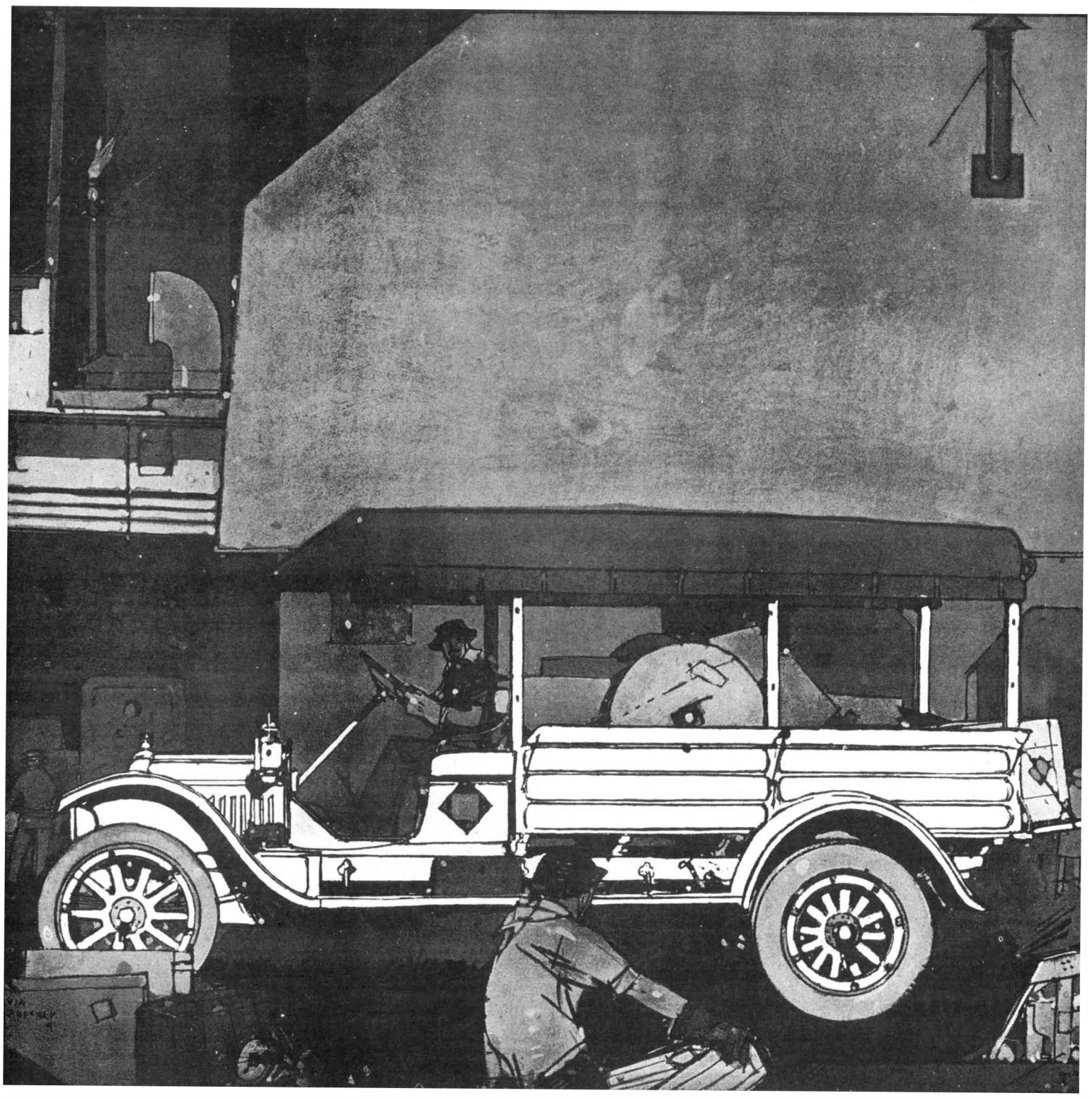
SCIENTIFIC AMERICAN

IN AN AMERICAN POTTERY; "PLACING THE KILN"—[See page 328]

October 7, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 15 Cents



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Manufacturers of Jeffery Motor Cars and Trucks

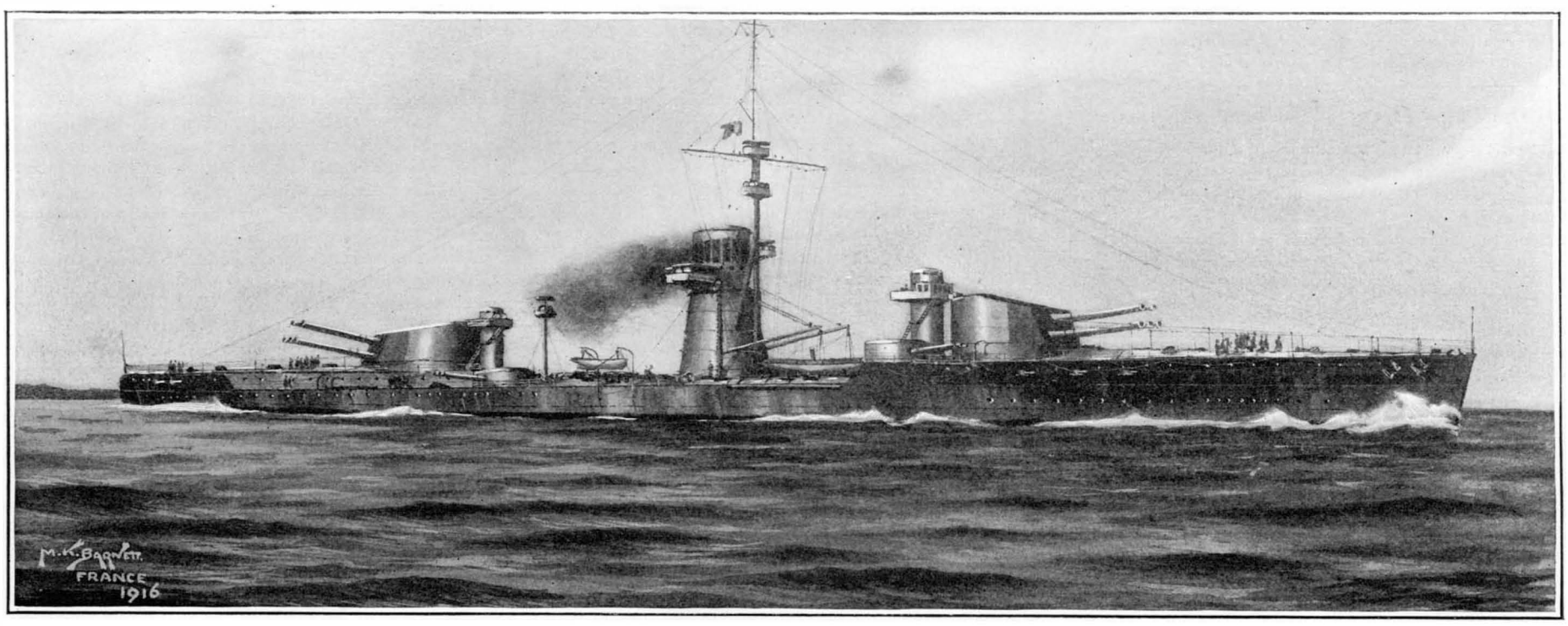
Kenosha, Wisconsin, U. S. A.

SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXV.] NUMBER 15] NEW YORK, OCTOBER 7, 1916 [15 CENTS A COPY [$4.00 A YEAR



Italian design of a battle-cruiser, based on the lessons of the war

Displacement, 32,000 tons. *Speed*, 28 knots. *Armor*, 12-inch belt, inclined inwardly to the keel. *Battery*, ten 15-inch guns in two 5-gun turrets, twelve 7.5-inch, and twenty-eight 4-inch

The Vindication of the Battle-Cruiser

THREE years ago the battle-cruiser was regarded by many naval experts as a questionable adjunct to a fleet; in fact the type only found place in three out of the five greatest Naval Powers. Experts affirmed that though the battle-cruiser was far more expensive both in construction and maintenance than the battleship, she would not prove such a strong weapon in line of battle, besides being more vulnerable. Beyond her fighting capacity, her vocation was very vague—she was neither "fish nor fowl." Theorists did not realize the many duties of which the battle-cruiser has since proved herself capable.

During two years of war the battle-cruiser has more than justified her existence, and is now regarded as an indispensable unit to any large fleet. She has played a prominent part in four out of the five most important naval encounters, and after an examination of these one feels indisposed to fix her limitations.

In the battle of the Heligoland Bight she took part in an extensive stratagem. As the final and potent factor she was enabled by her speed to successfully evade submarine attack, and come up at the crucial moment to turn the tide of battle against the German cruisers, who were pressing the British lighter craft hard.

The next great part played by the battle-cruiser was in the fight off the Falkland Islands. Here her rôle was to "round up" and destroy a strong squadron of armored and light cruisers, detached from the enemy's main fleet to prey upon lesser warships and commerce.

Later we find her in touch with vessels of her own class in the Dogger Bank action—an antidote, and perhaps the only antidote, to hostile raids by ships of her own type—and only then can she be completely successful if she is as fast and powerful as her adversaries.

With regard to the Battle of Jutland:—Rear-Admiral Knight, president of the American War College, having been requested by the American Navy Department to make a report on the engagement, stated that: "The importance of battle-cruisers has been vindicated, and a field of enlarged usefulness proved." And of the battle: "One fact is clear, and in it is the whole explanation of the incident. The battle-cruisers were doing the work of battleships for which they were not designed, and they paid the penalty which was more or less inevitable. They were not only engaging battleships, but engaging them at short range. It is claimed that they were doing this for a purpose which made it worth while to sacrifice themselves; that they were seeking to hold the enemy fleet until Sir John Jellicoe could come up; and they accomplished this. My view of the value of the battle-cruiser is somewhat enhanced by the results that are known."

THIS ARTICLE with its illustrations was received from Mr. Chas. B. Barnett whose letter of transmission says: "I am sending an article, just received from my son, Pte. M. K. Barnett, who is now serving in France, together with two drawings which he has been able to make in a cellar there." Mr. Barnett will be recognized as the contributor of several drawings of warships which have been published in the SCIENTIFIC AMERICAN.—EDITOR.

This bold move was more than justified, though it might have been more completely successful had better climatic conditions prevailed. Just as a destroyer flotilla may risk destruction or get "cut up" in order to torpedo and blow up three or four battleships—so may a squadron of battle-cruisers expose itself to heavier fire than the ships are built to withstand in order to cut off a number of enemy ships from their bases and force them into general action with its own fleet.

To sum up these four functions which the battle-cruiser has accomplished:

(1) To strike a final and supreme blow in a strategic engagement of smaller craft, as evidenced in the battle of the Heligoland Bight on August 28th, 1914.

(2) To round up and destroy a strong squadron of cruisers, detached from the main enemy fleet to prey on distant trade routes. Viz:—the Battle of the Falkland Islands on December 8th, 1914.

(3) As an antidote to a raid by hostile vessels of her own type as shown in the Dogger Bank action, which was fought on January 24th, 1915.

(4) To cut off a number of enemy vessels from their own harbors and force them into action with her own fleet as was done in the Battle of Jutland on May 31st of this year.

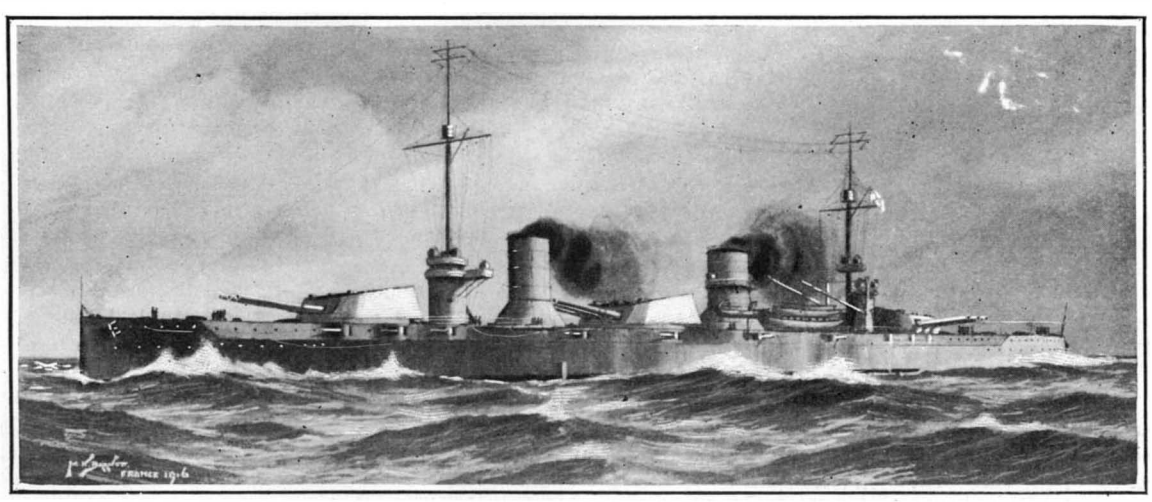
These examples give a good idea of the general utility of the battle-cruiser, but do not necessarily limit her possibilities.

Prior to the Battle of Jutland the House of Representatives had unanimously decided to build battle-cruisers—a type hitherto unrepresented in the U. S. Navy—and since the battle, and as a direct result of their consideration of it, the Senate Committee felt dissatisfied with the program, and in augmentation of the original bill provided for six instead of five battle-cruisers—four to be commenced as soon as possible.

With regard to battle-cruiser design — the type cannot be clearly defined, for in some cases it has fused with the battleship.

Among the most powerful battle-cruisers to date are the Russian "Borodino," "Ismail," "Vimburn" and "Navarin." These 28,000-ton vessels have a designed speed of 26.5 knots, and carry an armament of nine 14-inch guns and 20 5.1-inch guns. The main armament is mounted in three triple turrets, none of which are superimposed, all the super-

(*Concluded on page* 338)



Russian battle-cruiser Borodino; one of four ships recently completed in the Baltic

Displacement, 28,000 tons. *Speed*, 26.5 knots. *Armor*, 9-inch belt. *Battery*, nine 14-inch, twenty 5-inch guns

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, October 7, 1916

Charles Allen Munn, President, Frederick C. Beach, Secretary.
Orson D. Munn, Treasurer, all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada
Trade Mark Registered in the United States Patent Office

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.

The Ships of Our New Naval Program

FOR several months the technical bureaus of the Navy Department have been at work on the designs of those vessels of the new naval programme which are to be laid down at once. In these designs they have incorporated such military characteristics as the naval operations of the war have shown to be desirable. The very day on which the bill was affirmed the Department advertised for bids for the construction of four battleships, four scout cruisers, twenty destroyers, and thirty submarines of two distinct types. At the same time it directed the Navy Yards of Philadelphia, Boston and Charleston to proceed with the construction of a hospital ship, a fuel ship and a gunboat, respectively. As some features of the four battle-cruisers have yet to be decided upon, bids for these vessels are not yet called for, but will be within a week or two.

In response to the many inquiries we have received, we now are in a position to make known the broad characteristics of these ships. For obvious reasons, it is not advisable, just now, to publish any exact drawings of the vessels or go into the details of their interior construction and armor plan.

The battleships, which will be known for the present as numbers 45 to 48, inclusive, will be slightly larger than their predecessors, the "Tennessee" and "California." Their chief characteristics are: displacement, 32,600 tons; speed, 21 knots; battery, eight 16-inch guns, eighteen 5-inch guns, and four 3-inch anti-aircraft guns. The complement of officers and men will be 1,022. They will have the large cruising radius which characterizes all recent United States battleships. Both their armor and under-water protection will be unusually complete.

The four battle-cruisers—the first of their type to be built for our Navy—will greatly surpass any existing ships of their type in the navies of the world, except, perhaps, in the matter of armor protection. They will be by far the largest warships yet constructed. Their over-all length will be between 800 and 900 feet; their beam will be 97 feet, and their full-load displacement will be close to 40,000 tons. Their armament will consist either of eight 16-inch guns or a larger number of 14-inch, the latter being of the new 50-calibre type. To secure their contract speed of 35 knots, they will require an engine and boiler plant of over 175 horsepower. The drive will be of the turbo-electric type, and the enormous plant of water-tube boilers will be housed on two decks.

The scout cruisers, known as numbers 4 to 7, inclusive, will also be the largest and fastest vessels of this class so far laid down for any navy. The chief characteristics are: displacement, 7,100 tons; speed, 35 knots; length, 550 feet; beam, 55 feet; armament, eight 6-inch guns, four torpedo tubes, and two 3-inch anti-aircraft guns. The complement will be 330 officers and men. Their high-powered machinery installations will be protected by light but efficient vertical and horizontal armor. A new feature, never before incorporated in any ship of a powerful military type, will be the equipment for carrying, launching and operating four of the largest size hydroaeroplanes.

The torpedo boat destroyers, known as destroyers numbers 75 to 94, inclusive, will carry a heavy battery, and will have an unusually large cruising radius. They represent a small increase in displacement over our latest destroyers, but they will be faster by from five to six knots. Their chief characteristics will be: displacement, 1,185 tons; speed, 35 knots; battery, four 4-inch guns, four triple torpedo tubes, and two anti-aircraft guns. They will carry 95 officers and men. It should be noted that they must attain their rated speed on full designed displacement, and not on a much smaller displacement, which, as in the case of a number of foreign boats of this class for which very high speeds are claimed, was attained only by stripping these boats for the trial run of many essential weights.

So far, so good. The ships above described are all most admirable in their several classes, and represent, so far as we know, an advance upon the designs of any ships built or building in Europe. But when we come to the so-called coast-defense submarines, we find that twenty-seven of these, to be known as numbers 78 to 104, inclusive, are to be of the usual type lately built for our Navy—small, non-seagoing craft of about 500 tons displacement. Three others, making up the total of thirty, to be known as numbers 105, 106 and 107, will be of a new type of 800 tons displacement, which will come midway between the coast defense and the already authorized large "fleet" submarines. Each of these three vessels will represent different ideas in their detail designs, and the Navy hopes in their development to arrive at a size of vessel which will be sufficiently large to accompany the fleet, but at the same time sufficiently small to enable it to be built quickly and in large numbers.

This formidable programme of immediate construction is only a part, it must be remembered, of the total construction authorized by the new Navy bill, which calls for a total of ten battleships, six battle-cruisers, ten scout cruisers, fifty destroyers, nine fleet submarines, fifty-eight coast submarines, and a proportionate number of auxiliary ships.

If there is no slacking off of the energy with which the start has been made in building these ships, and even if no additional ships were authorized by successive Congresses, it is estimated that the approximate strength of the Navy in usable fighting ships in the year 1921 would be: dreadnoughts forming the first line, 27; predreadnoughts, forming the second line, 13; superannuated dreadnoughts, forming the third line, 9; scouts of 35 knots speed, 10; scouts of 20 to 22 knots speed, 21; destroyers, 108; fleet submarines, 12; coast submarines, 120. At that time, also, we shall have a proportionate number of auxiliary ships. Appropriations, however, are certain to be made by each succeeding Congress, and by 1921 it is reasonable to assume that we shall possess in ships built and under construction 37 dreadnoughts, 11 battle-cruisers, and at least twenty 35-knot scouts. In view of the serious losses suffered by the German fleet in the present war, and of the enormous financial burden which she must carry as the result of it, to say nothing of her vanished dream of attaining naval preëminence on the high seas, it is certain that the year 1921 will find the United States in her proper position as the second naval power of the world.

In conclusion, we direct attention to the great strategic and tactical significance of the combination of very high speed with powerful batteries which is to be found in our new battle-cruisers and scouts. When these ships are afloat and coöperating in the van of our main fleet, they will be in a position to overtake and sink the advance scouts of the enemy unless, indeed, the foreign navies come back at once with the construction of ships of the same speed and power, which, of course, must be reckoned as one of the possibilities of the future.

International Scientific Relations After the War

IT was but a few years ago that a well-known European man of science, speaking of the peace of the world, declared proudly that if the diplomats found themselves unable to maintain it, the scientists might do so, bending all their efforts to the preservation of the bonds of scientific union so patiently and carefully knotted, and of such mutual service among all civilized nations.

Not only have we seen this iridescent dream quickly fade, but we have found the scientists unable even to keep peace among themselves. The fair shrine of truth has been profaned by the violent voices of her worshipers engaged in reciprocal vituperation and absurd recrimination.

To our minds it is unthinkable that this sorry state of affairs should continue after treaties of political peace are signed. Yet there remains so much bitterness in the breasts of many of the intellectuals on both sides that it will take a determined effort on the part of those who have kept their minds unpoisoned by prejudice to effect a satisfactory bridging of the breach and to reëstablish coöperation.

Somewhat more than a year ago the *Swenska Dagbladet*, a Stockholm daily, addressed a round-robin of inquiry to certain prominent scientists as to the prospects of an early resumption of such international relations as existed among scientists before the war. The answers exhibited considerable divergence of opinion; some eminent men declared that not for long years, if indeed during the present generation, could the broken ties be joined, while others took a more hopeful view. Van der Waalse, for example, while believing that a considerable length of time must elapse before international congresses can be held, observes that individual coöperation can go on peaceably and quietly. We agree with him that among the strongest factors in the healing process will be the establishment of amicable correspondence between individuals engaged in the same domain of research.

Doubtless, too, the first *rapprochement* will be, as Dr. Zeeman remarks, between the different members of the more impersonal international organizations. Even now there appears to be no valid reason why there should be an interruption of the work of such institutions. But the international congresses wherein hundreds of scientists formerly derived so much profit and pleasure from personal contact with their compeers of other nations will, of course, be difficult to hold while resentment lingers.

It is just here, perhaps, that the scientific bodies of our own country can best be of service to the cause of unity and harmony. Let us offer the hospitality of our metropolitan and university centers for the meetings of international bodies. The neutral countries of Europe have been too much swayed by their nearness to one or another of the belligerents to offer the same impartiality of atmosphere. In a recent number of a popular French review Dr. Raoul Blondel went so far as to declare that it would be at least a generation before any Frenchman would consent to be a guest of the apostles of Kultur. Since there is equal bitterness of feeling among many Teutonic scientists, it is obvious that if international congresses are to be resumed within a reasonable time after the conclusion of the war, the places of gathering must be so selected that as little personal friction as possible will mar the functioning of the affair.

It is probable, too, that the permanent bureaus of various International Commissions might, at least for a while, be with advantage located in this country; for whatever the event of the war, it is safe to say that neither Berlin, Paris, London or Rome will in the near future furnish an ideal intellectual atmosphere.

In conclusion, we may revert to Dr. Blondel's proposition that the Allies and their sympathizers declare a scientific boycott against the learned men and learned institutions of the Teutonic nations. This the SCIENTIFIC AMERICAN wishes to denounce in the strongest possible terms as narrow-minded and self-injurious, as unscientific and unworthy of a generous nation. Let no man hide either his own or his neighbor's light under a bushel. It is only by the blending of the varicolored rays from every quarter that the strong white light of the sun of knowledge may be formed, to illuminate the upward path of mankind.

Ozone as an Antiseptic

AMONG the branches of surgery to which the exigencies of the European war have acted as a sharp stimulus may be mentioned the treatment of infected wounds. The proportion of patients who reach the military hospitals with their injuries thus aggravated is so large as to have given great importance to the subject of antiseptics, since obviously the perfect aseptic treatment which most cases can enjoy in ordinary hospitals in time of peace is out of the question for the majority of battle wounds.

Many antiseptics, unfortunately, though excellent germicides, are so toxic that there is danger of their harming the vitality of the tissues surrounding the wound. For this reason hydrogen peroxide is admirable, since it is germicidal without being in any way injurious to healthy cells. However, it is not adequate in those cases, so common in warfare, where there is a serious amount of suppuration. It is almost instantly decomposed, not only by pus, but by blood and most of the other liquids of the body tissues, so that the amount of nascent oxygen released is insufficient for the requirements of a serious wound.

The search for an oxidizing agent not open to this objection led to the trial of ozone, either dissolved in water and used in copious irrigations, or in a gaseous state, mixed with ordinary diatomic oxygen. The latter style of treatment is especially advantageous in the case of wounds which are slow in forming a scab, since the most spacious bandages often have a tendency to rub off the fresh scar tissue. This difficulty is avoided in the process in question by surrounding the wound with a hermetically sealed shell, into which can be passed the gaseous current. This method possesses the extraordinary advantage of leaving the wound open to the beneficial action of the solar radiations as well. Then, too, the total exclusion of the ordinary air from the tissue under treatment makes impossible the formation of nitrogen compounds, which might prove decidedly irritant.

The other mode of application, through the use of ozonized water, has been found particularly satisfactory for large shattered wounds, where the tissues have been directly invaded by septic substances. The irrigation processes may be indefinitely prolonged without bad effect, thus making possible a methodical and efficacious cleansing of all infected tissues, whether they be deep or superficial.

Automobile

Delivering Telegrams by Automobile.— It is reported from Philadelphia that the experiment of delivering telegraph messages by automobiles has proven most successful in saving both time and money, both of which items are said to have been cut in half by the new system. This is especially true for outlying districts, but can hardly be applicable in the congested parts of large cities, where the delivery radius is small.

