conducted only on a very large scale. The mines today are nothing like as picturesque as they were when the photographs we show were taken, as it was found that open mining, that is, cutting ground away in great bits like stone quarries, was impracticable on a large scale, so that at the present time deep covered shafts and galleries have been substituted. With all the resources of modern diamond-mining machinery, the final work of picking out diamonds from a mass of pebbles calls for skill, responsible, and, of course, proportionately highly paid labor. Ever since the mines were first opened, great attention was paid to the native diamond thief and to the white man whose business it was to buy stolen diamonds from the native workmen. The latter were known as the "I.D.B.s," illicit diamond buyers. To prevent the natives from yielding to their blandishments, the latter are kept in the compounds, or stockades, and even high wire nettings crown the fence to prevent them from throwing over packages containing diamonds. The laws are so strict that if a person should find a diamond on the street, he would at once have to take it to the police to be registered before he could legally have any claim to its possession. When the individual claims were being worked, some miners would dig into their neighbors' claims in such a way that the blue ground which was so much desired would tumble into their own workings. This was one of the evils which was naturally incidental to the existence of 3,143 separate claims within an area of 1½ square miles. Now matters are entirely changed. Great companies, like the De Beers, have consolidated, with a capital of $18,500,000. Of course, the possession of the mines by one or two corporations has given them an enormous power over the diamond market, and now it is said that there are many millions of dollars' worth of diamonds lying in the vaults at Kimberley, which are not intended to be put on the market until the conditions are ripe to obtain the highest possible price. It is needless to say that the mines pay handsome dividends, and there have been many enormous fortunes made in them.

The Trans-Siberian Railway.

A Russian newspaper has recently published some interesting particulars regarding the Trans-Siberian Railroad, which our commercial agent at Vladivostock, Mr. R. T. Greener, has supplemented by some facts of his own. In the haste of construction and the anxiety to get everything cheap, a special kind of light rails weighing 12 pounds to the foot was used on both the Siberian and Trans-Baikal lines. Wooden bridges were built wherever possible, and the crossings were made far apart. Under such conditions quick traveling on the road will be almost an impossibility, and it is doubtful if more than 20 miles an hour can be made. Only one passenger and two freight trains a day are run. To add to the danger, they put on the line a very heavy engine. The light weight of the rails and the steep gradients combine to make traveling very risky. On steep inclines the train drawn by the powerful locomotive already referred to runs 33 miles an hour, which has seriously injured the rails, and eleven cars were destroyed at one station. The engineers have come to the conclusion that a great deal of the road must be reconstructed. On the Trans-Baikal line there will have to be spent no less than $7,725,000, almost 50 per cent of the entire cost of the line; on the whole Siberian railroad, there will have to be spent not less than $62,750,000. The light-weight rails must be thrown aside, the wooden bridges replaced, and the number of stations increased. In places the engineers laid out the line on marshy ground instead of on the highlands where the ground is solid and firm, and in the near future it will have to be relaid. In some districts the mistake was committed in the choice of the direction of the line. Tomsk, the capital of western Siberia, was left 53 miles on the side and connected with the railroad by a bad road. In order to foster home trade, the rails and other supplies were ordered principally from Russian iron works in the Ural district, and they cost twice as much as if they had been obtained abroad. A considerable quantity of material was prepared in advance, and it became rotted before it could be used. The general cost of the great Siberian railroad is estimated at $180,250,000, including $60,770,000 for the construction of the Amur line, which project has been changed by the building of the Manchurian line. The last will cost $51,500,000.

It will be constructed by a joint stock company, but most of the shares are in the government's hands. The cost of a mile of railroad varies from $18,025 to $25,750 a mile, depending on the location. When the Manchurian line is completed, the distance from St. Petersburg to Port Arthur will be 5,819 miles, from Berlin 6,331 miles, and from Paris 7,060 miles.

