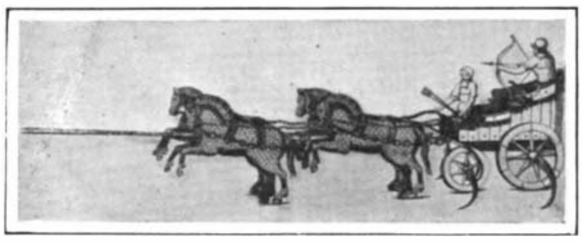
WAR CARS, ANCIENT AND MODERN.

BY LIEUT.-COL. C. FIELD.

Wheeled vehicles have been applied to purposes of warfare ever since the Egyptians invented the war chariot 4,000 years ago. After a comparatively short interregnum of 200 or 300 years they are again coming to the front, thanks to the evolution of the internal-combustion motor. It is not proposed to go into the question of wheeled transport, whether for stores or men, but so far as the limits of a short article will allow, to glance at the various vehicles which have been from time to time designed to take an actual part in the fighting itself. We must eliminate the ordinary field gun, which may be regarded merely as a weapon provided with wheels which enable it to be hooked on behind a limber or a small ammunition cart, and may be classified with vehicles intended for transport. The Holy Bible is full of allusions to war chariots. We may refer to the 600 belonging to Pharaoh which perished in the Red Sea; to that of Jehu, whose furious driving caused his identity to be recognized afar off, and to the 30,000 chariots which the Philistines brought to the battle of Michmash. These chariots or war cars were drawn by a pair of horses harnessed on either side of a pole and were, as a rule, only big enough to carry one warrior and his driver. The earlier ones were possibly square, but the later ones were horseshoe-shaped and remarkably well finished. A perfect specimen may be seen in the Archæological Museum of Florence. It was found in a tomb at Thebes and is considered to date from 1400 B. C. Like our modern motor cars, the bottoms of these chariots were very low, so that the occupants could easily jump in or out. Eastern nations, notably the Persians, adopted the war chariot. In fact, Ninus, King of Assyria (B. C. 2059), according to some authorities, is considered to be its inventor. In any case they improved on the Egyptian chariot by fitting curved scythes or knives to the axles, so that dreadful wounds would be inflicted by the vehicle itself as it was driven through the ranks of the enemy. The heroes of the siege of Troy appear to have used the chariot merely to bring them to close quarters with their enemies, for they are always represented as leaping to the ground to fight. The ancient Greeks and Romans copied the war chariot from the eastern nations, but with their more scientific and regular study of warfare soon discarded it, recognizing that it was of no use in rough or hilly ground, and that though it might be formidable enough in a plain, there was always the risk that the horses might be stampeded or driven back into their own ranks with disastrous effect. Added to this disadvantage was the ease with with which a slight obstruction would impede the speed of the chariots or stop them altogether.

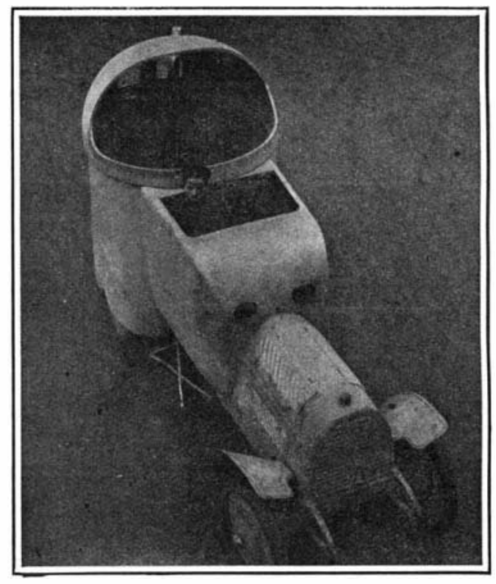


A Medieval Conception of a Persian Chariot.

An Egyptian War Chariot.