Uniform Traffic Ordinances.— At present every community has its own traffic regulations, and as these are not based on any uniform system, automobile tourists frequently find themselves in difficulties as soon as they get beyond their home district, for not only are the regulations encountered different, but their interpretation and methods of enforcement vary with the locality. This is not only extremely annoying to all concerned, but there is no good reason for such a state of affairs. It has been proposed that an effort be made to standardize the laws relating to vehicle traffic of all kinds throughout the country, and although it is a big undertaking, it could be accomplished by proper coöperation between automobile clubs and associations.

Foreign Trade after theWar.—The English papers are all busy devising schemes for assassinating German trade of all kinds after the war, and the automobile publications, although not in just the same words, are planning to apply similar methods for the benefit of British automobile manufacturers against American competition. This feeling of hostility is intensified in some quarters by the envy aroused on reading the reports of the war profit said to have been made by some of the American companies, and a writer in a prominent English automobile publication has the poor taste to characterize this as "blood money," entirely oblivious of similar gains made by most of his own, the British manufacturers. It is to be hoped that American motor vehicle makers are not oblivious to the situation.

The Motor Truck and the Horse.— A large trucking contractor in New York has tried out the motor vehicle, and has been converted to its value. He finds that he can undertake jobs that he would not dare to touch when he used horses, and that the distances that can be easily covered by the motor truck have greatly increased the radius of his operations, thus adding much new and profitable business. Horses, he says, were always a source of worry; they got sick, collapsed and died when most wanted, and every period of hot weather or snow put the animals down and out, so now he is through with the horses. Of course, this man employs competent men to operate his trucks, instead of immature boys, or cheap, ignorant laborers, and the good wages he pays are more than met by the saving in operating and maintenance costs, and the increased life of the machines.

Germany's Motor Mixtures.— Owing to the shortage of gasoline in Germany other motor fuels had to be sought, and it is stated that the one most used is a mixture of alcohol and benzol. According to a report of the American Consul at Lyons the results of experiments made with a 1914 Mercedes touring car, with an ordinary carbureter, showed a mileage of 4.66 miles with one pint of a mixture of equal parts alcohol and benzol, at a speed of 42 miles an hour. With 1 part benzol and 3 alcohol 4.34 miles were covered at 39 miles an hour. With 1 part benzol and 5 of alcohol the car covered 3.72 miles at 36 miles an hour. With pure benzol the car covered 3.79 miles at 42 miles per hour; and with gasoline the record was 3.60 miles at 44 miles per hour. These figures may be of value in this country when the cessation of war demands throws more benzol on the market.

Motor Fuel in England.—Between the high prices demanded and government regulations, motor car owners in England are having a disagreeable time over the question of motor fuel. The government required every owner to file an application stating the least amount of gasoline he could get along with, and for what purpose he used his car, which facts were to be considered in making allotments; but the official Dogberry was in charge, and this is the way he arranged matters: The man who asked for 16 gallons a month got 50 per cent of his estimate; the man who who wanted 24 gallons was allowed 33 per cent of that amount, while he who required 32 gallons got 25 per cent, without regard to the use it was to be put. In other words, everyone got eight gallons a month. A county surveyor, who was responsible for the upkeep of the roads in a district where there was an important military camp, was allowed only six gallons a month to keep his motorcycle going, while his neighbor, who ran a light car solely for pleasure, was allowed eight gallons. The whole thing sounds decidedly Germanic.

Science

A Low American Death Rate.—The Census Bureau announces that the death rate for the registration area of the United States in 1915 was the lowest on record; viz., 13.5 per 1,000 estimated population. This rate is based on 909,155 deaths reported from 25 States and the District of Columbia, together with 41 cities in non-registration States.

Potash from Kelp.— That the Department of Agriculture has not lost interest in the project of utilizing the great Pacific coast kelp-beds as a source of potash on a commercial scale is shown by the fact that, out of a special appropriation of $175,000 just secured for investigating American sources of potash, an experimental and demonstration plant for the extraction of potash salts from kelp will shortly be erected. The site is not yet announced, but it will be on the Pacific coast, where kelp may be harvested two or three times a year.

Misbranding and Adulteration.—The U. S. Bureau of Chemistry has published a statement of the facts in 100 actions under the Food and Drugs Act, more than half of which were based on false and fraudulent claims as to the curative powers of medicinal preparations, while the rest relate to the adulteration or misbranding of foods, beverages, stock feeds and mineral waters. The names and addresses of all the concerns and individuals found guilty is published, together with a statement of the penalty imposed in each case. Presumably the publicity attached to these cases is the real penalty, as the fines seem ridiculously small; the heaviest was $300, and most of them very much less.

Research in the Production of Dyes from materials produced in the United States will be undertaken by the U. S. Bureau of Chemistry with the aid of a special appropriation of $50,000, included in the last agricultural appropriation act. In this connection the bureau calls attention to the fact that while 80 per cent of the dyes used in our textile, leather, printing and other industries have heretofore been imported, all the raw materials needed for making such dyes are found in this country in abundance. Laboratory experiments will be made to determine whether coloring substances can be obtained from agricultural and other products not hitherto used for this purpose.

The Meteorology of the Globe in 1911.—The British Meteorological Office has recently completed the laborious task of compiling a collection of monthly and annual summaries of barometric pressure, temperature and rainfall at representative stations throughout the world for the year 1911, thus realizing the recommendations of the International Meteorological Committee that statistics of the weather of the globe should be prepared in a single publication and in uniform style as to the units employed, etc. Such a system of stations constitutes a "réseau mondial," and is of interest not only to meteorologists, but also to students of the interrelations between sun and earth. It is, therefore, to be hoped that the data for subsequent years will be compiled on the same plan. The publication is based on about 1,500,000 observations, and comprises about 50,000 values. So far as practicable two stations were chosen from each 10-degree square of latitude and longitude. The issue of the publication has unfortunately been delayed by a fire which destroyed the sheets originally printed.

Coal Gas for Motors.—Attempts are being made to employ illuminating gas for internal combustion engines, the gas being compressed in tubes at a high pressure and stowed on board a motor car or boat. It remains to be seen whether this method will have a practical value, but at all events, the idea is an interesting one. Using drawn steel tubes, a pressure as high as 200 or 300 atmospheres can be employed, and under these conditions the dead weight is about 0.7 pound per cubic foot of gas stored up. But it should be remarked that there is produced a partial liquefaction of the gas especially as concerns the components of the illuminating gas which have a relatively high melting point, so that the calorific power of the gas is lessened by 8 to 10 per cent. Data thus far obtained show about two horse-power per cubic meter of gas (30 cubic feet), and in the case of a 40 horse-power motor car, enough gas could be carried to provide for four hours' run at average speeds. But the dead weight of the tubes is considerable, so that such a system would need to be worked closer to real practice in order to serve for motor cars, though it might find an application for rail traction. Again, a promising field appears to be for motor boats, and the method has already been applied in France on the river boat "L'Idée," which is fitted with a Delamarre vertical gas engine of 40 horse-power two-cylinder type. The gas is compressed to 100 atmospheres and the boat carries 40 steel bottles stowed between decks. Should the attempts, which were interrupted during the war, prove successful, it would be possible to use the method for a river boat service between Paris and the sea.

Industrial Efficiency

Detrimental Effect of Soot on Boiler Efficiency.— A scoop of slack coal will convert 120 pounds of water into steam in any well-kept boiler. If the flues and flue sheets are covered with one eighth inch of soot it will only evaporate 66 pounds of water.

Tungsten Deposits in California, which were discovered in 1913, but remained practically unknown until the spring of 1916, have recently yielded considerable quantities of the mineral under the stimulus of the increased demand. A representative of the United States Geological Survey, who has visited the plant established there, finds that the ore bodies have some remarkable characteristics.

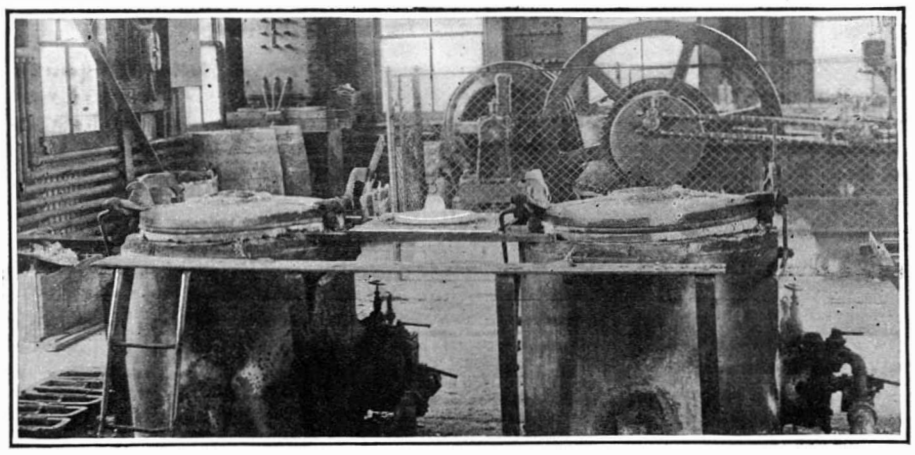
The Diamond Tool is the most efficient means of truing the face of grinding wheels for precision work so far discovered. The reasons, according to *Grits and Grinds*, are: (1) Diamonds or bortz are harder than the wheel to be trued. (2) They are obtainable in sufficient quantities to meet the demand. (3) They provide a means of making the wheel a true cylinder and at the same time provide any kind of wheel service desired. (4) They lend themselves to a reasonably easy setting and are conveniently applied to the work. (5) The waste of the wheel is negligible.

Milking Machines in Sweden.— Four different types of milking machines have been tested at the Agricultural and Dairy College at Akarp, Sweden, of which three were Swedish and one Danish. One of the Swedish manufacturers reports that he has supplied more than 100 machine-milking plants in Sweden by which between 4,000 and 5,000 cows are milked daily. It is claimed that one person can attend to six machines, milking from 30 to 35 cows per hour; as a rule it requires one machine for every 10 to 12 cows, or four machines for 40 to 50 cows. In certain cases the final stripping is done by hand. Electric energy, horse-power, or other motive power may be used.

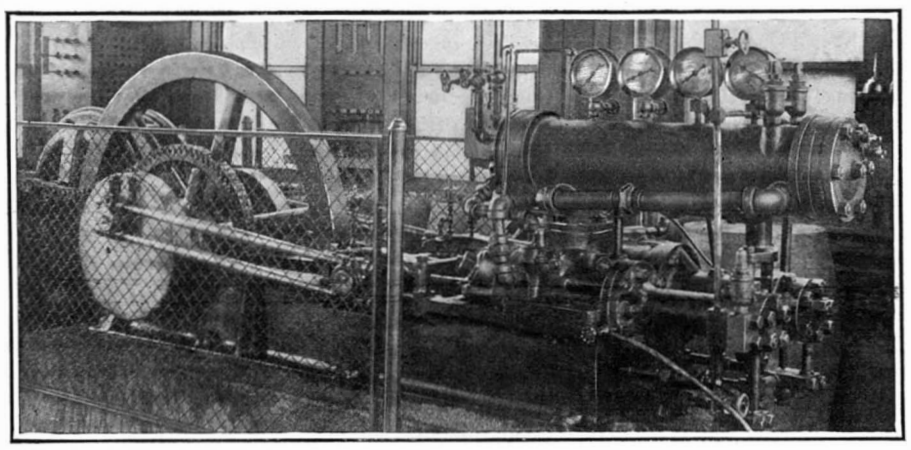
By-Products from Coke-Oven Operations.— The value of by-products recovered from American coke manufacturing in 1915 was nearly $30,000,000, a large increase over the previous high-water mark of $17,000,000 in 1914. Although there were material increases in the output and value of gas, tar, and ammonia, which was to be expected with a greater demand, the increase in benzol products presented the most interesting feature of the year in the coke industry. The value of these products rose from less than $1,000,000 in 1914 to more than $7,760,000 in 1915, according to the United States Geological Survey. Benzol has been recovered in this country from coke-oven gas for a number of years, but prior to 1915 the market was small and prices were low.

Rules for Women Workers.— Following is a list of special rules that have been adopted by the Iron Trades Employers' Insurance Association of Scotland for use in machine shops in which women are employed: No female worker shall be allowed to be in machine shops unless her hair is tightly done up, well secured, and confined by a tight-fitting cap of close net or of some other suitable and efficient material. Further, she must wear a close-fitting overall completely covering the dress—the said overall to fasten at side or back and to include sleeves buttoned or otherwise secured at their ends. Any machinist found trying a gage while her machine is running will be liable to instant dismissal. Belts must be changed by a male supervisor, or a man specially appointed for that purpose, and not by the ordinary operative. Machines must not be cleaned under any circumstances whatever while running. No guards shall be removed from any machine without authority from the supervisor, and such guards are to be replaced and the machine inspected and passed by the supervisor before a restart is made.

Increasing the Use of Wood Waste.—Extensive use by lumbermen and woodworking factories of the wood waste exchange conducted by the Forest Service is reported by officials who have just completed a short field study to determine the extent to which the opportunities offered are being taken advantage of. Only a small percentage of the total number of concerns listed were visited, but a comparatively large number were found to have benefitted by the exchange. Makers of wooden novelties, it is said, have been particularly successful in finding supplies of material near their plants. Other woodworking industries have been able to dispose of their waste at higher prices than they could otherwise have obtained. Many of the firms were located within short distances of each other, but until recently have had no way of getting together. The wood exchange was established by the Forest Service in 1914. It consists of two lists of manufacturers which are sent out quarterly to persons desiring them. One of these is of "Opportunities to Sell Waste" and contains the names of firms which use sawdust and small pieces of wood. The other is of "Opportunities to Buy Waste" and gives the names of concerns which have waste to dispose of.



Two of the oil furnaces used in the manufacture of graphalloy



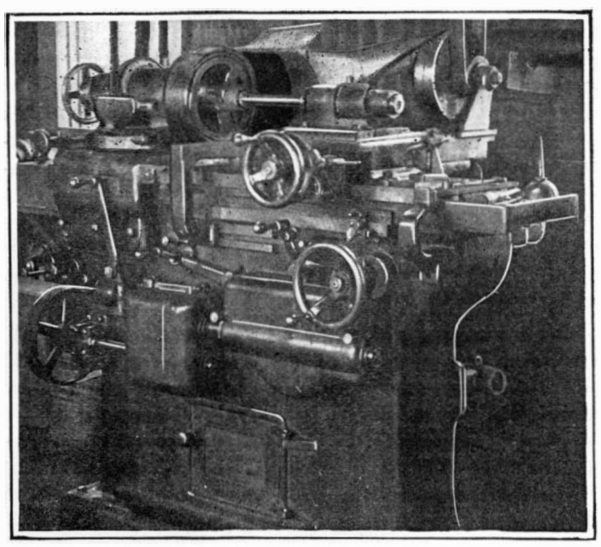
Compressor that supplies hydraulic pressure to the press used in impregnating metal with graphite

Combining Graphite with Alloy in the Manufacture of Self-Lubricating Metal

By Raymond Francis Yates

SCIENTIFIC men have long been seeking to produce a metal or alloy that will be of a soft, lubric nature and yet possess enough mechanical strength to withstand great pressures without rapid wear. Such a substance, if produced, would be of inestimable value in the realm of mechanics, when formed into bearings that would be independent of the common lubricating oil. Self-lubricating bearings made of such an alloy would find wide and profitable use, not only in machinery, which, outside of lubrication, needed only little attention, but in industries where lubricating oil forms an undesirable necessity. This is notably the case in the manufacture of textiles. Another factor which would offer firm support to the use of such bearings is the present high cost of lubricating oil, which forms a large item of expense in every manufacturing establishment.

It is a well-known fact that graphite possesses wonderful self-lubricating qualities, and that it would form a perfect anti-friction substance in the manufacture of bearings were it not for its being so fragile as to prevent it from bearing any appreciable mechanical stress. This disadvantage has been partially overcome by an American concern which has succeeded in increasing the mechanical strength of graphite by properly impregnating it with metal, thereby combining the self-lubricating properties of the graphite with the tenacity of the metal used. The resulting substance has made its appearance in the commercial market, and while its use is at present restricted to bearings of limited size, its production forms an interesting and practical achievement in the field of lubrication. It is certain that radical improvements will take place in the production of the new substance that will broaden its scope of application, and even in its present state of perfection there is the possibility that it marks the beginning of the evolution of a perfect anti-friction alloy.

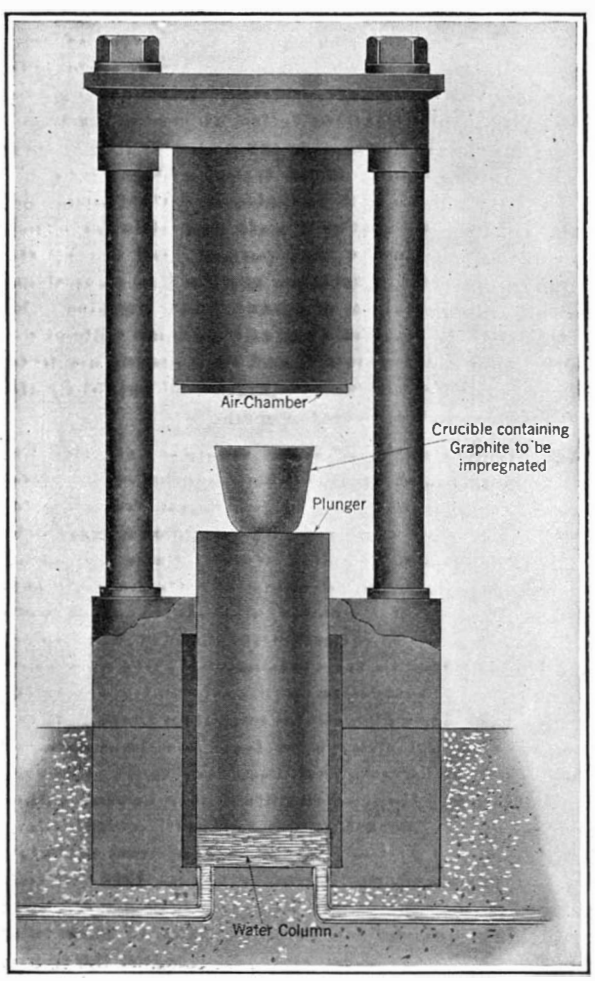


Grinder employed for finishing off bushings made from tubing

Graphalloy, as the substance is known for want of a better name, is not injured in any way by oil; in fact, its effects are entirely favorable. In some instances where the duty is rather severe, oil is used in connection with graphalloy, the latter affording a factor of safety in preventing seizing or sticking of the bearings should the oil supply fail. This is particularly true in loose pulley service, for which the new composition is largely used.

The graphite used for impregnation must be in the solid condition and absolutely free from foreign matter in the form of grit. It is generally in the form of plates or rods, of a porous character and of uniform texture. For very light duty service pure Acheson graphite is used, and the resultant product can be readily machined with steel tools in an ordinary hand screw machine. For heavier service, however, it has been found necessary to use a graphite containing a small percentage of carbon. The carbon content gives the necessary hardness and durability. The product obtained with the latter material is rather difficult to machine in quantity with steel tools, because of the fact that it tends to dull the tools rather rapidly. For this reason small bushings are manufactured from tubing by means of diamond-point tools, whereas bushings for shafts one inch in diameter and upwards are machined both internally and externally on an internal grinding machine.

The graphite to be impregnated is first placed in a crucible of the same substance, together with the molten metal with which the graphite is to be impregnated. The crucible is then placed in the cylinder of a large press and a partial vacuum created simultaneously with an application of heat that tends to expel the air from the pores of the solid graphite, previous to forcing the metal in. Upon the completion of this operation, air is admitted to the cylinder of the press containing the crucible, under a pressure equivalent to a million pounds. The plunger of the press, on which rests the crucible, is also forced up by hydraulic pressure and the molten metal entirely impregnates every available interstice and pore of the graphite.



Arrangement of the apparatus in the manufacture of graphalloy

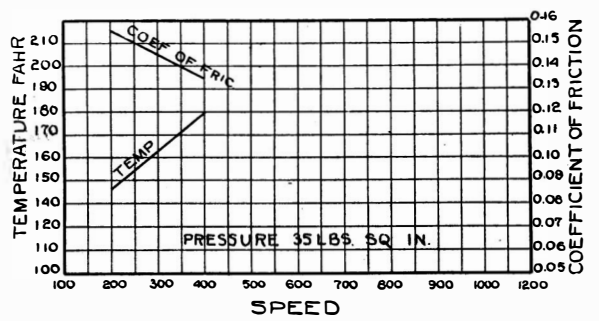


Fig. 1. Results of a test with bearings, using 35 pounds pressure

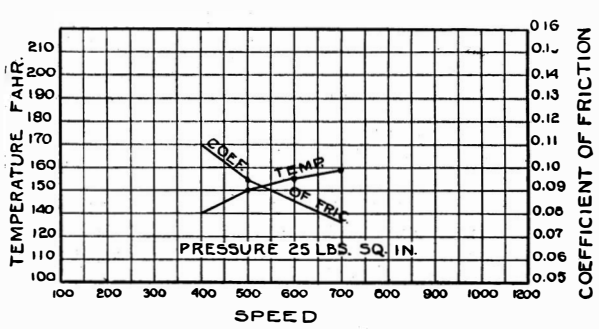
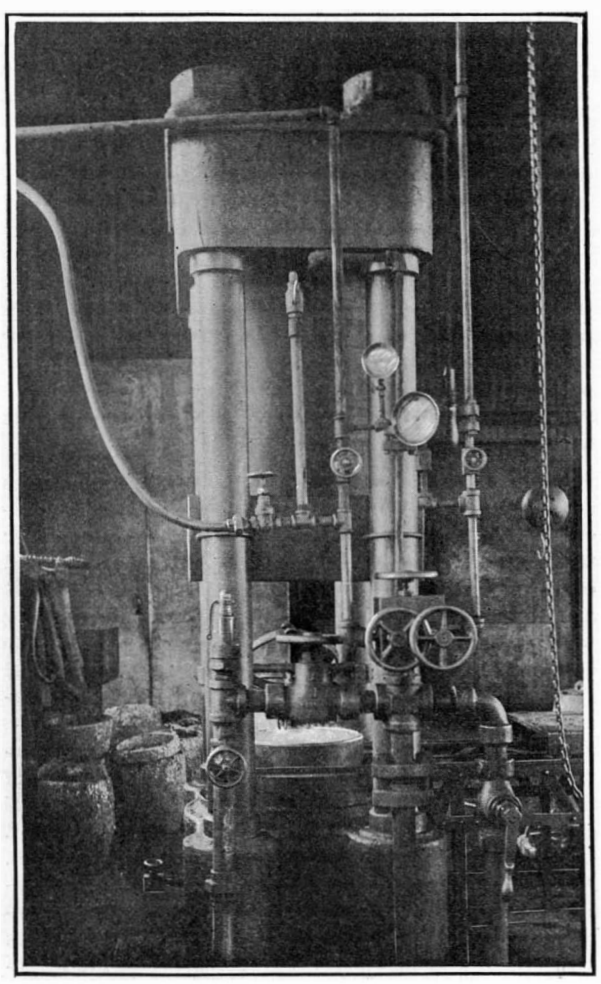


Fig. 2. Results of a test with bearings, using 25 pounds pressure



Hydraulic press employed in impregnating molten metal with graphite

After impregnation the graphite is found to have absorbed metal enough to increase its original weight approximately 150 per cent, which is equivalent to nearly 60 per cent of metal, or, by volume, 25 per cent.

For most bearing purposes, graphite impregnated with babbitt, or babbitt-graphalloy, is used. This composition is machined into bushings which are independent of oil lubrication in light duty service. When used absolutely without oil the following formula indicates the limits of service for which these bushings can be used:

Surface speed of shaft in feet per second, multiplied by the pounds per square inch of pressure on the projected area of the bearing, should not exceed a constant of about 200.

Under these conditions the bearings will be operated at reasonable temperatures and are said to be extremely durable. In cases where the oil supply is intermittent or neglected, graphalloy will far outlast an ordinary metal bushing. The most favorable usage of any self-lubricated bushing is in cases where the bushing itself revolves, as in loose pulleys, for which the graphalloy bushings are largely used. Among other usages might be mentioned vertical shaft bearings, light duty conveyor bearings, bearings for fans, small motors, idler pulleys and all sorts of bearings in special machines where it is desirable to eliminate oil lubrication.

