and the hoarse notes of voice and trumpet, of the crash of contact and the melee, the recoil of shattered squadrons and the charge again, wherein victory was snatched from a threatening moment and a nation was saved. Then they add, shaking their heads with sentimental regret, that the day of cavalry is over. But is it?

Early in the present great war, after the first few weeks of advance and retirement, the contending forces on the main western and eastern lines settled down in a desperate deadlock, crouched within the hastily carven, consistently elaborated system of trenchwork which laced the battle fronts. After the opportunity for maneuver had passed, when the flanks of the far-flung lines were brought to rest near non-turntable topographical points such as the sea or the boundaries of a neutral country, the No Man's Land between the trenches became a crater of death to any living thing which might venture upon it. The lines were held solidly in strength from end to end and consequently the employment of cavalry in normal functions of security, information and mounted action became out of the question; so the horses were kept in shape far to rear of the firing line or were loaned to the artillery to replace losses. Transportation requirements affected them little, for the supply problem of to-day has become one of gasoline solution, and for months horseflesh has had a comparatively easy time.

But the horsemen have only waited for their moment. At first the cavalrymen were grieved to the core that they should be asked to render dismounted service alone, to take to the trenches like a mud-crushing infantryman, but rather than not be in the fracas at all, they acquiesced with good grace; besides, they had to. But here, after almost two years of war, success and reverse, the Russians mass their reorganized, revictualled, re-munitioned forces and by sheer weight of artillery and numbers, slash a broad gap in the opposing Austrian lines in Volhynia, Galicia and Bukovina. So stupendous is the force of the onrushing human tide that line after line is carried and the broken flanks of defense curl back in stubborn effort to prevent sweeping disaster to the entire front.

Awaiting their moment, division after division of Russian cavalry which have been gathered in rear of the infantry attack, look again to saddle, cinch and saber, and when the break has been effected in the opposing line, the divisions spring to horse, mount and are gone, streaking away like a gray tornado, accompanied by the rumble of countless galloping batteries, on through the gap, striking for the flank, communication and rear of the Austrian forces. The full details of the Cossack's action have not yet been brought to this country; about all that is known is that they stormed through the breach in the line and once within, rode down their disorganized opponents wherever they fled; and when they encountered hastily formed lines of defense, the Cossacks tumbled from their horses and fought on foot under the supporting fire of their horse artillery.

It may come as a surprise to many that among officers of the United States Army, the opinion is rather general that cavalry tactics of to-day both at home and abroad are modeled upon those developed by the horsemen of North and South in the Civil War of '61-'65. But to place the credit squarely where it belongs, we must look further and acknowledge that these tactics were originated by the only true, unhyphenated Americans, the American Indians of the plains.

For years, centuries, war had been waged by rule of thumb. Footmen, whether members of a Macedonian phalanx or of regiments of infantry in the Eighteenth and early Nineteenth centuries, had definite tasks to perform in a definite way. Attack was just so; defense, this, that or the other thing. And from earliest times, throughout the Napoleonic era the horsemen had equally and exactly prescribed methods which relied mainly upon shock action. If any attempt was made to arm cavalry with firearms other than the clumsy pistol, it was on a small scale only and was applied merely to particular organizations. In 1693 the British Eighth (King's Royal Irish) Hussars regiment was formed of Irish Protestants who embraced the cause of William and Mary against James I.

This regiment was originally armed with swords, pistols, long muskets and bayonets, to enable it to serve as infantry and it is related that at the time its members were subjected to many jibes regarding their hybrid organization. Yet that regiment thereby became to a certain extent a precursor of the cavalry of to-day, although no one but its originator seemed able to see the advantages of its armament.

But back to the Indians. Of very necessity these tribesmen were warriors; the fighting instinct had been born in them and securely rooted through centuries of intertribal strife. As a result, with senses sharpened to a point of prompt appreciation, they recognized immediately the superiority of rifle to bow, and if he had none, an Indian would barter his all for one of the "firesticks." Once in his hands, he made himself master of it, although his untrained mind sometimes failed to fathom the mysteries of the hind sight. He got perfect direction as a rule, but his elevation frequently left much to be desired. This little failing saved many a soldier's life in the old days of the Frontier.

With the encroachment of settlement upon the Indian's own lands, Lo resented, and fought; and as the sword has invariably followed the cross—and civilization—the mounted troops of the young republic of the United States were sent westward to cover the encroachment of their civilian kind. And there the cavalry of America learned its great lesson.

Even the youngest hopeful of any American family to-day, and many of foreign domicile, can testify to the prowess of the American Indian. But the old soldiers and the frontiersmen who fought the original possessors of the land have prima facie evidence of his attainments in concealment and

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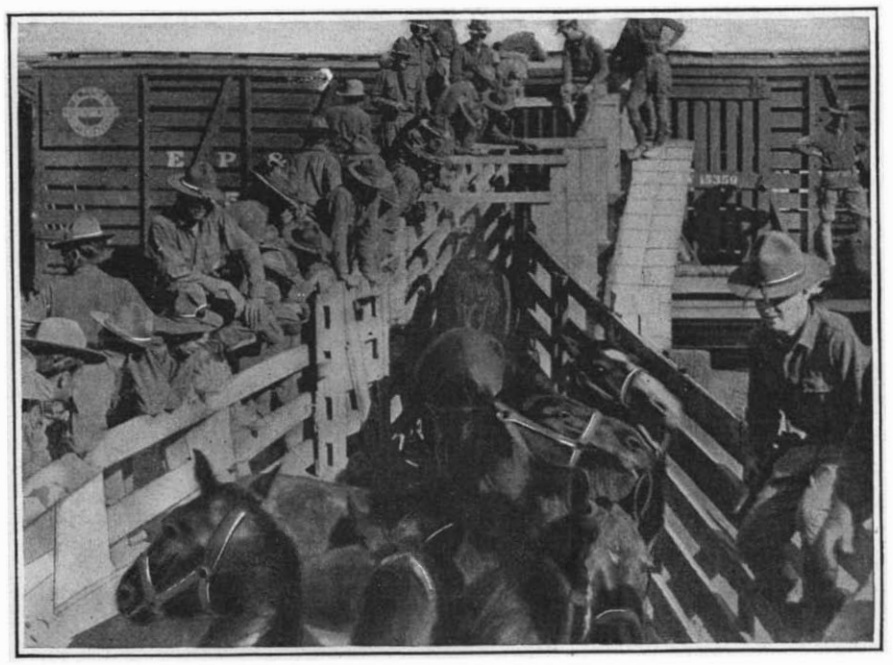
Cavalry of New York militia in camp



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Unloading cavalry horses at Columbus, N. M.

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A detachment of cavalry entraining for the Border

Lewis gun in action

The Machine Gun

Some Characteristics of the Three Types of Automatic Machine Gun Used by the United States Army

Benet-Mercier gun on the Border

THE idea of attaching to the rifle automatic mechanism which would perform the functions of loading and firing the gun made an early appeal to the inventor; for we find that as far back as 1854 (not to speak of the earlier and crude attempts applied to cannon) that great inventor Bessemer took out patents for an automatic rifle, which, in spite of their crudity, contained many elements of the modern machine gun. The credit for producing the first practical machine gun undoubtedly belongs to Sir Hiram Maxim, who secured patents on his inventions in 1884, and in 1889 was successful in having his gun adopted by the British Army. Mention should be made here of the Gatling gun, also an American invention, used in the Civil War and of the French Mitrailleuse which saw service in the Franco-German War of 1870. Each of these made use of a series of barrels which were fired in succession, and therefore they do not strictly belong in the present description, which confines itself to the single-barrel machine gun.

Machine guns consist broadly of two types: the first in which the energy of the recoil of the barrel serves to operate the loading and firing mechanism, and the second in which this work is done by a small portion of the gases of explosion. To the former type belongs the Maxim gun. In this gun the barrel is enclosed in a breech casing, which is filled with water for cooling the barrel. The after portion of the barrel together with the firing mechanism is inclosed in a rectangular, oblong box, known as the breech casing. The gun barrel is carried at its ends in asbestos packed bearings, within which it slides in recoil, the energy of recoil serving to operate the loading, firing and cartridge-case-ejecting mechanism located within the breech casing. The gun is held and trained by means of handles at the rear of the breech casing, and in front of the handles is a thumb piece by which the trigger is actuated. At the front of the breech casing is a recess which holds the feed-block through which is fed the belt of cartridges. The total recoil of the barrel is about 1 inch and the side plates and lock recoil with the barrel for a quarter of an inch, by which time the bullet has left the muzzle. The further movement of the barrel rotates a crank axle and opens the breech. The cartridges in the belt are fed forward by a step-by-step pawl action. It should be mentioned that a part of the energy of recoil serves to compress springs, whose energy in turn serves to operate part of the automatic mechanism concerned in the cycle of operations connected with the loading, firing, breech opening, cartridge case extraction, etc. To describe these movements in detail would take more space than can be devoted to the present article. The Maxim gun without its tripod weighs about 50 pounds. The disadvantage of weight is offset by the fact that in this gun the recoil is absorbed by springs and is not communicated directly to the operator, whereas in the lighter gas-operated machine guns, which weigh about 25 pounds without the tripod, the recoil acts directly on the shoulder of the operator, rendering it more difficult to keep the gun upon the target.

The Benet-Mercier machine gun, as will be seen

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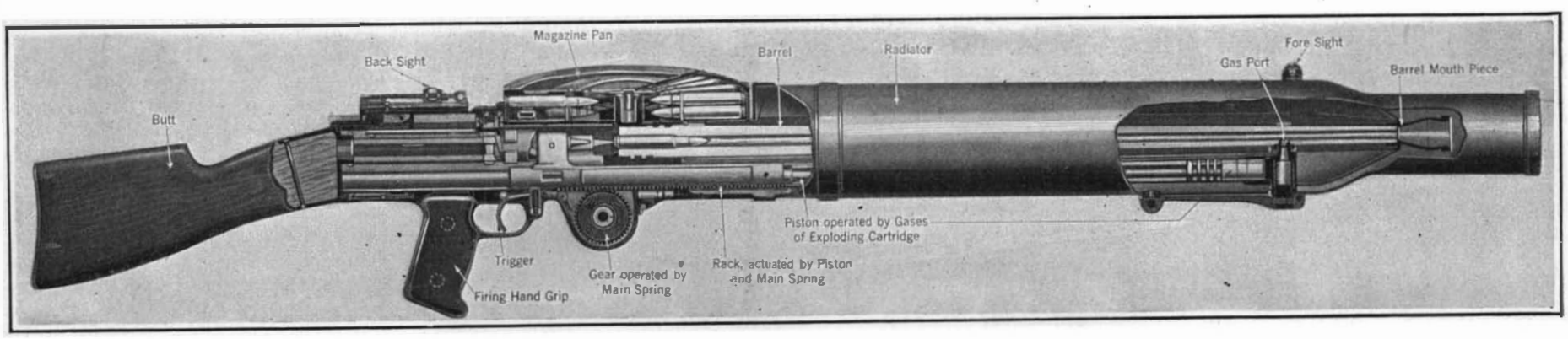
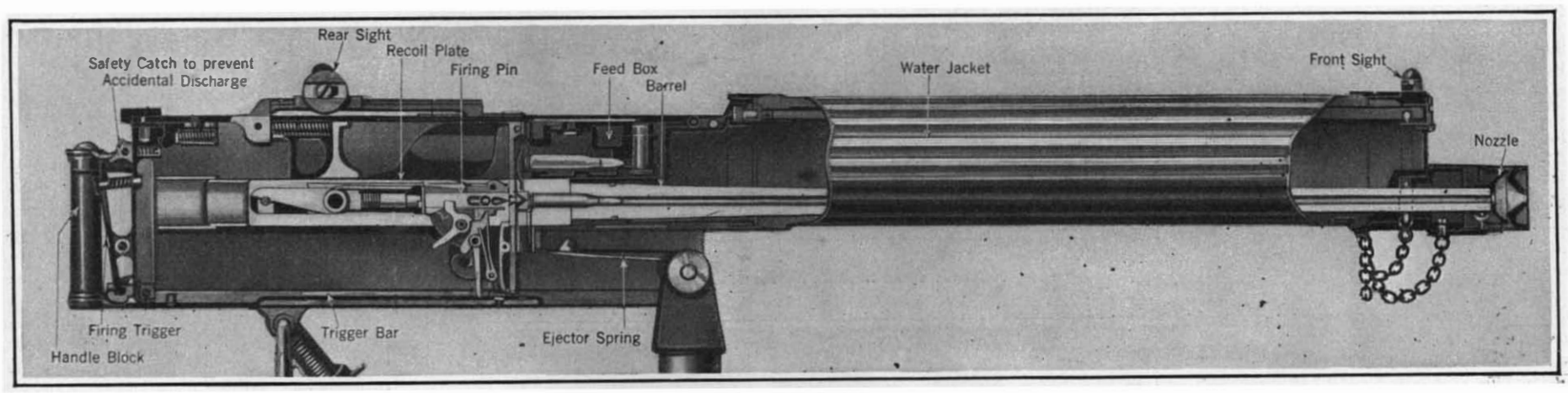
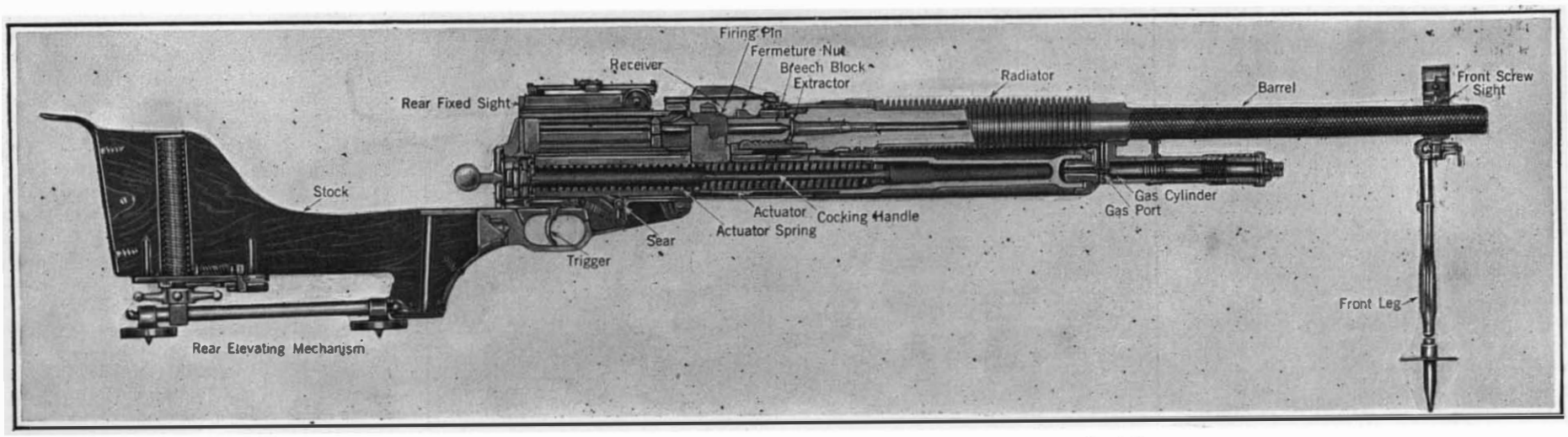


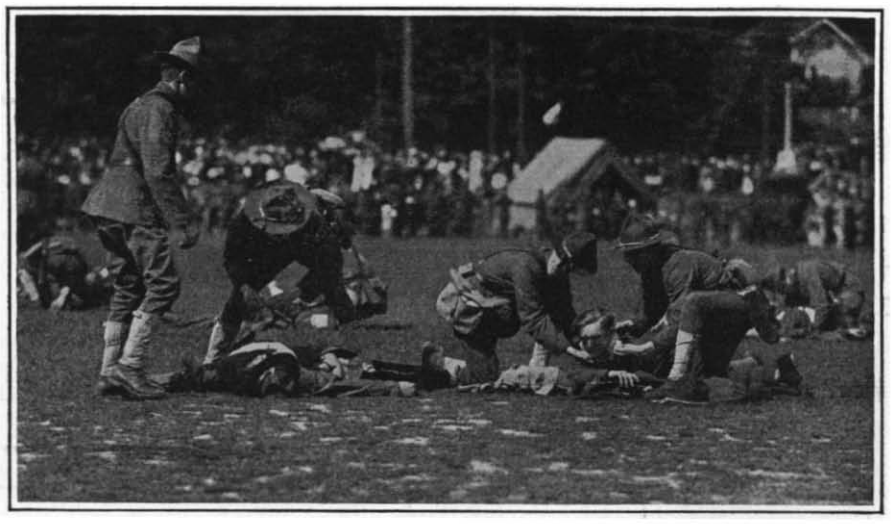
The Lewis gun, gas operated, recently adopted by the United States Army



The Maxim gun, operated by the energy of the recoil



The Benet-Mercier gun, gas operated, now in use on the Mexican Border



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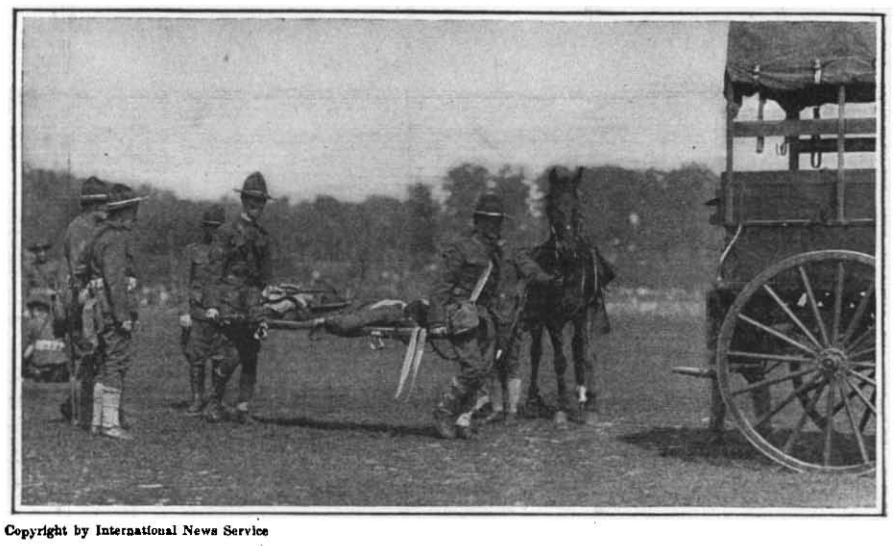
"First aid" on field to "wounded" soldiers



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Carrying "wounded" soldier to Red Cross wagon

The Sanitary Service in War

How the Wounded Are Cared for and the Health of the Soldiers Conserved

WAR is a terrible business and in its prosecution a certain hardness, callousness toward the customs of humanity, is inevitable. A man stands ready to give his most valuable possession, his life, if necessary in the service of his country. Under the same circumstances it is not, after all, unreasonable to assume that he must be equally willing to accept suffering; and the success of the armed forces in any operation is of paramount consideration. Therefore it is a harsh but true condition of battle that the first object of the medical service is not to relieve suffering, not to face danger through mere humaultarian principles, but to further the operations of the army by seeing to it that the disabled are cleared away from the front for the reason that if allowed to remain they might interfere with the achievement of victory.