As soon as the road is finished, it will be the shortest route between Europe and the Far East. One will be able to go from Paris to Yokohama in seventeen days. At present it requires twenty-five days going by way of Canada. The fare from London or Paris to the ports of the Far East is about $367 first-class; while in Russia, thanks to the lowered passenger tariff on great distances, one will be able to travel from the German frontier to Port Arthur or Vladivostock for $57 first-class, or a special train for $86. The cost of traveling from the west to the furthest point in the east will not be more than $175. Owing to the enormous distances, everything is being done to make the trip comfortable. Special Siberian trains will leave Paris weekly. There will be library, dining, bath and gymnasium cars, and traveling with such comforts would not be much more tedious and disagreeable than a long voyage by sea, except that a lack of exercise would undoubtedly be felt. The cost of transporting freight will hardly show as much decrease. In 1897, the cost of transporting freight from Shanghai to London, by water, was $9 per ton, and in February, 1898, it had dropped to $5.60. The Siberian road will not be able to compete at all with these prices; and while the freight-carrying trade between China and Western Europe will probably not amount to a great deal, the trade which the railroad will develop between China and Russia will be very considerable. The Siberian line will be of great importance as a means of quick and cheap passenger and mail communication between the different points in the two continents, which is alone sufficient to make it play a great rôle in international affairs.

CURIOUS MISHAP TO A BILLIARD BALL.

The mutilated billiard ball shown in the illustration was brought to this office by a friend who thought the subject would be of public interest. At first sight one would naturally suppose that the perforated ball and snugly fitting plug were the work of some deft mechanic, for despite its taper and irregular section, the one fits the other so closely that it is difficult to detect

SECTION OF DISINTEGRATED MAMMOTH TUSK, SHOWING NATURAL LINE OF SEPARATION.

CURIOUS MISHAP TO A BILLIARD BALL.

the joint. As a matter of fact, however, the "trick" was done, involuntarily, during a game of billiards, when this particular ball was struck heavily by another ball on the figure 13, with the result that the heart of the ivory was driven cleanly out, as shown in the illustration.

If a cross-section be taken of an ivory tusk, the center will contain a spot (the remains of the pulp) of darker color than the rest, and concentric with this will be noticed numerous circular contour lines, which are due to minute curved spaces, known as "interglobular spaces." In these spaces there is less of lime salts and more of organic matter than in the rest of the ivory. Hence, the ivory in these rings is less dense, and more likely to decay, and fossil tusks and the tusks of mammoths are frequently found to have separated into a central solid cone, with several superposed hollow cones embracing it, as shown in our engraving.

This billiard ball had evidently been turned from the heart of the ivory, the axis of the tusk coinciding closely with the axis of the ball. The sharp blow must have been delivered fairly in a line with the axis of the heart, and the piece which was driven out gave way at the circular line of cleavage, marking the presence of the "interglobular spaces" above referred to.

The Pollok Memorial Prize.

In response to the request of many of our readers, we publish in the current issue of the Supplement the official regulations regarding the competition for the Anthony Pollok $20,000 prize for life-saving devices, and those of our readers who are considering the advisability of exhibiting devices of this kind are referred to this issue for full official information. Detailed plans and specifications should be sent to John H. McGibbons, Director of Exploitation of the Paris Exposition Commission, Equitable Building, 120 Broadway, New York, and the exhibits should be marked "Pollok Memorial Prize." Small models may also be sent there.

As Others See Us.

At the close of the year, when many subscriptions to the Scientific American expire, the publishers often receive, together with the renewals, letters commenting upon the work of the editor during the past year. The publishers believe that it is only fair that readers should know something of the encouragement received, entirely unsolicited, by the editor concerning his work. It is, therefore, with all due modesty, but with a feeling of justifiable pride, that the following extracts from letters recently received should be quoted:

An admiral in the United States navy says:

"The Scientific American is second to none in this country, either in the scientific ability of its staff, or in its patriotic utterances."