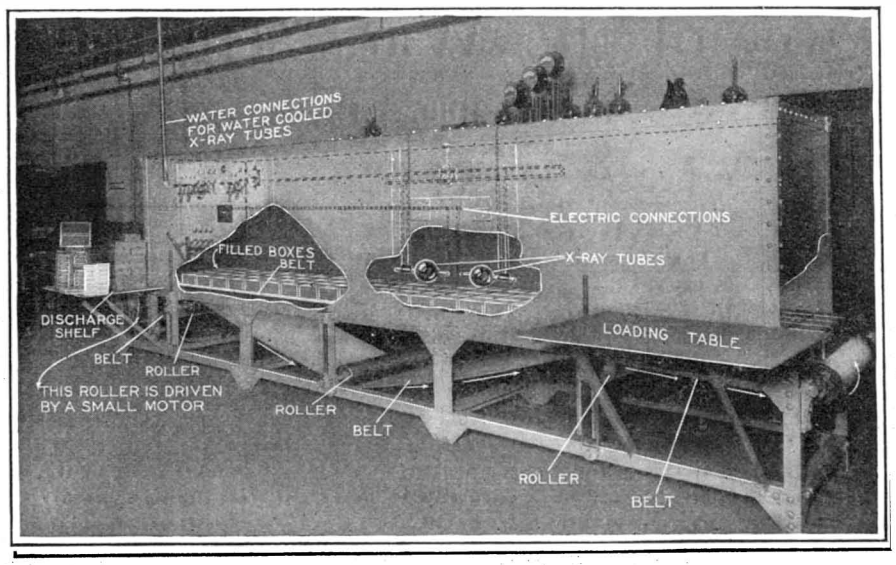
Graphite, when metallized with copper, has found broad use in the electrical field, as contacts and brushes for motors, generators and converters. It is evident that such a substance would make ideal brushes and contacts for electrical work, owing to the great heat-resisting and lubricating properties of the graphite, combined with the mechanical durability and electrical conductivity of the copper. The principal usages of the copper-graphalloy are in contacts for controllers; oil switches and circuit breakers; brushes for automobile starting generators and motor generators; and slip ring brushes for alternating current motors.

To obtain accurate data concerning the lubricating qualities of graphalloy, several careful tests were carried out at Columbia University with a friction testing machine of the Thurston design. The bearings used were small (1.315 inches in diameter and 1.52 inches in length), but accurately made and used without application of any lubricating oil. The results obtained gave values of a surprising nature as to the coefficient of friction and operating temperature. One test was made with a pressure of 35 pounds per square inch or a total pressure of 140 pounds, at a room temperature of 76 deg. Fahr., and a speed of 200 to 400 revolutions per minute. The results of this test are clearly shown in Fig. 1. In the second test the pressure was lowered to 25 pounds per square inch or 100 pounds total, and the speed was increased from 200 to 400 revolutions per minute to 400 to 700. The results of this test were considerably different from those in the first one, as is apparent in Fig. 2.

It will be noted that the operating temperature of these bearings is much higher than those utilizing lubricating oil. The cause of this can be attributed to the relatively low heat-conducting nature of graphite, and it becomes plainly evident that the temperature of these bearings, at a definite speed, would be in proportion to the amount of graphite content of the graphalloy.

It has been found in practice that a graphalloy bearing will immediately begin to deposit a thin film of graphite on the surface of the shaft revolving within. The formation of this film is accompanied by a very noticeable decrease in the coefficient of friction, and lowering of operating temperature.

It has also been found that in no case will an excess temperature cause a graphalloy bearing to seize the shaft. This holds true up to temperatures as high as 300 to 400 deg. Fahr.



Apparatus for X-ray sterilization of cigars

Scientific Annihilation of the Tobacco Beetle

By Robert G. Skerrett

DOWN in the Southland where the "fragrant weed" grows there also flourishes a wee creature known variously to manufacturers as the "tobacco bug" and the "cigarette beetle," and to the scientist as *Lassioderma serracornia*. Name it as one will, the bug has occasioned losses to tobacco men conservatively estimated at hundreds of thousands of dollars. No wonder, then, that cigarmakers have sought far and wide for means of surely exterminating this expensive pest. Just what the problem involves can best be understood by having some general knowledge of the habits of the beetle.

The tobacco bug or worm evolves from a tiny egg which is so small that it passes unnoticed when the cigarmaker handles his raw material. Unwittingly the operative works these eggs into his finished product. Later, and this incubation period depends upon the state of the weather, a white worm issues from the egg, and then, in seeking to reach the air, eats its way right through the tobacco. This performance, of course, ruins the marketable character of the product. From the white worm is developed a small brown bug, which wings its flight usually at night. This bug, in turn, lays eggs, and thus the life history of these pests is repeated. The cigarmaker's effort is therefore aimed at killing or neutralizing the eggs. A large variety of sterilizers have been tried in the past, but only within the last few years has an effective agent been found in the form of an X-ray apparatus.

One of the foremost cigar manufacturers in Tampa, Florida, began using such a machine about five years ago. The apparatus for the plant was designed and built in Philadelphia by a well-known electrical engineering concern. Some inequalities of performance were noted, due to initial inability to control the X-ray "dosage" and to the more or less advanced stage of the larvae. The more marked the vitality of the developing insect the more powerful the dosage needed to kill or to start dissolution. The enterprising firm in question has lately installed new tubes of the water-cooled Coolidge type, and it seems that these are not only susceptible of very nice control, but they have a sterilizing power which suffices either to kill the egg or to limit the life of the already developed worm to the very brief period of at most three days. In that time the worm can do but little harm, and as it is virtually moribund its appetite is a steadily dwindling one.

Heretofore, the cigarmakers have not worked the year through. They have not stocked up, but have busied themselves only when orders reached them just before the Christmas holidays. This has been the case because they feared to make up stock, only to have it injured in storage by the development and ravages of the tobacco bug. This has involved an operative handicap. In the summertime, with the windows open and the air moist, it is easy to work the leaf effectively, while cigarmaking in the drier indoor air of wintertime entails a decided loss. Now, thanks to the coming of the X-ray sterilizer, it is practicable to make up stock in the more favorable season and to store it, without fear of loss, against the coming of rush-order months.

The machine installed at the plant in Tampa is capable of handling on an average 40,000 cigars an hour. These are all selected, packed, inspected, and boxed before being passed through the machine; and after being exposed to the X-ray are not touched until handled by the consumer. The boxes are carried through the machine on a wide conveyor upon which are stacked, narrow side down, single rows of four boxes across the belt. The belt is functioned by a small electric motor, and the travel through the machine takes a trifle less than 20 minutes. During that time the steady stream of boxes moves 23 feet. The apparatus contains two X-ray tubes operating at a pressure of 45,000 volts, and current at 100 milliamperes is passed through them. The cigars are exposed to the direct rays of the tubes for a period of about four and one half minutes, but are subjected to the reflected rays for the better part

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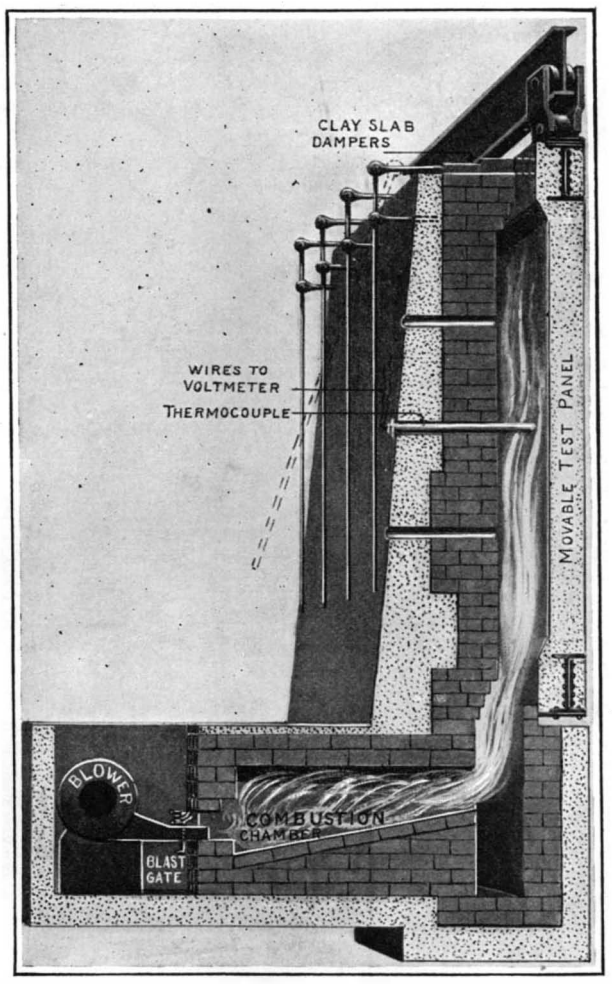

Cross section showing panel undergoing test

How Fire Conditions Are Reproduced in the Laboratory

THE Bureau of Standards has received a special appropriation from Congress for a study of the resistance of structures to fire, with the purpose of giving to builders and others reliable information regarding the relative fire-resistive properties of various forms of construction, and thereby aiding to diminish the enormous, and largely avoidable, fire losses in this country.

One of the important phases of this work is the investigation of the resistance of walls and partitions to penetration by fire; for the effectiveness of this resistance often determines whether a fire will be confined to one room of a building long enough to permit firemen to reach the scene and put it under control, or whether it will spread rapidly through the building and perhaps to adjoining structures.

The Bureau has just completed the erection of the largest panel-testing plant that has ever been constructed, in which walls and partitions of various constructions are to be exposed on one side to the heat of a large furnace, and then to the action of a powerful stream of water from a fire hose. The latter test is important because a partition that has been exposed to fire for a time without being penetrated, may nevertheless have become so weakened that a powerful stream of water will

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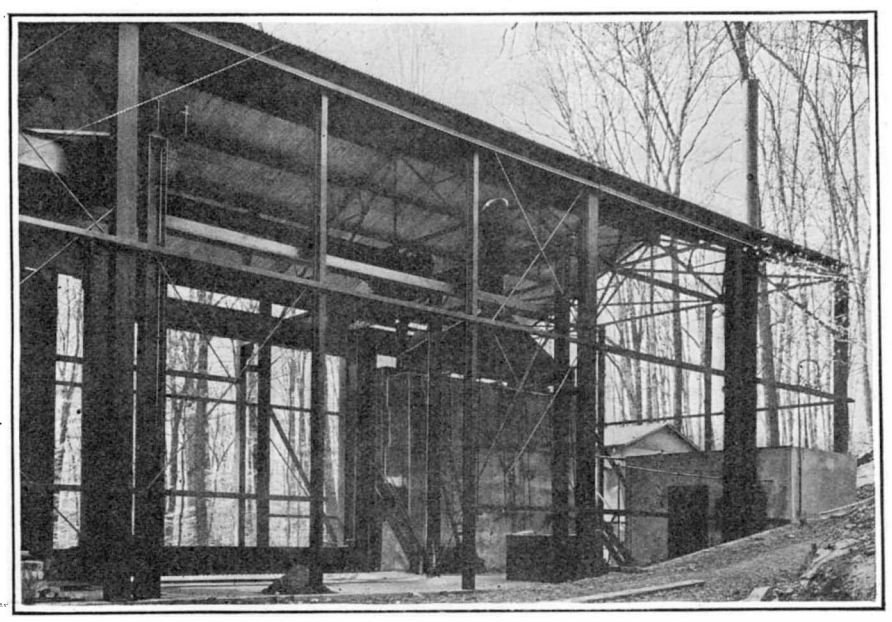


The housing of the panel testing furnace

Strategic Moves of the War, September 29th, 1916

By Our Military Expert

LATEST reports which, though unconfirmed at the moment these lines are written, savor so strongly of truth as to carry conviction, indicate that at last Greece, in the effort to save herself, has declared actively in favor of the Entente, and that the Grecian forces, numbering about 300,000, are to be mobilized and added to General Sarrail's strength in the Balkans.

There is every reason to believe the truth of the report. Grecian affairs, administered by a pro-Teutonic monarch against the wishes of the majority of his subjects, have long been in something of a mess. In the first place, Greece declined to come to the aid of her ally, Serbia, at the outbreak of war; uncertainty as to future developments and the Throne's interest in behalf of Germany conspired to hold Greece back. Later, when Serbia was overrun by Bulgaria and Austria and Germany, the example of punitive thoroughness which characterized the conquest instilled cold fear of similar fate into the national heart, although the individual pulses of the people seemed to throb in full sympathy for the unfortunate land.

With the massing of allied forces at Saloniki and the success of the Russian operations in Volhynia, Galicia and Bukovina, however, came crystallization of popular sentiment; and this, coupled with decisive action on the part of Entente diplomacy and force seems to have brought about a situation which leaves Greece but two choices:

Declare actively for the Entente, and enter the field of war. Maintain thereby some semblance of the present administration, or:

Fight the battle of neutrality out; in which case, we will take over your country, use it as we please, then return it at the end of the war to such a ruler as we may select—and with no share in the fruits of the war.

Apparently, Greece has chosen the first proposal. She will enter the war, send in her troops, sink or survive according to the outcome. But bad feeling already exists, for shattered Serbia naturally feels that had Greece sprung to her aid, as the diplomatic instrument required, Serbia would have been saved and Bulgaria would never have entered the war where and when she did. Greece and Serbia will fight side by side now; but afterward there is sure to be bitterness, perhaps embroilment, between the two.

The entrance of Greece into the struggle places at Sarrail's disposal practically a million men, a number vastly superior to what the Teutonic Powers can muster on the front. This force should be sufficient not only to extend the allied left across the Albanian gap to the Italian forces at Avalona, but sufficient as well to crush in the Teutonic defenses on the Macedonian border and across the Struma.

The Teutonic invasion of the Dobrudja seems at a standstill, carrying out the belief of the writer that it was a mere concession of territory by Roumania as far as her Danube line of defense and the line of railway, the Black Sea communication point with Russia. It takes considerable time to shift large forces from Russia through Roumania, but indications point to the development of a speedy offensive against Bulgaria, both from the north and from the south.

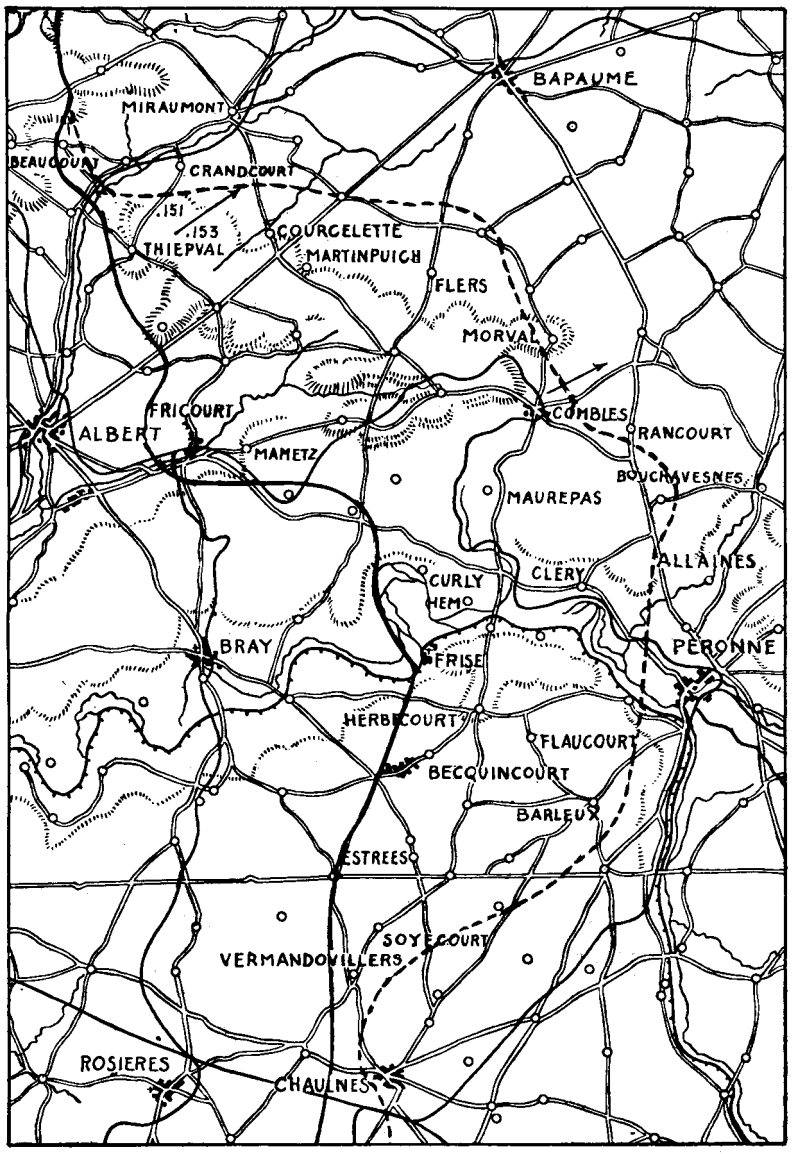
In the meantime, there has been no let-up in operations on the western front. Relentlessly the British and French have hammered away at the Somme defenses. Regardless of visible gain on this front and at this point, the principle gain which so far accrues to the Entente is to be found in Germany's resultant inability to detach any of her forces to reinforce the Balkan line. Forces undoubtedly she has sent; but it is dollars to doughnuts they came from the general reserve, as much a weakening desired by the Entente as moderate gains in battle.

After holding out since the beginning of the offensive —and incidentally holding up the lateral spread of Entente effort in the west—Thiepval, situated a little to the south of the Ancre brook and marking the left of the Allied dent in the German defenses, at last has fallen and the British have pushed beyond in the direction of Bapaume, gaining the Stuff redoubt and the main ridge northeast of the village.

The fall of these strong points opens up a promising line of advance for the British. The Ancre brook trends generally toward the northeast. The British gains northeast of Thiepval threaten the German forces to the immediate northward of the brook and if Haig can carry the line and clear the front to the Ancre, the salient, formed by its course and the position of the British line north of the brook, will soon become untenable and must be vacated ere long.

Farther to the south, by operations identically the same as the gnawing ones which gained Thiepval, British and French have surrounded and dominated Combles, forced its evacuation and now hold the town. Morval and Fregicourt, villages between Combles and Bapaume, fell on Monday of this week, their possession by the Entente actually forcing relinquishment of Combles by the Germans. And these points are in rear of the third permanent line of German defense.

Slightly to the northeast of Combles and its outlying villages now in Entente hands, the broken ground which has witnessed the recent desperate fighting, gives place to a far easier country over which to operate. If the British forces and the French can push into the open in ample strength to hold what they have won, the hill positions to the northward, in the direction of Bapaume, will be turned and it then will be possible



The Allied drive in Picardy

to operate freely and force the Germans out of their lines. As it is now, the main road from Peronne to Bapaume is useless, for it is well under the domination of the Entente's guns.

The winning of Combles serves to draw the net a bit tighter about Peronne, first by crowding the Germans north of the river into a salient which may be broken or rendered untenable by deeper thrusts eastward. When this ground is gained, the entire line will have advanced, the lines will be consolidated and again the points of attack will worm a way eastward, here and there; but with this difference—the Entente position will be entirely in rear of the old, so-called permanent positions of defense and in their attacks will have to storm with shell and bayonet only such hasty defenses as the intervening time has permitted to be built. The German line of battle has not yet been broken, but the line of defense has. Whether the break or the weakening is yet considered enough for the grand attack which must come sooner or later is known only to the High Command, but many military observers are of the opinion that when the gains are once consolidated there will be a tremendous and concerted attempt to force an open rupture and hurl every available man into the breach.

There is little doubt that enormous consequences should follow such a major break in the line. There is little use in dealing in small figures. Suppose 500,000 men are actively engaged in the assault; suppose the break occurs. Not only will every man on the spot be speeded through the gap, but the local reserves will race after, while reserves from other localities as well as general reserves will be hurried up to back up the thrust. Once such a body—or half such a number—is through, in rear of the lateral lines, at least a portion will move north or south, perhaps in both directions. The three strong lines of permanent field fortifications will be of no value whatever and the phase of the war, for miles north and south, will pass from siege to battle in the open field while the legions of the Kaiser will gather from all directions, forced at last to give battle wherein maneuver and tactics and strategy will supersede siege operations.

When the collapse comes, as come it must sometime, on either side, else the war must continue throughout eternity, it will come so suddenly as to be startling. The days, weeks, months and years of reports of little gains will give place almost to a moment wherein armies shift position; and it is not beyond the bounds of reason to believe that almost all Northern France, now held by Germany, may be evacuated within a week after such a blow. But such a week! The most gruelling war, involving the crash of human masses breast to breast with all the fire and picture of warfare of a past generation and century. It will be a fiercer battle than that of the Marne, a bloodier one than the Aisne, for more men will be engaged and in the desperation of a crisis.

And this may come to-day, to-morrow, a week, a month or a year hence—when, no man can dare even guess.

Certain it is that such a conflict must come sometime if through nothing more than the blood-tribute of attrition and the consequent tenuousness of holding lines. Certain it is that the Entente is now almost on the verge of open field fighting; and certain it is that arithmetic, pure and simple, cannot be gainsaid.

Narcotic Snuff of the Haitian Aborigines

IN continuation of his interesting studies on the economic plants and plant products used by the aborigines of America, Mr. W. E. Safford has succeeded in identifying the plant from which the inhabitants of Haiti, at the time of the discovery, obtained the narcotic snuff known as *cohoba*, which they were in the habit of taking through a bifurcated tube, and which was used in various religious ceremonies. This has heretofore been confused with tobacco, though its effects were quite different; it induced a kind of hypnotic state, accompanied by visions. Its real source was the seeds of a Mimosa-like tree. *Piptadenia peregrina*, L. This tree still grows in Haiti, and is also widespread in South America. Its seeds are even now used by various tribes of Indians in South America as a source of snuff, the effects of which are highly intoxicating. Several of these tribes also use bifurcated snuffing-tubes. The plant in question has not yet been studied chemically or therapeutically, and the cause of its intoxicating properties still remains unknown.

Dried Serum for Snake-bites

IN an interesting recent paper on snake venoms and antivenomous serums, published in the *South African Journal of Science*, Mr. D. T. Mitchell states that antivenomous serum can be desiccated, and in this form, besides being much more portable—a noteworthy advantage under the field conditions wherein are found the greatest opportunities for application—it has the advantage of retaining its antitoxic properties indefinitely if kept hermetically sealed. Experiments carried out with desiccated serum prepared against puff-adder venom at Pietermaritzburg Laboratory have shown that it is not only equal in activity in fresh solution to the ordinary serum, but also, if used locally in the dried form after fresh incisions into the area bitten, its action is much more rapid in neutralizing the injected venom than is that of permanganate of potash. In the dried form the serum is reduced to about one eleventh of its original volume, which represents a saving in bulk of considerable consequence to the average user. When required for use the powder can be added to boiled and cooled water, in which it readily dissolves, and may then be injected in the same manner as the ordinary serum.

Binocular Vision

Some Remarks on the Mechanics and Psychology of Seeing

By Frederic Campbell, Sc. D.

WHILE many insects, like the fly, are provided with a number or even with a multitude of eyes, the higher orders all have two eyes. This is true not only of man, but of the entire class of mammals, as well as of the birds, fish and reptiles. While one-eyed vision would have been perfectly possible to any of these, the organ of sight is everywhere duplicated.

Binocular vision is seeing with two eyes; monocular vision is seeing with one eye. But the possession of two eyes does not necessarily mean binocular vision. One may close one eye and see well with the other; one may keep both eyes open and look at an object with only one of them. Genuine binocular vision is not merely the possession and use of two good eyes; it is the seeing of the same object at the same time with both eyes, so that the two resultant images blend into one.

In this sense of the term, it is manifest that few of the two-eyed animals have binocular vision; for their eyes are not so placed as to make this possible. Most of them have their eyes situated on the two opposite sides of their heads, so that they look in opposite directions. It is true that, by reason of the sweep of their vision, they can see not only to right and left, but more or less to the front and rear. But in order to get a keener view of what is before, an animal will often turn its head, directing one eye toward the object of contemplation. It must be that it centers its attention upon what the directed eye is seeing, and ignores what the other eye beholds. And doubtless the same thing is done even when the head is held naturally. Here are seen objects to left and right; the attention may be directed to either the one or the other. Now all this is monocular vision, in spite of the fact that two eyes are open and seeing; it is only one eye that is engaging the attention.

A very few of the lower animals, like some of the monkeys, seem to possess the true binocular vision; that is, they center both eyes on the same object at the same time, and blend the two images into one. The dog is not one of these, in spite of the forward position of its eyes; it is but a single eye that the dog centers upon the object of interest. Man, on the other hand, possessing a well developed faculty of using both eyes upon the same object with successful results, probably leads the entire procession in the matter of binocular vision.

Some believe that, in the evolution of life, binocular vision is a recently acquired faculty on the part of man, and they point to its imperfections as indicative of its recent origin; it has not yet had time to attain its full development. For there exist more imperfections in binocular seeing than most people suppose. Oculists are finding that a considerable percentage of mankind do not habitually use binocular vision. While they have two eyes, they see consciously with but one. Only one eye at a time is concentrated upon the object to be observed; the other looks as it may. Like the off eye of the lower animal, its impressions are ignored by the mind. This is true not only of people whose eyes are divergent, or walled; in many cases where the eyes are normally forward, one of the two organs shirks duty, either constantly or by alternation with the other.