The duties of this branch of the army cannot be better described than in the words of the United States Field Service Regulations:

"In general the functions of the sanitary service are as follows:

"(a) The institution of all practicable sanitary measures, to the end that the fighting forces suffer no depletion in strength due to avoidable causes.

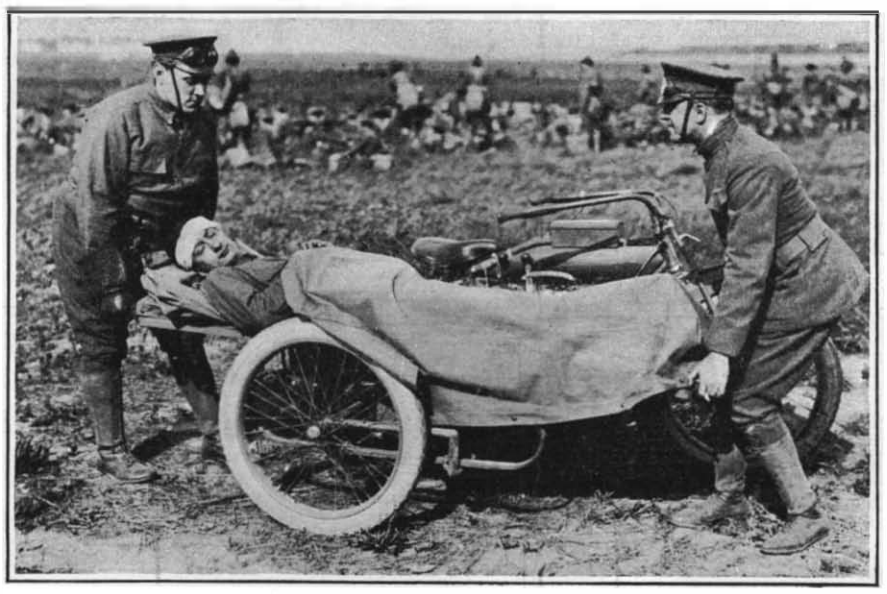
"(b) The temporary care and professional treatment of the sick and wounded and their transportation to accessible points where they are transferred with as little delay as possible to the line of communications.

"(c) The supply of the necessary sanitary equipment.

"In addition, the sanitary service is charged with the preparation and preservation of individual records of sickness and injury in order that claims may be adjudicated with justice to the government and the individual."

With an army in the field the sanitary service is organized as systematically as any fighting unit. Immediately in rear of each regiment's position the regimental aid station is established. These stations are charged with the collection of the wounded and with the application of such hasty aid as may be given under the circumstances. Farther to the rear, situated centrally with regard to a number of the aid stations, are to be found the dressing stations, which are established during combat by ambulance companies of the sanitary train. All wounded unable to walk are collected here from the advanced aid stations by bearers of ambulance companies. These ambulance companies transport the wounded from these points back to the next and larger elements of the sanitary establishment, the field hospitals. The dressing stations are more elaborately equipped than the aid stations and they provide light nourishment and stimulants for the wounded and afford facilities for more elaborate dressings and for emergency surgery.

Field hospitals are usually set up three or four miles from the battle field. Their location is determined by accessibility from both front and rear and by the availability of good water. The field hospitals are seldom set up when the sick and wounded can be turned over directly from the dressing stations to elements of sanitary columns or railway hospital trains on the line of communications. While much more elaborate than that of the advanced units, the equipment of field hospitals is limited to providing necessities for sick and wounded pending the evacuation to the rear by the line of communication service. Sometimes in rear of, sometimes coincident with the field hospitals, are to be found the evacuation points from which the sick and wounded are transferred directly to trains or boats, to be sent back over the line of communications to the base hospital or other hospitals in the homeland. The trausportation falls to the duty of the sanitary train, which is composed of ambulance companies, field hospital companies and reserve medical supplies. In addition, well fitted up hospital cars are made up into trains on the railway, which seek to keep the advanced hospital detachments clear of casualties so that room may be immediately available for further sick and wounded.



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A motor cycle ambulance for line-of-fire service

Copyright by International News Service

"Operation" at Van Cortlandt Park manoeuvers, New York

When a soldier is wounded, he himself or a comrade applies the first aid from the packet of bandages and compresses which is furnished to every individual of the army and is carried on the person. There, however, the medical activities of troops on the line cease, for no one is allowed to leave the firing line to aid a stricken comrade except members of the sanitary service who are there for the purpose.

A number of doctors, assistants and litter-bearers are attached to each regiment on the line, sometimes to battalions. These men advance with their organization and have not time to give more than hasty first aid to the wounded. In the great European war the casualties among these advanced units of the sanitary service have been enormous, for if they do their full duty—and they usually do—they are frequently more exposed to fire than the men on the firing line, who receive a certain amount of protection from their trenches or from their prone position during pauses in an advance.

The position of hospital units on the battle field is definitely marked. By day the Red Cross flag is flown conspicuously near dressing stations and other points of greater size in the sanitary service. By night a green lantern indicates the location of sauitary units. Up to a few years ago these places were marked by red lanterns, but the red has been given over to other uses and now marks the spot at which ammunition may be obtained.

Let us go with a soldier from the moment he is hit until he is comfortably cared for in a big, well equipped hospital in his home country.

During the advance of a line a whining something of steel and lead finds its billet and a man stops, dazed, looks surprised, then sinks to the ground resentfully. There is no time for a comrade to render assistance and the line forges ahead. A hospital corps man wearing on his left arm a white brassard bearing a red cross, runs up and kneels by the stricken soldier. He takes from his emergency pouch a pair of scissors and snips away the clothing until his wound with its glaring stain of red is disclosed. Then he opens the wounded man's first aid packet, applies the soft medicated compress over the gaping hole in the white flesh and bandages it securely, after which the patient is generally laid to one side out of the way. A little later litter-bearers, or possibly an ambulance comes up, the wounded man is taken up and sent to the rear. But first a non-commissioned officer of the sanitary corps has whipped out a book of tags,

(Continued on page 141)

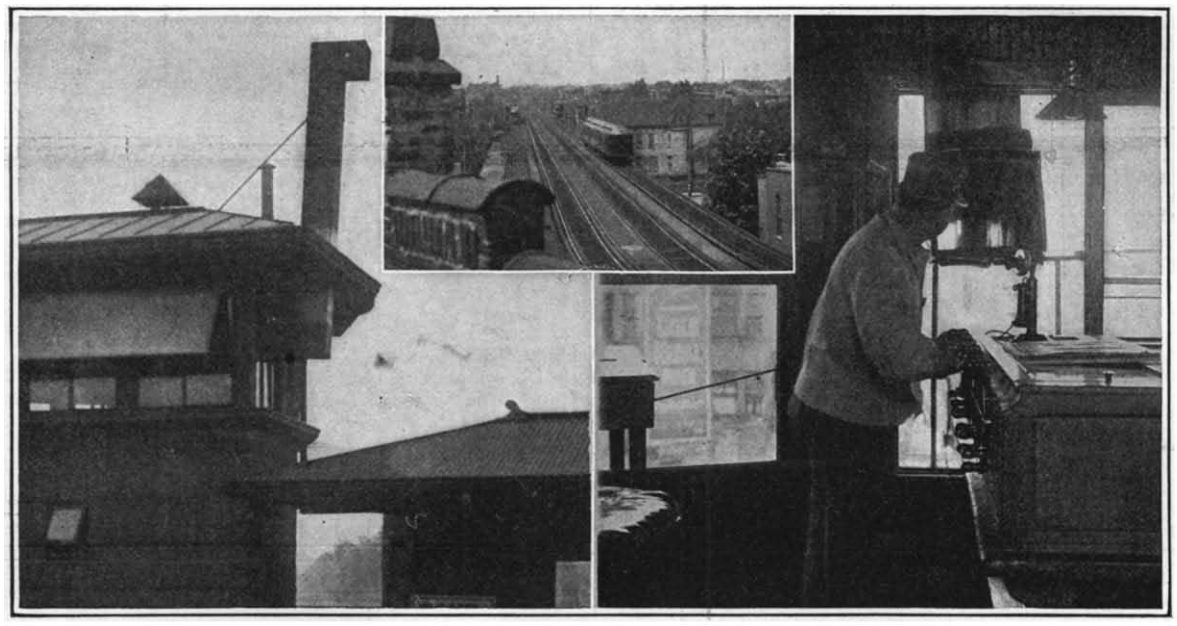
Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

A Periscope That Enables the Towerman to See Around a Railroad Bend

MENTION periscopes and there flashes to our mind a vision of a submarine in the act of torpedoing a surface craft. Again, it may suggest the soldiers in the trenches, using a simple periscope so that they may see the stretch of ground separating them from the trenches of the enemy, without exposing themselves as a mark to the ever-watchful snipers. In sum, we have come to look upon the periscope as an instrument of warfare, far removed from all peaceful pursuits.

Yet in Chicago a huge periscope is serving in a most peaceful capacity. The four-track structure of the Northwestern elevated system bends around in approaching the Clark Street station, where a switch tower stands. Buildings recently erected have shut off the view of approaching trains to the towerman; but, undaunted in their work, the railroad men have erected a huge periscope, 12 feet in height, on the roof of the signal tower. The periscope is of sufficient height to clear the intervening buildings and furnish the towerman with an unobstructed view of the tracks to the south. Thus by applying this simple optical device the all-important view has been restored to the manipulator of switches and signals in the railroad tower.



The periscope of the Chicago elevated system, which permits a towerman to see around a curve

Using Telephone Lines for an Automatic Fire Alarm System

AN inventor, who evidently believes in making use of existing commodities, has developed an automatic fire alarm apparatus which utilizes existing telephone systems and bell circuits for its operation, without interfering with the normal functioning of such systems or circuits. His apparatus is designed for hotels, factories, mines and public buildings, and for calling volunteer firemen in towns that have volunteer fire departments, or at any place where the telephone system might be utilized to advantage for such purposes.

Considered in its broadest aspect, the rotary automatic fire alarm apparatus consists of a rotating switch, operated by a spring motor, which automatically causes the bells in different circuits to ring a certain number of times as a fire signal. The apparatus is contained in a cabinet built with two compartments: the upper half contains the switch mechanism, and the lower the batteries for starting the alarm in magneto exchanges. Where the common battery system is used, the starting current is taken from the storage cells. The spring motor is wound from the outside, thus doing away with the necessity of opening the door to wind it.

The motor which automatically operates the ringing of the lines is a heavy spring motor, simple to control. There are five insulated rollers mounted on the spring drum of the motor, and when the latter is set in motion the rollers pass under the spring contact groups, raising the master spring in contact with the ringing circuit and breaking the line to the switchboard so that it does not interfere with the drops or signals on the board. The motor revolves once and stops, thus giving each line five distinct rings as a fire signal. When installed in a hotel, factory or other institution where more than one alarm would be necessary, the motor would be caused to revolve several times so as to ring any number of alarms that might be requisite.

There is a buzzer installed in connection with the alarm apparatus, that notifies the operator of the starting and stopping of the machine, so that there can be no doubt as to its proper functioning. Five 660-ohm resistance lamps are also included in the equipment. Each one of these lamps is in series with the ringing current and a group of eight springs which are commoned; that is to say, every fifth spring is connected to a common bar. For example: Spring 1 commons with springs 6, 11, 16, 21, 26, 31, 36; spring 2 commons with springs 7, 12, 17, 22, 27, 32, 37, and so on. There being only five lines rung at one time, there is only one line being rung through a lamp at any one time; and in case of a heavy "ground" or short circuit on any line or lines, this arrangement of springs and resistance prevents any interference on lines that are rung in common with lines in trouble.

Two relays are installed in the cabinet. One operates simultaneously with the starting of the machine, the contact springs of which are connected in multiple with the pole changer, or ringing power switch, so that in case the source of ringing power is cut off after busy

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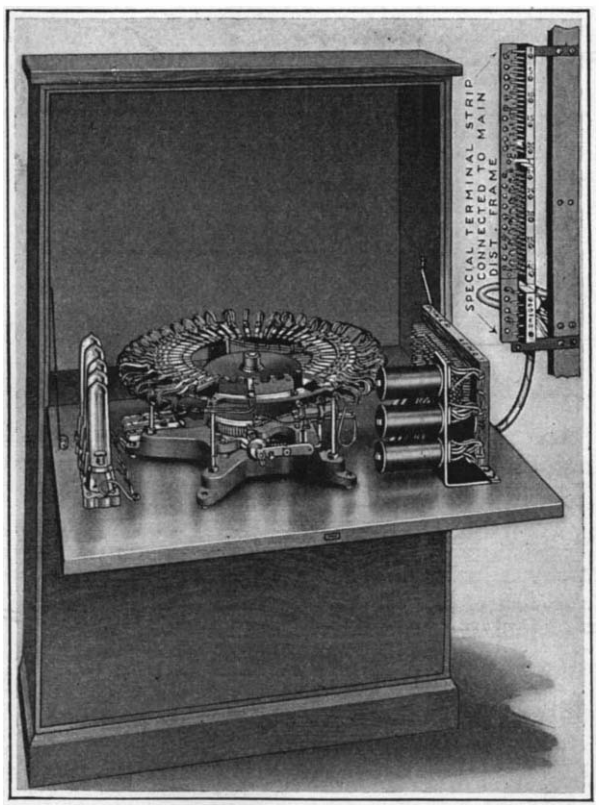


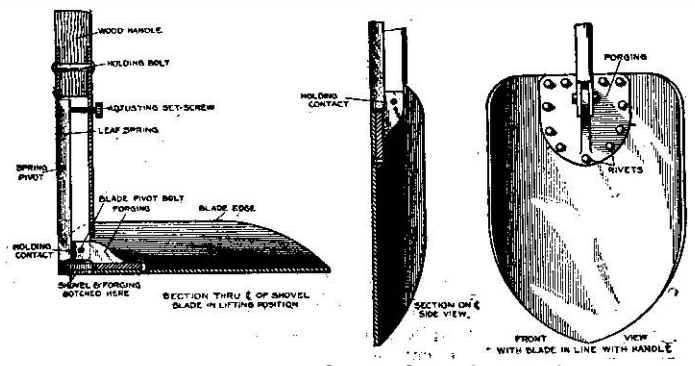
Switch mechanism of an automatic fire alarm system

New Collapsible Shovel a Time Saver

A TIME saver for every man who uses a shovel—be he a country commuter, a farm hand, a digger of holes for telegraph or telephone poles, or even a gravedigger—is the new type of collapsible combination shovel and spoon recently put on the market by a St. Louis manufacturer. The device differs from the conventional type of long-handled shovel in that the shovel proper, or blade, is pivoted on the bottom of the handle and may be set at any desired angle to the handle by simply pressing down on the latter.

In digging a hole or deep ditch, the blade is fixed in the same straight line as the handle, so that the edges of the earth dug may be cut clean and even. Then, as the hole or ditch gets deeper and deeper and it becomes more and more difficult to lift the dirt out, the shovel may be made into a spoon with the blade at right angles to the handle, as shown in one of the accompanying illustrations. This is accomplished by forcing the dirt to the extreme side of the hole, pressing down on the handle and then pulling the top of the latter toward you, causing the latch of the blade to trip. With the blade in this position, it is a simple matter to lift the earth out of the hole or ditch.

Getting down deep



The mechanism of the collapsible shovel

Another possibility of the new shovel

Removing earth from hole

RECENTLY PATENTED INVENTIONS

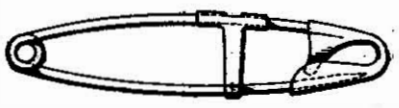
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

ATTACHMENT FOR OVERSHOES.—L. R. MOORE, 215 Bay View St., San Rafael, Cal.. This invention provides an overshoe with a non-elastic pull-on loop, so formed and located as to prevent the hands of the wearer from being soiled in pulling on the overshoe; provides an overshoe with a pull-on loop so located and secured as to lie beneath the ordinary boot or shoe between the same and the overshoe, when the latter is in use, whereby the loop will be out of view; and provides a pull-on loop that will be effective in facilitating the pulling on of the overshoe.

WRIST STRAP.—E. G. LEWIS, Blytheville, Ark. This invention relates to wrist supports, and the main object thereof is to provide such a support which is more easily installed in position than any of those now known to the inventor. It overcomes the very annoying features of attachments of those wrist supporters, without adding the weight, size, or cost thereof.

SAFETY PIN.—W. S. LITTLE, Bordeaux, Wash. Heretofore with safety pins commonly employed the movable member or shank containing the point is often bent and opened owing to undue strain thereon, sometimes occasioned by securing several thicknesses together, the opening of the pin often resulting in in-



SAFETY PIN

jury to the wearer. The present invention overcomes these objections by providing a brace slidably mounted upon one of the members of the safety pin and adapted to be detachably connected with the other member thereof, whereby said members are effectively prevented from being bent intermediate their ends, thus avoiding detachment of the pin point from its shield.