A clergyman writes:

"I find that the Scientific American is helpful in my ministerial work. It keeps me in touch with the scientific world, thus having before me an object lesson of the wonderful works of God.'"

A physician writes:

"I have been a constant reader for over thirty years and think the Scientific American is as useful to the practising physician as a medical journal."

Some members of Congress write:

"It is a great paper and one replete with interesting information."

"There is no paper I read with such profound interest as the Scientific American."

"It is the most valuable up-to-date scientific publication of its kind published. Its articles are always fresh and reliable, and written in such a popular style as to be easily comprehended by even the layman in scientific matters."

"I regard the Scientific American as decidedly the best scientific paper published in America."

"No paper which comes to my hands contains more information of a kind that is of practical use to legislators."

"I have been a constant reader of the Scientific American for many years, and find that it keeps pace with the growth of the country and the development of knowledge and ideas."

Several Senators write:

"It has no equal in the journalistic world."

The following comments have recently been received from some of our old friends:

"I have subscribed for your paper for over forty-eight years and have not missed a copy, and would not be without it."

"Please find renewal of subscription to the Scientific American for W. A. P., Rutland, Vt., who has been a subscriber for over forty years. Is he the oldest subscriber?

"I have nearly complete volumes of the Scientific American for some thirty-five years and consider myself a life member."

"Please renew my subscription to the Scientific American. I cannot afford to be without it, as it has become a part of my life. A perfect library, up to date every week."

"I have taken the Scientific American for the last twenty-five years and have every paper up to last Saturday. I would not think I could do without it. I think it is the best paper published in the world."

"For more than twenty-five years I have taken your interesting and valuable paper and probably shall continue as long as I live, and I wish that every young man could be a constant reader of it."

"Your paper is a grand instructor for any young man, and I would not be in want of it and the Supplement for $20 per year, as everything in the papers is good, moral and instructive."

"After being a reader of the Scientific American for about thirty-six years, and having near forty-five volumes, which I consider is a valuable encyclopedia for mechanics, I would be at a loss to place a value upon them. My boy will subscribe for 1900, and I will close my subscription for the paper, hoping that he will be a reader as long, or longer, than I have been, and receive as much benefit as others have. I take this opportunity to thank you for what knowledge I have received from reading them, and in ceasing to be a subscriber to say if I had the ear of all young mechanics I would urge them to read your paper first of all others."

The late Vice President Hobart wrote some time ago: "I shall derive much profit from the paper."

The United States Commissioner of Education writes: "The Scientific American is a newspaper that I have always taken a delight in ever since I first began to read it as a boy on a farm in Connecticut. I never let a week's issue of it go by without examining it and finding things of interest in it."

Recent Balloon Ascensions Near Paris.

MM. Gustave Hermite and Maurice Farman have presented to the Académie des Sciences an account of a successful and important balloon ascension carried out by them on the 16th of September last. The ascension is described by the aeronauts as follows:

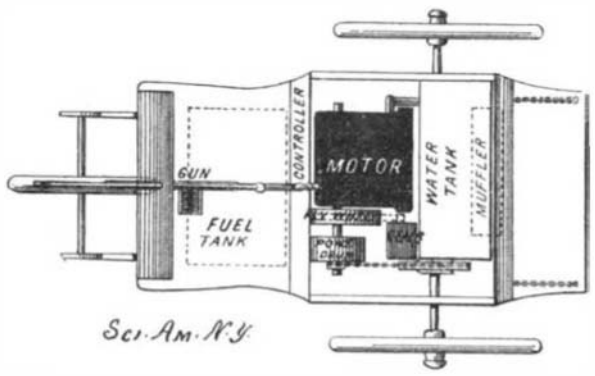
"The start was made from the gasworks, near Paris, at 6:25 in the evening, and a maximum height of 4,700 meters was attained, as indicated by our registering barometer of the Richard type, which worked perfectly, and was calibrated before and after the ascension by the Meteorological Bureau of Paris. After passing over the south of France, the descent was made on the borders of the Mediterranean, near the Gulf of Fos, after having remained fifteen hours in the air. The horizontal distance covered was about 655 kilometers. Our instruments included a registering barometer, thermometer, and hygrometer combined, also a second registering barometer, besides compasses, photographic apparatus, electric lamps, etc. A part of the ballast was made up of printed indication-sheets, which were classed and numbered. These we sowed along the route during the voyage at stated intervals. Of these sheets, many were sent back by post by the persons who found them, and thus we are able to reconstruct not only our route, but also the variations in horizontal speed. We left in a rather strong northeast wind, making 60 kilometers during the first hour. The direction, southeast, was not varied during the night, but the speed diminished gradually until morning, it being then 16 kilometers per hour. We were constantly surrounded by enormous clouds, but did not receive rain. We saw the earth at times through the rare openings in the clouds, and the moon permitted us to observe several optical phenomena, such as a lunar rainbow entirely colorless, which appeared for a few instants on our left and a little below us about 8 o'clock in the evening. Another phenomenon observed was that of the shadow of the balloon, projected upon the clouds and surrounded by a kind of halo, also colorless.

"The humidity, contrary to the general law, increased with the altitude and attained an approximative saturation at 2,800 meters, this height being reached a little before daybreak. The thermometer showed —5° C. At this time we were going directly south, and our speed, slow at first, became greater upon encountering a new air current, which a few hundred kilometers further south became a violent wind. It is at this point that we perceived a trumpet-shaped cloud, which enveloped us with a circular motion, and the equilibrium of the balloon was greatly compromised. We supposed that the circular motion was caused by the encounter of two currents of air. Having descended at 5h. 52m. in the morning to 900 meters, we recognized the country of Dombes, 45 kilometers to the north of Lyons, and there we received a few drops of rain. The balloon then commenced to mount toward the region of high altitude, and we passed above the clouds and saw the marvelous spectacle of an undulating sea of clouds, from which emerged, at a great distance, the principal summits of the Alps. Mont Blanc thus served us as a guide for a long time. At 4,100 meters we traversed a kind of ice-cloud, composed of microscopic crystals, which deposited themselves upon us with a peculiar crackling sound. Here the thermometer showed —7° and the hygrometer 40. Below us was a light rain. We saw also a rare phenomenon, that of the sun's image reflected from the clouds, which thus acted as a mirror.