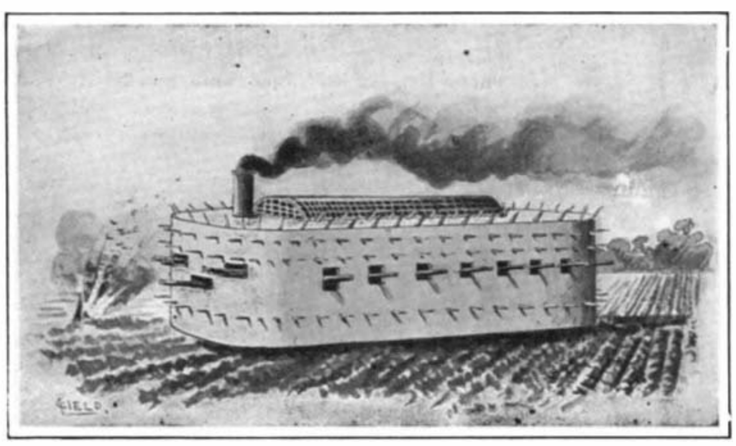
Vegetius, in his "De Re Militari," gives an illustration of a four-wheeled chariot or "quadriga" drawn by four horses carrying a large number of soldiers and equipped with a most bristling array of scythes and spikes. Another contrivance he depicts can hardly be called a chariot, consisting as it does merely of a pair of wheels fitted with scythes, and an extraordinary arrangement probably designed to prevent the enemy from hanging on behind. The driver is mounted upon one of the pair of horses which draw the machine and is embellished with a pair of wings the use of which it is difficult to imagine. If these vehicles did not remain long in favor with the classical nations, the use of them spread to all the more savage peoples of antiquity. The wicker-work chariots of the Britons with their sharp scythes were famous on account of the dashing pace at which they were driven and by their means Cassivellaunus inflicted severe loss on Cæsar's legions. The Scythians and Teutons also used similar cars, and not very many years ago two four-wheeled war chariots were unearthed in Jutland.

In medieval ages war chariots had quite gone out of fashion, but after the invention of gunpowder there was in some quarters a considerable use made of war carts. These vehicles occupied, for a time, the place later taken by the field gun. The earlier cannon—with some notable and ponderous exceptions—were something between the smallest kind of field piece and the "handgonne."* When the "men of Ghent" advanced to the defeat of the Earl of Flanders before Bruges in 1382 they had with them, according to Froissart, no less than "200 carts loaded with cannon." Judging from what follows, each cart carried one or two cannon; for directly the Earl's troops advanced, "the men of Ghent fired 300 cannons upon them." This seems to have been the only discharge, so long did it take in those days to reload. Later on, the war cart developed on the one side into the field piece and on the other to the "orgue" and "ribaudaquin" vehicles carrying a number of light gun barrels, either side by side or in a bundle and provided with an array of cruel-looking pikes and spears to keep infantry or cav-

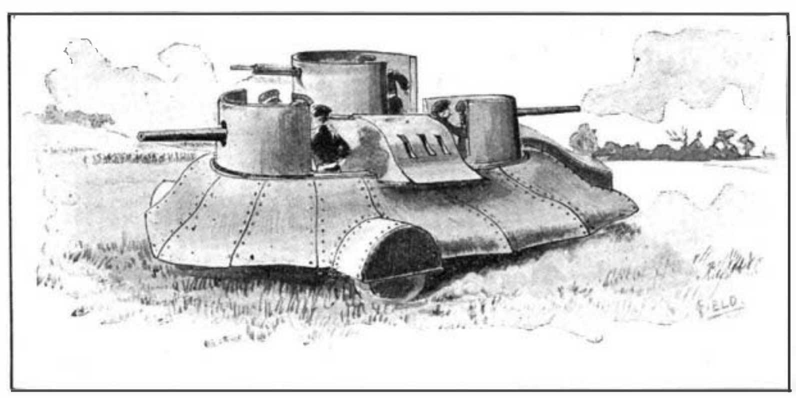


The Latest French War Car, 1907.

* Monstrelet mentions that in 1418 "the Lord of Cornwall . . . crossed the Seine . . . having with him in a skiff *a horse loaded with small cannons.*"

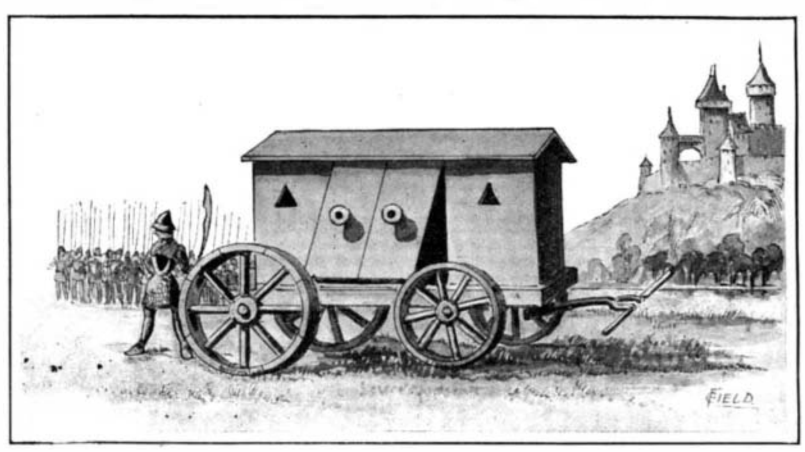


The Kaiser's "Battle Line Breaker," 1897.