Pertaining to Aviation

BIPLANE.—G. G. LELEVIER, Douglas, Ariz. This invention is an improvement in biplanes, and provides a device of this character, wherein mechanism is provided for stabilizing the device without the use of ailerons and without the necessity of warping any portion of the supporting wings.

Electric Devices

ILLUMINATED SIGN OR ELECTROGRAPH.—E. J. KINGSBURY, care of Kingsbury Electrograph Co., 961 Monadnock Bldg., Juneau, Alaska. The general objects of this invention are to provide an illuminated electric sign of the character referred to, which is thoroughly reliable and efficient in use, easily operated and controlled and so designed that a plurality of lines of monogram units can be embodied and controlled by a single machine.

AUTOMATIC ELECTRIC SWITCH.—S. S. STAHL, St. Petersburg, Fla. This invention provides operating means for an electric switch, which means includes a swinging arm which is connected by flexible elements with the blade or blades of the switches, and by means of a novel arrangement of spring the said arm after moving slightly beyond a dead center position is quickly thrown to positively jerk the switch open or force the same closed by a hammer blow

TELEPHONE ATTACHMENT. — ESTELLA SANDERS, 142 Amsterdam Ave., New York, N. Y. This invention provides a new and improved telephone attachment arranged to enable the user of the telephone to carry on conversation without removing the receiver from the hook and to permit the person to use both hands for writing or other purposes while using the telephone.

Of Interest to Farmers

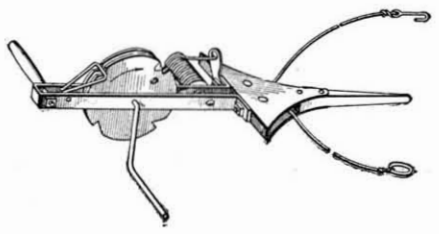
CLOVER HULLER.—J. W. FEELER, care of Buhl Grain & Produce Co., Buhl, Idaho. The present invention has reference to clover hullers involving a cylinder and a concave, and has for an object the provision of an improved construction that may be cheaply produced for the most part from elements and materials readily available.

SHOCK LOADER.—G. H. TARVIN, care of Cottingham Bros. & Co., Sisseton, S. D. The invention relates to a loader adapted to gather shocks of hay or grain, and deliver the same to a wagon. The present invention provides a loader having a novel arrangement of the principal elements, particularly with respect to the second fork, together with the means for controlling the operations of the fork and its swinging frame, as well as means for conveying the material laterally to be discharged to a wagon.

HOG OILER.—H. D. DUCKHAM, 453 E. Columbus St., Kenton, Ohio. The main object here is to provide a hog oiler in which the rubbing surface is automatically oiled and in which the supply of oil to the rubbing surface is discontinued after a few drops have been supplied thereto, no matter how long the animal continues to rub against the device.

HOG OILING DEVICE.—H. D. DUCKHAM, 453 E. Columbus St., Kenton, Ohio. The invention provides a belly rubbing device for hog oilers in the nature of a curved foot attachable to the lower end of the rubbing bar and provided with a cup for catching and retaining the surplus oil finding its way down the bar, the foot being of such shape and proportion as to readily engage under the jowls, arm pits, and flanks of the animals using the oiler.

FODDER TIER.—J. L. CASE, Willshire, Ohio. In this instance the invention has for its object the provision of a device for facilitating the tying of fodder in shocks or bundles with twine, wherein mechanism is provid-

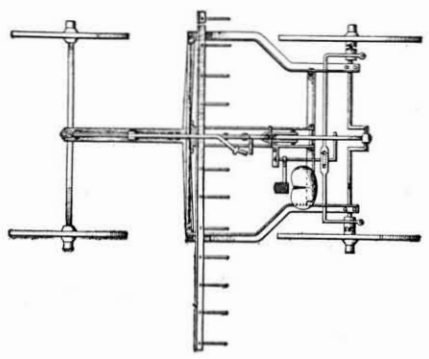


FODDER TIER

ed for compressing the shock or the bundle in such manner that the shock will not be twisted when raised from the ground, nor moved out of plumb or balance, and will be held evenly braced from all sides during the placing of a tie.

PLOW ATTACHMENT.—E. A. KOCH, Plaquemine, La. This inventor provides a plow with cutters or blades made of a strong thin material adapted to remain sharp until worn out, and adapted to be duplicated at a minimum cost, whereby the old method of equipping plows with coulters, which have to be sharpened every time the share is sharpened, may be done away with.

HAY RAKE.—H. C. MASTERSON, Cle Elum, Wash. This improvement has particular reference to adjusting devices for hay rakes. It provides a rake carrying vehicle having a mechanism mounted thereon and automatically oper-



HAY RAKE.

ated by the travel of the vehicle to adjust the rake in order to dump the contents thereof, said mechanism being adapted to be manually thrown into and out of clutching engagement with certain of the wheels at the will of the operator.

Of General Interest

WELL PACKER.—W. W. RHEA, Bartlesville, Okla. It is sought to produce in this invention a well packer provided with means for effectively preventing the passage of the gas through the packer and parts adjacent thereto; and also having a maximum amount of mechanical strength for the purpose of resisting vast pressures, such, for instance, as may be caused by water and oil accumulating within the well.

DRYING APPARATUS.—E. DISDIER, 95 Muelle, Malaga, Spain. This apparatus is intended more particularly for the drying of natural or industrial substances which, when moist or warm, are of a sticky or pitchy nature. An important feature is the continuous cooling of the vane-fitted shafts. These shafts, provided wih helicles extending across a metal chamber, serve to convey the moist product, the contact of which effects the cooling of the shafts.

FENCE POST.—P. T. BAILEY, Melville Station, Newport, R. I. An object here is to provide a metallic post which may be cut out of a sheet of metal and then bent into the proper shape for providing a tapering structure in order that the wire or other fastening material may be properly supported and held in position without danger of sliding or moving under pressure.

COIN BANK.—E. F. KAVANAGH, 9600 Redell Ave, Cleveland, Ohio. The box is composed of two separable sections constituting in effect a body and a cover. These have engaging members, and in addition co-acting locking devices. The latter instead of being operable by a key are so arranged as to be controlled by a hook inserted through the coin slot in the bank whereby to move a resilient latch device forming a part of the locking elements.

GREASE CUP.—T. O. ORGAN, care of Office of Consulting Engineer, Keystone Lubricating Co., Newton, Neb. This invention provides means in connection with the cup whereby the flow of the lubricant will be retarded should the cup and bearing be subjected to excessive vibration or should the cup be subjected to higher temperature than that of the atmosphere, so as to cause the lubricant to thin down. It provides within the shank of the cup a tubular retarder of soft metal supported in the shank of the cup and having a bore forming a constricted outlet for the flow of the lubricant.

SIGHT FOR FIREARMS.—J. C. CRITCHETT, 801 Arizona St., El Paso, Tex. This improvement has for its object to provide a sight for firearms having a transparent member on which are indicated a plurality of sighting marks and a scale which may be compared with the outline of an object to determine which sighting mark is to be used when firing at the object.

PARCEL POST CASE.—C. T. GOEWEY, 851 Park Ave., South Bend, Ind. An object here is to provide transporting means which will bear both sending and return addresses so positioned thereon that but one is visible when the carrier is ready for shipment. Another object is to provide retaining means for the articles to be carried that shall be capable of being secured together so as to insure safe transportation of said articles.

ANIMAL TRAP.—E. S. CUNNINGHAM, Mansfield, Ill. The trap is arranged to permit of readily setting it without danger of injuring the fingers, to allow of releasing the dead animal without touching it, and to prevent the animal from reaching the bait, thus allowing the use of the bait for a considerable length of time without rebaiting after each capture.

DEVICE FOR SETTING FENCE POSTS AND PILING.—H. F. KISER, Box 396, Palmyra, Mo. This improvement refers to devices for setting fence posts or piling, the more particular purpose being to provide such a device in which the weight of the operator coacts with the weight of the device itself and also with the effective blows from a maul or hammer in causing the post to sink into the ground.

STERILIZER.—G. PULLETS, 927 Freeman St., Bronx, N. Y., N. Y. This invention has reference to sterilizing apparatus and has particular reference to an apparatus of this nature designed particularly for use in barber shops for cleansing and sterilizing towels and implements used in such shops.

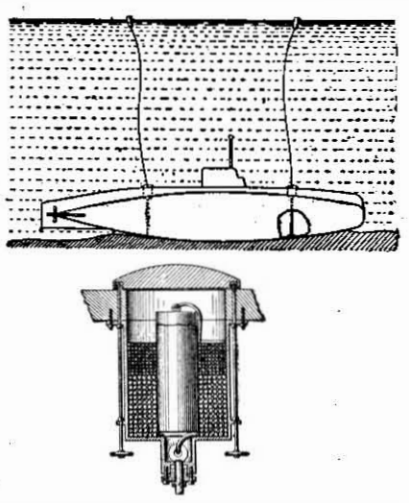
FOUNTAIN PEN.—M. BERNSTEIN, 393 Central Park West, New York, N. Y. This improvement has reference to stationery appliances, and particularly to fountain pens and the like, and it has for its primary object the provision of an implement which is more convenient for use than ordinary pens and which will insure a practically uniform flow of ink.

HORSESHOE.—G. S. MEYER, 80 Front St., Newburgh, N. Y. Among the principal objects which this invention has in view are: to avoid the loosening of anti-slipping devices when placed in service; to provide means for automatically increasing the grip of a shoe on said devices; and to simplify the means for accomplishing the said result.

PANE.—LILLIAN M. LEA, Ramsey, N. J. The invention provides a pane for use in windows, glass doors, partitions and other structures, and arranged to permit looking through the pane from one side and to prevent seeing through the same from the other side. The pane is strong and durable and has a lace curtain effect.

BOTTLE PROTECTOR.—J. E. COSGRIFF, 201 W. 109th St., New York, N. Y. The invention has particular reference to a means for protecting a child's nursing bottle. It provides a cage-like protector to prevent breakage of the bottle due to impinging against the floor, crib, chair, or other device. It provides means for attaching the bottle to a flexible strap or the like, whereby it is impossible for a child to throw the bottle beyond its reach.

MEANS TO RAISE SUNKEN VESSELS.—C. T. BOWERS, 196 Paterson St., Perth Amboy, N. J. The invention has particular reference



MEANS TO RAISE SUNKEN VESSELS

to means providing for the rescue or recovery of stranded submarines or sunken vessels of any other type. It equips a submarine boat with one or more, preferably a plurality of, devices, each including a casing secured to built within the hull of the boat and having its outer end adapted to be opened to the sea to admit sea water for the purpose of buoying from the casing a float which, rising to the surface of the water, will carry with it a line through which a heavy power cable may be secured for the manipulation of the stranded boat or vessel.

CIGARETTE CASE. J. SPILLANE, 1662 Zerega Ave., Westchester, N. Y. Mr. Spillane provides a case arranged to permit of conveniently filling it with cigarettes, to allow of singly pushing the cigarettes partly out of the case for final removal by the user and to prevent injury to the cigarettes in the case, especially while ejecting the same.

PERPETUAL CALENDAR. — H. LANGMAN, 417 Elton St., Brooklyn, N. Y., N. Y. The calendar has two cards movably mounted on a base card on which centuries are indicated, one of the cards having marked thereon the months and days of the month, the other the different years in a century, so that when the card with the years is moved into position where the year in question will be disposed relatively to the other card at the month and day of the month in question and the two cards are positioned relatively to the base card, the day of a week which is marked on the base card will be exhibited through openings in the two cards mounted thereon.

FIRE EXTINGUISHER.—J. W. BYERS and H. HATCH, care of Mercer Planished Steel & Iron Co., Mercer, Pa. The main object here is to provide means for enriching the solution discharged from fire extinguishers with the fire quenching gas, particularly in the early stage of such discharge, whereby the efficiency of the extinguisher is greatly enhanced over the type now in use.

ENVELOPE.—W. J. CARR and G. F. HUTCHINGS, 1224 Paseo, Kansas City, Mo. In the present patent the invention is an improvement in envelopes, and has for its object the provision of an envelope which is capable of more than one use, the envelope being so arranged that it may be used many times without destroying the same.

DETACHABLE CONNING TOWER AND LIFE BUOY.—C. KAEMPFER, White House Station, N. J. An object here is to provide a conning tower so connected to a submarine as to be dispatched from the same to the surface of the water while the submarine is located at any suitable distance below the surface, whereby observations may be made along the surface of the water at any time irrespective of the depth at which the vessel may be located below the surface.

CORNER AND END POST.—J. W. HANGER, Address Reuben R. Carr, Attorney, Akron, Ind. This invention provides a construction of corner and end posts, having wire tighteners attached and designed for permitting the ends of wire fencing to be connected to the posts in such manner that the fence will be held taut and upright, and may be retightened to compensate for any stretching that may take place.

CRAB TRAP.—R. KRULISH, 1008 1st Ave., New York, N. Y. The invention relates particularly to traps for catching crustacea, as for instance, crabs, lobsters and the like, and has for an object the provision of an improved construction which will quickly and automatically open when a crab rests upon the bottom or other support.

ATTACHMENT FOR STEAM BOILERS.—W. L. BALDWIN, care of Dawson Varrity Works, Dawson, Ga. This invention relates to an attachment for steam boilers for the treatment of the feed water, so that the scale-forming matter will be precipitated and collected before reaching the boiler. Mr. Baldwin has found by practical tests that the use of the attachment on a steam boiler serves to remove scale already accumulated in the boiler.

CONTAINER.—E. J. YORK, 2924 Cochran St., Houston, Tex. The invention relates to containers, such as crates, barrels and other members adapted for containing merchandise, fruits, vegetables, etc. It comprehends a container adapted to be made up in so-called collapsible form, and to receive its final shape after a comparatively small expenditure of labor, its final shape being suitable for the ultimate use of the article, considered as a container.

PROCESS OF LIQUEFYING GAS MIXTURES AND FOR SEPARATING THE CONSTITUENTS.—RUDOLF MEWES, Berlin, Germany. This process is carried out in such a manner that the mixed liquid formed before the point of expansion is not allowed to escape, but is separated into its constituents before the point of expansion by repeated condensation and vaporization, so that practically only the less volatile constituent passes into the expansion engine or the like.

Hardware and Tools

INSTRUMENT FOR SURVEYING DRILL HOLES.—C. B. GALVIN, Cornwall-on-the-Hudson, N. Y. In order to accomplish the desired result in this invention, use is made of a flexible carrier adapted to be inserted in the drill hole and to conform to the contour thereof, and means in the said carrier for determining both lateral and vertical deviations of the carrier in any position in the drill hole.

IMPLEMENT.—E. KINZEL, 468 Elk St., Albany, N. Y. The inventor provides an implement such as a shovel, spade or the like, arranged to permit of quickly and securely assembling and fastening together the handle and blade without the use of special tools or to disassemble the parts with a view to form the same into a small bundle for convenient carrying in a knapsack, bag, grip or other similar receptacle

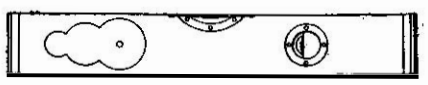
DOUBLE-ACTING, NON-SAGGING DOOR HINGE.—W. R. PATTERSON, care of Stanton &

(*Continued on page* 130)

(*Continued from page* 128)

Rowberg, Thief River Falls, Minn. The improvement provides a double-acting, non-sagging door hinge having an arrangement of springs for causing the automatic closing of the door, the spring means being so designed that the tension can be easily and quickly adjusted and the parts easily and quickly assembled in the manufacture of the hinge.

CARPENTER'S LEVEL.—A. DE TULLIO, 126 N. Arno St., Albuquerque, New Mex. In this case the invention is an improvement in carpenters' levels, and the invention has for its



CARPENTER'S LEVEL.

object the provision of an instrument adapted for use as a surveyor's level, and wherein the entire mechanism is housed in the bar of the level, in such a manner that it cannot be injured or damaged.

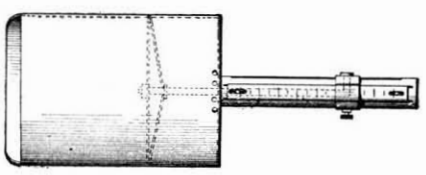
RAZOR RECEPTACLE.—H. JONAS. Address Joseph Jonas, care Clegg & Sons, Figtree Lane, Sheffield, England. This invention provides a receptacle for storing and carrying razors when not in use; provides a temporary cover operable by contact with the razor when said razor is lifted from the receptacle; provides a service cover adapted to limit or prevent the splashing of the contents from the receptacle to which the cover is applied; and provides a temporary or traveling cover for concealing the receptacle to prevent the release of liquid carried thereby.

MICROMETER CALIPERS.—J. H. MULLER, 1512 24th Ave., East Oakland, Cal. This invention relates to micrometer calipers of the large type. The object is to provide an inexpensive micrometer caliper, simple and solid in construction, having a measuring point and a graduated rod provided with a micrometer measuring point and removable from the caliper frame.

UNDERREAMER.—J. W. PIPPIN, Nashville, Ark. An object in this invention is the provision of a tool which is simple in construction, positive in action, and which embodies certain elements which give the tool great strength, thereby preventing the breaking of the bits or cutters when reaming hard rock.

POST HOLE DIGGER.—C. HIGBY, Idaho City, Idaho. The invention provides pivoted co-operating scoop members which are normally in closed relation and with which weighted means are associated to cause said members to open during the projection thereof toward the ground so that the scoops will be in open position before entering the ground, said weighted means being also adapted to facilitate the entry of said scoop members.