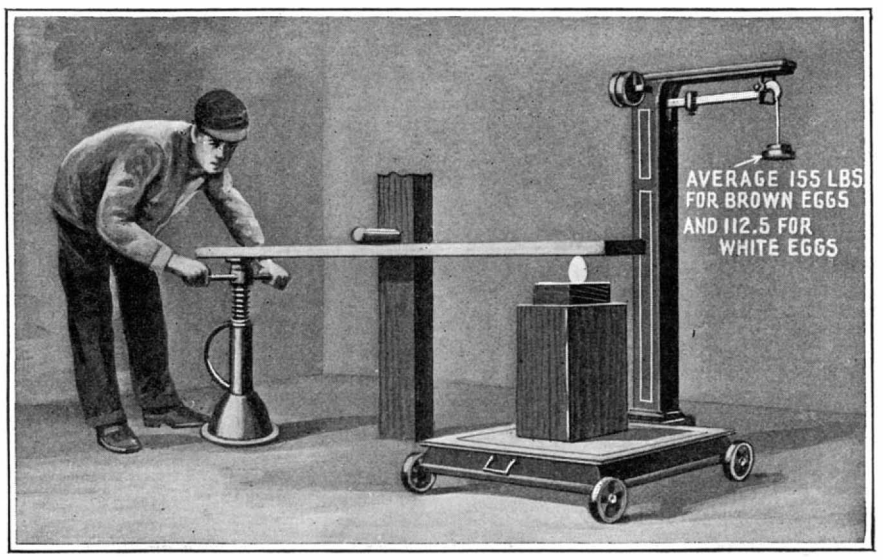
This widespread use of one eye instead of two may be due largely to certain difficulties in the way of securing with two eyes two pictures so identical that they may be easily blended into one. The evolutionists would have us understand that man has not yet fully learned this lesson. And it is particularly difficult in cases where the two eyes are different from one another, and so have to perform somewhat differently in securing blendable images. Oculists tell us that it is a rare thing to find two eyes exactly alike in the same person; in almost every case there are differences great or small. Now, without instruction, merely following the uncertain impulses of our nature, it is a most delicate task to train these two marvelous organs to do exactly the same work. It is no wonder, therefore, that many a man, though it be without full consciousness, gives up the struggle for binocular vision, and contents himself with one-eyed seeing.

Such persons, whether they realize it or not, must lose a large part of the satisfaction of normal human sight. For the many who are successful in the simultaneous use of both eyes know by a moment's trial how loth they would be to part with an eye. Close one eye and glance out the window; you will be amazed to see how flat the field of vision seems. By reason of the little separation of about two inches from center to center, a beholder possesses a parallax, so highly valued in astronomy, whereby he exercises stereoscopic vision, and obtains a constant space-perception of the objects contemplated, giving a comprehension of both their distance and their shape. This is of immense advantage, especially as related to objects within a distance of twenty-five feet.

For some it is even a greater effort than they realize to make the two eyes work in absolute unison. Many of these know that something is wrong, though they know not what. The oculist finds the disparity in the eyes, corrects it with lenses, and thus relieves the strain, the results of which upon the nervous system may have been quite serious. He is likely thereby also to relieve those frequent headaches arising from eye conditions.

A recent study of this subject has brought out evidence that people of one-eyed, monocular, vision are not troubled with eye headache. Whether one eye be disabled or whether its use has simply been abandoned, either constantly or alternately, the fact that seeing is done wholly by one eye eliminates the struggle to make two unequal eyes work in perfect unison. Freed from the strain of that struggle, the subject finds that the reflex influence upon the cranial nerves is no longer a matter of pain.

While one may thus be relieved of headache by the practice of using one eye instead of two, it must, however, be remembered that the only normal vision for man is binocular, and that correct normal vision cannot be productive of pain. It is quite as practicable to relieve eye headache by inducing proper binocular vision as by falling back upon the use of a single eye, and the former is by far the preferable alternative. Hence binocular vision should be insisted upon. Neither eye should be allowed to shirk, and necessary optical aids should be accepted at the hands of a skilled oculist who can determine exact conditions and prescribe the proper remedy.



Testing the longitudinal strength of an egg

Production and Exports of Japanese Tungsten

ACCORDING to the *Official Gazette*, tungsten and molybdenite, those invaluable adjuncts of twentieth century technology, and the supply of which has been so profoundly affected by the war, have been added to the list of goods whose exportation from Japan is prohibited without special permit from the Minister of Agriculture and Commerce.

An American exporter of tungsten ore is of the opinion that this ordinance will only affect irregular shippers, who are unwilling or unable to satisfy the authorities that the shipments are not intended for German or Austrian accounts. The ordinance is not expected to affect the price materially. The price of tungsten is now, f.o.b. Yokohama, about 40 yen per unit, the ore generally averaging 65 per cent; the cost per ton, 65 per cent ore, is thus 2,600 yen, or, at the present rate of exchange, a little more than $1,300.

The tungsten mines of Japan proper are the Kiwada mine in Yamaguchi Ken, with a production of 25 to 40 tons of ore per month; the Taketori mine in Ibaraki Ken, which produces 10 to 11 tons a month; and several small mines, with a combined production of about 75 tons per month. The mines of Chosen (Korea) produce between 50 to 60 tons each month. Japan also imports small quantities of tungsten ore from Manchuria through Chosen. Attempts were made to obtain tungsten from Siam, but it was found that the ore thus imported contained a large percentage of tin, which greatly reduced the value.

The exports of tungsten ore from Japan in 1915 were as follows: United States, 85 tons; France, 214; United Kingdom, 110; total, 409 tons. The estimated shipments for this year, up to July 20th, were 480 tons, most of this amount being sent to the United States.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Strength of Eggshells

To the Editor of the SCIENTIFIC AMERICAN:

Few people are aware of the wonderful provision made by nature to protect against breakage the egg of a bird by the use of the arch.

The fact that no man, no matter how strong he may be, is able to break a sound hen's egg, by squeezing it between his hands, applying the pressure according to the axis of the egg, made me to try to find out the resistance that an egg can withstand in this way.

I conducted some experiments and let you know the results, thinking you may find them of some interest.

Brown eggs proved stronger than white ones and broke under a pressure averaging 155 pounds, the minimum being 125 pounds and the maximum 175.

White eggs broke under an average pressure of 112.5 pounds.

The method employed was as shown in sketch: The egg setting point upward, was placed on a platform scale and pressure was applied to it by a lever and a jack; felt seats conveniently disposed prevented the eggs coming in contact with the wood.

The shells were measured for thickness and found to be .013 inch to .014 inch. When it is considered that the average diameter of the eggs was 1¾ inches some idea may be formed of the enormous strength provided by nature.

Westerly, R. I. G. HERRASTI.

Battle-cruiser vs. Battleship

To the Editor of the SCIENTIFIC AMERICAN:

I am something of a half naval expert myself and I want to say that I am not at all satisfied with the proposed naval program. The new battleships should carry ten guns of 16-inch caliber and not eight. We are about to spend a lot of money. Is it too much to ask that it be spent wisely? So I say get in and do something toward getting the people in Washington to put ten guns into those batteries, *i. e.*, on the battleships.

Now, as to the types of ships. I will come right out about it. I believe the battle-cruiser is a mongrel. I would not put a cent in one of them. Some time ago I read a book by a foolish author who claimed that the battle-cruiser would displace the battleship. I could have refuted him long before the battle of Jutland. It is true that the battle-cruiser can outpace the ship of the line, but that is all that we can say. It cannot stand the pounding.

A battle-cruiser is a luxury for a Power who wants to spend a lot of money on its navy. But our money is limited. We have no business with luxuries. I claim that all the money that is about to be sunk into battle-cruisers is lost money. It ought to go into ships of the line, not into a mongrel type intended to be a ship of the line as well as something else.

There are only two real types, the fast scout and the floating fortress. The battle-cruiser tries to combine both qualities and as a result is neither. Why put millions into a lightly armored heavy ship? It is the very height of folly.

But our radical thinker wants fast going with heavy guns. That is, he wants to get there first. But it is clear that this is the courage of the jackass. It is well to be swift and bold, but not too swift nor too bold.

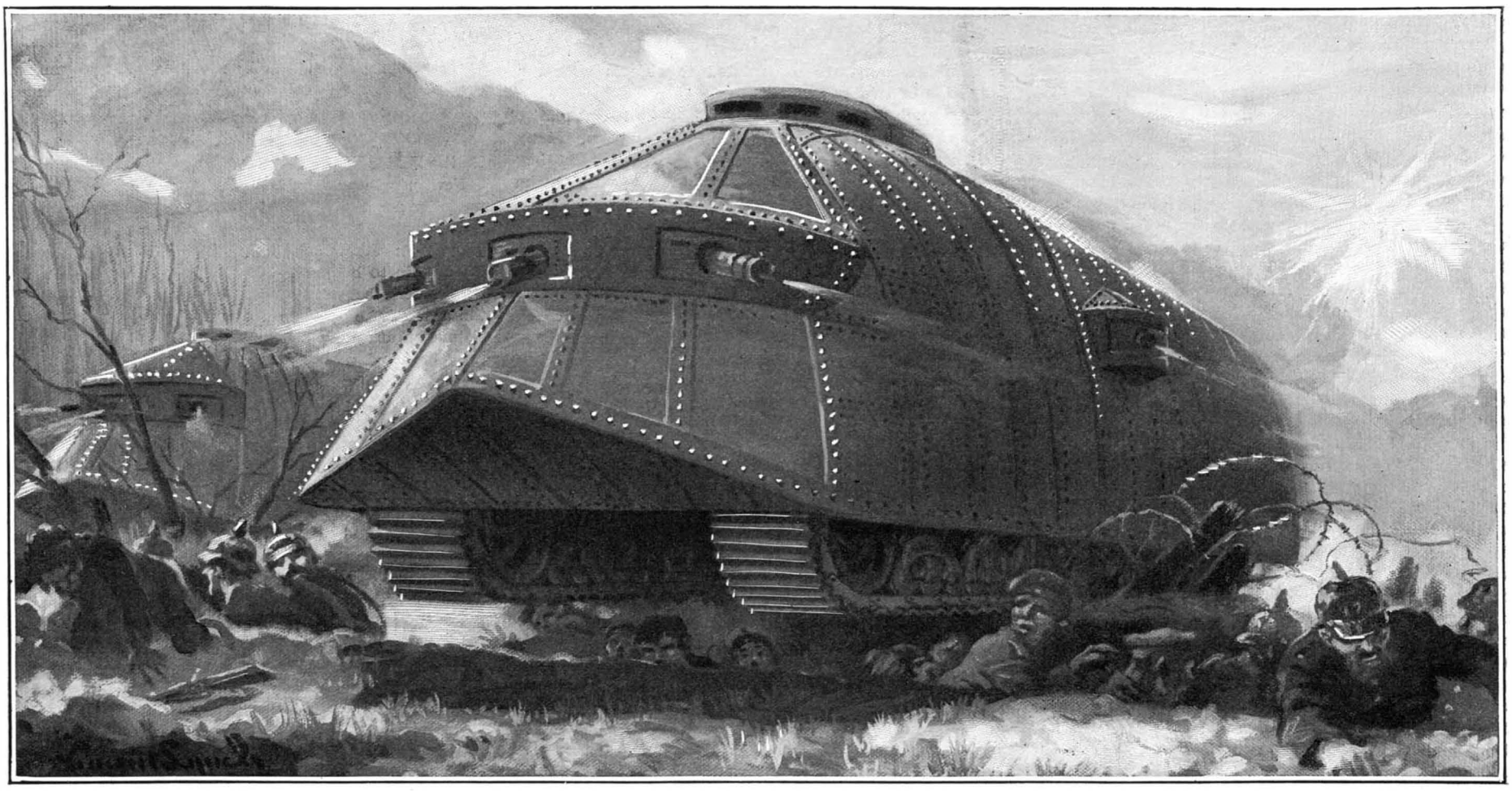
In short, we have no business whatever to be building battle-cruisers. That money should go into the only true type, the ship of the line.

Twenty-two sea miles an hour is plenty enough speed. Ten 16-inch guns are at this time of naval development a proper battery. And what is left of this 32,000-ton unit should go into armor, and lots of it should be used without question. Pile on that armor 14 or 15 inches thick. Don't think that a ship with all engine power and 6 or 7 inches of armor is going to get the command of the sea away from the true type. If necessary, to secure great armor protection, increase the displacement up to 34,000 or 35,000. Battle-cruisers are all right for England with lots of money to spend on her navy; but not for this country with only limited money.

Of course we want fast scouts. But give us a true type again. What we want is a vessel of some 7,000 tons, speed some 35 sea miles an hour, and carrying half a dozen 10-inch quick-firing guns in her battery. Such a vessel could knock the socks off anything now afloat not in the first line.

In conclusion I repeat, cut out the mongrel type that is ambitious to be everything and in consequence is nothing.

W. F. JOHNSTON.



Our artist's conception of the armored "Armadillos" in action on the Somme. Based on reports of eyewitnesses at the front

Armored Tractors in the European War

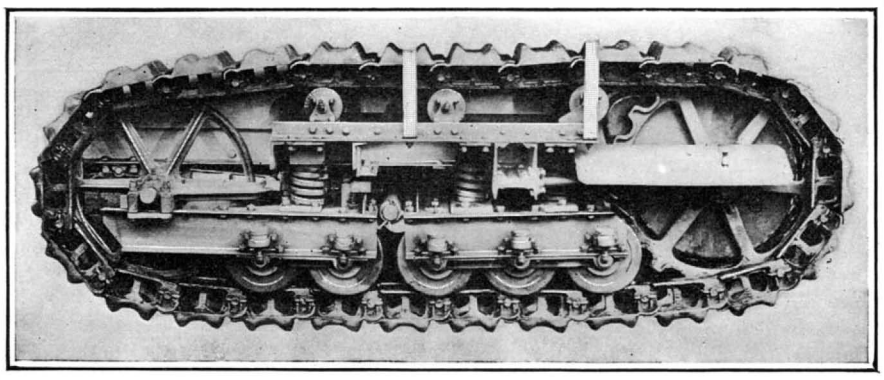
A New Weapon Which May Break up the Deadlock of Trench Warfare

THE most novel, if not the most spectacular feature of the recent successful offensive by the French and British armies on the Somme, was the presence of several armed and armored tractors of the caterpillar type, which, if we may judge from the press reports, proved wonderfully effective in following up the heavy gun attack, riding down or cleaning out machine-gun emplacements, enfilading trenches and otherwise preparing the way for the rush of infantry attack.

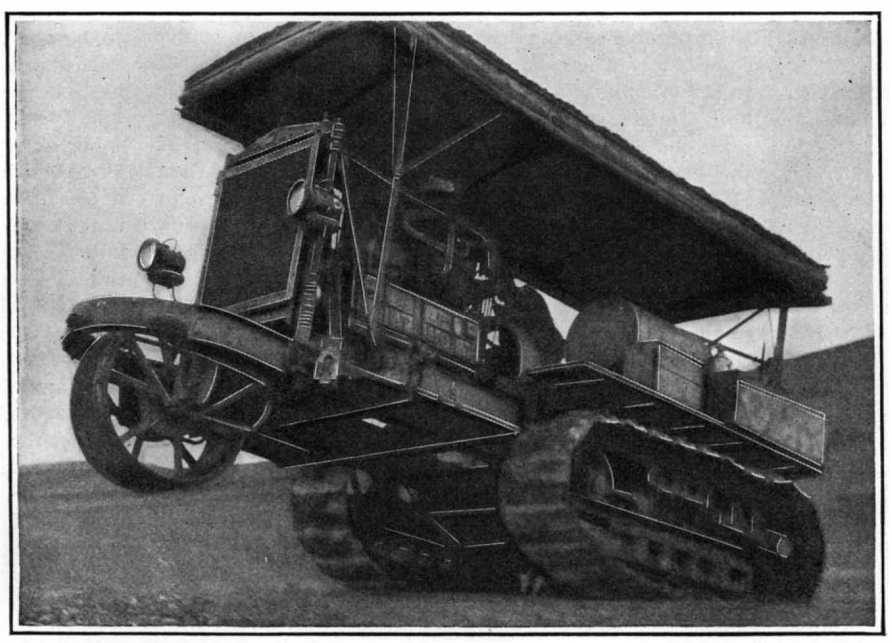
At the first reading, when the war correspondents described these uncouth monsters (modern counterparts in steel and iron of the mammoth creatures of the antediluvian period) the credulity of the reader received a rather stiff jolt; but when his facile pen went on to speak of these creatures as crawling slowly but irresistibly over the belt of "no man's land" between the Allied and German trenches; straddling the German trenches and enfilading the troops within them with machine-gun fire; riding over and breaking down machine-gun emplacements; crushing their way irresistibly through the woods of the French terrain; waddling down a length of barbed-wire entanglements and flattening it into the mud or earth—the monsters themselves meanwhile being absolutely proof against rifle and machine-gun fire, to say nothing of bombs and hand grenades—then it was that credulity was stretched to the breaking point, and many of us pronounced an emphatic "no."

Investigation of what tractors of the generic caterpillar type have accomplished in this and other lands, while they were working in the field of peaceful agriculture, engineering and industry, shows that the feats performed by these armored tractors in France had been anticipated in some measure by the smaller and lighter machines that have been developed in our American fields and factories. The idea of providing a pair of wide and long endless belts, cross-ribbed to secure a good grip upon the ground, which should provide at once an endless track of great load-bearing capacity, even on soft ground, and an adhesive effect which would enable the full tractive power of the engines to be realized, is American both in conception and practical application.

At the beginning of the war, and particularly during the two years of its progress, the warring nations provided themselves with a large number of these American-made machines. Thus, in 1914, Germany and Austria possessed about 80 of the best-known American make whose horse-power ranged from 60 to 75. Great Britain has purchased since the war began over 1,000 caterpillar tractors of the same horse-power. France possesses to-day about 100 of the 45-horse-power. We present several illustrations of this type of machine, from which it will be seen that they are carried upon a single leading wheel and upon two caterpillar endless belts, which extend over about one half of the length of the tractor. The endless belt is driven by means of two massive sprocket wheels and a countershaft provided with clutches which enable the two belts to be operated independently. Each machine can turn within its own length by throwing one belt out of gear and operating the other. The machine will turn upon one belt as a center. This is shown in the accompanying photograph of a tractor turning within its own length upon the snow.



A well-known form of caterpillar. Note the flexible joint between the trucks which transfer the load of the tractor to the inner rail of the belt



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An American caterpillar climbing out of a hollow

The feats performed by the armored tractors in France, which, probably, are of much greater power than any which have been built for commercial purposes, do not seem to be exaggerations, in view of what commercial machines of this type have done in this country. Thus, the work of clearing some 8,000 acres of woodland in the basin of the Ashokan Reservoir was performed by three 75-horse-power "caterpillars," which had no difficulty in pulling down trees of from 8 to 18 inches in diameter. When the trees were down, the lumbermen trimmed off the roots and branches and cut up the trunks ready for transport to the mill or elsewhere. In approaching the belt of standing timber, the tractors easily overrode this mass of tangled branches, left from the already fallen trees; and they would back up and attach themselves by cables to the still-standing timber.

Furthermore, the feat of pushing the trees bodily down and over-riding them, has frequently been accomplished by the caterpillars engaged in the reclamation of the Everglades. It has been found that the larger caterpillars, if driven against a tree 6 or 7 inches in diameter, will commence to ride up the trunk and bend it over, finally uprooting the tree as the pressure increases; or else, in the case of the more brittle trees, breaking them off short.

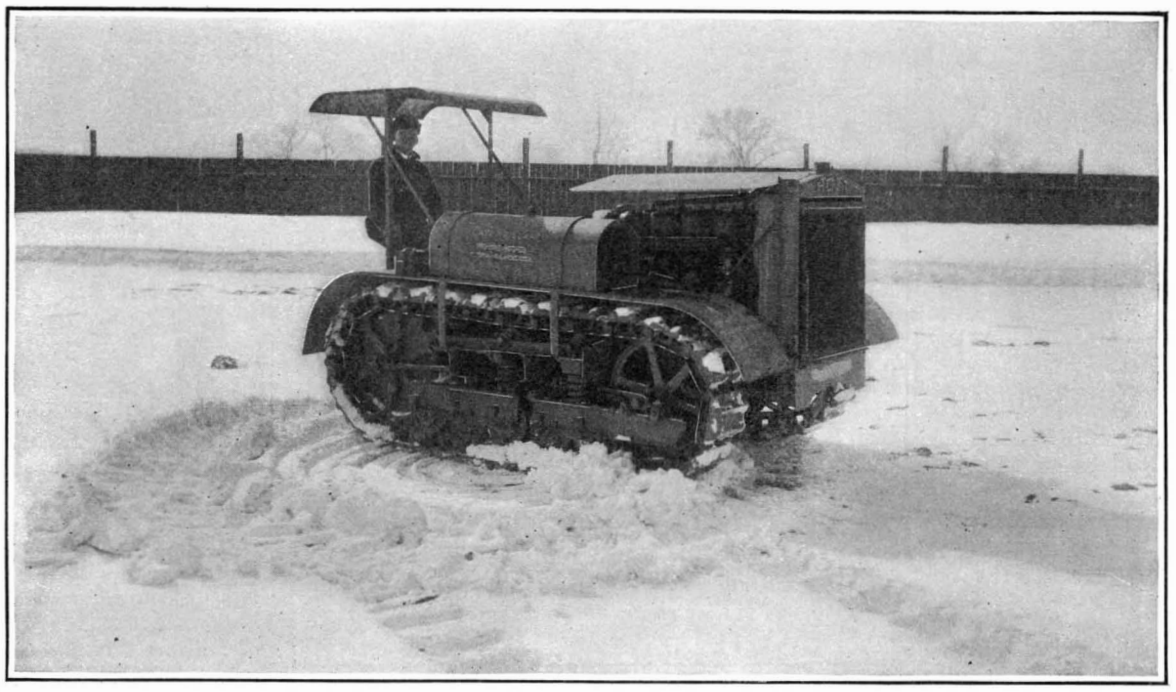
We present drawings of a design for a military tractor for use against the trenches, which was made in response to a request from Great Britain to a Western firm, for plans of a machine suited to the purpose. These plans were submitted to the Naval Munitions Board in

London, and although no order was received for machines, it is possible that the big fellows which have been doing such good work at the front are modeled somewhat upon the lines of the tractor here shown.

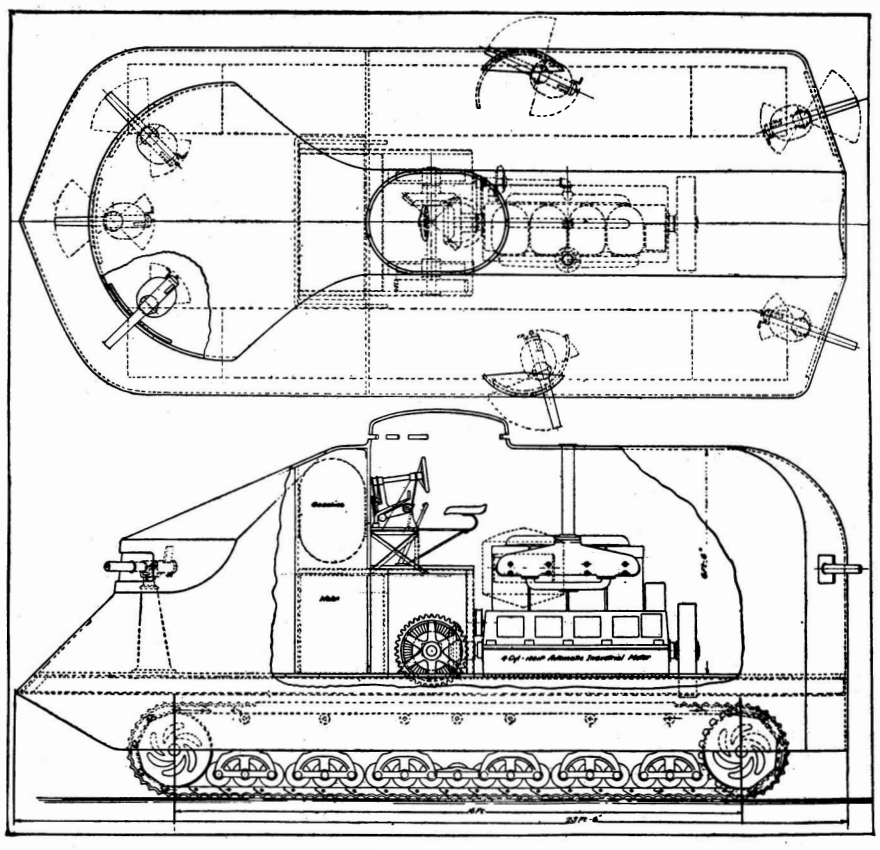
Now, as to the form, size, weight and power of the armored tractors used by the British in the present Somme offensive, it is to be noted that no definite information has been allowed to pass the censor regarding these features; so that what we have to say in this regard is a matter of mere speculation. The largest tractors sent from this country to Great Britain are of 75 horse-power, but tractors of the same type have been built up to a weight of 15 tons and 120 horse-power which are capable of moving under normal conditions at 4 miles per hour. They are provided with a caterpillar belt, which extends for a little over one half the length of the tractor; but the firm which built them has constructed tractors in which the belt extends for the full length of the machine. It is possible that the British tractors consist of a group of four, coupled together laterally in pairs, each pair being also connected by heavy couplings to the pair in front. This would provide a flexible tractor with an average horse-power of between four and five hundred and weighing altogether about 60 or 70 tons.