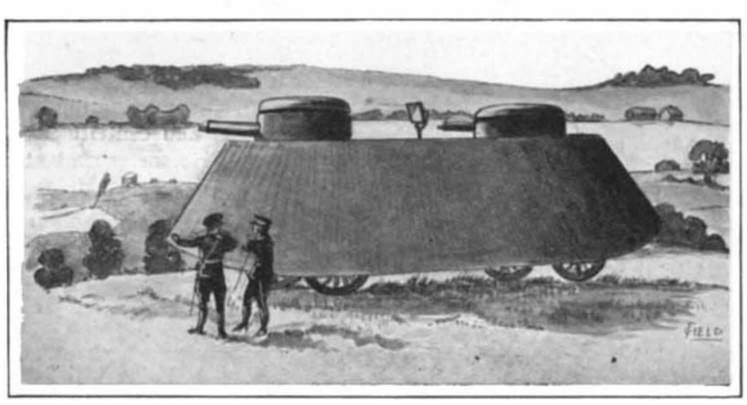


Proposed Improvement on Pennington's Car, 1900.

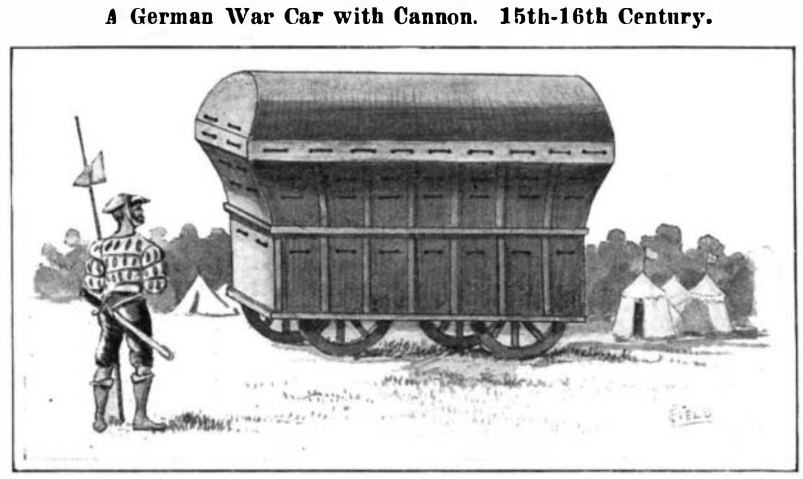
An 18th Century Suggestion.



A German War Car with Cannon. 15th-16th Century.



F. R. Sims's Fortress Car, 1902.



An English War Car in the Middle of the 16th Century.

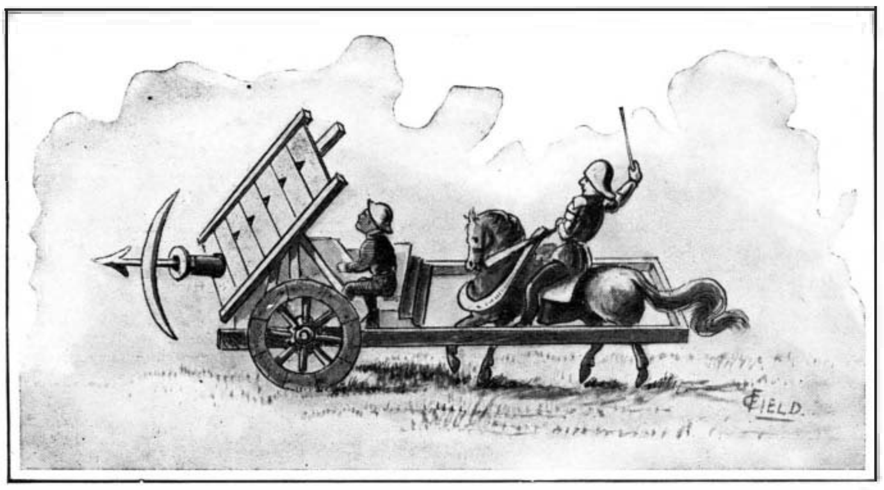
WAR CARS, ANCIENT AND MODERN.

alry at arm's length. These contrivances were the machine guns of the Middle Ages. In Germany especially the war cart proper continued for some time, at one period assuming the form of a European bathing machine carrying one, two, or more cannon and affording a considerable amount of protection to the guns' crews. These were probably a vast improvement on those we have referred to as used by the "men of Ghent" which were most likely ordinary vehicles fitted with cannon.

Henry VIII. of England had with him a number of specially designed war carts at the famous Field of the Cloth of Gold, if we may rely on the old paintings of that event. They were apparently intended for the transport and protection of infantry (probably archers) only, as they carried no guns and were pierced on all sides with several tiers of loop-holes. When on the move in action the horses were inside between the wheels and the soldiers occupied the upper portion only. Gun carts are represented in the same picture, but they were practically small, double-barreled field guns, breech loading, and covered with a long conical shield. But the progress of the evolution of the field gun and the portable musket soon abolished the war cart, and for practical purposes it did not appear again till the present time, when the perfection attained by the automobile has opened new possibilities in its use.