MEASURING SCOOP.—D. D. MURRELL, 114 W. Michigan Ave., Tampa, Fla. The inventor provides a scoop especially adapted for grocers' use, having an adjustable partition or disk arranged in the scoop whereby the vol-



MEASURING SCOOP

ume of the scoop may be varied in order that various predetermined quantities of material may be accurately measured. It provides a scale on the scoop handle by which the partition may be accurately adjusted so that the scoop will hold the required amount, the scale being adjustable relatively to the scoop handle, whereby different varieties of commodities may be accurately measured.

SAW GUIDE.—E. A. KINLEY, 7 Maple St., Cliftondale, Mass. The saw guide is placed over the saw to rest on the surface of the board, or other material, the guide being adapted to be moved slightly across or along the surface of the board with one hand, while the saw is operated with the other hand, whereby to make an absolutely square cut, regardless of the length of the cut, and thus enable an unskilled person to do as accurate work as a skilled mechanic.

PLUMB OR LEVEL.—D. W. L. FRANK, 2024 West Harrison St., Chicago, Ill. An object of this invention is the provision of a plumb or level having units, each unit comprising a dustproof casing which incloses the spirit tube or tubes, said unit being capable of being expanded or contracted to fit level stock of various thicknesses.

COMBINATION RAZOR.—V. T. MILLER, Ness City, Kan. To insert the blade the members are open and the blade is hung on posts. The members are then closed, the oblique end of one member dovetailing into the end of the other. The fact of the blade being between the two members slightly opens the members at their outer end, and when they are crowded together they form a spring which holds the dovetail together sufficiently secure. The guard plate is then attached. This plate can be instantly removed and attached to either side of the blade as desired.

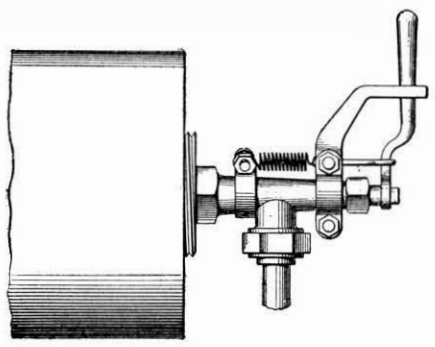
NAIL HOLDING TOOL.—H. PERKINS, Montague, Mass. This invention relates to a device for holding a nail and properly positioning the same for driving with a hammer. With the improved tool the nail can be held and struck with force enough to send it through the crowning side of from one to four thicknesses of steel of metal roofing with one blow without any possibility of injuring the fingers.

DENTAL PLIERS.—J. B. MCALLISTER, Milo, Cal. In the present patent the invention has reference to pliers, and particularly to dental pliers, and has for an object the provision of an improved arrangement whereby a ligature may be operated properly and easily for producing a separation of adjacent teeth.

Heating and Lighting

STAND FOR BURNERS.—H. A. LACERDA, 303 Campbell Ave., Schenectady, N. Y. An object here is to provide a stand more especially designed for use in boiler shops and other places for supporting a hydrocarbon burner, or other burner, and arranged to safely hold the burner and to allow vertical and horizontal adjustment for effectively and accurately directing the flame of the burner to the work to be heated.

GAS FEED REGULATOR AND KEY RETAINER THEREFOR.—G. F. BREUNINGER, Bedford Hills, N. Y. Among the principal objects which the present invention has in view are: to provide means for predetermining the



GAS FEED REGULATOR AND KEY RETAINER THEREFOR

service position of a gas control feed key; to provide means for adjusting the service position of the key; and to provide means for holding the key in service to avoid loss thereof. The engraving shows a side view of an end fragment of a gas tank, showing in conjunction therewith a delivery pipe and control valve, a key for said valve, and means for holding the key in position to regulate the feed of gas from said tank.

Household Utilities

CLOTHES STAND.—M. FINKELSTEIN, 1800 7th Ave., New York, N. Y. This invention relates particularly to a stand for clothes, as for instance, hats, coats, trousers, or ladies' clothing, and has for an object the provision of an improved arrangement whereby the clothes will be held in position and some of the clothes stretched.

SASH PULLEYS.—W. A. BRANDT, 933 Park Ave., New York, N. Y. The invention has reference to overhead sash pulleys. It provides pulleys which can be secured to a window frame without any screws. And provides a sash pulley which can be easily and quickly placed into position or removed when necessary.

DUST SEPARATOR.—R. W. RIORDAN, 252 Westminster Road, Brooklyn, N. Y., N. Y. The separator can be placed in an ordinary bucket and submerged in water, whereby the dust-laden air is caused to pass through the water by the special construction of the device for the elimination of the dust particles from the air, the separator being so constructed that it can be easily and quickly cleaned without the disagreeable features common to dust bags or receptacles now in use, and since the dust is taken up by the water the mere emptying of the bucket disposes of the dirt.

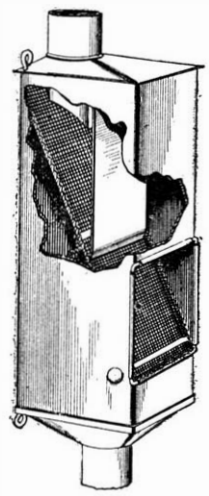
INFANT'S CRIB.—G. E. PETTERSON and R. G. LAWTON. Address the former, 1816 W. 11th St., Pine Bluff, Ark. This improvement provides a crib or bed arranged to protect the infant or child occupying the bed from the attacks of mosquitoes, flies and other insects, and to allow of raising the bed within a sheltering inclosure for conveniently placing the infant or child into the bed or removing it therefrom.

CONTROLLING DEVICE FOR WATER HEATERS.—H. A. COCHRAN, 913 South Congress Ave., Austin, Tex. The invention refers to water heaters having a gas burner controlled by the flow of the water. It provides a controlling device arranged to insure a positive opening and closing of the gas supply valve for the burner whenever the water is turned on or shut off.

GAS BURNER.—H. A. COCHRAN, 913 South Congress Ave., Austin, Tex. This invention relates to gas burners such as are used on water heaters having a gas and water controlling device, such as shown and described in Mr. Cochran's application for Letters Patent, Serial No. 55062. It provides a burner arranged to assure complete combustion of the gas and the production of a high heat on an economical consumption of gas.

BED SPRING.—H. GARFINKEL, 55 Union Ave., Brooklyn, N. Y., N. Y. The invention provides a bed-spring adapted to be lifted from service position to facilitate the cleaning of the floor; provides a spring with means for preventing sagging of the bed clothing when in service; provides means for preventing the mattress from falling off the spring when the latter is uptilted to expose the floor beneath the bed; and provides means for adjusting the marginal edges and spring whereby said edges are completely adjusted in advance of said spring.

RAIN WATER FILTER.—HENRY L. KUENZLI, Nevada, Ohio. This invention provides a device for interposition in the pipe or downspout leading to cistern or other receptacles, and wherein mechanism is provided, arranged within the length of pipe and between the receiving and the delivery ends for the purpose of filtering the rain water during its passage, and for removing all sediment from the water, and wherein the said removing means is so arranged that the action of the water coming



RAIN WATER FILTER.

on to the said means will clean the sediment from the cleaning means and deliver it outside the pipe. The filter will remove from the rain water as it flows from the roof all sediment, insects, leaves, bird nests, coal soot, cinders, etc., which would otherwise pass into the cistern and decay. The filter is for use in downspouts and railroad sheds and other buildings to prevent cinders and other sediment from passing from roofs into drains and sewers and clogging them. It is self-cleaning and not damaged by freezing.

PROCESS FOR COOKING HAMS.—A. REUBOLD, 1340 Chisholm St., Bronx, N. Y., N. Y. This invention provides a device employed in the process of cooking hams. More definitely stated, it relates to a jacket or wrapper of peculiar construction and utility, in which the meat to be cooked is tightly wrapped and when so wrapped is introduced into the cooker. It improves the flavor and retains the juices within the meat.

BATH SPRAY SUPPORT.—M. KLINE, 203 E. 174th St., Bronx, N. Y., N. Y. The invention has particular reference to shower baths. The principal object is to provide an improved, cheap, neat and reliable support for the flexible hose and nozzle of a shower bath apparatus, the same being adapted to be readily aplied to any standard bath-tub fittings.

CHAIR SEAT.—F. H. HURD and E. J. HEULE. Address Horatio V. Gard, Attorney, Superior, Wis. This invention is an improvement in chair seats, and the invention has for its object the provision of a seat of the character specified, wherein a new and improved form of spring cushion is provided, capable of attachment to chairs of any character.

Machines and Mechanical Devices

AUTOMATIC CENTRIFUGAL GLASSWARE MAKING MACHINERY.—B. F. GIFT, Dunkirk, Ind. This invention relates to the art of making glassware by the utilization of the action of centrifugal force. It provides a machine for shaping molten glass into ware of various shapes by the action of centrifugal force and to turn shaped glassware out in a finished state.

PAWL AND RATCHET MECHANISM.—A. C. GRAHAM, 311 Cherokee Ave, Bartlesville, Okla. The prime object of the invention is to provide for actuating the band-wheel by an internal combustion engine to overcome the expense and inconvenience of operating a steam engine under conditions where water for the steam boiler is required to be brought from a distance. With the ordinary band-wheel and rigid crank rig the internal combustion engine, owing to its heavy fly wheels, is not adapted to give the necessary drilling movement to the crank. The invention overcomes the difficulty.

LUMBER STACKER.—G. A. BAKER and F. DU VALL. Address the former, P. O. Box 66, Grasonia, Ark. This invention relates to an automatic stacker for lumber for use in connection with lumber drying or treating kilns, a primary object being to automatically stack lumber in such manner as to provide for the free circulation of air and gases therethrough for the efficient treating of the lumber in the kiln. The inventors have invented another lumber stacker which provides a wholly automatic arrangement in which the stack is stationary during formation, the automatic mechanism for placing the lumber thereon and the spacing sticks between the lumber, being movable vertically as each tier or layer of lumber is completed with respect to the stack.

WEIGHING SCALE.—A. HUELSMAN, 225 Amory St., Fond du Lac, Wis. The invention provides a weighing scale having a shaft with a scale secured for rotating therewith, there being at one end of the shaft coin-controlled mechanism for releasing the shaft. Disposed with the scale there is a lever having a sliding weight for co-operating with the scale when the scale and the shaft have been rotated, to operative position, after a coin has been introduced in the slot of the coin-controlled mechanism.

CIGAR CUTTER.—O. WILHERMSDORFER, 1345 Clay Ave., Bronx, New York, N. Y. The invention provides means for trimming the ends of cigars at an established length thereof; provides a scale for determining the length of cigars, operable in conjunction with the means for trimming; provides for a cutting blade and means for rotating the same during the active period thereof; and provides means for safeguarding the hand while using the cutter.

CLOCK.—G. J. ANDERSON. Address A. W. Biber, Spartanburg, S. C. This invention is an improvement in clocks, and the invention has for its object the provision of a clock wherein the usual spring and works are omitted, being replaced by electrically operated mechanism for moving the hands in accordance with the passage of time.

SMALL ARMS.—W. BAKER, 87 Snow Hill, Birmingham, England. The object in this ease is to construct a firing mechanism for drop-down guns of the hammerless type; the arrangement being such that when the gun opening lever is actuated the safety lever is automatically released so that it can restore the firing pin and trigger to the cocked position, but the gun cannot be fired until the firing spring has been compressed and the safety lever reëngaged with its catch.

GRINDING FIXTURE.—B. B. STENVALL, 14 Mt. Kimball Ave., Morristown, N. J. The inventor provides a grinding fixture more especially designed for use in a watchmaker's or jeweler's lathe, and arranged to permit of conveniently and quickly reducing the diameters of different sized stock watch glasses, to correctly fit the same into the bezels of watches.

PNEUMATIC TRACK AND STREET CLEANER.—F. L. WARNER, 139 Clinton St., Brooklyn, N. Y., N. Y. This improvement provides a machine made functional either by a blast of air, air suction, or a combination of suction and blast for the purpose of drawing or blowing dirt or dust from or through the rough ballast of railway road beds, or along places ordinarily inaccessible by the usual sweeping apparatus.

MINE DESTROYING MEANS.— E. T. ROBESON, Swansboro, N. C. An object here is to provide a mine-destroying means including a pilot boat and a conveyer or charge-carrying boat adapted to carry an explosive charge for exploding the mine, the respective boats to be equipped with means whereby to automatically control the direction thereof as well as their relative speeds.

MOUNTING FOR PROPELLER SHAFTS.—V. GAOVE, Callao, Mo. The invention is of peculiar value in connection with propeller shafts used for driving boats, aeroplanes, and even cars, in instances where it may be practicable to use propellers, and, in fact, the invention may be employed in all relations where a propeller can be used and in which it is desirable to shift the axis of rotation of the propeller to relatively different angles.

PHOTOGRAPHIC CAMERA REGISTER.—C. B. BAZZONI. Address Robin Steele, 298 Wall St., Kingston, N. Y. This invention provides means for notifying the user that the sensitized material which at any time is placed in the focal area is fresh, or has been exposed; provides means operatively connecting a sensitized material and the register to set the same to indicate the pressure of a fresh sensitized area, said means being operable by the exposed area or medium as the same is removed from focal area.

PHOTOGRAPHIC CAMERA SHUTTER.—C. B. BAZZONI. Address Robin Steele, 298 Wall St., Kingston, N. Y. The invention provides means for avoiding the double exposure of sensitized medium; provides a lock to prevent the double operation of a photographic shutter for exposing a sensitized medium; provides a lock for the shutter mechanism of a camera and means for releasing the same; provides said means for releasing said lock with automatic attachments to be operated by conventional physical characteristics of the usual sensitized mediums for cameras; and provides a mechanism adapted for attachment to structures of usual make.

CLAMPING DEVICE.—C. A. RAHMEL, 730 Kitiner St., Defiance, Ohio. This invention refers to means for quickly clamping and unclamping material being worked in desired positions on wood and metal working machines, and the main object is to provide a clamp which securely holds the work, but which, when desired, may be immediately unclamped to permit the work to be moved into other positions.

CLOTHES LINE SUPPORT.—M. BUBIN, 356 Atlantic Ave., Brooklyn, N. Y., N. Y. This invention provides means for drawing the receiving end of a clothes-line opposite a window opening during the period when clothes are being placed on the line or taken therefrom; provides a fixture whereby the line may be disposed as above set forth temporarily,

(*Concluded on page* 132)

Tarvia

Preserves Roads
Prevents Dust~

The use of Tarvia means *better* roads and *lower* taxes

TWENTY-FIVE years ago, smooth and well-kept roads were the special pride of Old England, where they were the product of two centuries of incessant road improvement.

But those fine roads were only macadam and they were not fitted for the gruelling of automobiles.

Now, with the automobile everywhere, you find in all sections of America examples of better roads than Old England's best roads of twenty-five years ago.

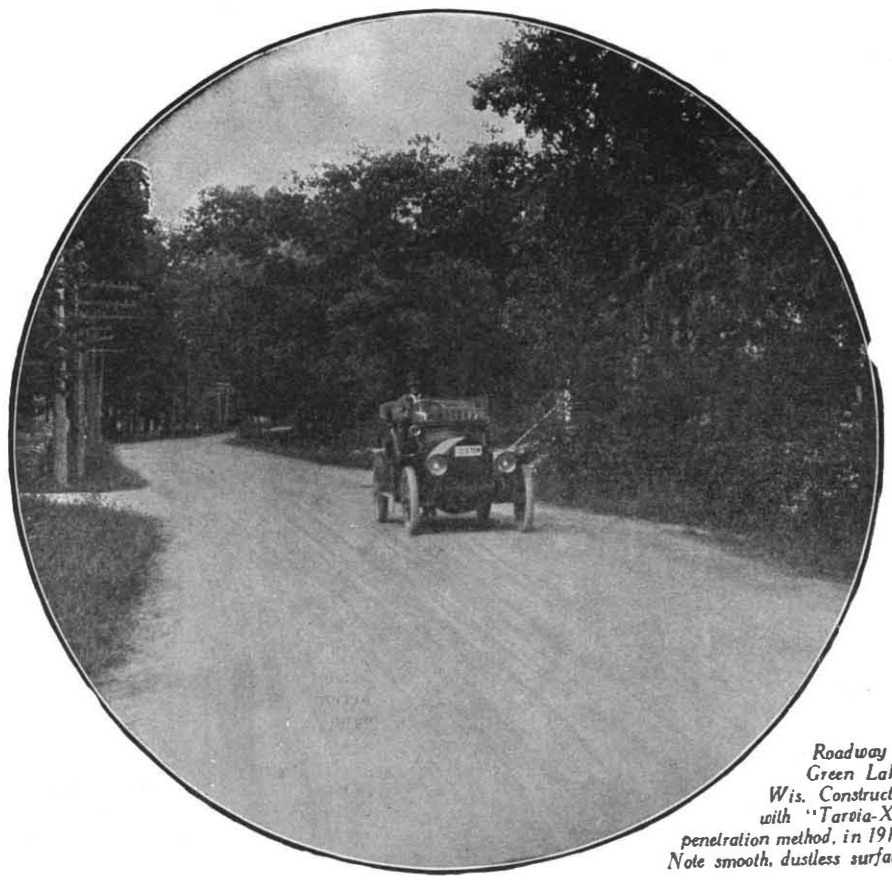
Tarvia has been an important factor in this development.

Good roads now don't require generations of labor nor immense outlays from the taxpayers.

The use of Tarvia on an ordinary macadam road will make it the pride of a community; it will give comfort to all the citizens; it will be a delight to visitors; —and most important perhaps, it will result in reduced taxes.

Recently a town celebrated the completion of a Tarvia road by having a civic dance on it in the moonlight, helped by the electric lights. The road was almost as clean and resilient as a waxed floor.

Do you know what Tarvia is, and what it does? It is a special coal tar preparation peculiarly fitted for binding as well as reinforcing the surface of macadam roads.



Roadway at Green Lake, Wis. Constructed with "Tarvia-X," penetration method, in 1913. Note smooth, dustless surface.

What Tarvia does to a road is almost magical.