It is more than likely, however, that the British have developed a machine specially designed for the work, and, as a matter of fact, an American officer who has recently returned from England, tells us that he saw one of these machines under construction several months ago, and that, while he was not at liberty to give any dimensions, he could state that it was of great breadth and length, far exceeding anything of the kind yet built and that it was provided with several hundred horse-power. He stated that it carried sufficient armor to be proof against bombs and machine-gun fire. In all likelihood the caterpillar belts extend for the full length of the tractor, and they must, in the nature of things, be long enough to enable the machine to span the German trenches without tipping, and take a grip on the farther edge of the trench, which is what the correspondents state that they actually did in the recent attack.

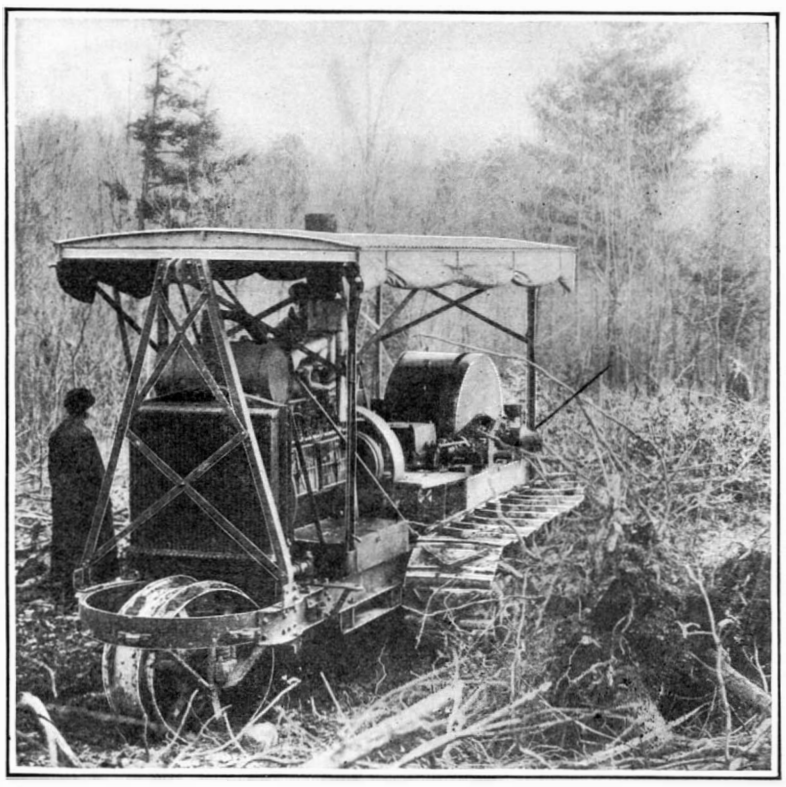
What part these machines are destined to play in the later stages of the war is a matter of pure speculation. The British speak of them as a great success; Berlin, naturally, describes them as being a complete failure — unwieldy, slow, and liable to break down. If they are successful, Germany is certain to come back with something of the same kind; and, if so, we may see squadrons of these mechanical armadillos maneuvering against each other in the open field —truly a sight for the gods.



A caterpillar turning in its own length upon the right-hand belt, which is temporarily uncoupled from the engine



Plan and section of an armored tractor design, submitted to the British Government some months ago



Crushing its way through felled trees and brush, to make fast for another pull

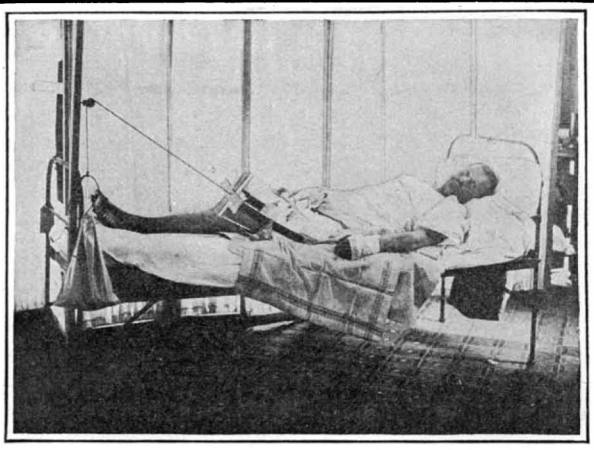
Caterpillar uprooting a tree 18 inches at the butt

The Current Supplement

MANY of the skilled industries of Europe have been greatly interfered with by the war, not only in the countries engaged in the conflict, but in neutral countries as well. One case of the kind is the diamond cutting industry of Amsterdam, which is now almost at a standstill. In the meantime the diamond business of New York has been increasing rapidly, and as a result of these conditions many expert diamond cutters have come to this country from Holland, and the article on *Diamond Cutting in America*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2127, for October 7th, tells of the new industry that has sprung up in New York. It is copiously illustrated by a large number of special photographs. *The Mechanism of Chemical Change in Living Organisms* considers interesting physiological problems, and how a slow reaction can be made faster. *The Sense of Proportion* treats of the application of the principle of similarity to the practical designing of machinery. *Ploughing Drainage Ditches* tells how immense ploughs have been utilized for reclaiming rich bog lands for agricultural purposes, and is accompanied by illustrations showing the apparatus and how it is operated. *Wood Flour* tells of the manufacture, characteristics and uses of a new and novel product. *The Nature of Explosives* describes the general principles on which their composition and action depend, and forms a supplementary chapter to the valuable work on explosives by Mr. A. Marshall. *The Preservation of Sandy Beaches* is a new study of an elusive problem in engineering of great importance in many localities. It is fully illustrated by diagrams. Other important articles are *Propelling Machinery for Ships*, and *The History of Condensed Milk, with a Note on Its Therapeutical Uses.*

New Work of the Weather Bureau

WITH the aid of an addition of $30,000 to its appropriation, the Weather Bureau is preparing to extend materially its field of observation and its storm-warning service in the Caribbean Sea and the Gulf region. A number of new stations will be established, and headquarters of this branch of the service will be located in the Canal Zone. The Bureau originally organized a West Indian service in 1898, during the Spanish-American War, especially for the purpose of safeguarding the American fleet from the hurricanes which are such a notable and dangerous feature of West Indian weather. After the war the service was maintained on a reduced scale. The opening of the Panama Canal, with the consequent increase of shipping in American tropical waters, makes a more efficient lookout for hurricanes imperative. The current appropriation also provides funds for improving the meteorological and climatological work in Alaska. Telegraphic reports from Alaska are found very useful in connection with forecasts for the United States.

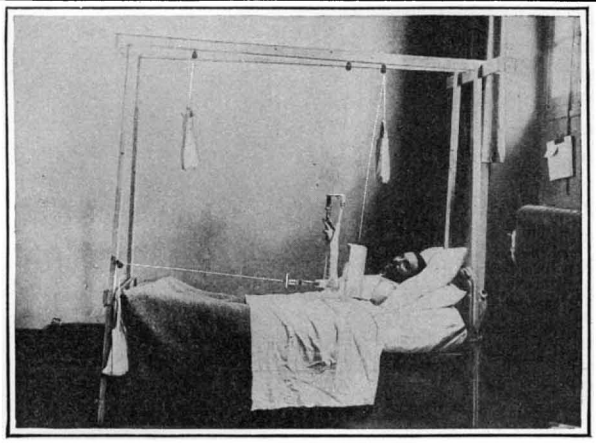


Keeping the stump of an amputated leg under tension

American Red Cross Ambulance Service in France

Personal Experiences of a Volunteer at Verdun

By Neal Truslow



Supporting a wounded arm during the knitting of fractured parts

THE AUTHOR of this article has recently returned from the western war front where he spent a year in the American Red Cross Ambulance Service. He brings back with him the Croix de Guerre conferred upon him for bravery in picking up the wounded under fire, before Verdun.

EDITOR.

"Medicin Chef Chattencourt á Medicin du B ———: Prier envoyer d'urgent autos pour 350 blesses, 200 couches graves."

SUCH was the telegram received at our headquarters from the captain of the first dressing station at Dead Man's Hill, the worst section in the Verdun district.

It was the night after a hard day. The boys were trying to steal a little sleep, but in ten minutes they were dressed and out to answer the call. The headlights of the 12 cars flickered among the ruins of the little town where we were quartered as we passed through. In every quarter troops could be seen. The civilians had long before been evacuated to positions of greater safety.

We all knew the danger before us and in the distance could see the reflection of the gun fire from that inferno, the Verdun front. Though some of us had been in before we were not without fear and dread of what lay before us. But there were wounded to come out and we must get them.

The purr of the motors seemed to give us courage as we drove along the once splendid highway leading to Verdun. We passed through B——— and at X——— turned sharp to the left up a long winding hill leading to the Valley of the Meuse, past two sentries who demanded a halt and the word.

The reflection of the fire ahead of us grew constantly more brilliant. The roads showed the effect of heavy hauling. Hundreds of big guns and 5-ton auto trucks passing day and night were tearing them to pieces. We had to weave our way through this slow mass of activity, often forced into deep mud-filled ditches to pass these heavier vehicles.

As we approached the summit of the hill the roar of the artillery was plainly heard above the noise of the motors. We were now in easy range of the German guns. All lights were put out. We extended the distance between the cars to 200 yards. This was done so that not more than one car could be struck by the same shell.

The Germans knew this was the best and shortest road leading to Mort-homme and Hill 304 and were shelling it constantly with shrapnel and high explosive shells in the hope of catching troops or ammunition trains.

In this purpose they were occasionally successful. Even the ambulances were not exempt from casualties. The night before one of our cars had been struck by the fragments of a high explosive shell, though fortunately no one was injured.

We were now in the Valley of the Meuse. The flashes of the German guns showed distinctly on the other side of the valley. The roads, so badly torn by shells constantly being dropped on them, would have been considered impassable in times of peace yet we went ahead slowly, feeling our way in the darkness, dropping back into second, then into first gear as the roads got worse, and making frequent stops to pass artillery trains and troops.

The convoy halted near a battery of 155 mm. guns. The concussion was terrific. The air was hot from the guns, and the force of the explosions so great that we feared the cars would be overturned.

We were now several miles from Chattencourt, our destination. Two cars went forward alone. The difficulty of bad roads and darkness increased as we entered the fire of the 75 mm. guns, whose flashes were so blinding that frequently we were obliged to stop. Finally we reached Chattencourt, halted and turned our cars around some two or three hundred yards from the dressing station and walked in to report to the "Medicin Chef" or head doctor.

The Germans were shelling a battery just back of the town. The screach of the shells was even more sickening than their explosion. During the preceding two days the Germans had been attacking the French line with increased violence, and had taken the edge of Hill 304. It is estimated that the Germans had, on this hill alone, used 150 train loads of ammunition, or something over 800,000 shells, with practically no result. The French were now making a counter attack.

On the exposed hill side occupied by the French at Verdun the trenches are so destroyed as to be uninhabitable. The troops are forced to take shelter wherever they can find it, and shell holes are their only refuge. Large shell holes contain two and sometimes three men who carry on the fight and make themselves as comfortable as possible in such cramped quarters.

Naturally the number of wounded in this district is enormous. Three and frequently five hundred a day make their way or are carried into Chattencourt, the first dressing station. Until nightfall the men must care for themselves, because assistance cannot be got to them except under cover of darkness. Each man carries a first dressing kit sewed to the lining of his coat.

The field doctor and stretcher bearers wait for the shelter of darkness to go to the aid of their wounded comrades. The first medical attention given is a hypodermic of anti-tetanus serum. Next there is a hurried binding of serious wounds. Minor injuries are not touched, but the men are sent at once to the dressing station a few hundred yards back of the lines.

The dressing station is more or less shell proof. It is usually in the cellar of a ruined church or house, logs and earth having been placed on the floor above to give protection. When a better place cannot be found a barn or stable barricaded by sand bags is used.

Lighted by a lantern, or candles if lanterns are not available, the surgeons work rapidly. The urgent cases are cared for first while the less seriously wounded await their turns. Wounded German prisoners receive exactly the same treatment as the French soldiers. Trepanning and amputations are the only operations performed and these only when absolutely necessary.

The service now becomes that of the Ambulance Corps, in removing the men to the base hospitals.

The old type cars used at the beginning of the war carried six stretchers, the handles of which fitted into loops attached to rollers, the whole sliding into the cars on rails. The springs attached to these loops gave a double vibration, causing the wounded much suffering. The body of the car was high and difficult to load. This type of car when crowded could seat but six passengers.

The best of the new type bodies are low, carrying five stretchers which slide very easily on grooves attached to the inside of the car and to a partition through the center. A long seat folds down on each side of the

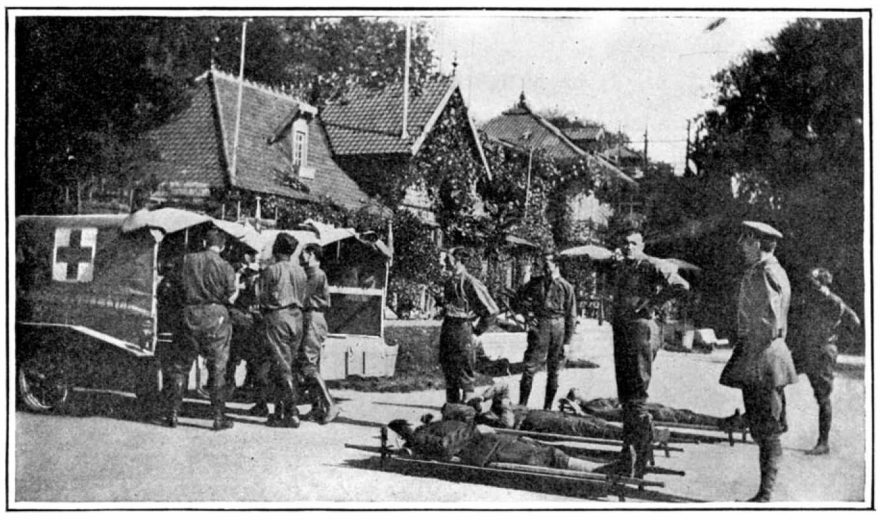
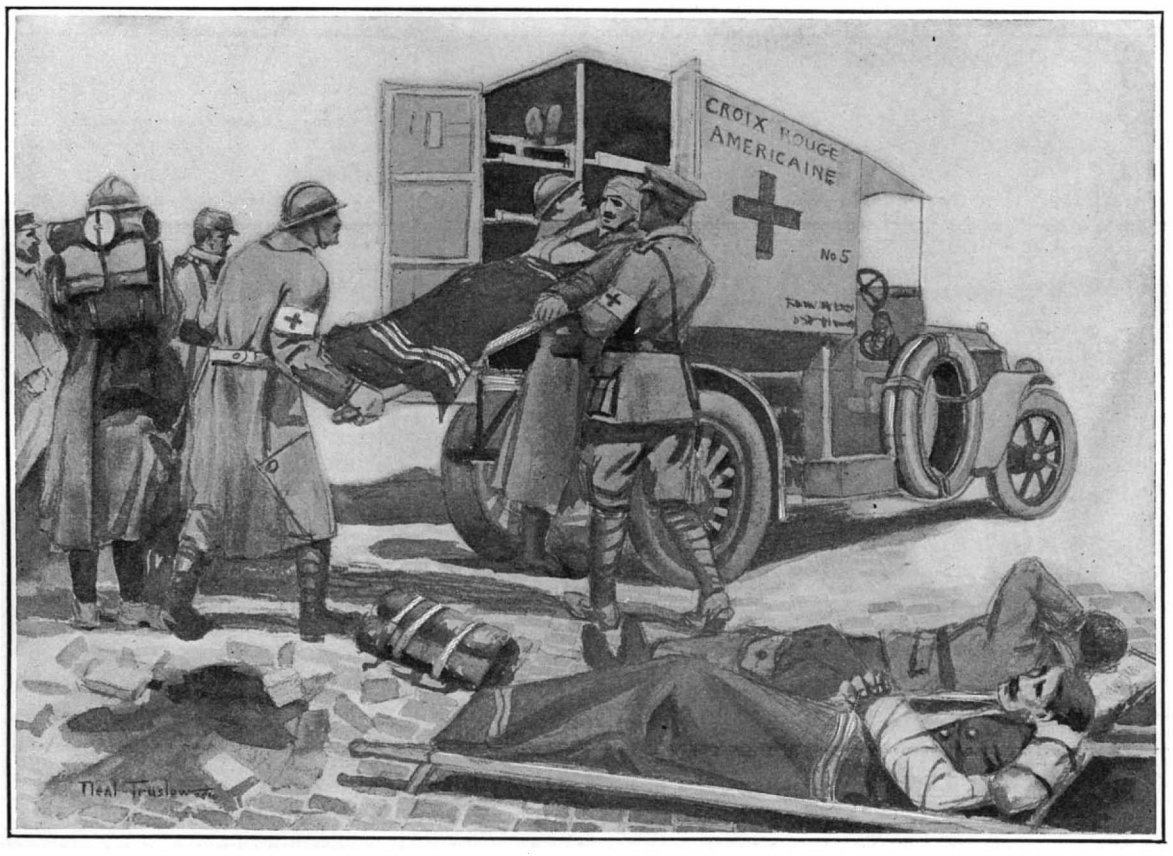


Photo. by Triangle Film Co.

American college boys at ambulance drill, "somewhere in France"



Loading an ambulance. The stretchers are laid in tiers

car, giving ample space in the center for knapsacks and baggage. The center partition is easily removed, making a light truck for carrying medical supplies, gas masks, etc.

When the cars are loaded the stretcher cases come first. We make our way back over the same road we came in. Two more cars are told to enter as we pass our section.

The wounded suffer considerably from the rough roads. Under fire the driver is tempted to step too heavily on the accelerator. Yet it has been a question, both with the doctors and the men, whether it is better to go slow and prolong the suffering, or run fast and shorten it at the expense of increased jolting.

Finally we arrive at the base hospital, usually in a church or some other large public building safely situated some 10 miles back of the lines. Here the men receive all necessary treatment and care, and the circuit of the first line ambulance service is completed. The same roads and routine are gone over until the cases allotted to the section are brought out and discharged at the base hospitals.

The most active units with the American Red Cross in France are the Norton section and the Harjes Formation. The latter has had a long period of continued service on the first line. This section consists of 22 cars, a three-ton truck fully equipped as a repair shop, another truck for supplies and an old ambulance fitted out as a kitchen. The section has 35 men, including two mechanics who attend to all repairs, though the drivers are expected to keep their cars in shape as far as possible themselves.

From my experience I would say that a section should be made up of one make of car so that the parts may be interchangeable. Most of the European makes are too heavy and low hung. A car should have at least 10 or 12 inches clearance for this work.

The most effective car I saw at the front was an old four-cylinder, thirty-horse-power American machine, comparatively light and simple to keep up. It had a capacity of eight sitting-up cases, enough power to get out of a hole, and was strong enough to stand the strain of bad roads.

The light car used almost exclusively by the American Ambulance section in Paris, is greatly over-estimated. It carries but three stretcher cases. One constantly sees them on the side of the road with broken axles, burnt out bands in the transmission, bent radius rods, wheels dished and numerous other troubles that one never hears of in a heavier car more adapted to the purpose. Their only advantage is their lightness, but in heavy roads they have not proved efficient.

A particular case comes to my mind. We sent a light car to get three wounded about 4 miles from our headquarters. The road was heavy. The last half mile led through a soft field that had been cut up by the artillery. They got their wounded but were unable to get out, even with the assistance of soldiers. After a great delay we were telephoned that the car was stuck and that they had five wounded in all. Two more light cars were sent out, both getting caught in the same place. We then sent a thirty-horse-power car and were surprised to find the ease with which we got in and out again, even going deep into the ditch when passing the other cars. The same car returned and pulled the others out with no difficulty.

The men operating the small cars were exhausted struggling in the mud with their cars. One of the wounded men was dead, and another, owing to exposure, not expected to live. It had taken four cars all night to get out with five wounded, which should have been accomplished with one car in an hour.

This case is unusual, but serves to illustrate how the effective force of a unit can be crippled by inferior mechanical equipment.

There are several hundred American volunteers engaged in ambulance service in France. The French Commissary department supplies food, gasoline and oil, but all other expenses, including the purchase of cars, are met by the men individually, and by the American Red Cross from contributions for that purpose. The service is rapid and effective and the wounded consider it quite an honor to be brought out by these well-organized units from beyond the sea.

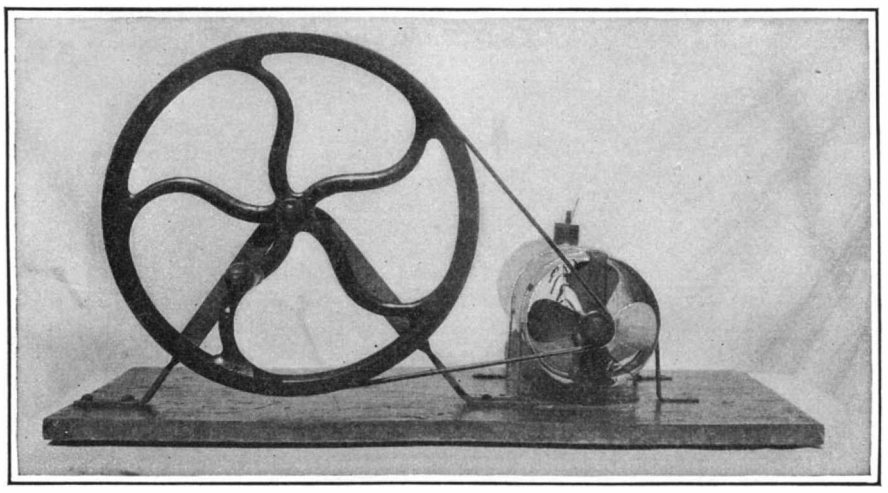
Hall, a Westerner, is the only man killed, though ten or twelve have been wounded. The French government has shown its appreciation of the bravery of these American ambulance drivers by conferring the Croix de Guerre on those who have shown unusual courage in the performance of their duties. There is a constant demand for thoroughly competent men who can afford to give their services.

What Plants Are Responsible for Hay Fever

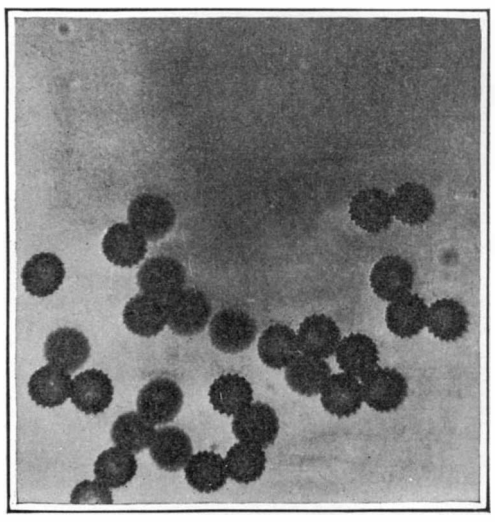
By Dr. William Scheppegrell, President, American Hay-Fever Prevention Association

IT has been demonstrated that the only pollens which cause hay-fever are those that are found in the air, being thus distributed from plants that are wind-pollinated. In many plants, the pollen has easy access to the pistils, while in many others this transfer is made by insects. In wind-pollinated plants, however, the pistillate and staminate blooms are at a distance from each other, in some cases even on separate plants or trees, so that fertilization is dependent upon the wind, which carries the pollen often to great distances.

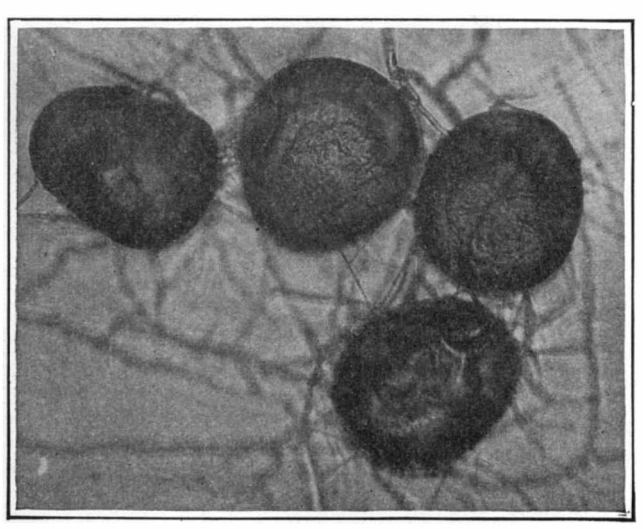
On account of the great loss incident to this method, the pollen of such plants is generated in enormous quantities. There are usually several million spores lost to each one that actually comes to serve its purpose of fertilization. This is exemplified in the oak, pine, willow and other trees; in the rag-weeds, marsh elders, cockle-bur and other plants with spiculated pollen causing direct hay-fever; and in the grasses, amaranthus and yellow dock, causing indirect hay-fever.



Machine for testing extent to which pollen is blown by the wind



Rag-weed pollen, magnified 500 diameters



Corn-pollen, magnified 500 diameters

There are many plants, however, whose pollen-grains give the positive reaction of hay-fever when inhaled directly from the flower, but which do not cause ordinary hay-fever, as their pollen is not found in the air. This is the case with the golden-rods, daisies, dandelions, sunflowers, etc. As it is important, therefore, to determine which plants really are wind-pollinated, an apparatus has been devised in the biological laboratory of the American Hay-Fever Prevention Association by means of which this test may be made without the necessity of visiting the growing plant. It is called the anemophilometer, from the technical term describing the class of plants in question—anemophilous, literally "wind-loving."