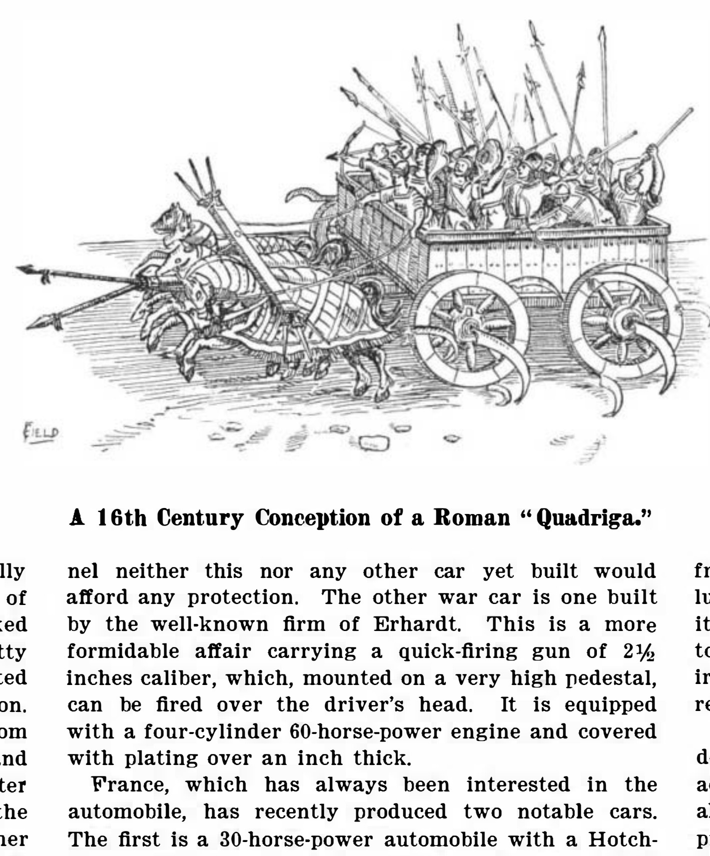
During the last century more or less vague ideas of steam-impelled vehicles adapted for offensive purposes occasionally crossed the minds of military men and inventors. A writer in the United Service Journal proposed something of the kind in 1833, and the Kaiser, that versatile genius, designed what he termed a "battle line destroyer" in 1897 which was to be as big as a Pullman sleeper, to be covered with steel plating and to bristle with guns and sharp prongs. So far as is known, this shore-going ironclad never reached the practical stage. The first year of the present century saw the first military motor to be really completed. This was a 16-horse-power car armed with a couple of machine guns, the car and its armament protected by rifle-proof steel shields. These gave the machine somewhat the appearance of the hull of a small man-of-war on wheels. It was the invention of Mr. Pennington, and a larger sized car carrying two six-pounders and a couple of machine guns was proposed as an improvement on his first design, but was not built. Two years later a car very similar in appearance to Pennington's first design was built to the order of Messrs. Vickers Sons & Maxim, by Mr. F. R. Sims, its inventor. It was a considerably bigger affair, being 10 feet high, 8 wide, and 28 long. It was completely covered with armor and carried a pair of "pom-pons" in revolving turrets. All its crew of five men were under cover. One, standing amidships, steered by aid of reflecting mirrors; one man in each turret worked the guns, extra ammunition being passed up by a man seated below. A war car of somewhat peculiar design was exhibited in Paris at the end of 1902. Generally it was much like an ordinary car with a pair of bucket seats, but behind these was fitted what looked like a traveling bath. As this was perched up pretty high the Hotchkiss machine gun which was mounted in it could be trained to any quarter of the horizon. The gunner got a certain amount of protection from the "bath" and the gun shield, but the chauffeur and any other passenger had to do without. The later types of war automobiles are all more or less of the closed cab type. The Daimler Company built a rather remarkable car for the Austrian government in 1905 at their works at Neustadt. It was completely covered with armor, had a revolving cupola at the top and both front and back wheels were directly driven by the motor, thus rendering it more than usually able to cope with the difficulties presented by rough or broken ground.

Russia is experimenting with a car built by Charron, Giradot & Co. at their Puteaux works. It is steel armored and provided with four-cylinder engines of 40 horse-power. Even the wheels have thin nickel-steel disks fastened to them. The car has a species of revolving turret at the top carrying a light gun and is provided with a set of steel rails of special construction in cases on either side, which can be used to bridge over anything very difficult in the way of a ditch or narrow stream that the car may come across.



A Medieval War Car.