It makes it smooth, resilient and dustless.

It gives to the automobile a glide that makes a mile seem like a quarter. It gives to carriage riding a welcome comfort and to teaming an easier pull.

It abolishes the curse of dust and the messiness of mud.

A Tarvia road brings the farm, the town and the city closer together. It is an asset to the community.

Tarvia roads often last years without any renewal. But even renewals of Tarvia are the lowest cost road improvement that has been invented.

The reductions in maintenance expense, for a Tarvia road, in most cases more than cover the total cost of treatment.

There are three kinds of Tarvia. "Tarvia-X" is very heavy and dense. It is used as a binder in road building and is the most thorough and permanent of the Tarvia treatments. "Tarvia-A" is a lighter grade, used for hot surfacing applications. "Tarvia-B," which is fluid enough to be applied cold with modern spraying apparatus, is for dust prevention and road preservation.

Kingshighway, St. Louis, Mo. Constructed with "Tarvia-X," penetration method, in 1915.

Illustrated booklet on request. Address nearest office.

Special Service Department

In order to bring the facts before taxpayers as well as road authorities, The Barrett Company has organized a Special Service Department, which keeps up to the minute on all road problems. If you will write to nearest office regarding road conditions or problems in your vicinity, the matter will have the prompt attention of experienced engineers. This service is free for the asking.

If you want *better roads* and *lower taxes*, this Department can greatly assist you.

The Barrett Company

New York Chicago Philadelphia Boston
St. Louis Cleveland Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis
Nashville Salt Lake City Seattle Peoria

THE PATERSON MANUFACTURING CO., Limited: Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

(*Concluded from page* 130)

to be returned to its service position outside of the window and removed from the path of the sashes; and provides means for supporting the temporary fixture during the period of loading and unloading the line.

PICTURE FILM APPARATUS.—W. P. McNEEL, 1123 N. French Place, San Antonio, Tex. This improvement relates to moving picture machinery and has particular reference to means for manipulating the films of such machines. It provides facilities whereby the rewinding of a film preliminary to a successive display or projection thereof will be avoided.

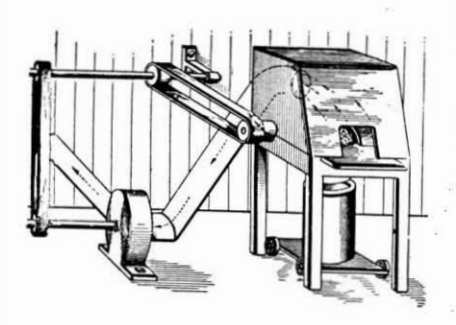
TRANSMISSION CHAIN.—J. LYNN, Box 176, Alice, Tex. This invention is a transmission chain made up of separate links, some of which are provided with spring material for centering the chain and for giving the latter increased flexibility, as well as for protecting objects disposed near or accidentally thrown into close proximity to the path of travel of the chain.

KEYING DEVICE.—A. G. MOGAN, Natalbany, La. The invention has reference to eccentrics, the inventor's more particular purpose being the provision of an eccentric made in parts and provided with means for readily securing it firmly upon a shaft so as to avoid the use of shaft keys, studs, bolts, nuts and set screws.

PRINTING PRESS.—M. B. DISKIN, care of Lakin Bros., 149 Wooster St., New York, N. Y. The invention relates more particularly to a hand press mainly intended for printing in two different colors. It provides a press for printing labels in which the numbers or letters indicating the measure or price are printed in a different color from the reading matter relating thereto.

FLEXIBLE SHAFT COUPLING.—M. T. THOMAS, care of Thomas Coupling Co., Troy, Pa. The object in this case is to provide a coupling, the structural parts of which are simple, durable, and inexpensive, and at the same time of such a nature as to provide for the use of laminated flexible rings and, from the nature of the said rings, obviate all danger of crystallization in use.

GRATING MACHINE.—A. SCARPITTO. Address J. Vaughan Gary, Attorney, 1001-1002 Travelers Bldg., Richmond, Va. The machine is especially adapted for grating horseradish and other pungent materials, wherein a support is provided for a grating wheel having a discharge chute below the wheel, and an inner inclosing hood above the wheel having an opening at one side of the wheel for permitting access thereto, and an outer inclosed hood inclosing the inner hood and having an opening registering with the opening of the inner hood, and having an outlet at the opposite side, together with exhausting apparatus connected with the outlet to remove the pungent odors without affecting the grated material.



GRATING MACHINE

CENTER FINDER.—D. L. SAUERHERING, Wausau, Wis. One of the principle objects here is to provide a center finder of economical construction adapted to be readily operated by one hand for quickly and exactly determining the center of square, round, elliptical, octagonal, hexagonal, or other shafts of regular cross sectional configuration.

TAKE DOWN DEVICE.—S. B. HENSHAW, care of Charleston Window Glass Co., Charleston, W. Va. The present invention has reference to mechanism utilized in connection with window glass machinery, to take down the drawn glass cylinders preparatory to capping the same into lengths, which lengths are thereafter flattened out into the finished sections of window glass.

WASHBOARD.—J. J. COFFEY, 401 Smith St., Brooklyn, N. Y., N. Y. This invention relates to washing and scrubbing and has particular reference to the construction of washboards. Among the objects of the invention is to improve the construction of a washboard with respect to simplicity and its sanitary nature in practice.

PAPER HOLDING AND FEEDING MEANS FOR DUPLICATING DEVICES.—H. W. MORLEY, Angola, Ind. The invention provides a device for duplicating the work done on a typewriting machine, in which paper holders are provided which dispense with the necessity of using carbon copies, thereby eliminating the time necessary in inserting and taking out carbon paper, eliminating the cost of the carbon paper and doing away with the possibility of soiled hands of the operator by the handling of the carbon paper.

DREDGE SPUD BRACE.—A. B. CLARDY, Box 145, Balboa, Canal Zone. This invention has particular reference to means for temporarily holding the dredge stationary while in operation. More definitely stated, it provides a means for so bracing the spud commonly used on dredges as to prevent the damage thereto and to the dredge body or hull incident to the tendency of the dredge body to recede under the force applied to the dipper.

Musical Devices

STYLUS LEVER FOR PHONOGRAPH SOUND BOXES.—H. TEICHLAUF, 110 Rodney St., Brooklyn, N. Y., N. Y. A specific object here is to provide a stylus lever which has a longitudinally divided or V-shaped arm between the pivot or fulcrum of the lever and the point of connection with the diaphragm, whereby louder and clearer sounds and better tones are obtained than with a lever having a solid arm.

COMBINED GUITAR AND MANDOLIN.—O. NONFRI, 47 Delancey St., New York, N. Y. This invention relates to musical instruments, and particularly to a combined guitar and mandolin, and has for an object the provision of an arrangement whereby the strings of each instrument may be independently played while using the same head and the same sounding board.

UPRIGHT PIANO ACTION.—A. KLEIN, 403 E. 90th St., New York, N. Y. The principal object of the invention is to provide means whereby the hammer may be held in check at any desired distance or position from the string, the means, however, being adjustable according to the desire of the operator or the maker of any particular type of instrument. Mr. Klein has invented another upright piano action, and the invention relates to upright piano actions of a nature similar to the mechanism described and claimed in his copending application, Serial No. 40,440. Among the objects of the present device is to improve the mechanism with respect to delicacy of adjustment and reliability of operation.

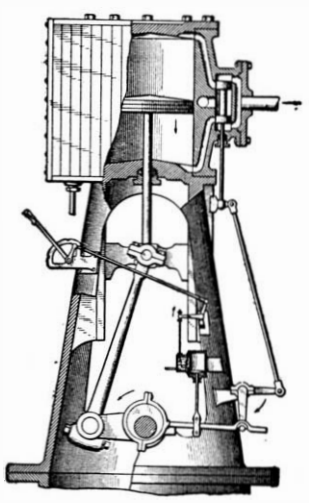
DISK RECORD HOLDER.—C. F. HANSELMANN, 307 49th St., Brooklyn, New York, N. Y. The object of this invention is to provide a new and improved holder for phonographic disk records, which is simple and durable in construction, cheap to manufacture and arranged to allow of conveniently placing a record in position in the holder or removing it therefrom.

Prime Movers and Their Accessories

CARBURETER.—H. C. MERRIAM. Address J. R. Morgan, 305 Lombard Bldg., Indianapolis, Ind. This invention provides means for insuring the vaporizing or atomizing of the fuel, whereby air is readily mixed therewith and perfect combustion thereof results, with the consequent economy of engine operation, maximum engine efficiency at each speed, and practical elimination of soot deposit in the cylinders of the engine.

ROTARY ENGINE.—K. FUJITA and G. B. MARKLE, JR., 219 E. Broad St., Hazleton, Pa. This internal combustion engine is of the rotary type. The inventor provides a simple and efficient rotary engine the stator and rotor of which form a combustion chamber and turbine elements at the ends of said chamber to be actuated by combustion gases of the chamber.

OVERCOMING DEAD-CENTERS.—I. F. WILDEY, 1098 Woodycrest Ave., New York, N. Y. The improvement provides means for applying steam automatically beneath or ahead of the steam engine piston just as the engine is being stopped and the usual throttle has been closed, for the purpose of preventing the piston from making its full stroke, such cushion of steam serving to hold the piston in such position as to insure that the crank will be held substantially on the quarter. The invention relates to power machinery and has particular reference to means for overcoming dead-centers in or connected with prime movers.



OVERCOMING DEAD-CENTERS.

Railways and Their Accessories

COUPLING.—J. P. METZGER. Carlstadt, N. J. This coupling is such as is used on locomotive injectors, which have a sectional coupling ring. The invention provides a coupling arranged to permit of quickly and conveniently coupling or uncoupling the parts without disturbing the position thereof. Mr. Metzger has invented another coupling and the object of the improvement is the provision of a coupling more especially designed for use on the injector of a locomotive and arranged to enable the engineer to quickly couple or uncouple the steam supply pipe and the injector. In still another invention of a coupling by the same inventor, the object of the invention is the provision of new and useful improvements in couplings whereby the engineer is enabled to readily manipulate the locking device for locking or unlocking the key section of the locking ring.

ELECTRIC BOND AND FISH PLATE.—C. J. SCHULZ, 441 E. 176th St., New York, N. Y. The general objects of this invention are to improve and simplify the construction of rail bonding and connecting means so as to be comparatively simple and inexpensive to manufacture and apply to the rails, and so designed as to permit the rail sections to readily expand and contract without impairing in any manner the effectiveness of the electrical connection.

HAND BRAKE ATTACHMENT.—W. A. HUBBARD, 915 Lincoln St., Hoquiam, Wash. The invention is embodied particularly in an improved ratchet-and-pawl attachment of a brake rod or staff for railway cars, whereby greater rigidity and strength, also security, are obtained. An advantageous feature is the security of the pawl against accidental displacement.

RAIL TIE.—J. E. DEWEESE. Address Hon. G. H. Hodges, Olathe, Kan. The object here is to provide a tie with rail seats wherein rails may be held without the use of spikes, and in such manner as to prevent bunching of the ties in use, and whereby joints may be completed without the use of scarfs, fish plates, and other complicated connections such as now proposed.

LUBRICATING DEVICE.—O. SWANSON, Atchee, Colo. This improvement relates to lubricating devices for lubricating the flanges of the wheels of railway rolling stock. The device is characterized by the provision of a lubricant container mounted to swing and maintained against the flange of the wheel by the action of gravity upon the container.

RAILWAY TIE PLATE.—J. SCHIMMEL, JR., Paoli, Pa. This invention produces a one-piece anti-rail-creeping tie plate having provision for attaching the same to the tie so that it cannot lose contact therewith and thereby become ineffective. It provides a tie plate that will permit the rail to perform its wave motion without lifting the tie or its tie plate from its bed.

Pertaining to Recreation

SEESAW.—E. HAKOY, Canton, Mo. This invention relates to amusement and recreation devices, and more particularly to seesaws, one object being to provide a seesaw which can be readily operated by children. A further object is to produce a seesaw that may be loaded at the ground, elevated and caused to oscillate from the seats of the seesaw.

KINETOSCOPE FILM MAGAZINE.—P. J. PROKOP, 536 W. 145th St., New York, N. Y. This invention pertains to the rewind magazines of motion picture projectors, and the main object thereof is to provide such a magazine from which the film may be fed into the projector for another projection without the necessity for the intermediate reverse winding now common, thereby saving much time and greatly reducing the wear on the film.

GAME APPARATUS.—L. G. JERRAM, E. E. GLUCK and G. HENSLE. Address the last, 610 Riverside Drive, New York, N. Y. This improvement provides an apparatus for furnishing amusement and introducing an amount of skill incident to a contest between players of the game wherein the apparatus is used; provides an apparatus which is attractive in appearance and simple in construction; and provides an apparatus which may be stored within small compass.

EYE FOR DOLLS.—D. PUDLIN, 329 E. 29th St., New York, N. Y. This invention refers to eyes especially adapted for dolls, although they are not necessarily limited to this use. The general objects are to provide an unbreakable eye of novel, simple and inexpensive construction, and having a close resemblance to a natural eye.

ATTACHMENT FOR PROJECTORS.—V. PINI, 127 Fort Greene Place, Brooklyn, New York, N. Y. This invention provides an attachment for the projecting head whereby various color effects may be thrown upon the screen with untinted films in order to enhance the effect, to accomplish the same results produced with tinted films, and to improve on the latter by differently tinting the projection at different positions on the screen as, for instance, tinting the sky blue or yellow, and the ground or water green.

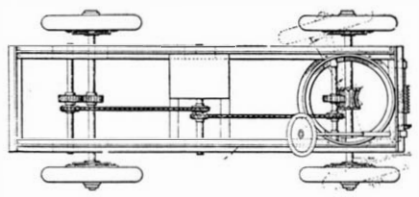
Pertaining to Vehicles

AUTOMOBILE PULL AND LIFT.—Z. E. HOUSE, Cass Lake, Minn. The inventor has for his object to provide a jack of this character, of light weight and capable of easy transportation, and of various uses, the said jack being adapted to lift the automobile or to pull the same forward, and for use in many other capacities.

TIRE CHAIN AND ARMOR.—W. J. PUTNAM, Deposit, N. Y. This invention is an improvement in tire chains and armor, and the invention has for its object to provide a chain of the character specified, adapted for use with tires of any character for preventing skidding and slipping and for increasing the traction of the wheel.

CLUTCH RELEASE.—A. L. ZIMMERMAN, Valparaiso, Ind. This inventor provides a clutch release for automobiles and particularly of the Ford type, which connects the brake pedal with the clutch lever, with which the clutch pedal is also connected. The brakes are applied in the usual way, and at the same time the release throws the clutch mechanism into inoperative position.

MOTOR VEHICLE.—J. BOHAN, R. F. D. No. 1, Box 79, New Hartford, Iowa. This invention has for its object to provide mechanism in connection with motor vehicles of every character, for applying the power of the motor directly to the four wheels, without interference with the steering of the vehicle. A further object is to provide mechanism in connection with the front axle for steering the vehicle, by swinging the axle, thus dispensing with the usual pivotal spindle and providing for greater strength in the axle.

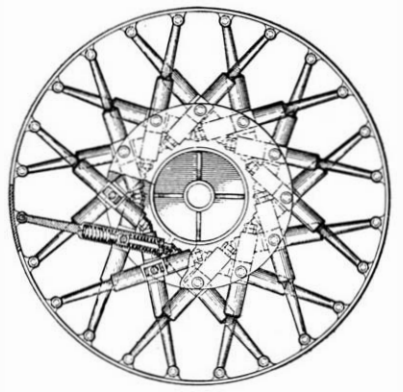


MOTOR VEHICLE

AUTOMOBILE JACK.—B. J. CONDON, 387 Prospect Ave., Brooklyn, N. Y., N. Y. An automobile jack is here provided which may be operated by the automobile engine or hand power to raise or lower the chassis relatively to the ground to replace tires and wheels, to make repairs and to preserve the tires when the automobile is not in use. As the operating means for the jack may be locked, it will be understood that the jack may also be employed to prevent the use of the automobile by unauthorized persons.

FOUNTAIN BRUSH.—W. C. FREDERICK, Salisbury, N. C. This invention relates to improvements in fountain brushes for use in cleaning vehicle bodies, walls, etc. It provides a fountain brush or mop having a back which is perforated to permit the entrance of a stream of water, and which is provided with means for detachably holding the strands of the brush or mop.

VEHICLE WHEEL.—F. V. UBEZZI, 58 Perry St., New York, N. Y. The invention provides a wheel having a rigid frame and a floating hub, with resilient means for normally holding said hub concentric to said rim, to distribute the traffic strains between the said rim and hub to accommodate a variety of traffic conditions; avoids collapsing of the structure incident to side thrust thereon; and provides means for carrying the resilient tension of the structure connecting said rim and said hub.



VEHICLE WHEEL

RADIATOR.—G. W. FRAZIER, 2521 Filbert St., Oakland, Cal. The object here is to provide a device especially adapted for motor vehicles, wherein the radiator is of that character shown in Mr. Frazier's co-pending application, Serial No. 879,315, that is, the said radiator is detachable and removable from the vehicle, and wherein a particular type of connection is provided, together with a particular type of radiator.

TRACTION DEVICE FOR MOTOR VEHICLES.—S. SYLVESTER, Lisbon Falls, Maine. This invention pertains particularly to an improved traction device for motor vehicles. The object in view is to provide a traction device of substantially the caterpillar structure which will present enlarged gripping surfaces whereby greater power may be secured.

Designs

DESIGN FOR A CUP.—G. LEACHMAN, Newell, W. Va. The design of this patent embodies the patentee's idea of a drinking cup having a concave annular flange at the top, whereby to permit cooling of the coffee or other liquid being consumed.