The apparatus consists of a hollow cylinder with a fan attached at one end, by means of which a current of air may be sent through the tube at any desired velocity from one to fifteen miles per hour. The flowers to be tested are held in place by means of an attachment in the center of the tube, and at the outer end there is a receptacle for holding the glass slides on which the wind-blown pollen is captured.

These slides are given a thin coat of glycerin so that the pollen spores, once caught, are retained. The wind velocity and the length of time are noted, so that the rate of pollen deposit may be computed. When the slide is removed, a glass cover is placed over the glycerin, and a stain added to facilitate the count. This is made with a mechanical stage by means of which every part of the glass slide is passed in its turn across the field of the microscope. The count is then expressed as so many spores per square inch of slide surface. A microphotograph of a small portion of such a slide is shown in one of our illustrations.

The hay-fever pollens which have the highest averages in these tests are those of the common rag-weed, *Ambrosia elatior*, which is closely followed by the giant rag-weed, *Ambrosia trifida*, and the marsh elder, *Iva ciliata*. The grasses, *Graminae*, which are the principal cause of indirect hay-fever, also spread their pollen in enormous quantities, but their potential area is more restricted, on account of the greater size of their pollen (forty microns). This is especially the case with the pollen of the corn. The latter is high in protein and may cause indirect hay-fever, but its pollen is so very large (eighty microns) that its potential area is extremely small. Under conditions that would cause the pollen of the common rag-weed, fifteen microns in diameter, to travel half a mile the corn pollen would only reach a distance of forty-three feet. On this account hay-fever from corn is rare.

The American Hay-Fever Prevention Association has established the study of hay-fever upon a scientific basis, and the anemophilometer is one of the means of facilitating the work.

New Method of Blood Transfusion

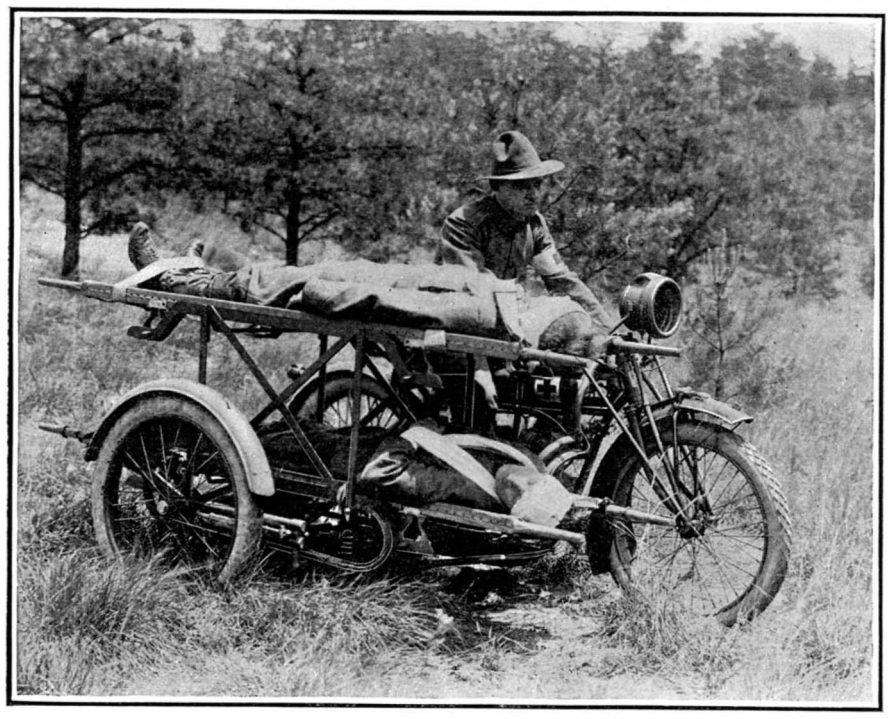
IN the latter half of the nineteenth century the subject of blood transfusion received a good deal of attention, and a careful technique was elaborated for its use in cases of severe hemorrhage of all kinds. Naturally, the present war has enormously increased the opportunity for its application, and hence the interest in improving this technique.

The operation has always been one of great delicacy, as well as of considerable pain to the giver of the blood; for the tendency of the vital fluid to coagulate immediately upon contact with the air has made it absolutely necessary that the blood injected into the veins of the patient shall not for a single instant suffer such exposure. This end has been accomplished either by direct suturing of the artery of the giver and the vein of the receiver, or else by joining them with a tiny rubber tube carrying a glass spout on each end. When the operation is finished, the artery of the giver is gently compressed with forceps, the vein of the receiver is ligatured, the patients separated, the open wounds sewed up and bandaged, and the pain of the giver alleviated by an injection of cocaine.

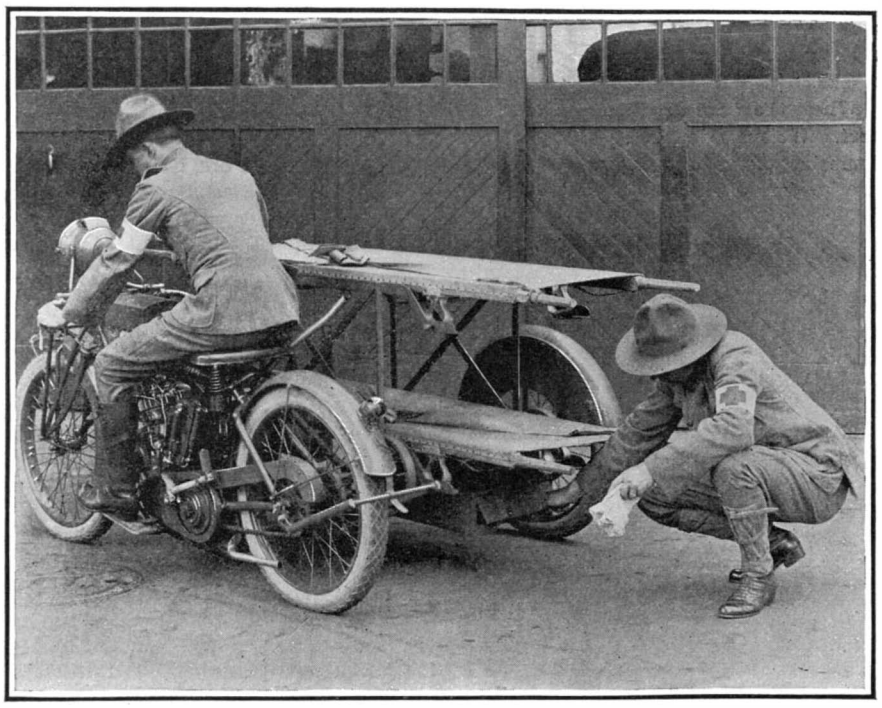
In marked contrast with this procedure is the method recently devised by a Buenos Aires physician, which eliminates all these complications, which does away entirely with the necessity for making an open wound in either patient, and which so simplifies the entire operation as to rob it of all its terrors, alike for surgeon and subjects. The essential feature consists in the discovery that the addition of a certain proportion of the neutral citrate of soda to the blood causes it to remain liquid upon exposure, so that it can actually be drawn from the giver into containers and later injected into the veins of the receiver, without any occasion for connecting the blood vessels of the two patients at all.

The method consists in drawing from the elbow of the giver, by means of a puncture less than a millimeter in diameter, a certain quantity of venous blood, which is collected in a receptacle containing a solution of the citrate in the proportion of one part of the salt to one hundred parts of the blood to be drawn. This mixture makes the fluid incoagulable, without robbing it of any of its vital properties; and since the citrate thus employed is inoffensive to the organism, the solution may be injected into the forearm of the receiver without danger. In this simple manner are sidestepped all the difficulties which have hitherto hampered the transfusion process.

The method has been subjected to exhaustive tests in Buenos Aires, under the most severe supervision, and has made good without reservation.



The double-decker motorcycle ambulance in actual service, showing the arrangement of the wounded



Rear view of the double-decker motorcycle ambulance. Note the first-aid cabinet mounted below the stretchers

Motorcycle Ambulance of Double-Decker Design

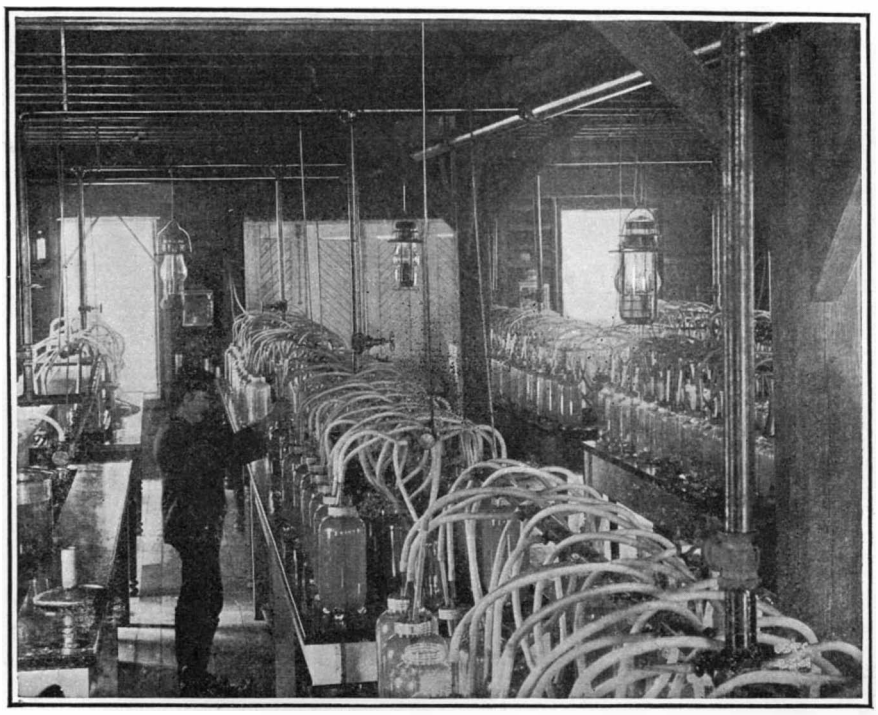
WHAT is believed to be a great advance in the application of motorcycles to military ambulance work is presented in the double-decker machine just introduced by an American manufacturer.

The stretcher carrier of the new motorcycle ambulance is of the double-decker design in order to accommodate two patients each trip. Regulation stretchers are used, fitted with special pedestals which set into sections of the carrier frames, where they are clamped to prevent slipping. The chassis on which is mounted the stretcher frame is of special reinforced construction with such features as vanadium steel springs and adjustable tread. The machine will climb the steepest of hills and has a speed up to 60 miles per hour on the level. A cradle-spring frame, three speeds, starter, double controls, and a heavy duty clutch are among the special features which are said to make the present machine most adaptable to hospital work.

A first aid cabinet is mounted below the lower stretcher on the chassis of the motorcycle ambulance. This affords opportunity for the ambulance attendants to give dressings right on the battlefield without the delay which would be occasioned if the patient had to be moved to the hospital in the rear. When the mobility of the equipment, its speed, reasonable cost and small size are taken into consideration, it is evident why the motorcycle ambulances are proving of extraordinary value in the European war theater.

Giant Fish Incubators

SO great has the demand grown upon the Government to furnish young fish free for private and public owned ponds, lakes and streams of the country that Uncle Sam found it utterly impossible to comply under the old methods of hatching eggs of the finny tribe. Because of the enormous growth in the work, the Bureau of Fisheries has adopted a new apparatus which can easily hatch millions of fish eggs annually. The device is known as the McDonald automatic hatching jar. It is used to hatch eggs of shad, pike, perch, yellow and white perch, and whitefish.



A battery of the new fish-hatching jars

The jar is cylindrical in shape, of good size, holding seven quarts of water. The bottom is hemispherical, and stands upon three knobby glass legs. A screw top serves as a cap, and in the surface of this cap, which is of metal, are two holes, into which glass tubes are fitted. Through one flows the fresh water into the jar, and through the other the waste water is carried.

Not fewer than 80,000, nor more than 100,000 eggs are put into one jar. It is then closed, the water turned on, and the feed tube introduced into the jar. The water flows at a pressure of eight pounds per square inch at the top of the hatching jar. Each jar is supplied with two quarts of water each minute. The rubber tubing which runs from each jar connects with supply pipes. The waste water flows off in drains.

After the flow of water has been properly regulated the masses of eggs are turned over and over continuously, each one having its turn at the top. The dead eggs come to the surface and remain. These form a distinct and separate top layer and are carried off by an outlet tube.

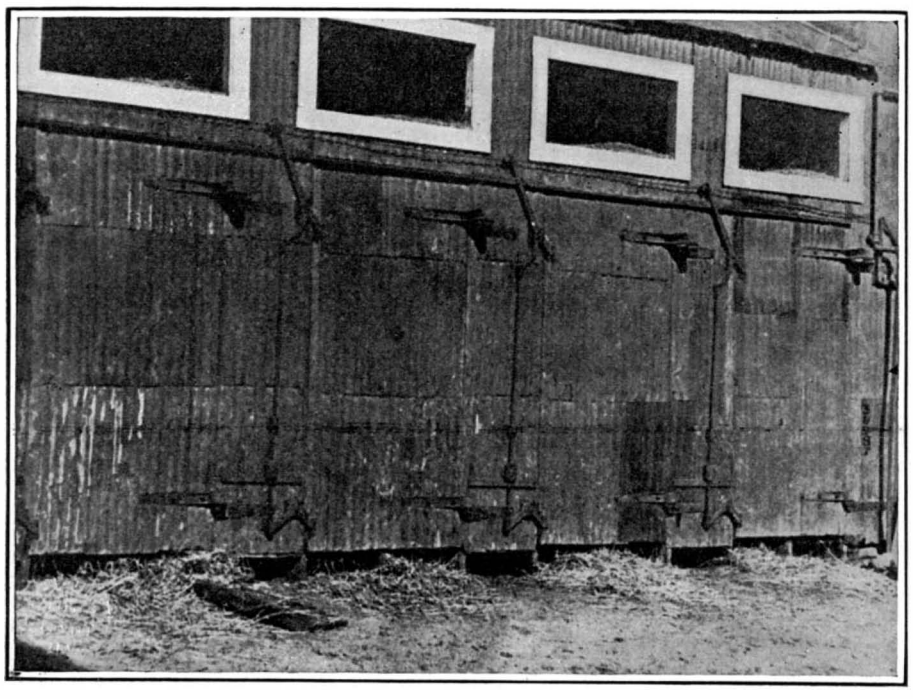
In high temperature the eggs of shad hatch in three days; as a rule they take from six to ten, and it is not unusual for them to take longer. Dark and rainy days are unfavorable to a quick hatch, while sunshine greatly accelerates matur-

(*Concluded on page* 338)

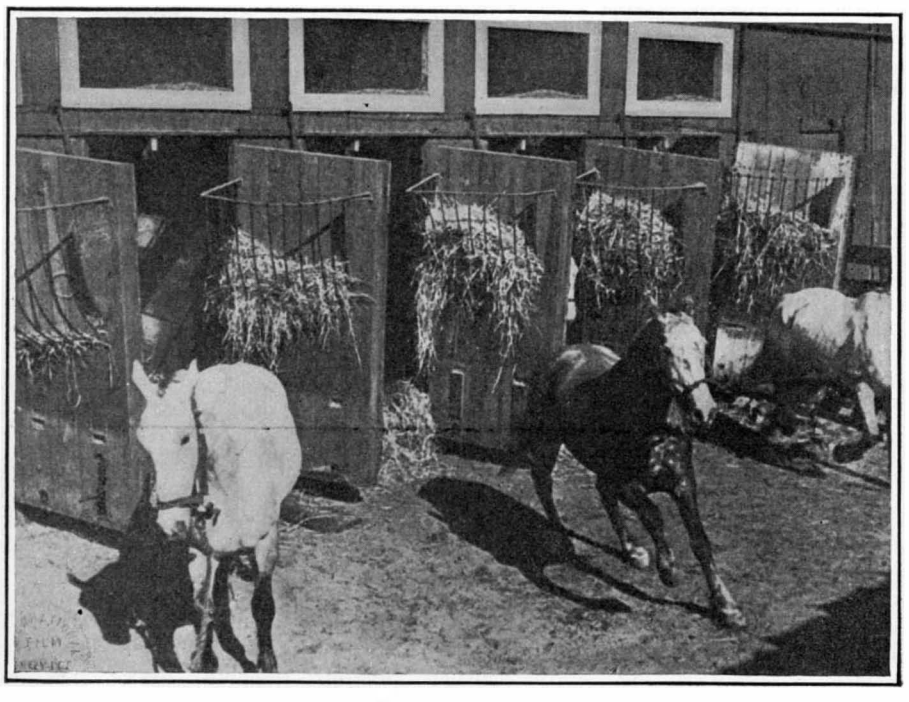
A Fire Escape for the Horse

AT last an inventor has devised an automatic release for the horse in case of fire, an apparatus not only for opening a way of escape for each animal, but at the same time barring its retreat into the stable. This invention is in actual use in a huge stable in Los Angeles, and the photograph shows the animals running into the yard five seconds after the alarm had sounded for a fire drill. The device will prevent the destruction of animals by fire when it is generally adopted, and the horrors that

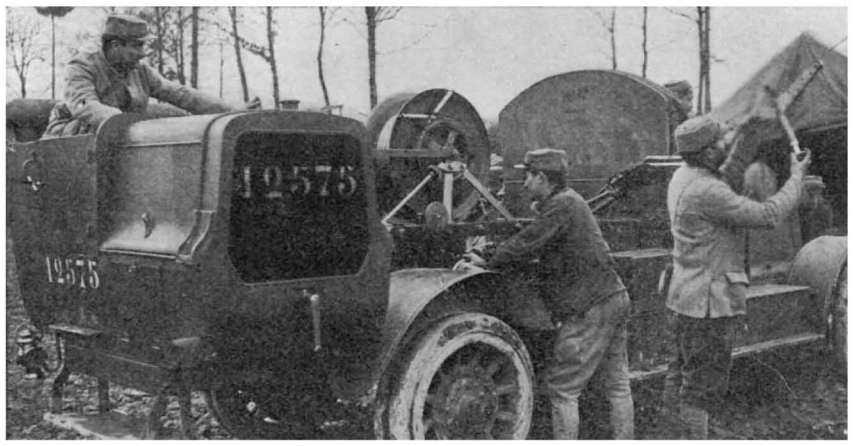
(*Concluded on page* 338)



Exterior view of safety doors for stables



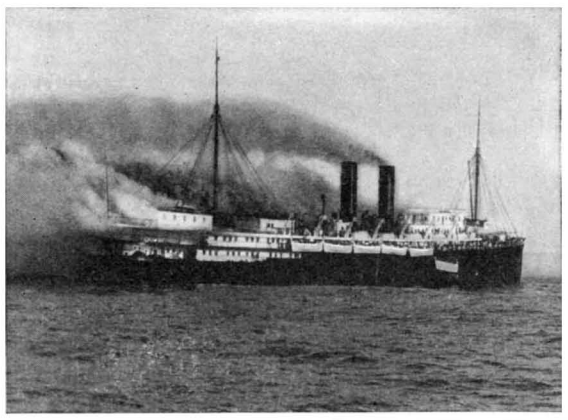
Five seconds after an alarm of fire



HAULING down a captive French balloon is accomplished in a very short space of time with the automobile windlass shown here. The windlass is driven by a gasoline power plant separate from that of the motor truck on which it is mounted. Upon the approach of a hostile aeroplane, the crew of the automobile windlass work feverishly to bring down the huge gas bag before it can be subjected to the fire rockets or bombs of an enemy airman. But should the gas bag be struck and set on fire by incendiary devices, its passenger can escape by means of a parachute—a comparatively recent development.

AT a point in the French first-line trenches nearest to the enemy is this "listening post" which is manned by a volunteer, since the duty is extremely hazardous, sometimes being but a few feet distant from the enemy's parapet. The duty of the man stationed here is to listen for any suspicious activity on the part of the enemy, and to warn the defending forces of impending gas attacks. To warn his companions above the din of battle, he presses a button connected in circuit with an American automobile horn, the sharp note of which readily pierces the air, making a surprise attack almost impossible.

PICTORIAL NOTES



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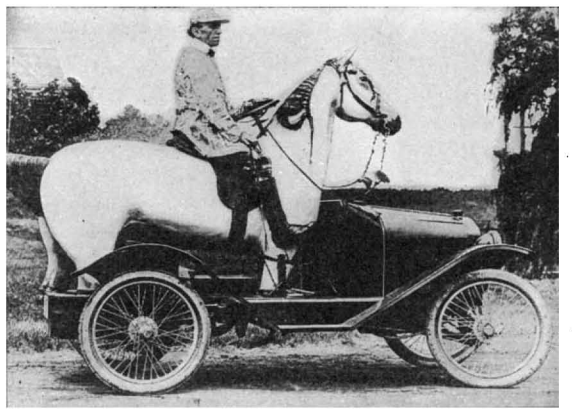
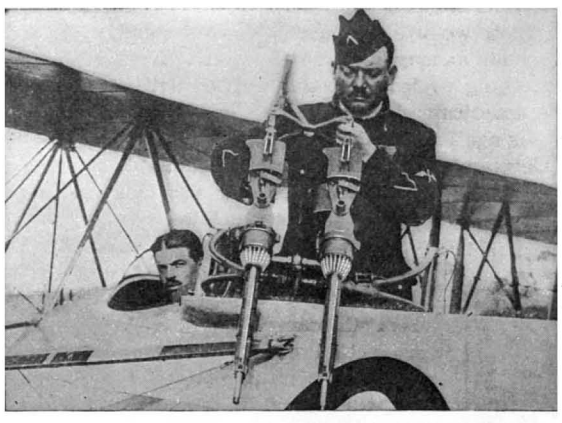
SHORTLY after leaving Seattle a fire broke out on the palatial steamer "Congress," and within sight of Coos Bay, Oregon, the vessel was reduced to a mass of twisted steel within the shell of the hull. The U. S. dredge "Michie" stood by two miles off shore, and rescued all passengers and crew. This view is most remarkable in that it not only depicts the volumes of smoke issuing from the doomed steamer, but the life boats being lowered over the side.

AMONG recent exhibits of the American Museum of Safety is this graphic presentation of the causes of lockjaw. Rusty nails, revolvers, fireworks, and metal with sharp edges are, according to this exhibit, fruitful sources of the dreaded lockjaw. "Be careful" is truly good advice.



MOTORING on horseback is what this man is doing, not as a sport, but as a new idea in publicity. The horsemobile, as the new vehicle is named, consists of a light pleasure car, stripped and slightly altered, upon which is mounted a wooden model of a thoroughbred Kentucky racer. Steering is accomplished by means of a wheel in back of the horse's neck. The stirrups serve to operate the clutch and engine control, by slight pressure of the feet.

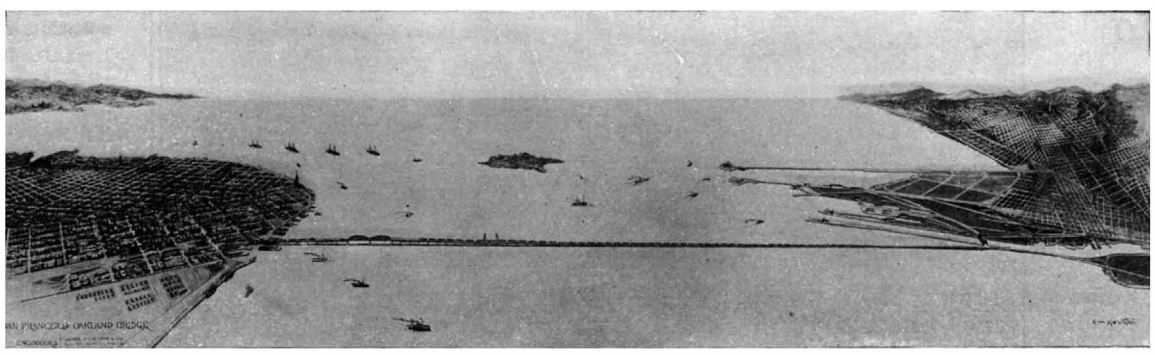


Copyright, Underwood & Underwood

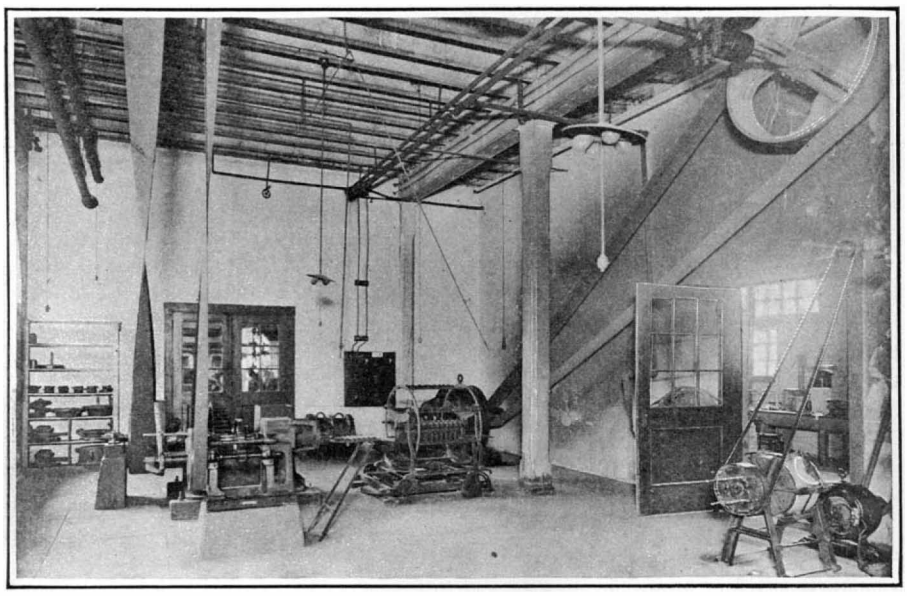
NOT contented with showering enemy airmen with the fire from one machine gun, the French have recently developed a double machine gun, with the object of firing twice as many bullets at any target desired. Mounted parallel to each other, the two machine guns may be fired singly or together.