It may naturally be supposed that Germany does not hang behind in the provision of warlike novelties, and we find her making trial of two types of car. The one is hardly a fighting car in the ordinary sense of the word, as it is not provided with any offensive equipment. Nevertheless, it is armored so that the Kaiser—for whose special use it is designed—can, with some of his staff officers, brave the bullets of any of the enemy's scouts who may be in the neighborhood of his armies. Against artillery fire other than shrapnel neither this nor any other car yet built would afford any protection. The other war car is one built by the well-known firm of Erhardt. This is a more formidable affair carrying a quick-firing gun of 2½ inches caliber, which, mounted on a very high pedestal, can be fired over the driver's head. It is equipped with a four-cylinder 60-horse-power engine and covered with plating over an inch thick.



A 16th Century Conception of a Roman "Quadriga."

France, which has always been interested in the automobile, has recently produced two notable cars. The first is a 30-horse-power automobile with a Hotchkiss rapid-fire gun in its turret. The car, which weighs only 6,393 pounds, is completely armored with the exception of the tires, and the driver and gunner are protected. The turret is revolving, allowing the gun to point in any direction. The armor is about ¼ inch thick, and is practically impervious to rifle bullets. The latest is a 35-horse-power car, weighing 5,070 pounds and capable of traveling 28 miles an hour on good roads; though like all modern war cars it is specially designed for crossing rough country, and carries rails to bridge ditches.

So far, the modern war car has scarcely passed the experimental stage, but it is probable that before many years have passed the war automobile will be a recognized part of every civilized army.

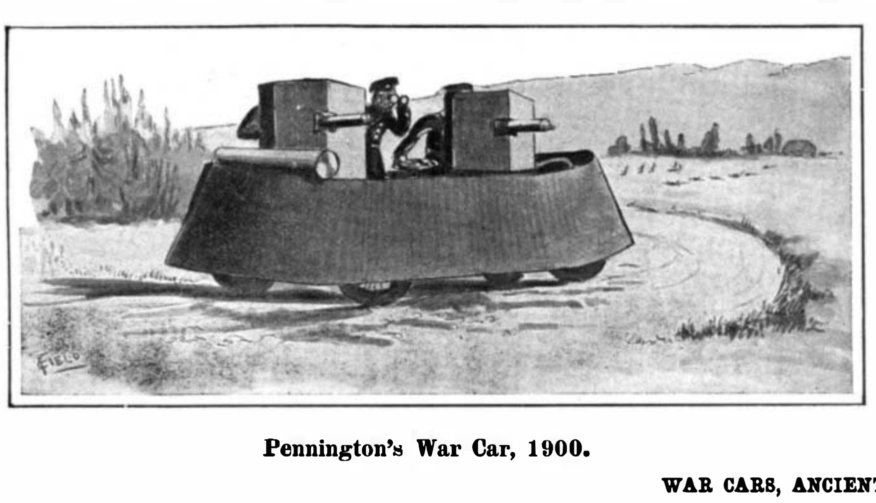
Amorphous Graphite as a Lubricant.

Although the excellence of graphite for all sorts of lubrication and its particular adaptability to certain difficult lubrication is a matter which is familiar, few, perhaps, are cognizant of the fact that there are two forms of graphite: flake, or foliated, and amorphous, or non-structural, graphite; and that though chemically the same, the latter is capable of finer pulverization and with careful treatment may be reduced to an impalpably fine powder absolutely free from grit or any sort of harmful impurity. Flake graphite, on the other hand, no matter how finely pulverized, always retains its original mica-like or crystalline structure and, comparing one with the other, there is a vast difference in nature, texture, action, and effect.

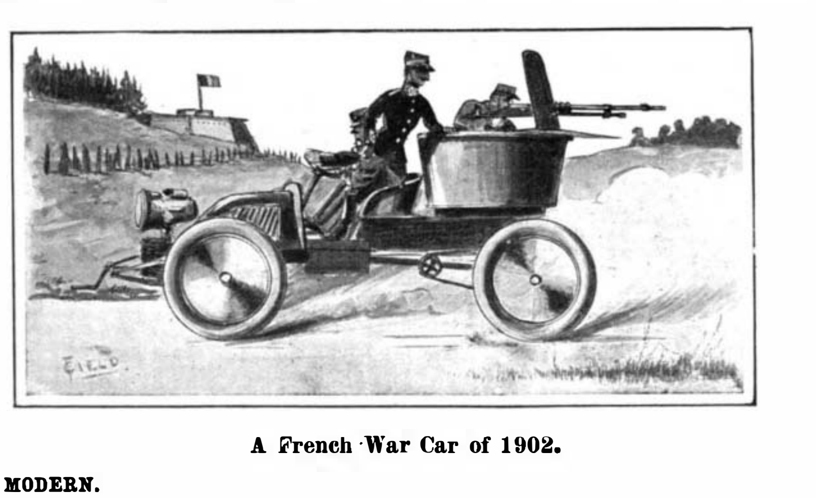
In the first place, amorphous graphite is adhesive in the highest degree. It stays put, and adhesiveness is one of the first requisites of an efficient lubricant in that to cool a hot bearing it is absolutely essential that the lubricating agent "stay put" where applied. To illustrate: Take a pinch of finely pulverized amorphous graphite and rub same in the palm of the hand, on paper, or on some other convenient surface, and observe its action. Note that the more one rubs the more effective the lubrication, for this form of graphite is not easily removed from surfaces in frictional contact, but maintains constant and effective duty right at the point of contact and is at its best under heavy frictional pressure in that as above stated it is adhesive in the highest degree—"stays put"; there is absolutely no waste, as every particle is an active lubricating factor. Then, too, as an impalpable powder it readily and quickly penetrates and distributes itself in a smooth, slippery, even coating between the tightest bearings, filling every pore, crevice, and interstice, thereby evening irregular bearing surfaces and reducing friction to a minimum.