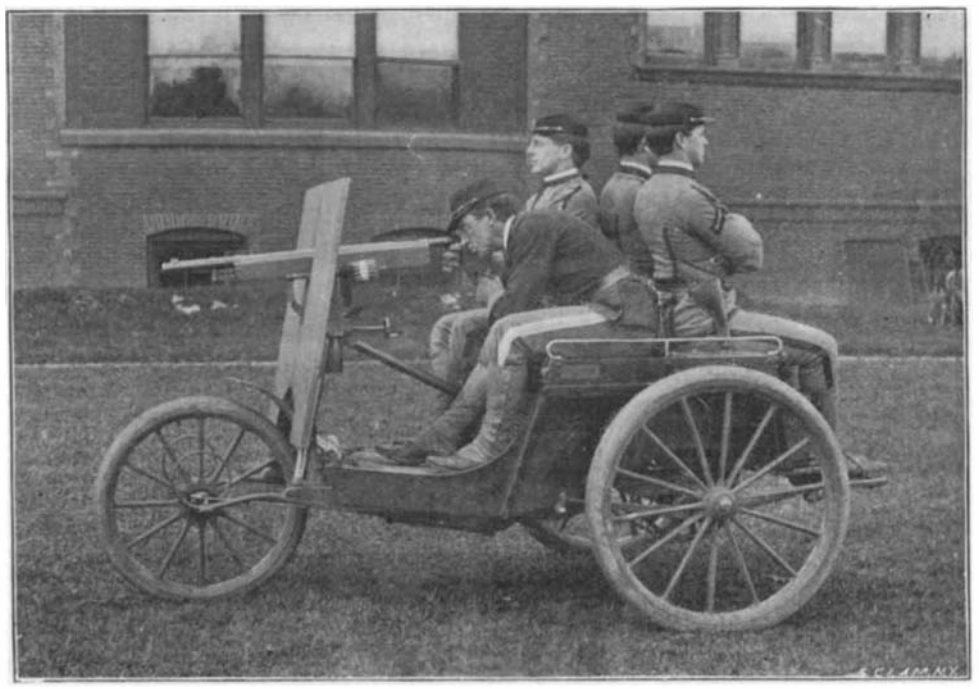
"Following the left bank of the Rhone, the clouds dispersed by degrees, being swept by the Mistral wind and carried back upon the mountains. Below us opened a transparent gulf, at the bottom of which we saw pass, at lightning speed, the towns of Valence, Montelimar, Orange, etc. At 9h. 12m., being then above Avignon, we came in sight of the Mediterranean. (Barometric altitude, 4,700 meters; thermometer, —10°; hygrometer, 26.) We allowed the balloon to descend, and felt a strong wind. At 1,500 meters the wind whistled violently, and at 9:33 we took earth in the great plain of the Crau, after some terrible shocks. We had made 130 kilometers per hour since leaving Avignon, and near the earth the speed was undoubtedly much greater. The successful landing under such perilous circumstances was due in great measure to the accessories which were specially constructed for the purpose. The diagrams which we obtained with our registering instruments are very clear and show a decrease of temperature of 1° for every 185 meters. The working of the hygrometer was normal during the day. We also took some photographs in the high regions."

MILITARY MOTOR CARRIAGE.

We have been favored by Major R. P. Davidson, of the Northwestern Military Academy, of Highland Park, Ill., with a photograph of the military motor carriage, designed by him. It was built by the Peoria Rubber and Motor Vehicle Company, of Peoria, Ill., on the Duryea plan. The gun carriage is driven by gasoline. It weighs, with gun and full equipment, 1,100 pounds. The wheels are 36 inches in diameter and are provided with wooden spokes and pneumatic tires. The fuel tank is in front and furnishes gasoline to the 6-horse power Duryea three-cylinder engine, which has a fly-wheel 16 inches in diameter. There is a single feed-pipe and an exhaust pipe, and a single set of cam shaft gears which operates all the valves and igniters. The location of the various parts will be seen by reference to our diagram. The carriage has a windlass attachment, and by fastening a rope to it and anchoring the end of the rope, the carriage can pull itself out of holes or up steep grades. The tank holds enough gasoline for a run of 200 miles, and it seats four persons with tents, blankets, equipment, extra supplies, rations for a week or ten days, and 4,000 rounds of ammunition for the 7-mm. Colt automatic rapid-fire gun which fires 480 shots a minute. The gun has a range of 180 degrees and the firing range of the gun is over 2,000 yards. A detachable bullet-proof shield protects the operator, and the tank and machinery are also made bullet proof. It is Major Davidson's intention to ascertain what the carriage can do on good roads, rough roads and over plowed fields. It will be taken to Washington in the spring and exhibited at the Ordnance Bureau. Major Davidson has given the matter five years of thought.



PLAN OF GASOLINE GUN-CARRIAGE.



MAJOR DAVIDSON'S MOTOR MACHINE-GUN CARRIAGE.

Production of Alcohol from Plants.