[Copyright, Underwood & Underwood

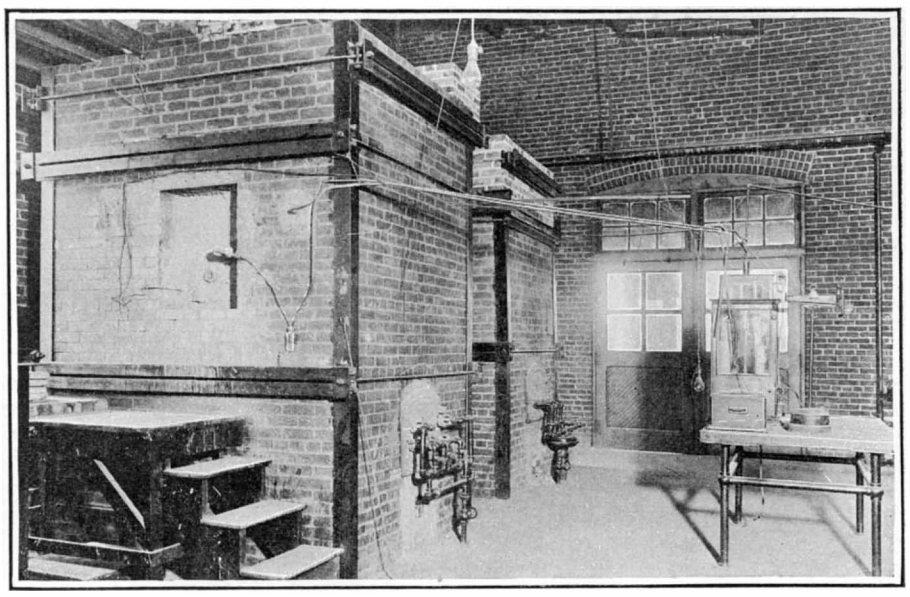
ANOTHER view of the double machine gun, showing the elaborate and very serviceable supporting member. Without getting up from his seat, the *tireur* or observer can turn around in any direction and still keep the gun in front of him: the supporting member of the gun moves with the seat.



COMPLETE plans have been prepared for a structure some five miles in length, to join San Francisco with its biggest suburb, Oakland. In contemplating a bridge of such magnitude, the layman will inevitably think of enormously long spans high in the air. Such a design, however, would be quite impracticable. Aside from the two spans of 600 feet across the main shipping channels near the western shore of the Bay, the bridge is to consist entirely of spans 250 feet or less, and comparatively close to the high-water level. It is estimated the cost will be $22,000,000, and the time for construction about four years. The San Francisco-Oakland bridge is to be one of the heaviest bridges ever constructed, for it will carry four railroad tracks and three roadways. The former are to run along the lower deck, while the latter are to run along the upper deck, the structure being of double-deck design. Two of the railroad tracks are intended for overland passenger trains, while the remaining two are to be used by local electric trains. Near the San Francisco shore, it will be noted in the adjacent view, there are to be the two long and high spans under which can pass the shipping of San Francisco Bay. The contemplated bridge is to relieve five ferry systems now handling traffic.



Some of the apparatus in the general molding room



View in the interior of the kiln house

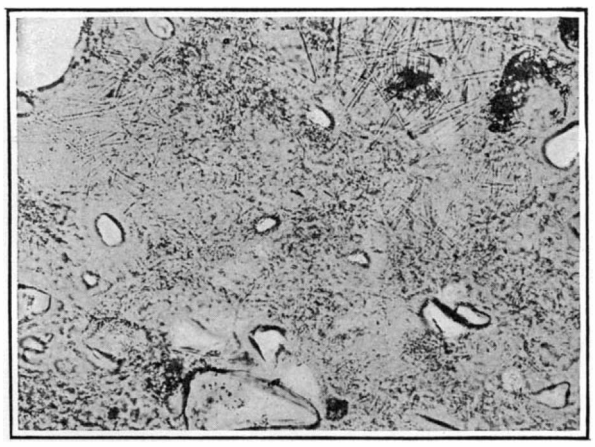
Industrial Preparedness for Peace

What the Bureau of Standards Has Done for the Clay Industries

OUR country is realizing a greater measure of independence to-day than ever before in its history. This has not been of our own seeking, but has been forced upon us by our isolation from the European markets. The war is teaching us to become truly self-reliant. The resourcefulness of the Yankee has asserted itself. Industries which have been dependent upon foreign countries for raw materials and products have been forced to look for substitutes at home. Our land has been combed for raw materials to take the place of those previously imported. As a result, we have discovered that our own natural resources are rich in materials which, we had previously supposed, could be found only abroad; also we have discovered new products of great value, but most important of all, our manufacturers have come to realize the value of scientific research. Instead of being afraid of the word "science" and treating it as something entirely academic, they have come to find that it is a most valuable aid in all lines of manufacture. Our laboratories have been busy testing domestic materials to see how they compare with foreign materials and investigating foreign materials in the effort to ferret out the secret of their manufacture.

Among the industries that were very hard hit by the cutting off of the supplies from Europe, were those that make use of clays. It may not be generally realized that our imports of clays prior to the war ran up into the millions of dollars. One would naturally suppose that somewhere in this great country we could find clays equaling those of Europe; but the domestic clays received scant attention at the hands of our manufacturers. Probably the man in the street does not realize that clay is used not only in potteries, but also in the manufacture of paper. In order to obtain a level surface for printing, it is necessary to treat paper with a filler of clay. The clay used for this purpose has been imported largely from Wales, because there the natural product is very pure and a careful process of washing has resulted in the production of a very fine material. On the outbreak of the war, the imports of Welsh clay dwindled, and the cost became excessively high. Paper manufacturers were in a quandary. They did not realize that here at home clays fully as good could readily be obtained.

Several years ago, the Bureau of Standards established a section devoted to the study of clay and clay products. As the result of the research work begun by the late H. E. Ashley, and based on the investigations of Keppler, a very simple process of purifying kaolins and clays was developed. This consists in washing the clays with water containing a very small amount of caustic soda. Clay ordinarily contains a quantity of coarse granular matter, whereas the plastic material consists of extremely fine grains. By a system of washing, it is comparatively easy to get rid of most of the coarser impurities, but some of the impurities are so fine that it is very difficult to separate them from the clay proper without the employment of a process which would be commercially unprofitable. Particularly is this the case when biotite mica is found in the clay. This instead of being granular takes the form of fine flakes which are exceedingly difficult to separate from the fine clay particles. Mr. Ashley showed that, by the use of caustic soda or in some cases, sodium oxalate the fine clay particles are deflocculated, allowing the granular matter to settle out and affording a separation of the coarser and finer material. This comparatively inexpensive process produces a clay of far greater purity than could be obtained by the use of water alone, as in the old washing methods. After the impurities have been settled out, the "slip," that is the water containing the clay in suspension, is run into another tank where it is coagulated for the purpose of filter pressing. Because the particles are exceedingly fine, they would tend to clog the filter cloth, unless they were coagulated. The coagulation is effected by treating the "slip" with acids or salts, like aluminum sulphate.



How our ceramic chemists ferret out long-standing secrets of manufacture

Photomicrograph of a thin section of Japanese porcelain, showing crystallization of sillimanite and solution of quartz.

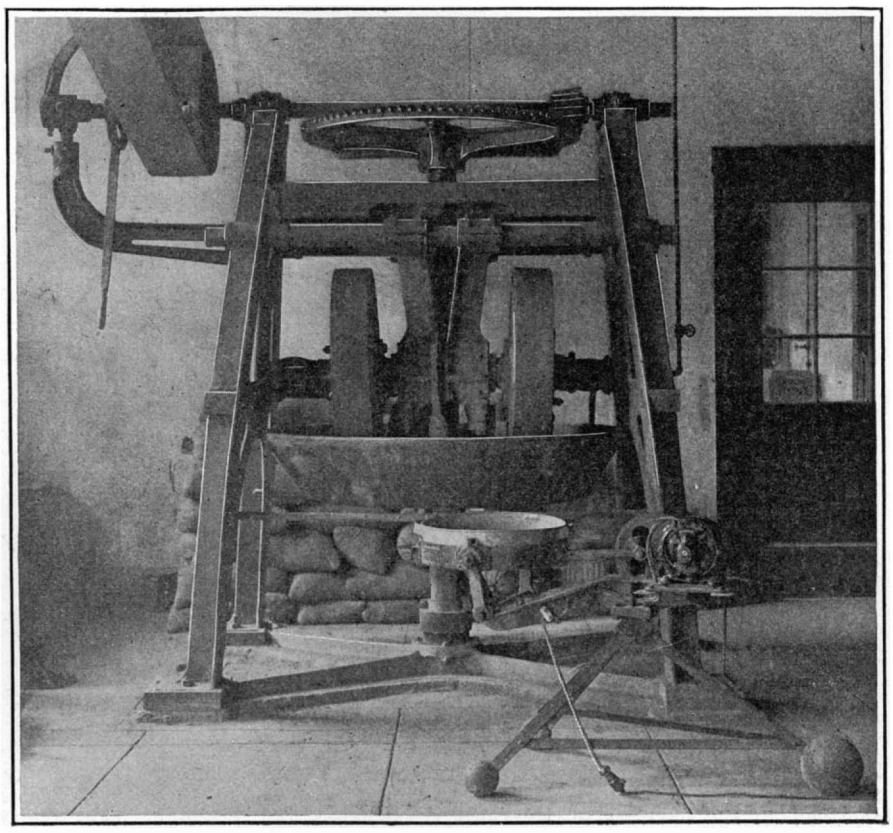
By this system of treatment, the Bureau of Standards succeeded in producing from American clays as fine a product as any that could be obtained abroad. Furthermore, the process of purification is commercially practicable.

Although this was known before the outbreak of the war, and although American clays were being purified in this way, manufacturers hesitated to make use of them because they were obtaining satisfactory results with the foreign clays and feared that if they tried the domestic product they might encounter difficulties that would interrupt and seriously disconcert their business. However, they are now giving their attention to the use of domestic clays and are gradually adopting them. There is no reason why we should have to import such clays after the war ends.

Not only was the paper manufacturer affected by the cessation of clay import, but also the manufacturer of china and fine porcelains. These manufacturers too were loath to believe that anything could be produced in this country which could equal the fine foreign clays. But they have had to try the domestic clays and they find that they satisfy the requirements of their work. In fact, we are producing in this country as fine a porcelain as may be made anywhere. No doubt we have something to learn in the way of artistic decoration, but American manufacturers can match their porcelain wares against any in the world.

Germany has made a specialty of chemical porcelain, and at the outbreak of the war our chemical laboratories could not obtain the crucibles, pyrometer tubes and other porcelain articles they required. But these are being produced in this country, fully the equal of those heretofore imported from Germany. With reference to the production of the refractory Marquardt porcelain for pyrometer tubes, etc., it might be stated that the Bureau of Standards was instrumental in establishing the first American plant of this kind on a commercial basis.

The work of the Bureau of Standards in clay research during the exigencies of the past two years is invaluable. A microscopic study of foreign and domestic porcelains has enabled the Bureau to arrive at the real mineral structure of the porcelain wares. This study reveals the solution of quartz and formation of sillimanite in the ware, and it has been possible thereby to classify porcelains very satisfactorily as to their composition and burning temperature. So that by the use of a microscope we are able to ferret out the secrets of manufacture that have been developed by long experiment abroad, and to reproduce the product in our own plants. One of the accompanying illustrations is a photomicrograph in which the large blotches represent the solution of quartz by feldspar, while the crystallization of sillimanite is shown by the needle-like structure. This Bureau, realizing the need of more information concerning the plastic bond clays hitherto imported



A clay grinding machine

from Germany for making glass pots and graphite crucibles gave attention to this subject by making a study of representative samples of these materials and determining their physical and chemical properties.

It is possible now to know accurately just what properties a domestic clay must have, to be considered a substitute for the imported material.

The subject of glazes and enamels for clay products has been studied quite thoroughly by the Bureau of Standards, and typical compositions have been worked out, representing the most important textures and colors in use in the several branches. The topic of glazes free from lead for the whiteware industry has been reviewed and new results published in a bulletin.

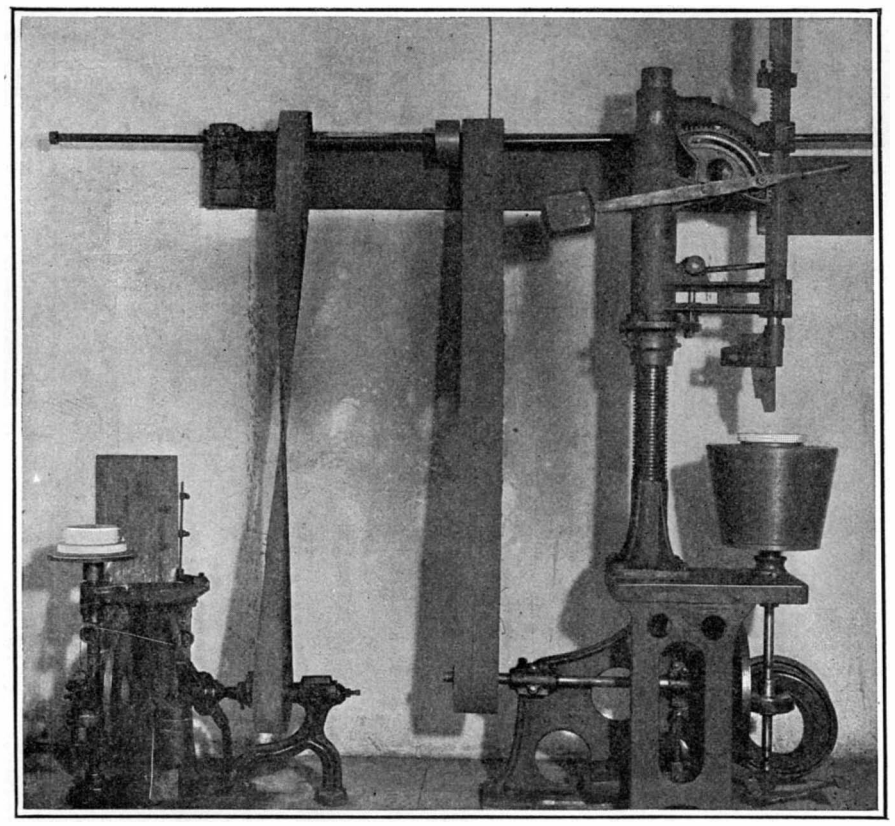
The clay section of the Bureau of Standards has been very busy supplying information to manufacturers of clay products concerning specific questions and problems which sometimes are unique in character and out of the ordinary. Coöperation with technical organizations, like the National Brick Manufacturers' Association, The American Society for Testing Materials, The American Ceramic Society, The American Paving Brick Manufacturers' Association, The American Gas Institute, The American Refractories Manufacturers' Association, etc., constitutes an important part of the work. In some cases, as in the coöperation with the National Brick Manufacturers' Association, such investigations assume an elaborate character. In this particular instance it involved the building and testing of many large-size brick piers, representing different grades of brick, mortar and methods of bonding. Similar tests are under way on hollow building tile and architectural terra cotta.

The rapid development of the enameled cast iron and steel industries and the frequent calls for coöperation along these lines, have made it necessary to begin investigations dealing with this interesting subject, and the Bureau has been fortunate in securing a well-known expert in an advisory capacity.

Similarly, researches are under way in connection with several problems of the glass industry.

The equipment of the Clay Products Section is quite complete, and includes all the necessary machines for the preparation, fine grinding and washing of all kinds of clays, and similar materials, jiggers for the making of pottery, casting equipment, dryers, and six kilns and furnaces for the various firing and melting operations. In addition, apparatus of all kinds for laboratory experiments is available. The section is particularly well-equipped with reference to high temperature measurements. The accompanying engravings represent some views of the ceramic laboratories.

We are indebted to the Bureau of Standards for the photographs, and particularly to Dr. A. V. Bleininger, Ceramic Chemist of the Clay Products Section of the Bureau of Standards, in Pittsburgh, for much of the material published above.



Machinery for making pottery

Our cover illustration shows the work of "placing a kiln," in a typical American pottery. The clay articles are set in large earthenware vessels, known as "saggars." These vessels are without lids or covers, but as they are placed one on top of the other in the kiln, each saggar forms a cover for the saggar it rests upon. A roll of clay is laid about the rim of each vessel and this is mashed down by the weight of the next saggar placed, thus sealing it. The man in the foreground may be seen applying the clay to the rim of a saggar.

Can We Put the Sun to Work?

By K. P. Frederick

THE power and heat which go to waste to-day would light every home, run every factory, keep the street car systems and railway systems going, run all the automobiles and then there would be some left over. This power comes from the sun's light, and is only awaiting some twentieth century Franklin to discover how to utilize it.

Every boy and girl in the country knows how the ordinary rays of the sun can be so concentrated by an ordinary reading glass or watch crystal as to burn holes in paper, light matches and the like. This is a practical demonstration of the sun's heat, but is not a solution of the manner of harnessing it.

However, Old Sol is not to be left to undisputed possession of all this energy, if Uncle Sam can find a way out of it; and for that purpose the United States Weather Bureau has established three stations for the observation and recording of the sun's power and heat. These stations were the result of a decision on the part of the Bureau to get down to the real cause of the weather, if possible. The department already had plenty of instruments for measuring rainfall, winds and temperatures. These instruments, however, shed no real light on the causes of weather.

The Weather Bureau officials came to the conclusion that the very existence of weather is due to the sun. Without it, there could be no rain or winds, no areas of high and low pressure. So Herbert H. Kimball was put in charge of the department of solar investigations, and stations for daily observation were established at Washington, D. C.; Madison, Wis., and Lincoln, Neb. The first station is to observe conditions along the seaboard, the Wisconsin station is to take care of the upper Mississippi valley, and the Lincoln station will make reports covering the Missouri valley.

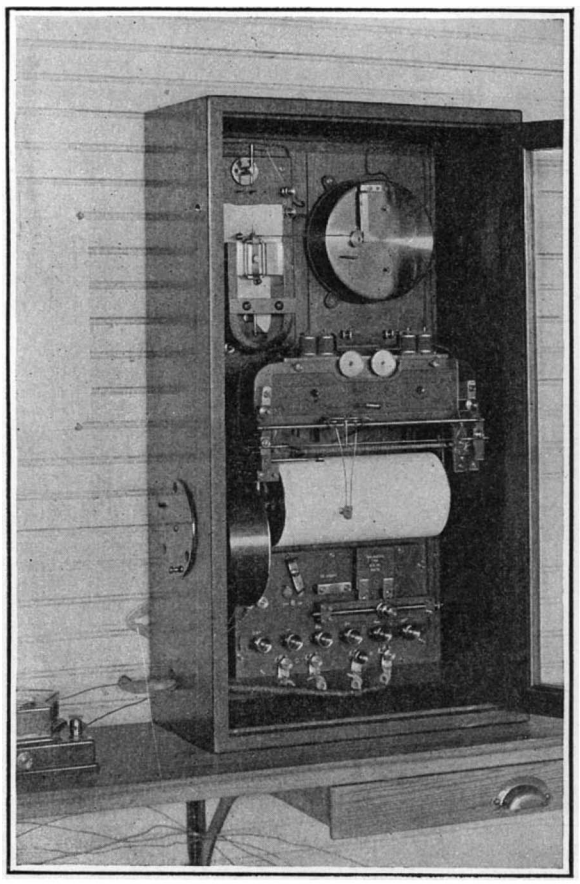
The Government is not through establishing stations, but the high cost of instruments and the fact that the investigations have not progressed very far preclude the possibility of establishing any more in the near future.

Way above the tops of the trees at the Nebraska University Agricultural College, on the top of the experiment station hall, is a little glass bulb, set on a steel plate, and connected by wires with the station below it in the attic of the building. Inside the bulb are four small squares, two white and two black, the colors alternating. These squares consist of platinum wire wound on mica plates. The wire is coated with black enamel to form the black squares. This is the apparatus that records the sun's rays as they fall upon the top of the building.

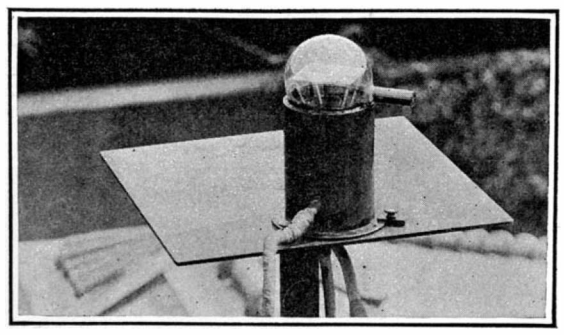
The station, or little room about 15 feet square, below this piece of apparatus, contains the instruments that receive the sun's impulses from the roof and record them on a sheet of paper that is constantly revolving on a cylinder. The dark squares, in the little glass case on the roof, absorb more of the sun's heat than the light squares, just as black cloth absorbs more heat than white. The heated black squares thus offer more resistance to the passage of an electric current through the platinum wires than do the light squares. After passing through these squares the current is received by the instrument in the room below. This instrument is constructed on the principle of the Wheatstone bridge, with an automatic registering device added, which pushes a pen across the sheet of paper, and makes a continuous record of the difference in resistance of the white and black squares. This is of course proportional to the difference in heat received by these squares. From this sheet of zig-zag lines the operator can compute the day's work of the sun. This apparatus is called a pyrheliometer.

A second instrument for the same purpose, but of another kind, is much more simple than the first, being used only for instantaneous readings, while the larger instrument keeps the record for a day. This smaller instrument simply consists of a metal tube about a foot long, black inside, and equipped with a coil of wire through which a current passes, and the reading at any particular moment shows the resistance the coil is presenting to the electric current as a result of its heat.

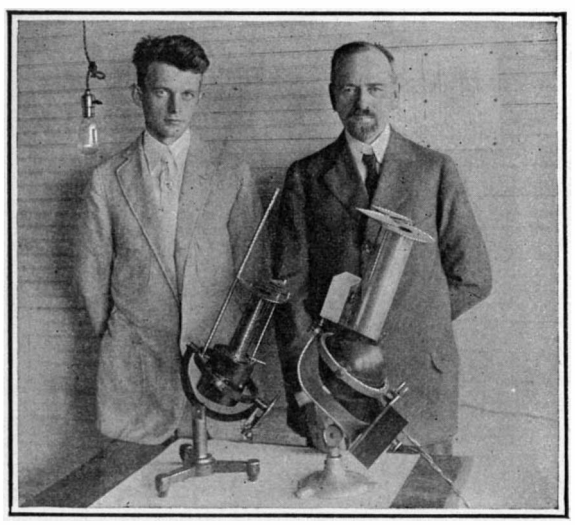
One hot day in July, 1915, this instrument recorded heat energy of over one horse-power per square yard. Multiply this by 10,000 approximately the number of square yards in a city square and you have something like 10,000 horse-power going to waste in every city block, as well as in the same sized tracts over the country side. Dividing the energy produced by the sun in a square between the 20 or more property owners in the square and every housewife would have power enough to do the washing, ironing, light the house and run the automobile, with some to spare.



The recording apparatus of the pyrheliometer



The pyrheliometer catching and measuring the sun's energy



Small portable pyrheliometer for instantaneous readings

The first of these instruments was introduced into the Government service something like two years ago. One of the first discoveries made by it, was that the sun's heating power grew less after a violent volcanic eruption. After one such outbreak, when complaint was generally made that the heat from the sun had grown less, it was discovered by the pyrheliometer that the cloud of volcanic dust which spread part way around the globe, though invisible to the eye, really lowered the intensity of the sun's rays at the earth's surface.

"The hours of sunshine" theory of the agricultural experts seems to have been given a jolt by the new instruments. The Weather Bureau has always taken hours of sunshine into consideration as a vital factor. The new instrument shows that an hour of sunshine at noon is worth several times what an hour of sunshine is at 10 A.M. or 3 P.M. The

(*Concluded on page* 336)

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

What Science Is Doing to the Packing Box

THE ordinary wooden box which inhabits our shipping rooms in such vast quantities would seem to the casual observer to afford about as small a field for scientific investigation as anything under the sun. A bit of reflection, however, will make it clear that this impression is not necessarily correct. It is not so much the 4,500,000,000 feet of lumber used annually in the making of these boxes that gives them an importance far above their apparent station; it is the fact that millions of dollars' worth of merchandise more or less susceptible of damage from breakage and exposure is shipped in them, and depends upon their resisting powers for safe arrival at its destination, that makes the subject of packing boxes one of far greater consequence than the mere intrinsic value of the boxes themselves.