Let us also see how, mixed with lubricating oils, this amorphous graphite will minimize friction. A microscopic examination of perfectly smooth bearings, cylinder surfaces for instance, will disclose many minute irregularities, which, in the nature of things, must be productive of more or less friction. This friction of course means wasted energy, energy that instead of being utilized as power is absorbed as heat, a condition that more often than not means an overheated bearing with the consequent loss of time and temper. To effectively overcome this friction and utilize this otherwise wasted power, a lubricant possessing considerable "body" is required—it must be a substantial lubricant of such a nature as to eliminate as far as possible these microscopical irregularities and provide a bearing offering minimum resistance to the surfaces in play.

Experience, which is man's teacher, has not only demonstrated time and again that oil in itself will accomplish this only to a certain extent, but it has also taught that pure soft finely-powdered graphite, properly and judiciously applied, will do wonders, so it only remains to make the proper application of the right sort of graphite. It has, therefore, long been the endeavor of intelligent engineers to secure a graphited oil, that is to say, an oil in which graphite floats or is held in suspension without precipitation sufficiently



Pennington's War Car, 1900.



A French War Car of 1902.

WAR CARS, ANCIENT AND MODERN.

long to perform its duty, for it is easy to see the great advantage to be derived from the use of an oil having every drop impregnated with solid lubricating matter.

This seemingly simple problem, however, is one that has until lately baffled engineers of experience, but it has now been found that amorphous graphite when reduced to an impalpably fine powder, when mixed with oil in the proportion of about one teaspoonful to the pint of oil, will remain in perfect suspension long enough to feed through lubricator tubes without clogging, thus causing every drop of oil to carry its mite of graphite.—The Railway and Engineering Review.

BLOOD PRESSURE AND MENTAL CONDITIONS.

In addition to those bodily movements which are called "voluntary," various bodily phenomena which are clearly involuntary accompany violent mental excitement. The blush of shame, the distinctive flushes of joy and of anger, the pallor and sweat of fear, the tears of grief, and the "creeping" of the flesh provoked by horror, are familiar examples. The respiration is quickened by joy, and retarded by anxiety, and the feeling of relief finds expression in a deep sigh. Violent emotions often disturb the digestion. The heart "bounds with joy," "is paralyzed by horror," "leaps to the throat" in terror. The connection between the heart and the emotions is so intimate that the heart was long regarded as the seat of the soul.