A number of interesting experiments have been recently made by M. V. Kuess as to the production of alcohol from plants. He finds that certain plants may be used to produce alcohol in profitable quantities and may thus afford an important source of supply. The plants best adapted for the purpose are the scilla (squill), the asphodel, and the alfa. The former is well known as a medicinal plant; it is interesting to observe, however, that the alcohol obtained from it does not contain any traces of the active principle which gives to the plant its medicinal properties. It is estimated that by proper treatment at least 25 per cent of alcohol may be obtained from this plant. The asphodel furnishes equally 25 per cent of its weight of alcohol, which possesses all the properties of the alcohol obtained from spirits, and besides a residue is left which does not contain injurious matter and may be used as food for animals. The alfa is a plant which is very abundant in the south of France and in the north of Africa, and from this source may be obtained not only alcohol, but also a fibrous matter which may be utilized for the production of paper paste or textile fibers. The experimenter finds that 100 kilogrammes of the plant will give 14 liters of alcohol and 60 kilogrammes of paper paste, or, by another treatment, 10 kilogrammes of textile fibers. The production of paper paste from this plant has been carried on for some time, and it has been known also that the plant gives fibers long enough for the production of tissues, but M. Kuess seems to have been the first to make known its value as a source of alcohol, while at the same time the production of the paper paste is not interfered with. He considers that it is the gum and the cellulose of the plant which furnish the alcohol by their fermentation. To separate these substances from the fibers, the plant is crushed in a mill and acidulated water added; the mixture is heated in a boiler, and during the operation the mass is traversed by an electric current. By this means the gum, cellulose, and coloring matter enter into solution; this is filtered and transferred to the fermenting vats. At the end of three days the fermented liquid is distilled and an alcohol of 45 per cent strength is obtained; this has at first a disagreeable odor, but the experimenter, by designing a special distilling apparatus, has succeeded in rectifying it to a point where no odor or taste is appreciable. The residue of the filtration is transformed into paper paste. If it is wished to obtain textile fibers, the plant is at first pressed between rollers, in place of grinding it, and is afterward treated by electrolysis in sea water. The alcohol obtained from the three plants above mentioned has the great advantage of containing neither acid nor ether, and may thus be directly employed in the different industries.

The Psychology of Fishes.

Numerous facts witness in a vague way to the ability of fishes to profit by experience and fit their behavior to situations unprovided for by their innate nervous equipment. All the phenomena shown by fishes as the result of taming are, of course, of this sort, but such facts have not been exact enough, says Mr. Edward Thorndike in The American Naturalist, to make clear mental or nervous processes involved in such behavior, or simple enough to be available as demonstrations of such processes. Through the kindness of the officials of the United States Fish Commission at Wood's Holl, he was able to test the efficiency of some simple experiments directed toward this end.

The common fundulus was chosen and the fish was kept in an aquarium. The space at one end was shaded from the sun by a cover, and all food was dropped in at this end. Along each side of the aquarium were fastened pairs of cleats, allowing the experimenter to put across it partitions of wood, glass or wire screening. These partitions were made each with an opening at some part, and then the experiments were begun. When the fish was caused to leave a shady corner and swim up the sunny end by putting the slide without any opening in behind him, and moving it gently up toward the forward end, the opportunity was given for observing the animal's behavior to good purpose.

This fish dislikes the sunlight, and tried to go back to the shaded portion. He swam against the screen, bumping against it here and there along the bottom; occasionally he stopped and remained still for a while. Sometimes he would rise up toward the top of the water, especially while swimming up and down the length of the screen. The screen used in the first experiment was cut away slightly at the upper corner so as to leave an opening, so that the slide somewhat resembled a letter with a postage stamp on it, the postage stamp representing the aperture. After the fish had been experimented upon six or eight times a day, it was found it swam against the screen less and less. He swam up and down it fewer and fewer times until finally his only act was to go to the right hand side, rise up and swim out. The fish had clearly profited by his experience and modified his conduct to suit his situation, for which his innate nervous equipment did not definitely provide. He had, in common language, learned to get out.

James Hamblet.

James Hamblet died on January 2, aged seventy-five years. He was one of the pioneer electrical manufacturers, and in 1878 he organized the time service for the Western Union Telegraph Company. He introduced a large number of improvements into the electrical distribution of time.