DESIGN FOR A HAND BAG.—L. WOLF, care of Wolf & Co., Inc., 50 E. 9th St., New York, N. Y. This design comprises a series of superposed cascades, ripples, waves, billows, festoons, hammocks, etc., arranged on the central vertical line of the bag, of equal sizes, or of varying sizes.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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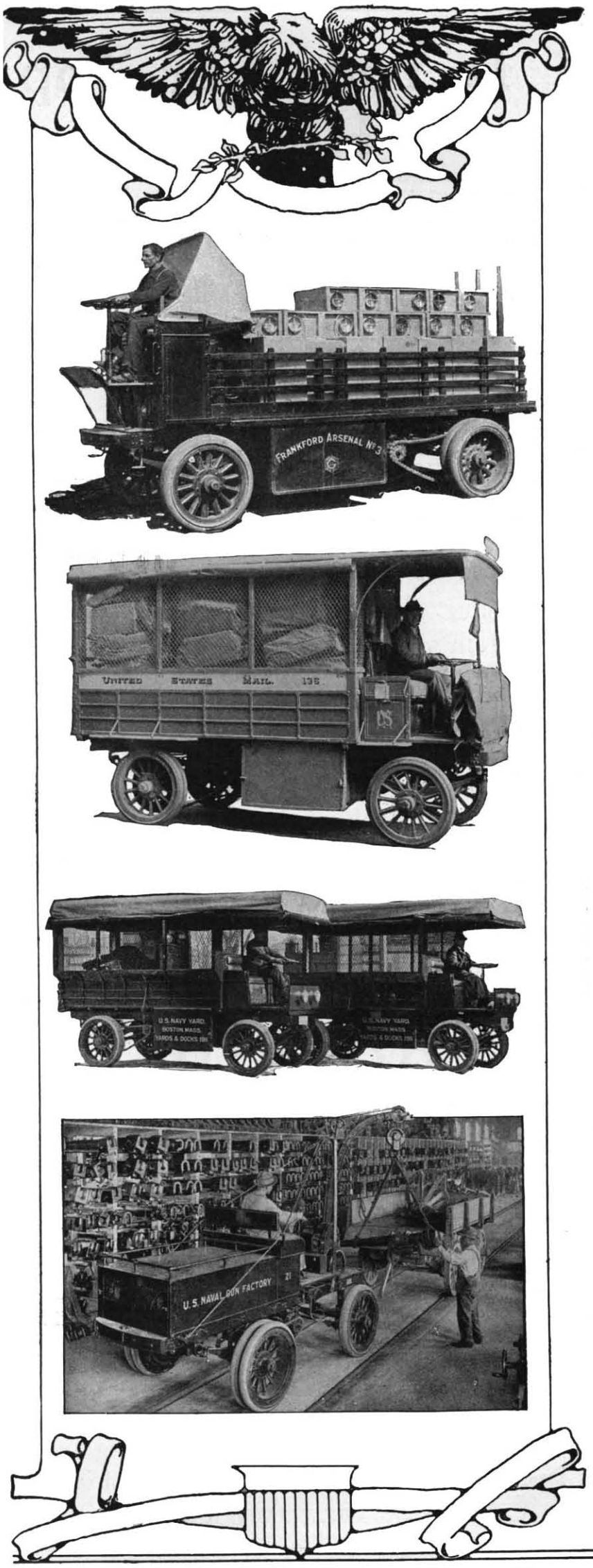

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1696

Our Cavalry

(*Concluded from page 124*)

enterprise. The Indian seldom battled as a member of an organization; it was every man for himself, the band or tribe in general. With uncanny ease the far-sighted scouts detected the approach of the soldiers, quietly signaled their waiting fellows and slipped around some low hill or through a shallow arroyo, or even over naked plain, each to crouch motionless behind nothing more protective than a wisp of a bush, frequently stuck up by himself in the ground for the purpose, and fade into the dun landscape. Then when the approaching forces came within range, a shot, a cluster of shots; and when the cavalrymen charged over to the puffs of smoke, there was nobody there. A moment later came the spatter of fire from some other place and the disheartening chase continued.

Troops soon grew weary of charging over in masses; the target presented was too large, too compact, and the deployed line, the skirmish order of to-day, came into vogue. Sabers were about as useful against the Indians as so many clubs and the custom of carrying rifles was adopted. After that, at the first shot the cavalry lines opened out immediately after the horses had been linked and led to the rear, the men dropped prone and sought the most promising cover.

The cavalry learned, too, the lesson of protection as well as of cover. Cover, in the broadest sense, merely offers concealment, but more than concealment was necessary in the face of a heavy searching, hostile fire. The Indian met the occasion, if nothing better offered, by placing before his head which bugged the ground, a stone no larger than a fist or two. In comparing the ratio of the dimension of the balled fist to that of the head, it is obvious that a certain percentage of protection against a bullet was gained. With the peculiar effect which mottling has, a simple little stone frequently so broke the definite line of the body that the body became almost invisible, and that not far away. A twig or two stuck up in the ground completed the effect and the Indian disappeared like a quail.

From these rough lessons, the art of cavalry action which should combine the mobility of horsemen, the formation which offered the least inviting target, the ability to develop accurate rifle fire and appreciation of cover and protection, expanded and grew until time and experience made its tactical employment general.

For years before the Civil War, the greater part of the United States Army was very busy on the plains, fighting Indians: Therefore most of the officers and men had had ample opportunity to acquire this new method of fighting, and to perfect it. And when the war came and the men took sides, many rising to eminent leadership eventually, they carried the lessons away with them and incorporated them into the organization of the huge cavalry forces which were raised on both sides.

Further development resulted, for this was a kind of warfare differing from that of the frontier; great masses of cavalry were employed and opportunities for the use of shock action were frequent. The two methods of fighting, the dual functions of cavalry to engage in either mounted action or dismounted, relying upon weight of fire, were tested and retested until at last a definite tactical scheme was elaborated, a method which remains practically unchanged to the present day. General officers, commanders of armies, when a portion of their infantry lines was broken or even threatened with breaking, learned that they could rely as well upon the fire action of the cavalry as upon that of the infantry and the superior mobility of the cavalry enabled them rapidly to fling reinforcements into the breach. In the development of the cavalry screen, that long line of widely separated units and thin line of skirmishers which preceded the main body of an army sometimes by three and four days march, it was found that the arming of the cavalry enabled it to seize an advantageous advanced position and hold it with success until such reasonable time as it took for the main body to come up.

On retreat, the cavalry offered the same advantage. To cover a retiring army, bodies of cavalry would take position well concealed, open fire upon the pursuit as soon as it came within range, force it to deploy for attack—all of which gained needed time for the main body to put a little more distance between it and its pursuers; and about the time the enemy was ready to drive home the attack, the cavalry would slip away, mount and dash off, to take up another rear guard position farther on.

With the forces of North and South were many observers, officers from European armies, wide-awake chaps who were able to analyze and grasp the advantages which unfolded before them. When they returned to their homelands, they reported enthusiastically what the American cavalry had been able to accomplish, and the result was that the European armies, ever on the lookout for improvement, adopted the methods just described, with the proper arming of the men, and the cavalry of all Europe underwent reorganization along the new lines.

In Mexico to-day, the United States has its advanced units far to the front, a flexible, mobile command composed exclusively of cavalry and mountain or horse artillery, with a stiffening of infantry in motor transportation. Mounted cavalry, in this day of the modern high-powered, rapid-fire rifle, does not attack intrenched infantry; it would be suicidal. But when the searching of shellfire and the thrust of the infantry attack have swept a force out of position, uncovered the possibilities for maneuver, then comes the time for the cavalry of both sides, the one to break through, complete the retirement or rout, to cut off bodies of the enemy, and garble the communications generally; the other, even at the expense of complete sacrifice, to hurl itself into the fray to save the all-important infantry from complete disaster and in this action, mounted as well as dismounted action may be used.

The Indian is almost extinct, his doings are now little save tradition. Yet from his clear, logical, common-sense methods of warfare has come a most important tactical development which is utilized by the highest military units of the world to-day, the armies of struggling Europe.

How An Army Hears

(*Concluded from page 122*)

of the duty of the signal corps to thoroughly understand. This code is also used for general visual signaling, radio telegraphy and on cables using siphon recorders. The American Morse code is used on telegraph lines, on short cables and on field lines. It is not used in communicating between the army and the navy.

Under the former code all visual signaling is done. This embraces communication by flag, torch, hand lantern, beam of search light without shutter, heliograph, flash lantern, and search light with shutter. In addition, the two-arm semaphore code is used both by hand-flags and fixed mechanical arms.

With the exception of the semaphore system and those methods of visual signalling which require the flashing of dots and dashes, the general scheme of indicating the various letters and words is the same.

For the flag used with the General Service Code, there is one position and there are three motions. The position is with the flag held vertically, the signalman facing directly toward the station with which it is desired to communicate. The first motion (the dot) is to the right of the center and embraces an arc of 90 deg., starting with the vertical and returning to it, and is made in a plane at right angles to the line connecting the two stations. The second motion (the dash) is a similar motion to the left of the sender. The third motion (front) is downward directly in front of the sender and in-

stantly returned upward to the first position. This is used to indicate a pause or conclusion.

In the use of the torch or hand lantern, a foot light is employed as a point of reference to the motion.

The moving lantern is swung out upward to the right of the foot light for a dot, to the left for a dash, and is raised vertically for front. The beam of the searchlight though ordinarily used with the shutter like a heliograph also is used for long distance signaling in a manner similar to that of the flag or torch, the first position being a vertical one. A movement of the beam 90 deg. to the right of the center indicates a dot. A similar movement to the left indicates a dash; the beam is lowered vertically for front.

In signaling with heliograph, flash lantern, or searchlight with shutter, the first position is to turn a steady flash on the receiving station. The signals are made by short and long flashes, a short for a dot and a long steady flash for a dash. The heliograph, as is generally known, is an arrangement of two mirrors and a shutter. These mirrors are so adjusted that a brilliant flash may be thrown in any given direction. A drawback of this instrument, however, lies in the fact that sunshine is necessary to its use. Of far more general value is the searchlight; its flash is independent of background and is used for signaling by day as well as by night. In the day time and in ordinary weather the searchlight with shutter can be used for distances up to 10 miles.

In the United States Army, aviation is under the direction and control of the signal corps. In this particular the corps has been laboring under a great handicap due to the fact that so few funds have been made available by Congress for aeronautic equipment. The solution of heavier-than-air flying which was discovered and applied by the Wright brothers in America was promptly seized by the military authorities of all foreign powers, developed and put to general practical use; but in this country, as with many other discoveries of great value, in aviation we lag sadly, but it is no fault of the service that the few aeroplanes which we now have are not of the latest type and are not particularly well adapted for war usage. It is a wonderful service, that of the signalmen, full of interest, full of complexities and full of dangers. It is to be doubted if any branch of the United States Army has reached a higher point of development than has this, considering the limitations under which it has had to struggle for progress and effectiveness. This, however, but reflects more credit upon those who have devoted to it the efforts of a life time.

Using Telephone Lines for an Automatic Fire Alarm System

(*Concluded from page* 127)

hours the machine automatically operates the relay, thereby starting the pole chamber or source of ringing power. This provision was made to take care of cases where exchanges are closed at night, or on Sundays, where the alarm might be turned in from the street from a weather-proof telephone or pull box installed for that purpose. The second relay is for operating a general alarm in case one should be used in connection with the machine, such as a large vibrating gong located on street corners or in factories, siren horns, or other electrically-operated devices that might be used for general alarm purposes. When the machine is started it rings the lines connected to the apparatus five times each and just before it stops it automatically operates the relay sounding the general alarm, which continues to operate until stopped by the operator pressing the restore key. There is a standard pull box located in the operating room at some convenient point. The pull box contains a starting key and a restore key. The operator, being notified of fire by telephone or other means, turns the starting key which releases the motor and automatically rings the lines. After the alarm has been sounded the operator, by pressing the restore key, restores the machine to its normal condition.

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The Machine Gun

(*Continued from page* 125)

from our illustration, has no water jacket, a series of fins at the mid-length of the barrel serving to keep the latter cool during continuous firing. This gun is of the gas-operated type, the automatic devices being controlled by a portion of the gases of explosion and a spring located beneath the gun barrel. When the bullet has covered about one-half of its travel through the bore, a portion of the gases escapes through a gas nozzle, and acts upon a cup at the forward end of a hollow, cylindrical actuator, throwing it backwards toward the breech. This movement carries back the firing pin and turns the latter through part of a circle. This latter movement in turn acts upon the cartridge clip, bringing a new cartridge into position. Meanwhile the fermeture nut, which locks the breech, is rotated by means of a cam connection with the actuator, and this serves to unlock the breech-block, which is thereupon moved to the rear. An extractor then seizes the empty shell and ejects it from the gun. A new cartridge now drops into place. It will be noticed that within the actuator is a long spring, which during the rearward movement is compressed. The energy of the compressed spring serves to close the breech, lock it, and fire the new cartridge.

The latest gun to be adopted by the United States Army is the Lewis machine gun, which is also of the gas-operated type. In this gun a portion of the gases is admitted to a cylinder located beneath the gun barrel and drives the piston in the operating cylinder backward. This movement serves to perform the operations of ejecting the empty cartridge, inserting a fresh cartridge and placing the firing pin in position to fire another shot. The after part of the piston below the breech mechanism is provided with a rack which engages the toothed periphery of a case containing a coiled spring. The rearward movement of the piston partly winds this spring, which, in unwinding, closes the breech and returns the various parts to the firing position. The gun is supplied with ammunition from a rotating drum magazine holding 50 cartridges. A fresh magazine can be substituted in two seconds. The gun is cooled by means of a series of longitudinal ribs of aluminum, fixed to the barrel, which are inclosed by a sheet metal case open at the rear and extending beyond the muzzle in the form of a contracted sleeve. The passage of the bullet through this sleeve induces a flow of air which carries off the heat of the burning.

This gun which is the invention of an American officer, Col. I. N. Lewis, was offered for test by the Army and General Crozier submitted it to two tests at the Springfield Arsenal and rejected it. The enormous success of the gun after its adoption by all the Allied Powers aroused a feeling in America that here was yet another case of a rejection of a good American invention after it had been offered to the Government. Hence, particular interest attaches to a field test (as distinguished from the shop tests instituted by General Crozier) which was ordered by Major General Wood and put through at Plattsburgh. The test was carried out in connection with identical tests of the Benet-Mercier gun. The report of these tests, as published in the *Army and Navy Journal*, is as follows:

"In the tests, the loaded magazines were filled with wet and dry sand and were fired without cleaning, except removal of such sand as fell out when magazines were shaken. The Lewis gun fired the required number of shots in one minute and three seconds, while the Benet-Mercier guns fired only eight or ten shots in five minutes of firing and went out of action for the balance of the tests, having become jammed and unable to continue the tests. The Lewis gun immediately thereafter fired 188 shots in fifty-three seconds, to demonstrate its functioning without the sand being removed from the gun.

The most interesting test, however,

(*Concluded on page* 138)

was when the magazines of both guns were filled with thick mud, the guns remaining uncleaned after the sand test. The Lewis gun performed in forty-eight seconds, while the Benet-Mercier gun was unable to function after the sand test, and therefore did not even attempt to enter the mud tests. After the conclusion of these tests the Lewis guns fired twenty shots with deformed cartridges and battered shells in three seconds.

"The superiority of the Lewis gun in every other particular was clearly demonstrated, the following special advantages being noted:

"(1) Simplicity—this was especially important in the night work; (2) the comparative rapidity and ease with which a fresh magazine may be attached and removed in case of jam; (3) more efficient cooling device; (4) ease in cocking piece for first shot; (5) comparative ease in reduction of jams; (6) remarkably satisfactory action in mud and sand tests, and with deformed cartridges."

NEW BOOKS, ETC.

CRIMINALITY AND ECONOMIC CONDITIONS. By William Adrian Bonger, of Amsterdam. Translated by Henry P. Horton. Boston: Little, Brown, and Company, 1916. 8vo.; 737 pp.; illustrated. Price, $5.50 net.

"The Modern Criminal Science Series" is composed of translations of foreign treatises, and makes accessible to American readers a body of literature of the highest significance. Dr. Bonger's work abounds in statistics; since these deal with convictions for rather than commissions of crime, deductions based upon them must be somewhat unfair to the poorer classes, who lack the means of hushing up their transgressions or of evading conviction by the employment of able and unscrupulous legal talent. Other considerations are the greater ability of the educated to bring doubtful transactions "within the law." Yet again, to the cause of bad environment in childhood must be added the reaction from too strict discipline—a factor less easily determined. All these considerations, however, do not prevent the statistics given from being extremely valuable, particularly when our application of them is guided by so broad a mind and so skilled a pen as those of Dr. Bonger. His indictment of economic conditions is no less emphatic because it is eminently impartial, and his manner of marshalling the facts concerning the various schools of criminology, social and sexual conditions, and the different classes of crimes, is little short of masterly. The publication of this Series is an event of no small importance to the social investigator and to the community at large. The judiciary, too, should obtain from such works as this of Dr. Bonger's a truer estimate of social and individual factors and an understanding sympathy that shall subordinate the letter of the law to its underlying principles of justice and amelioration.

ZEPPELINS AND SUPER-ZEPPELINS. By R. P. Hearne. New York: John Lane Company, 1916. 12 mo.; 177 pp.; 25 illustrations. Price, $1 net.

England has made a woefully inadequate defense against the night raids of Germany's Zeppelins. The English author of the little work in hand places a rather high psychological value upon these successful raids, and shows what must he done to meet this method of warfare. In the simplest of language, aided by some really admirable plates and diagrams, he gives the reader an intelligent idea of the construction and operation of the Zeppelin, and his later pages are largely concerned with what he terms the super-Zeppelin, the aerial warship of the future. His work shows a broad knowledge of the subject in all its phases; he was one of the first to call attention to the Zeppelin menace, and his predictions are usually well within the bounds of possibility.

INDUSTRIAL ACCIDENT PREVENTION. By David Stewart Beyer, Ph.B., Manager Accident Prevention Department Massachusetts Employees Insurance Association. New York: Houghton Mifflin Company, 1916. 4to.; 421 pp.; illustrated. Price, $10 net.