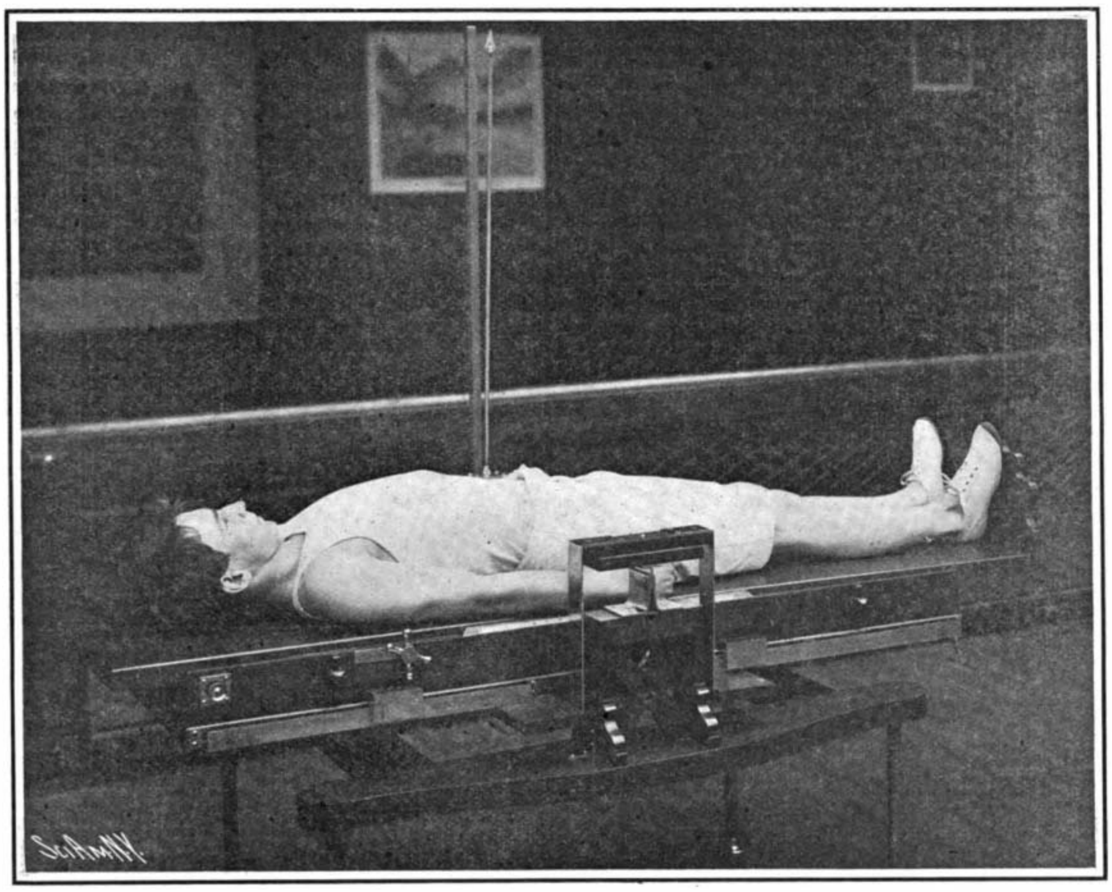
Most of these involuntary physical concomitants of mental excitement are brought about by a special part of the nervous system, the sympathetic nerve and its branches which ramify to every part of the body. The best known branches are those that govern the dilatation of the blood vessels, which are profoundly affected by mental states. These phenomena are susceptible of exact quantitative determination by means of a method devised by the Italian physiologist Mosso. The result is fairly accurate measurement of the variation of blood supply in the brain. The subject is laid on a board which is balanced on a fulcrum at the center of gravity in the manner illustrated in the accompanying engraving. When the subject is quiet and undisturbed the board lies horizontal. Now, if an unpleasant sensation or emotion is induced in the subject his head is involuntarily elevated, indicating diminution in the quantity of blood in the brain. An agreeable sensation or emotion produces the opposite effect.

In the course of the last twenty years, a great many experiments of this character have been made by many investigators, and have led to substantially identical results. The method of experiment should be adapted to the character of the subject. In many cases the feeling of pleasure can be aroused by offering a coin or other gift. At the moment of presentation the head-end of the board is tilted sharply down, indicating a sudden rush of blood. Then if the gift is taken away, with the explanation that it was presented in jest, the blood vessels contract and the head-end is elevated. Similar results are obtained by giving students favorable or unfavorable reports of examinations, reading poems to persons of fine sensibilities, etc.

There are great differences in the intensity of the physical effects of various mental processes. Difficult tasks in mental arithmetic, performed in private, cause only slight contraction of the blood vessels but the same calculations made in the presence of several persons, especially persons regarded with awe, cause great contraction. In general, emotional excitement, which common experience proves to be more fatiguing than purely intellectual activity, also affects the board more strongly.

Like many other modern discoveries these revelations are not absolutely new. Variations in the pulse were regarded in antiquity as indications of mental perturbation. Nearly 2,500 years ago Erasistratus, by feeling the pulse of the son of King Antiochus in the presence and in the absence of his young and charming stepmother, successfully diagnosed the young prince's puzzling malady as an "affection of the heart."

Severe bodily pain is commonly attended by alterations in the pulse and the pupil of the eye. This method of ascertaining whether a patient's suffering is as acute as he pretends was introduced by French physicians centuries ago.



BALANCED BOARD USED TO ASCERTAIN THE RELATION BETWEEN BLOOD PRESSURE AND PSYCHICAL CONDITIONS.

The Lost Continent in the South Seas.

The contention that Fiji and contiguous islands are remnants of a lost continent is supported by the investigations of Dr. Woolnough, of the Sydney University. Recently he spent several weeks in Fiji, when he directed special attention to the occurrence of granite recorded by Kleinschmidt some years ago. The main difficulty in the way of reconciling existing conditions with an original great area was that depths of 2,000 fathoms occur between the islands under notice. The Solomons and other islets were undoubtedly the visible links in the chain which ended at New Guinea. But against this theory had to be placed the immense volcanic and coral areas of Fiji, which were of more recent origin than the rocks forming the basic fabric of the continental area. It was necessary, therefore, to look for land evidences of faulting or breaking to account for the submarine depths. The granite area in Viti Leva was found to be from 400 to 600 square miles in extent, underlying the modern volcanic rocks. He was, however, unable to determine the relationship between the granites and slates, although he traced the lines of junction to some extent. A range of granite mountains with precipitous cliffs on each side gave evidence of heavy faults, creating chasms of great depths. He found the rivers forming a marked rectangular network, an upraised coral reef 200 feet above sea level, conglomerate rock showing sea-shells at a height of 800 feet above the sea, certain earth tilts and tuffs which had formerly been submarine and were now at a height of 4,500 feet. All these indicated a tremendous uplift, sufficient to cause greater faulting in the original continent. The rivers of Fiji were of comparatively youthful development, and even at present passing through their cañon cycle. Many beautiful examples of hanging valleys were observed.

The Scientific American Trophy.

The Scientific American Trophy is now on exhibition in the window of Messrs. Reed & Barton, 32d Street and Fifth Avenue, New York. It is attracting much attention. It will be competed for at St. Louis October 22, 1907.

Change in the Time of Allowance of United States Patents.

As most inventors know, it has hitherto been the practice of the United States Patent Office to issue patents on inventions three weeks after the date of allowance on payment of the final government fee. The Commissioner of Patents has given instructions that hereafter the period between the date of allowance and the issue of the patent shall be four weeks.

Farmers have always considered that hogs should be turned loose in an orchard. By picking up the windfalls they destroy many insects, whose presence is often the cause of the fall. It is stated on good authority that they are very destructive to the larvæ and pupæ of the codling moth, and will grow fat in an infested district.

A UNIVERSAL ASTRONOMICAL CLOCK.

BY DR. ALFRED GRADENWITZ.

The astronomical clock which is illustrated herewith is a most marvelous example of horological and mechanical skill. It was designed and constructed by Christian Reithmann, astronomer and scientific mechanician, at Munich, and involved four years of work (not including two years of preparatory calculation; the mathematical rate calculations were worked out to from six to ten decimal places, in order to dispense with any future readjustment of the works). It is intended for the tower of the new Munich town-hall, and pending the completion of this building has been exhibited at the German Museum of that city.

This clock, the decorative part of which was executed by Prof. Otto Hupp, has the form of a three-tower structure, and is fitted with thirteen artistic dials. The lower part of the construction, in front of which there is a projecting balustrade, together with the planetarium, is made of stained wood, and the middle and upper parts of ornamental gilded copper. An enormous number of wheels was required to perform the manifold functions of the clock, the planetarium alone comprising no less than 400 wheels with an aggregate number of 20,000 teeth, in order to represent with astronomical accuracy the revolution round the sun of the eight main planets and their satellites.

The central dial of the clock consists of twelve parts. Two of the hands will indicate the local time of Munich, and a third the mean European time. Adjoining this central panel is a *polytopical clock*, comprising a twenty-four-hour ring, the hours of the day being marked in white, and those of the night in black figures. On another ring surrounding the whole there are marked in artistically arranged panels the names of the eighty principal cities of the world. Each of these panels is provided with a golden arrow pointing toward a given part of the ring, which bears the Roman figures, thus allowing the local time of the city in question to be read at any moment. All of the dials and hands are real masterpieces of art.

The main dial to the left of the polytopical clock is the *astrolarium*, showing the actual position of the sun and moon among the constellations, as well as the right ascension, declination, and longitude of these bodies. The dial of the astrolarium comprises several movable rings, one of which gives the nodal position of the moon's orbit, the position of perigee and the distance of the moon. Whenever the sun and moon meet in one of the nodes of the lunar orbit, there is known to occur an eclipse of the sun; if, however, the moon at the same moment enters the earth's shadow, it will traverse the latter, producing an eclipse of the moon. The motions of the moon and sun are represented by Mr. Reithmann's mechanism with their characteristic irregularities, thus reproducing with absolute accuracy the relative positions of the two bodies, and the times of eclipses. On the inner part of the astrolarium dial there are shown the phases of the moon and seasons of the year, as well as the length of day and night for the actual date. A smaller dial on the left-hand tower will mark sidereal time, which is known to correspond to two successive passages of a fixed star through the meridian. This time is the most important to astronomers, allowing the *mean time* (according to which our clocks are adjusted and regulated) to be calculated.

The *calendarium* dial, to the right of the central dial, will indicate automatically the day of the week and the month, as well as leap days and leap years, while by means of an extensive mechanism the movable holidays are readjusted automatically, on the last day of December. The same dial further comprises two smaller dials, the apertures of which are opened more or less according as required for illustrating the duration of visibility of the sun and moon above our horizon. The rising and setting of these heavenly bodies are represented as well. The phases of the moon are likewise shown above a crowing cock (marking the hours) on the top of the middle tower. On the lateral tower of the clock, above the calendarium, there is marked *true solar time*, that is to say, the time given by sundials, and which corresponds to two successive passages of the sun through the meridian. A *movable stellar map* with the various constellations