Our workers have been paying a heavy toll to industry; each year has recorded more than 2,000,000 accidents, some 35,000 of them resulting fatally. We are coming to see that much of this sacrifice of life and working efficiency may be eliminated by simple devices and precautions, and Mr. Beyer brings a remarkable array of these to our attention in his lucidly written and typographically beautiful volume. The size and quality of the paper employed sets off to the best possible advantage the hundreds of clear illustrations, most of them photographic; for the work deals with accomplished facts, not theories, and the actual photograph of a safeguard in daily successful use is more convincing than a sketch which may embody only an untried idea. Since compensation legislation has been the spur to much of the progress we have made toward

safety, this is briefly summarized in the first chapter. Statistics of accidents by years in several large plants follow, and the causes of about 90,000 injuries are alphabetically listed. Among the considerations which vitally affect safety are plant arrangement, provisions against fire, shadows and glare in illumination, and constructional equipment such as stairways and railings. All these considerations are set before the reader in their many aspects, without the introduction of an unnecessary word. Machinery is of course a prolific source of accident, and it is with machinery that the greater portion of the book deals. Boiler and engine equipment, electrical installation, power transmission, and shop machinery are ably and helpfully discoursed upon, and it is demonstrated that slight modifications in design, or the use of simple guards, may do away with the greater part of the danger. Railroad equipment and chemical works and laboratories are the subjects of special chapters, and certain important manufactures, such as textiles, leather and shoes, and paper have their own sections which take up the machinery and risks peculiar to their distinctive operations. Safety education and the matter of bulletins and signs are discussed, and such factors of safety as eye protection and frequent, intelligent inspection are not overlooked. While the work is chiefly concerned with accident prevention proper, yet some pertinent material on sanitation and first-aid equipment is included. The volume is a dignified, thorough, and intensely practical contribution to the literature of safety, and provides the factory owner and manager with specific information and a wealth of suggestion that, properly used, must result to the advantage of both employer and employee, with a material shortening of the accident record.

OUTLINES OF INDUSTRIAL CHEMISTRY. A Text-Book for Students. By Frank Hall Thorp, Ph.D., with assistance in revision from Warren K. Lewis, Ph.D. New Work: The Macmillan Company, 1916. 8vo.; 665 pp.; illustrated. Price, $3,75.

Since the first edition of this book in 1898, the important discoveries and substantial progress made in the industrial application of chemistry have made necessary the entire rewriting of many sections of the work, the discarding of outgrown methods, and the inclusion of much that is new. In its present form it offers an elementary course that is excellent in its portrayal of the more important industrial processes, and in its use of the modern concepts of chemistry. The first part of the work deals with inorganic industries, the second with organic industries, and the third with metallurgy. Although the space devoted to each subject is necessarily brief, students familiar with the elements of physics and general chemistry will find the exposition exceedingly helpful in giving them a working knowledge of the devices and processes of the more noteworthy manufacturing operations, in so far as these are based upon chemical changes. The text will be found to be adapted to almost any educational institution which includes a course of this kind.

THE YACHTSMAN'S ANNUAL GUIDE AND NAUTICAL CALENDAR. 1916. Boston: Clarence B. Hogg. 8vo.; 394 pp; with charts and illustrations. Price, cotton duck, $2; paper, $1.

In addition to the varied information that one would expect to find in a yachtsman's guide, the enthusiastic Corinthian will find a number of useful features. There are large folding charts of the harbors of Boston, New York, Gloucester, Marblehead, Newport, and many other places frequented by pleasure craft; there is also a corrected chart of Cape Cod Canal, and another of Long Island Sound; the Woodman motor boat courses, a noteworthy contribution to the annual, cover the harbors and inlets of this unequalled section. Signal codes, national flags, and the burgees of clubs and associations are shown in colors, and there is a very full directory and flag index of American and Canadian clubs. The rapid development of power boating has led the compilers to include much new material relative to motors and ignition. To the pleasure-boat navigator the guide offers a most complete and indispensable handbook of practical information.

GAS ENGINE IGNITION. By Earle B. Norris, M.E., Robert K. Winning, B.S., and William C. Weaver, B.S. New York: McGraw-Hill Book Company, Inc., 1916. 8vo.; 174 pp.; illustrated. Price, $1.50 net.

This publication of the Extension Division of the University of Wisconsin takes up an important component of gas engine practice, and presents a systematic course of instruction applicable to both stationary and automobile engines. The course is peculiarly adapted to the requirements of the man in the factory or repair shop, and hence includes some systems that are no longer manufactured, but which are still widely in operation. The arrangement is a convenient one for home study, and will prove in every way satisfactory to the practical man.

ENGLISH AND AMERICAN TOOL BUILDERS. By Joseph Wickham Roe. New Haven: Yale University Press, 1916. 8vo.; 330 pp.; illustrated. Price, $3 net.

We have but grudgingly given up a small portion of our industrial literature to those who created the tools upon which modern industry is founded. It is, therefore, an act of justice which Prof. Roe performs in placing before us in so interesting a light the work and influence of the great tool builders. He traces the origin and progress of tool building in America, and gives some idea of the importance it has assumed. With so vast a subject, only the main lines of influence can be presented in a single volume, together with something of the individuals and the cities that have been most closely identified with the art; for its later history the author has gone directly to those who are familiar with it through actual participation. Excellent plates show the earlier machinery and its originators, and the result as a whole is a most attractive and able exposition.

TACTICAL NOTES FOR SCHEME PROBLEMS OR OUTDOOR EXERCISES. By Major W. F. Trydell, Adjutant 68th Divisional Royal Engineers. London: William Clowes & Sons, Limited, 1916. 8vo.; 64 pp.; with plans and sketches. Price, 5s.

The writer is a British officer of long experience in military instruction, and his notes are intended to aid officers of the new armies in their solutions of tactical projects. Among the points which the manual considers are the disposition of guards, the composition, ammunition, and the rations and forage of an infantry battalion, march problems, night attacks, and skeleton orders. Bridge construction and trench warfare are also touched upon. The situations are clearly indicated in plans and sketches, and Major Trydell's explanations and suggestions in every case go straight to the heart of the subject.

CONCRETE ON THE FARM AND IN THE SHOP. By H. Colin Campbell, C.E., E.M. New York: The Norman W. Henley Publishing Co., 1916. 12mo.; 149 pp.; illustrated. Price, 75 cents.

To-day everyone knows the advantages of concrete as a building material; it is fireproof, sanitary, inexpensive and permanent. Its failure in individual cases simply means that wrong materials have been used, or that the right materials have been used in the wrong proportions. This plainly-worded treatise tells the whole secret of success, and enables the farmer, with his unskilled labor, to make tanks, troughs, cisterns, fence posts, floors, hotbeds, and innumerable other accessories of farm and home, and to make them so that they will be useful, sightly and permanent in the highest degree.

A SELECTION FROM THE LIFE OF SAMUEL JOHNSON, LL.D. By James Boswell, Esq. Edited with notes and an introduction by Max J. Herzberg. New York: D. C. Heath & Co., 1916. 12mo.; 307 pp.; illustrated. Price, 40 cents net.

The author has exercised a nice discrimination in this abridgement of Boswell's famous work. He has also devoted more attention to Boswell himself than is customary, and has succeeded in making very real the eccentric personality of this clever Scotch lawyer and, through him, the interesting life of the eighteenth century. Despite the necessarily large omissions, so skillfully have the selections been made that the interruptions in the narrative are never unduly disturbing to our sense of consecutiveness. While Boswell's spelling has been modernized and his punctuation occasionally amended, his actual words are everywhere carefully retained. A set of exercises is provided which will greatly aid the student in a comparison of this biography with Macaulay's Life of Johnson.

YIDDISH-ENGLISH LESSONS. By I. Edwin Goldwasser and Joseph Jablonower. New York: D. C. Heath & Company, 1916. 8vo.; 256 pp.; illustrated.

The authors, instructors of experience in the schools of New York, have come to the conclusion that the "direct method" of teaching English to foreigners does not adequately meet their needs, and that the teaching should be in vital relationship with the common experiences of the student. In the text they have written, these experiences are utilized in such a way as to lead up to those with which the student is sure to come in contact later. Difficulties of idiom are carefully dealt with, formal grammar is developed through inductive study based on a continuous story, and the arrangement, permitting the student to advance as rapidly as his ability warrants, aims at the unfoldment of individual thought and self-reliance.

THE ORIGIN OF THE EARTH. By Thomas Chrowder Chamberlin. Chicago: The University of Chicago Press, 1916. 8vo.; 271 pp.; illustrated. Price, $1.50 net.

When a man rejects a scientific theory that has long held its own, we are apt to regard either his ratiocination or his motives as open to suspicion, despite the fact that all progress has come by the process of modification and rejection. It is a pity if this essentially human attitude toward new modes of thought should lose for a single reader the pleasure of following the author's brilliant work. He seems born to the use of the pen, and his style, free from unnecessary technicalities, is consistently delightful. The theory his twenty years of investigation has led him to reject is that of the nebular hypothesis—and with it, of course, all earlier theories—and his work is "an attempt to detect the vestiges of past action in the status of present planetary ongoings, and to interpret these as well as may be." Aside from whether we accept the author's final con-

clusions or not, his critical survey of the bases of our prevailing beliefs and the new light he throws upon difficult subjects will generously repay any time spent upon his well-written and scholarly volume.

A HISTORY OF CONTINENTAL CRIMINAL LAW. By Carl Ludwig von Bar and others; translated by Thomas S. Bell and others. Boston: Little, Brown, and Company, 1916. 8vo.; 617 pp. Price, $4 net.

Prof. von Bar's notable work constitutes volume six of "The Continental Legal History Series," published under the auspices of the Association of American Law Schools. It is impossible to make any broad study of Anglo-American law without finding ourselves thrown back upon the racial and intellectual movements of Western Europe—the struggle and coalescence of the old Roman code with the customs disseminated so widely by Germanic migration. It is impossible properly to know and appreciate the history of our own law without tracing its threads back to their "tangled common ancestry," as the general introduction to the Series points out. In the volume in hand, the Roman and Germanic elements with their influences and interactions are admirably disclosed; under "The Middle Ages" we find an historical exposition of the law of the Christian Church, of the medieval Germanic law, and of Scandinavia, Switzerland, and France in the later middle ages; the recital then carries us through the Renascence and the Reformation, through the French Revolution and the French and German reforms of that period, and finally through the developments of modern times. Part II presents a history of the theories of criminal law, and the volume closes with a critique of these theories—a sane and masterly contribution that is worthy of the closest study.

WORKSHOP HINTS FOR MUNITION WORKERS. Compiled and edited by Bernard E. Jones. New York: Cassel and Company, Ltd., 1916. 12mo.; 156 pp.; illustrated.

This English handbook is a timely effort to familiarize the munitions worker with the tools he will encounter and the processes he will need in his daily work. Highly specialized operations are left to more ambitious volumes, and general usefulness is made the key to all instruction. The workman who has but recently entered this branch of manufacturing will find the manual a guide to the rapid mastery of his new duties, and with this understanding will come an enhanced pleasure in his employment. Tools, materials, operations, finish and accuracy are presented with a wealth of illustration that conduces to the quickest and most thorough grasp of the necessary knowledge.

OFFICIAL AMERICAN TEXTLE DIRECTORY. 1916. Compiled by the Textile World Journal. New York: Bragdon, Lord & Nagle Co. 8vo.; 651 pp.; illustrated. Price, office edition, $3. Traveler's edition, $2.

This well-known publication, now in its twenty-second year, lists 7,258 textile establishments in the United States and 429 in Canada; these are arranged by location, alphabetically, under states, cities and towns, and there are numerous maps by which the exact location of any mill may be conveniently ascertained. The trade will find it a most comprehensive and accurate directory, with very complete information as to the management and capacity of each mill and the name of buyer and selling agents. The arrangement of material and the feature of the thumb-index make it a handy volume to consult. It includes a yard trade index, with lists of concerns which sell to or buy from textile mills. Its reliability is vouched for by the *Textile World Journal*, which revises the compilation, up to the day of going to press, by personal canvass and official reports from the trade.

LAND AND MARINE DIESEL ENGINES. By Giorgio Supino. Translated by Eng. Lieut.-Commdr. A. G. Bremner, R. N., and James Richardson, B.Sc., A. M. Inst. C. E. London: Charles Griffin & Company, Limited, 1915. 8vo.; 309 pp.; illustrated.

The author of this monograph died suddenly at the age of twenty-seven, just before his work came from the press. The prompt recognition of his genius, not only by his own countrymen, but also by Europe generally, makes this English translation a fitting tribute to his thorough investigation and solid accomplishment. The translators have performed their duties conscientiously and well. Dimensions, which in the original are according to the metric system, here frequently add the equivalent British units, and a conversion table is given. The translators have also tried to make the nomenclature apt and consistent, a matter of no small difficulty where so new a subject is in question. The work begins with a lucid explanation of the conditions under which the Diesel engine proves most satisfactory for the stationary plant. The most space is naturally devoted to a discussion of the marine engine, for it is in this field that the type has best vindicated its superiority, and there are chapters especially given over to the two-cycle type of high power, which is still in the transition stage; these chapters will be particularly appreciated by the expert. The peculiar adaptation of the oil engine to the submarine, while fully recognized when the book first appeared, has since taken on an added interest by reason of submarine developments during the present war. The volume is a shining example of lucid and scholarly writing, demonstrating to the full the logical, studious and practical faculties of the young author's mind. It is profusely and admirably illustrated by cuts, full-page plates, and folding inserts of engines, installments, and details, and attains a high reference value by the inclusion of the latest rules of classification as formulated by the leading authorities.

EXPORTERS' ENCYCLOPÆDIA. Twelfth (1916) Edition. New York: Exporters' Encyclopædia Company. 8vo.; 1175 pp. Price, including monthly corrections, $7.50.

The main body of this authoritative guide consists of an alphabetical arrangement of the countries of the world, giving area, population, commerce, products, and shipping routes and regulations, a space being reserved at the end of each section for corrections, which are supplied to the subscriber monthly. The work also furnishes in readily accessible form much general information necessary to the exporter—American consulates in foreign cities, statistics of our foreign commerce, our export trade as affected by the war, and the opportunities opened to us. There are lists of banks and bankers, export commission houses, and ocean steamship lines and agents, with cable rates, foreign coinage and weights and measures and United States equivalents, while under "General Shipping Instructions" will be found a most concise exposition of shipping procedure; foreign postage rates and regulations are included, and altogether this year's issue of the guide more than sustains its well-earned reputation for completeness and authenticity.

THE MORTALITY FROM CANCER THROUGHOUT THE WORLD. By Frederick L. Hoffman, LL.D. Newark, New Jersey: The Prudential Press, 1915. 8vo.; 826 pp.

One of the greatest problems confronting humanity is that of the mortality from cancer, which, after due allowance has been made for incomplete observation and faulty records, we must still admit to be increasing at an alarming rate. The charts and appendices of this volume present statistics that have been compiled by the authorities of the world. They show the mortality by years, by sex, by age, by occupation, and by the organs attacked. Age and sex factors are of primary importance to correct conclusions, and the former has too frequently been ignored in the past. The author's notes, however, warn the student of any oversight in the data, and these warnings should point the way to more definite and comprehensive methods of investigation and classification. Above all, it is urged that the slightest suspicion of a foreign growth should be submitted to a competent physician at once; were this course to be followed generally, a comparatively slight and safe operation might promptly remove the menace, and as a social problem cancer would no longer present the gorgon aspect that it now does. Dr. Hoffman performs a distinct service to the profession and to mankind in bringing together in one volume so rich an array of vital statistics, illumined by sane and incisive observations.

1,600 BUSINESS BOOKS. A List by Authors, by Titles and by Subjects. Compiled by Sarah B. Ball, in charge of the Business Branch, under the supervision of John Cotton Dana, Librarian Free Public Library of Newark, New Jersey, Chairman of the Committee on Libraries of the Associated Advertising Clubs of the World. New York: The H. W. Wilson Company, 1916. 8vo.; 166 pp. Price, 75 cents.

Nine years ago the Newark library recognized the advantage of making business literature accessible to the business man, and inaugurated a branch library for his particular benefit. This guide is essentially a catalogue of that branch, in which advertising, selling, credit, accounting, office methods, efficiency, and the administrative side of business are all well represented. Authors, titles, and subjects are given under a single alphabet, each work appearing as many times and in as many places as is necessary to assure the finding of any information with the minimum of time expenditure. Under each subject-heading appear references to allied subjects, and special lists of jobbers and commission merchants, commercial organizations, directories, and periodicals are included.

COAST ARTILLERY MATÉRIEL. Description, Adjustment, and Operation in Drill and Target Practice. By Captain W. P. Platt, Coast Artillery Corps, U. S. Army. Kansas City, Mo.: Franklin Hudson Publishing Co., 1916. 12mo.; 170 pp.; illustrated. Price, 60 cents.

This timely handbook is directed toward furnishing National Guard officers and enlisted men with a working knowledge that shall fit them to handle coast artillery matériel; it contains the gist of some twenty separate publications, and covers guns, ammunition, and gunnery, fire control apparatus, drills and inspections, searchlights and signaling, cordage, warships, and the conduct of target practice. Capt. Platt appends a list of questions on drill regulations that will test the progress of the student thoroughly. The work is approved by the Division of Militia Affairs of the War-

Department, and should prove of the greatest aid and convenience to both officers and men.

THE SPELL OF EGYPT. By Archie Bell. Boston: The Page Company, 1916. 8vo.; 359 pp.; illustrated. Price, $2.50 net.

Those who know the merit of "The Spell Series" will look forward to this volume as to a particularly pleasurable experience, and they will not be disappointed. A land so rich in historical and artistic relics and ideals cannot fail, under the pen of so accomplished a translator as Mr. Bell, to render up, albeit at second hand, a most vivid and satisfying picture, a pageant of the present reflecting a mighty past. It may be true that "The books that have been written about Egypt would dam the Nile," but that thought need not spoil our enjoyment of a description that sets the Nile flowing for such of us as might never otherwise know its magic. The frontispiece, showing an old street in Cairo, is a particularly delightful example of good color work, and most of the other plates and duogravures serve well to heighten our perception of the beauties and mysteries in which Egypt is prodigal.

The Sanitary Service in War

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noted the announcement on the metal identification badge which hangs about the wounded man's neck, and scrawls a hasty description of the wound location upon the tag, tears it from the stub and fastens it to the uniform of the fallen man.

At the dressing station, located behind a gentle swale, where perhaps a sparkling brook runs, a Red Cross flag droops. The wounded man is deposited there among scores of others and a busy surgeon comes to him in turn, makes his examination, and if the wound is of such character as to require immediate attention, he operates. If the wound is not dangerous, however, a hasty glance at the dressings already applied apprises his trained mind that the man may well be sent farther to the rear without more attention.

Soon the ambulances come up and the wounded are placed within them. Keeping well to the right of the road—for nothing must interfere with oncoming traps and ammunition—the ambulance column speeds to the rear where field hospitals have been established. Again the wounded are looked over, for the ambulance surgeon examines each one on the way to the rear. But before the ambulances leave, those of the wounded who are able to walk have been directed to proceed to the station for slightly wounded, the location of which is pointed out.

At the field hospital, perhaps, it has been found unnecessary to erect the tentage, for the houses of a village offer immediate and better shelter. The cooks have fires going and food is in course of preparation, for an important duty of the service is to provide stimulating food for the patients. After the strain of a long fight and following great effort, vitality falls low and it is necessary to speedy recuperation that it be restored at once. With the capacity of the hospital already taxed to the uttermost, ambulances come and go, evacuating the wounded without delay. Even empty wagons of the supply service going to the rear to replenish are pressed into service with the permission of the officer in charge, and many wounded who can be moved without serious threat to chance of life are sent rearward to the evacuation points on the line of communications.

Such a point may be located at a little town on a railway some miles to the rear. On sidings stand extemporized hospital trains all made up in anticipation of use. If there has been time, the cars have been fitted up solely for the purpose of caring for the wounded. Berths in tiers have been erected, operating tables provided and arrangements have been made for cooking sustaining food for the patients. Perhaps Pullman cars have been pressed into service and sometimes even ordinary freight cars are used when nothing else is available. As each train is filled it is dispatched on the way to the base where the wounded can be given the best of care and from whence they can be sent along on the way home.

Another situation. With the coming of night the advance of the firing line has halted and the troops entrench. Perhaps the stop has been made necessary by the stand of the enemy, and the ground im-

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mediately to the front has been fought over, to and fro, for hours; if this be the case, it is a shambles and dead, dying and wounded are strewn thickly over it. There has been no opportunity to care for these men, for the first business of the army is to fight.

There comes a lull in the firing. Immediately the sanitary detachments go forward into the night, sometimes walking, sometimes creeping, sometimes striving to succor the wounded under the mantle of darkness, sometimes clearly indicating the humanity of their mission by green lanterns. From the opposing lines sanitary detachments of the enemy come forward in like effort. Stricken friend and foe are found together, and often they have tried to bind up one another's wounds, for they are out of the fight and are merely human beings. Perhaps the last precious drops from some nearly empty canteen have been forced upon a fellow sufferer; and the same stretcher party bears them away. Perhaps between hostile lines sanitary detachments from the opposing forces meet and work together.

The ground intervening between the lines is literally torn to shreds by the explosion of shells, and in the craters so formed many wounded have sought protection from the hail of fire. Wounded men just able to crawl try to creep toward their lines; as long as a man can move he is allowed to go by himself, for there are many others to be cared for who cannot help themselves. The search for the wounded continues with great haste, for there is no telling when the battle may break out again.

A suspicious searchlight flashes out over the field from one side or the other and its restless finger discloses a dark, closely packed mass of men surging forward—one side is attacking. The other side has expected such a movement and waiting batteries and trenches burst into flame. There is no time for sentiment, there is no moment for consideration for friendly Samaritans. A storm of shrapnel balls and a sheet of rifle fire sweep the ground to the front. Members of the sanitary corps bearing their quiet burdens stagger and fall, dead or dying; and as the charging line rushes onward its ranks become thinner and thinner under the terrific fire directed upon them. Its speed is checked, it pauses, it wavers; no living thing can face the blast, and though supporting lines strive by their momentum to carry the charge forward, it is beyond the limits of human endurance, and slowly, angrily, the assault is compelled to retire, leaving the ground black with the bodies of the fallen, the price the attack has paid.

What happens next? Undismayed, as soon as the next lull falls over the field, other sanitary detachments go forward to bring back the wounded; and there is no telling at what moment the fight will be on once more.

The Field Artillery of the United States Army

(*Concluded from page* 121)

good for between 2,500 and 3,000 rounds before its rifling become so worn out that the gun becomes inadmissibly inaccurate. The larger field guns would last longer; say for 2,000 rounds. In the big howitzers, which fire a much heavier projectile at lower velocity, because the heat of the propelling gases is much lower, there is very little erosion, and according to Gen. Crozier they have "an almost indefinite life."

Now we referred above to the fact that in a single action the field guns may be called upon to fire at such rapidity, that within a few days' time their rifling will be worn out and they will have to be sent back to the gun shops. Hence, not only do we need to increase the number of our field guns from 900 to over 2,000, but we should provide a large reserve of such guns, and should provide ourselves also with ample facilities for manufacturing a large number of new guns, and for relining the worn out guns during the progress of hostilities.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14125) O. M. asks: 1. When a stone is dropped into a still pool of water the waves set into motion are not transferring the particles of water toward or from the place of disturbance, but are only raising them up and down in a vertical direction. My opinion is that the waves cause the surface water to move in a forward and outward direction of motion. Am I right or wrong? 2. Kindly give me the correct theory on the following: If any thing at rest has a tendency to remain at rest. Does not any thing moving in a straight line have a tendency to keep in motion after the force has been discontinued? A. 1. You can find out for yourself whether the water waves produced by dropping a pebble into a pool carry the water along with them towards the sides of the pool or not. Place some light bits of wood on the water at various distances from the point at which the pebble is to be dropped and watch their motions very carefully. You will find that they move very slightly forward and backward but mostly up and down. The actual path of a drop of water in a wave is in a circle moving as much forwards as backwards and as much up as down. 2. Newton's First Law of Motion which the world has held for about 200 years as rigidly true is "A body at rest remains at rest and a body in motion remains in uniform motion in a straight line unless compelled to change by some external force." You give half the law. The other half is equally true. A base ball moves on after it leaves the bat or the hand of the pitcher, does it not?

(14126) P. K. P. asks: Is there any particular electrical advantage in using electrolytically deposited copper coated Leyden jars (as used by the Marconi Co. on transmitting sets) over similar coated glass plate condensers? I understand that the ease with which they may be replaced at sea is one of their important advantages. A. The advantages of a Leyden jar which is coated with copper electrolytically would seem to lie both in a mechanical and in an electrical direction. The electrically deposited coating would be in complete adhesion on the glass, and the charge would pass to the dielectric glass over the entire surface of the glass. The discharge would be more sudden and complete. The mechanical advantages are that a thinner coating can be used with less weight, and as you say with easier handling.

(14127) A. L. asks: A year or two ago I saw an article in the SCIENTIFIC AMERICAN describing a process of producing heat without blaze. This seemed to be accomplished by forcing gas through magnesium.

I am beginning to make investigations along this line, and will gladly pay for any copies of the SCIENTIFIC AMERICAN which you can send me, giving data on this subject.

Also would thank you for names of any other books or papers which would be useful in this connection. A. We are not able to locate the article upon the production of heat without fire from your indefinite description that it was in the SCIENTIFIC AMERICAN "a year or two ago." There is no process of this sort in practical use at present. It has been known for a long time that the occlusion of gases in certain finely divided metals would cause the evolution of considerable heat. Platinum sponge and palladium are the metals showing this effect. They are heated red hot by placing a lump of the spongy metal in a current of hydrogen or street gas. You will find the subject discussed in Ganot's Physics, which we can send you for $5.00.

(14128) G. S. C. asks: Could you tell us what would happen if the rotation of the earth upon its axis stopped and the earth only revolved about the sun? A. If the earth stopped in its rotation suddenly, all things lying on its surface remote from the poles would fly off into space. If it stopped slowly enough nothing of this sort would occur. Day and night would cease, and it would be perpetual day on the side towards the sun and continual night on the opposite side. The moon is in this condition as regards its relation to the earth. We see the same side of the moon all the time. The planets Mercury and Venus are held with the same face towards the sun.

(14129) S. W. C. asks: As a constant reader of your weekly paper, will you please be so kind to inform me the name and nationality of the inventor of the following: Photography or camera, Internal combustion or gas engine, Microscope, Automobile, and Machine Gun, U. S. A. A. The invention of Photography is accredited to Daguerre, a Frenchman. The first commercial gas engine was

the Otto engine, patented in 1876. The first proposal to use the pressure of the explosion of a gas mixed with air was, according to the Eucy. Brit. in Street's Patent in 1704. Street was an Englishman. Invention of the microscope is shrouded in antiquity. Leyard found a convex lens of rock crystal among the ruins of the palace of Nimrud, and men doubtless used a drop of water placed in a small hole drilled in a metal plate in cutting gems so fine that they could not possibly have done the work without optical aid. The earliest automobile consisted of two wheels and a bar on which a man sat astride and propelled himself by his feet. It preceded the bicycle. The Gatling Gun was the first American machine gun, and came into use in the later years of the Civil War.

(14130) C. S. V. asks: A thin wire pint bottle was suspended in the center of a prominent show window and supported by a thin wire frame through which there was no possibility of water passing. The bottle was black and shaped like an ordinary pint beer bottle. It was inclined almost horizontal with the mouth of the bottle, pointing slightly downward from which flowed a constant stream of water into a small center receptacle about 2 or 3 feet below the mouth of the bottle which receptacle rested on the floor of the show window. Water constantly poured from the bottle, and the receptacle into which it fell did not overflow. The whole outfit was small and seemingly inexpensive. One can plainly look on every side, the top and bottom of the whole thing, which was in plain sight, but could not figure where the water was coming from or going to. A. We are not able to give you the address of the party which handles the constantly flowing bottle which you describe. It has been used here for two years or so. Had you looked more carefully you might have seen a tube in the center of the stream which flowed from the bottle, curving in the same manner as the stream down into the cistern below. The stream covers and conceals the tube, especially if wine or a colored liquid is used, as has been the case here. A glass tube might be nearly or quite invisible in clear water. A motor below pumps the liquid up into the bottle as fast as it runs out and so the stream never ceases. It is an excellent advertising device.

(14131) D. L. W. asks: 1. I have a quart size Grenet Cell Battery which is to use a solution of diluted Sulphuric Acid and Bichromate of Potash. How much water should be added to the Sulphuric Acid to make a correct diluted acid solution for this size battery, and how much Bichromate of Potash should be added in weight to the above one quart solution to get the best results? 2. Should the Sulphuric Acid solution be added to the Bichromate of Potash or the Bichromate of Potash to the acid solution? A. For a bichromate solution for a Grenet Battery, take for each pound of Bichromate of Potash, 2½ pints of water and about 2 pints of Sulphuric Acid, or a little less than two pints. Dissolve the Bichromate in the water by boiling. When the solution has cooled pour the Sulphuric Acid into it slowly and with constant stirring. There will be much heat produced and at a certain point there is a marked change of color. When all the acid is mixed with the solution allow it to stand over night. It will then be found that there are many crystals in the bottom of the dish. These are of no use. Decant the liquid and throw the crystals away. Two or even three parts of water may be added to this solution for use in a battery. The solution as made above is a stock solution and may be kept for replenishing the battery from time to time. One charge will run the battery for 4 to 6 hours. It must be thrown away when it is exhausted. You speak of adding water to Sulphuric Acid. Never do this. Heat is evolved so rapidly that an explosion is produced, throwing the acid in all directions.

(14132) G. B. G. asks: 1. In your opinion does the heavy cannonading in the European war effect in any way, especially the temperature and precipitation, and low temperature in the United States. 2. About how long does it take for people living in the central part of the United States "figuring the normal progression of the atmosphere eastward" before we occupy the same atmosphere that is along the battle line in Belgium? A. 1. No connection has been shown between the rainfall and artificial shocks communicated to the atmosphere, and so we see no reason to connect our cool season and its rainfall with the European war. You will find in Moore's "Descriptive Meteorology," page 206, a discussion of this subject. We can send the book postpaid for $3.25. Professor Moore was the Chief of the Weather Bureau, and the book was the text-book for that service. He says, page 207, "In the Government tests heavy charges, such as dynamite and rosselite, were carried aloft, and even into the interior of clouds by means of kites and exploded there, but with no resulting rain." It has not been shown that a shock can produce condensation of water vapor into drop or cause the fall of rain from a cloud. 2. We have no data for any statement of a time after which air which is at one time here will again be here having meanwhile traveled around the world. The motion of the atmosphere is rather a whirling than a progressive motion over continental spaces. From the Doldrums nearly to the poles the lower air is moving from the southwest toward the northeast, in the northern hemisphere, and towards the southeast in the southern hemisphere. The upper winds are moving eastward in both hemispheres. There is a continual intermingling of winds, and a setting up of cyclonic motions in these airs, so that a steady progress around the world is difficult to establish in the middle latitudes. The cyclone progresses just as a local whirlwind does, but the air which is in the cyclone to-day is not the same cyclone a few days later a thousand miles to the east of its former position. Air which is now over Europe may at some time be over America, but we know of no way of determining the rate of motion which shall bring it here.

(14133) R. C. G. asks: It is a known fact that when a direct current is passed through pure water, oxygen will be given off by one electrode and hydrogen will be given off by the other. Is there any known method of uniting the two gases to generate an electrical current? If so, how is it done? Why is not this method used in storage batteries? A. You mistake in saying that oxygen and hydrogen are produced from "*pure* water" by passing an electric current through the water. Pure water is almost an insulator. Either an acid or an alkali must be added to water if it is to be decomposed in any quantity by an electric current. However, that is not the question which you ask. The gases from the water do tend to recombine and produce an electric current. But the process is not practical. The current is too small, and it would be far better to use the original electric current for work before it had been put to the work of decomposing the water. You will find in some text books of physics, especially the older ones, an account of Grove's "Gas Battery." See Ganot's "Physics," price, $5, for an account of this battery.

(14134) A. S. asks: In the "Encyclopædia Britannica," Vol. VIII., page 801, under the heading "Earth," I read the following: "The variation of the line of apsides is the name given to the motion of the major axis of the earth's orbit along the ecliptic. It is due to the general influence of the planets, and the revolution is effected in 21,000 years." This should mean, in other words, that if, when the earth is in its perihelion, the sun is projected against a certain point in space, or against a certain star, as seen from the earth, it would take 21,000 years for the perihelion to be again in the same place of the earth's orbit, relatively to this point or star. Such, however, does not seem to me to be the case. From calculations based on the difference between the sidereal and the anomalistic year, it is evident that the line of apsides describes a complete revolution in about 113,000, and not in 21,000 years, as it would appear from the above statement in the "Encyclopædia Britannica." The cycle of 21,000 years is simply this: That if the earth is in its perihelion on January 2nd, 1916, it will be again in its perihelion on January 2nd, 22916—viz., after 21,000 years. However, it seems to me that this does not mean that the line of apsides has made a complete revolution around the earth's orbit in 21,000 years. It simply means that, in this period of time, on account of the precession of the equinoxes, the earth shifts about 294 deg. westwards (about 50 inches per annum) in its orbit, and the perihelion during the same lapse of time shifts 66 deg. eastwards (about 11 inches per annum) on the earth's orbit; and therefore, after 21,000 years, the earth reaches again perihelion on the same day as 21,000 years before. (294 deg. plus 66 deg. being the complete circumference.) But, as already stated before, the line of apsides has not really made a complete revolution, in 21,000 years, relatively to the stars, but only about one-fifth of it. Please let me know if I am right in my contention. A. Your statement regarding the motion of the line of apsides of the earth's orbit is quite in agreement with the text books of astronomy. Young's "Manual of Astronomy," page 143, and on, discusses the secular perturbations of the earth's orbit, and states that the direct revolution of the line of apsides would be completed in about 108,000 years, if other causes did not prevent; Barlow's "Mathematical Astronomy" has several references and a discussion of the topic with the same conclution. We send the Young's for $2.50, and Barlow's for $2.60 by mail postpaid.

(14135) F. M. B. asks: Am writing in search of information. Have been laboring under the impression that the constant bombarding and the use of so many high explosives in the great European War is the cause of our unseasonable weather of this continent. Would you kindly tell me if such is the opinion of people whom you come in contact with and who write for your magazine, and oblige? A. We have not seen in any authority writing on the subject any claim that war can alter the weather of a continent, much less of a half world. It is not evident that battles cause rain or alter the course of storms. The shooting of clouds to prevent hail has not succeeded according to the authorities. Nor has the present season been any worse in the same respects than others have been. There have been colder and wetter Junes, and hotter and drier Junes. The seasons vary as they always have done, and doubtless always will do. We see no way yet disclosed for accounting for or foretelling what a season will be.

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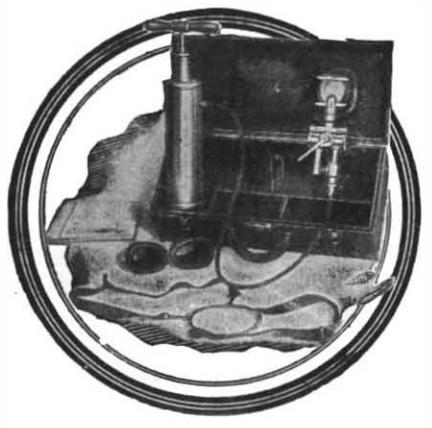

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