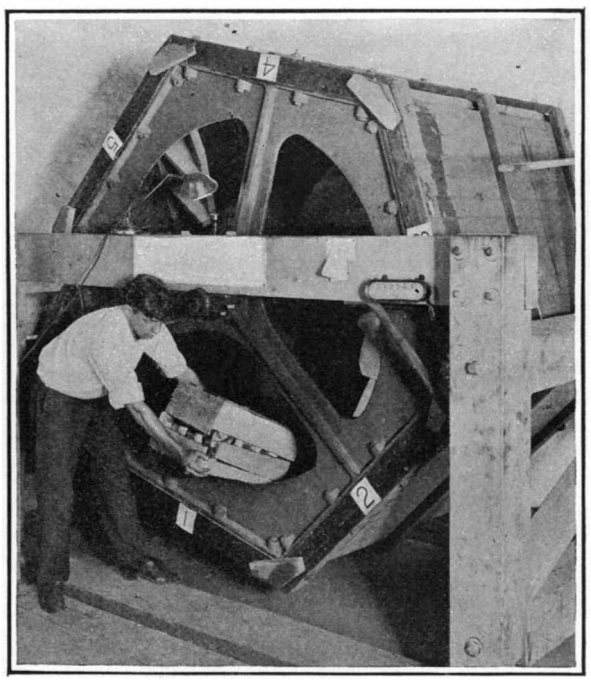
So we need not be surprised to learn that the investigators employed by the Federal Government to discover new facts and improved methods of value to American business have given the matter of better boxes some of their attention, and that a machine for testing the strength of boxes has been devised by engineers of the Forest Service and is in use at the Forest Products Laboratory at Madison, Wisconsin. The machine is the result of a series of tests carried on during the past year, in coöperation with the American Society for Testing Materials and the National Association of Box Manufacturers, for the purpose of determining the strength of boxes of various woods and of different constructions.

This device consists of a large hexagonal drum, lined with thin steel sheets. Strips of scantling are bolted to these to form what are known as "hazards." In making the tests, boxes filled with cans containing water are placed in the drum, which is then rotated. The hazards cause the boxes to be carried part way around and then dropped back to the lower level of the drum. Each fall of this sort is a pretty fair imitation of the probable treatment the box would receive in shipment. The boxes are watched carefully, and notes are taken on the manner in which they give way and the number of falls required to break them in pieces.

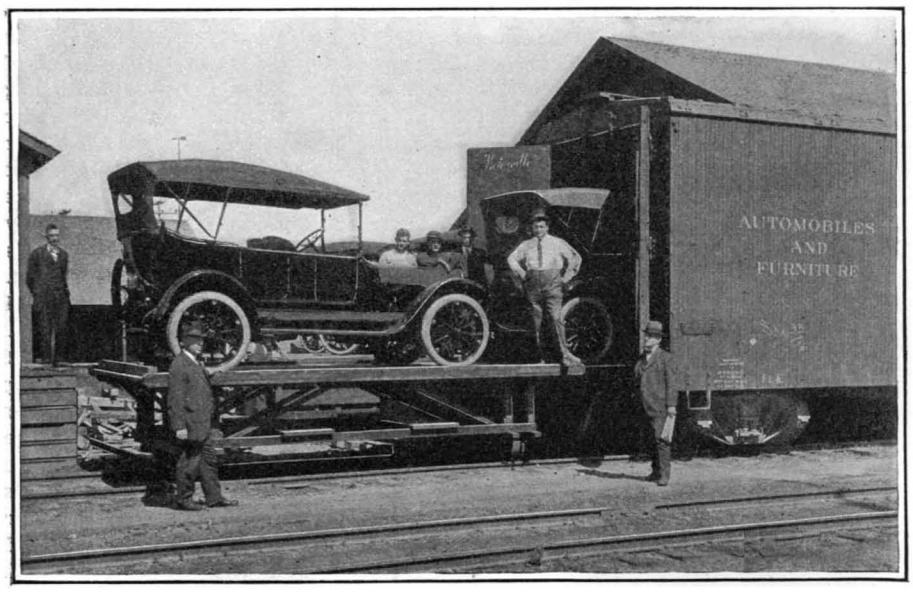
In this way, say the officials who have conducted the tests, it is possible to determine what kinds of woods are best suited for boxes. The tests showed a decided need for a standard classification of box woods, and three groups have been made, based on the data obtained.

The tests also show the best methods of box construction. The experts say that one of the most striking things brought out was the inadequacy of the ordinary methods of nailing up boxes. The number of nails used and the way they are put in are of great importance. One nail more to the side of a box will give it a great deal more strength than might be thought. Nor should the nails be driven too deep into the wood. In many cases, it is said, proper nailing will allow a reduction of the amount of lumber used without any decrease in the value of the box. Boxes with cleated ends were found to be much stronger than those without cleats.

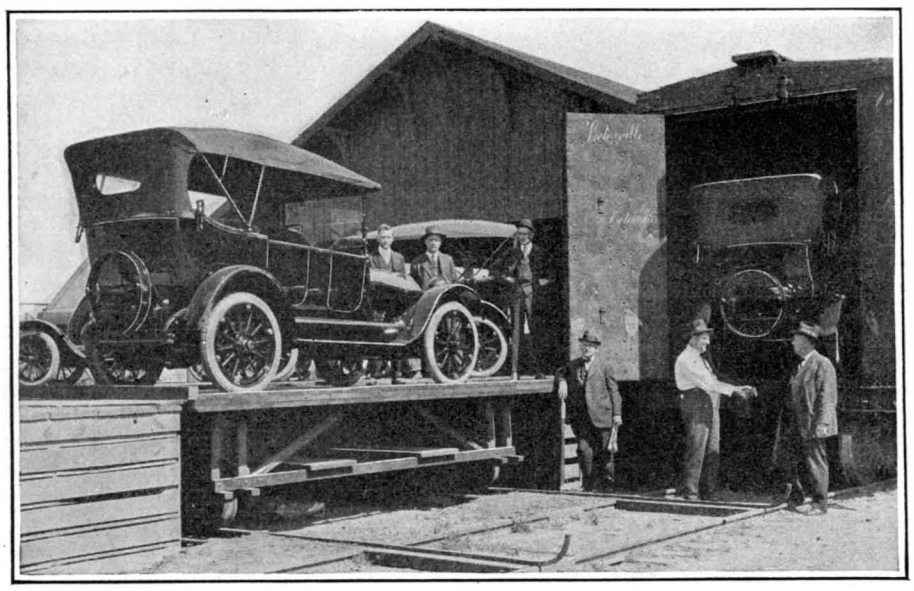
As a result of the tests made at the Forest Products Laboratory, tentative specifications for boxes used in shipment of canned goods of every description have been drawn up and submitted for discussion to the various parties interested in the matter.



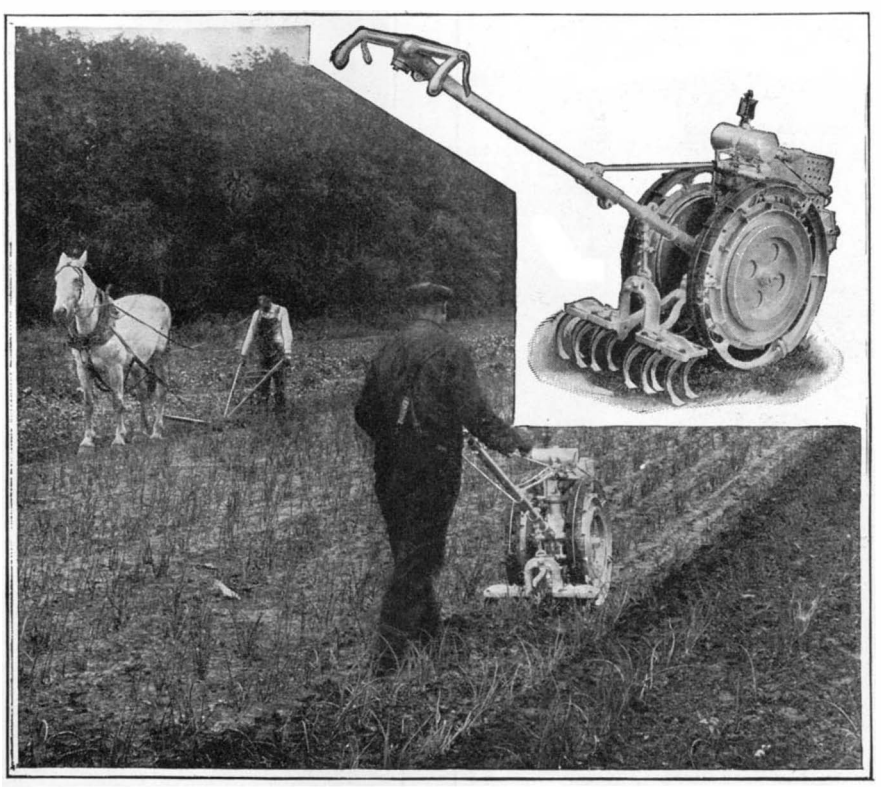
The machine for testing boxes



Running the car out onto the platform, which has been slid out for the purpose



Ready to wheel the car to the warehouse. The platform has been returned to its place



The walking engine for the one-man job

Unloading the Automobile

WHEN the purchaser of a new car accepts a quotation "f. o. b. Detroit" he thinks, probably, that that is the end of the matter. If he interviewed his local freight agent on the subject of getting that automobile out of the box car in which it will arrive, he would get an interesting side-light upon the delivery of touring cars and limousines, with perhaps a bit of profanity thrown in. For this is about the worst job that the freight handler has to tackle with unaided man-power.

A device invented by the agent of the Santa Fe railroad at Riverside, California, promises to solve this problem. The device consists of a movable platform on wheels, which ordinarily remains a part of the warehouse platform. When a carload of automobiles is received it is switched to the house track and the platform run out. This permits of easy access to the end of the car and the machines are run onto the platform through the end door. The platform is then shoved back and the automobiles wheeled into the warehouse.

To facilitate the movement of the platform it is run on a track of lightweight rails, slid out across the siding rails from beneath the permanent platform, and shoved back when not in use. The device is credited with a saving of from ten to fifteen dollars per car in unloading, and with eliminating the use of the flat car in this connection.

A Tractor for the Walking Job

FOR the big jobs about the farm there are tractors and tractors; but what of the little jobs that the tractor will not stoop to, and that are none the less a great drag to do by hand? What farmer has not discovered that it costs more in physical effort to cut his lawn than to harvest his wheat crop, that the preparation of a hundred-acre field for a planting of oats involves much less investment of human labor than does the proper care of a small patch of land destined for garden truck? It is the old problem of hand labor versus machine labor, but in a most aggravating form.

This state of affairs need no longer exist. The "walking engine" changes the whole aspect of small farming. No great labor would attach to cutting the lawn if the lawn-mower supplied its own power for wheels and cutting blades, and required the services of a man simply to keep it on its course. This is precisely what is accomplished by the walking engine; and not merely for the lawn-mower, but for the entire collection of small hand-operated farming tools.

As our cuts will show, this engine in its essential features consists simply of a gasoline motor hung between a pair of wheels and mounted on the end of a long handle. The motor turns the wheels and propels the apparatus wherever the man who walks behind chooses to direct it with his long handle; and it likewise operates anything in the way

(*Concluded on page* 336)

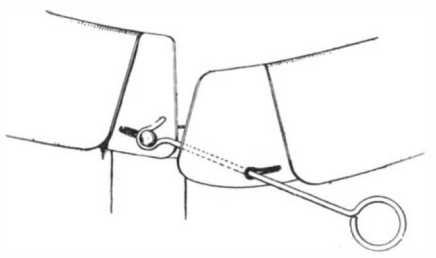
RECENTLY PATENTED INVENTIONS

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

HOSE SUPPORTER.—C. J. HAUSEN, 368 W. 50th St., New York, N. Y. The object here is the provision of a new and improved hose supporter arranged to securely grip the hose without danger of tearing the same and to allow of conveniently engaging the grip with the hose or disengaging it therefrom.

COLLAR BUTTON HOOK.—J. ESCHENBRENNER, Farmingdale, L. I., N. Y. This hook is especially designed for buttoning collars to the collar band of a shirt. The invention



COLLAR BUTTON HOOK

improves the construction of buttoning devices of this character so as to be reliable and efficient in use, simple and inexpensive to manufacture, and so designed that the collar can be easily and quickly buttoned without danger of injuring the collar fabric or the buttonhole, and without danger of soiling the collar.

THIMBLE RETAINER.—G. B. MULLEN, 18th St. and 7th Ave., Whitestone, Flushing, L. I., N. Y. The present invention relates to a device for retaining a thimble on the finger and is especially useful for those who sew by occupation, as the annoyance of the thimble becoming loose and dropping off the finger is effectively avoided.

Pertaining to Aviation

AEROPLANE.—C. A. TEFFT, Gloversville, N. Y. This airship combines the buoyancy of a dirigible balloon and the characteristics of an aeroplane. It has substantially the speed of an aeroplane and the usual characteristics of such a machine, and in addition the buoyancy which will prevent falling in case of trouble with the engine or other parts of the machine.

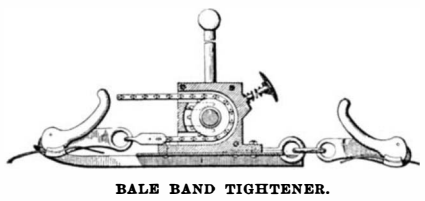
Electrical Devices

OPERATING ELECTRIC CIRCUITS.—M. H. LOUGHRIDGE, 28 Oakwood Ave., Bogota, N. J. The invention relates to electric circuits as used in fire alarms, railway signal systems, etc., and secures greater safety in circuits of this kind so that broken wires, grounds, or crosses with other wires will not cause a false signal, and prevents the improper operation of a remote controlled circuit when energized from any source other than its normal supply.

Of Interest to Farmers

DRAFT BAR.—W. F. DUNN and J. E. KERBY, Talent, Ore. In this case the improvement provides a draft bar which is cheap to manufacture and arranged to permit of conveniently connecting the draft bar with the harrow and with the team or power employed for dragging the harrow over the field.

BALE BAND TIGHTENER.—P. A. SAPP and W. B. MARKSTEIN. Address the former, care of Sapp & Miller, 138 Broad St., Eufaula, Ala. The invention is for use in tightening bands around bales of cotton. It comprises a housing having a rotatable drum or shaft



BALE BAND TIGHTENER.

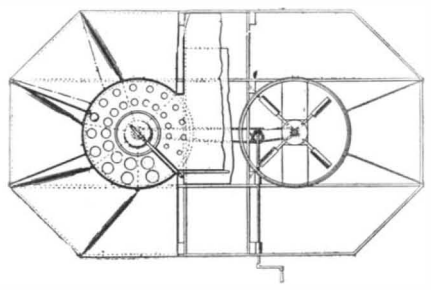
mounted therein and around which passes a flexible connection, to one end of which is secured a band clamp. The housing also has a band clamp secured thereto, and suitable operating means are provided for drawing said connection around said shaft, whereby the ends of the band are brought together.

CHICKEN COOP.—C. W. WRIGHT and H. B. WILLSON. Address the former, 2522 Summit Ave., Little Rock, Ark. This coop is for use in containing poultry or other animals. It may be used until worn out or destroyed, is capable of being set up or knocked down, and when set up will remain firmly and rigidly in this condition, and when knocked down will occupy a small space and will be compact in form.

HAY UNLOADER.—J. J. SHENK, Frederick, Md. In this device a fixed pulley is arranged directly above the wagon to be unloaded, and a movable pulley which may be arranged to permit the hay to be deposited at any point in the barn, and wherein the pull or unloading rope is so arranged that the hay fork with its load will be drawn directly upward toward the fixed pulley until the fork and load are high enough to clear obstructions, and will then be moved to the place where it is to be deposited, and will be released by mechanism, under control of the operator on the wagon, or by an automatic release.

INCUBATOR BROODER SYSTEM.—H. CHARLESWORTH, Mount Kisco, N. Y. This improvement provides an arrangement of hovers and associated parts together with a single heating element arranged to heat each of the hovers and associated parts and to supply to each hover the necessary heat for that particular hover independently of the supply of heat to the remaining hovers.

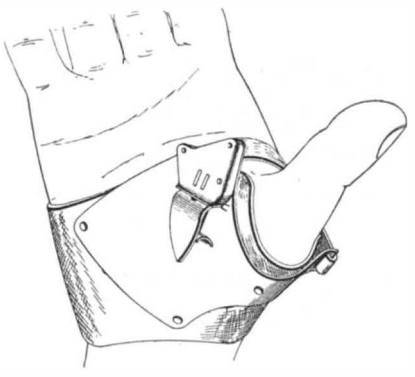
FRUIT GRADER.—F. J. HEACOCK, R. 2, Salem, Ind. This apparatus is so arranged that an attendant can expeditiously remove the culls and separate the remaining apples into two general grades and deposit the same on grading tables, means being provided whereby the apples on each table will be automat-



FRUIT GRADER

ically separated according to size and directed to receiving tables presenting pockets optionally variable for altering the relations of particular pockets to the respective outlets in the grading table, whereby to control the sizes received by particular pockets by diverting from the pockets apples of smaller or larger size.

CORN HUSKER.—H. C. CASKEY, Box 45, Sioux Rapids, Iowa. The inventor provides a hook corn husker having means for automatically keeping the hook free of kernels and unentangled with shreds and fibers of the



CORN HUSKER

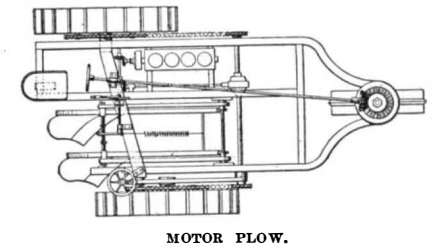
corn husks, disadvantages commonly accruing to hook corn huskers in general. It provides a corn husker in which a spring actuated plunger is arranged for automatically keeping the hook clear of encumbrances.

Of General Interest

SAFETY ATTACHMENT FOR HAND BAGS.—E. E. ROGERS, 7 Clinton Place, Bronx, N. Y., N. Y. This improvement relates to ladies' hand bags and has particular reference to an attachment adapted to render it practically impossible for the hand bag to be surreptitiously opened without detection, but not interfering materially with the proper opening thereof.

GREASE CUP.—W. H. LINDENFIELD, Box 49, Lexington, Tenn. This invention relates more particularly to lubricators designed for supplying hard grease to wrist pins or like parts to be lubricated. It provides a force feed lubricator which will guard against the loss of parts and which involves a simple construction and enables the lubricant to be positively fed.

MOTOR PLOW.—O. O, BOWERS, Cape Girardeau, Mo. This invention provides an arrangement whereby the plows may be mounted in place, and used in the usual manner of plows, or they may be removed and the remaining structure used as a motor tractor. It provides

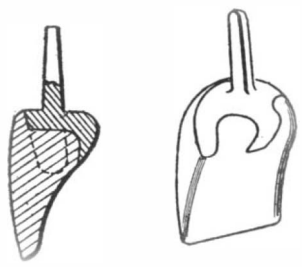


MOTOR PLOW.

a motor plow construction and forms the parts so that one wheel will be in advance of the other so as to cause the plows to plow at an even depth on an uneven surface as well as on an even surface. It also provides a motor plow with a plurality of traction wheels and mechanism for quickly and easily raising and lowering the plows at any time.

CASING SPEAR AND TRIP THEREFOR.—H. C. BREWSTER, care of Oil City Iron Works, Shreveport, La. This invention relates more particularly to a casing spear including a trip whereby the spear may be removed independently of the pipe in connection with which it is engaged, in the event the latter cannot be withdrawn, and provides a device substantially automatic in its action, and which may be readily controlled from the surface for disengaging the spear when desired.

TOOTH.—J. J. WATTS, Natchez, Miss. This invention provides a tooth comprising a body and a separable backing, the body and backing having interengaging means for attaching the



TOOTH.

body to the backing, in order that when the tooth has been once placed, the bodies may be interchangeable. It is an interchangeable all porcelain crown and bridge tooth. It can be used for vulcanite work. The crown or bridge teeth can be ground down close to the coatings of metal and still have ample strength to grind with.

CONTINUOUSLY OPERATING VACUUM EVAPORATOR.—J. DO A. CASTRO, Praca da Republica 34 Sao Paulo, Brazil. This improvement refers to vacuum pans for evaporating sugar juices and other liquid, and the general objects are to improve the construction of vacuum pans so as to be continuously in operation, and hence of large capacity, easily controlled, and so designed as to take up comparatively little space, considerating the output of the device.

SUPPORT FOR TURPENTINE STRIPS OR TROUGHS.—F. S. BAILEY, care of Branch & Snow, Attorneys, Quitman, Ga. The object here is to provide a support adapted to be driven into the tree at the scarf, and adapted to support the pail or cup for receiving the drip, and to support the lower end of the spile or trough for conducting the drip to the cup or pail.

EASEL FRAME.—E. OLDENBUSCH, 366 Butter St., Brooklyn, New York, N. Y. This invention provides a support which will allow the frame on the easel to be moved freely, and, if desired, left in any adjusted position. It provides a pivotal mounting for an easel and a picture frame, the structure being so interlocked as to allow a free pivotal movement of the frame within certain limits.

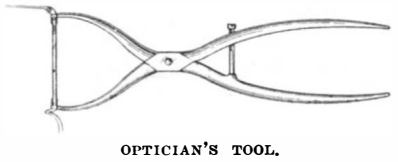
MANUFACTURE OF ARTIFICIAL ROOFING SLATE.—O. J. OWEN, care of Cambrial Slate Mfg. Co., Middle Granville, N. Y. This invention provides improvements in the manufacture of artificial roofing slate from waste slate material whereby the cost of production is reduced to a minimum, and the slate or tile produced is of lasting quality and is practically rendered nonporous, and hence not liable to absorb moisture when in use.

TRUNK.—KATIE L. TRAWEEK, R. R. No. 1, Box 56, Waelder, Tex. In this trunk all the conveniences of home are embodied. It is especially adapted to the use of tourists when remaining abroad for a great length of time, and for purposes of convenience at such times the trunk embodies a wardrobe, an arrangement of drawers, suitable trays, dressing case, book case and writing desk.

COMPOSITION FOR PRESERVING EGGS.—J. H. O'DELL. Address International Egg Co., Inc., care of H. Cleveland Harris, 149 Broadway, New York, N. Y. This invention relates to a composition for preserving eggs. It is simple and inexpensive, and will effectually protect them without reducing the marketable qualities of the eggs as to their appearance or taste. The object of the invention is to provide a composition for efficiently preserving eggs.

Hardware and Tools

TOOL.—W. B. LAMB, Mount Holly, N. J. This invention relates to tools for tightening the lips or shoes of rimless eyeglass or spectacle mounts. It provides a tool more es-



OPTICIAN'S TOOL.

pecially designed for use of opticians and other persons and arranged to permit of quickly and conveniently tightening the two opposite sets of lips or shoes on the edge of the lens without removing the mount from the lens.

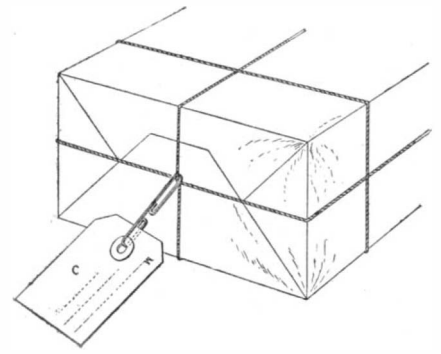
BINDER.—A. V. WELLS, care of Miller & Wilkinson, U. S. Bank Building, Portland, Ore. The device is especially adapted for binding pads or clips of forms in protecting covers, as for instance, check forms, receipts, notes, bills and the like in leather, cloth, imitation leather, imitation cloth, paper or like covers, in such manner that pad or clip will be firmly connected with the cover and in such manner that the stubs of the clips or pads may be removed after the forms have been detached to permit the reuse of the binder and the cover.

FLOATING REAMER HOLDER.—R. RAILTON, 391 High St., Valley Falls, R. I. The socket member for securing the reamer floats in a direction transverse to the spindle having guided movement on the face of the spindle and the socket has means therein which permits the floating of the reamer in said socket in a direction transverse to the floating movement of the socket member so that a parallel movement of the reamer is positively insured in any direction.

AIR PUMP FOR OIL CANS AND OTHER CONTAINERS.—A. J. TOOL, Murdock, Neb. This improvement while applicable to containers generally from which a fluid is to be dispensed, is more particularly intended for embodiment in oil cans. It relates especially to a can equipped without an air pump whereby to produce air pressure within the can for discharging the contents thereof under pressure.

CHAIN WRENCH.—E. PHELPS, 30 Longwood Ave., Brookline, Mass. This invention improves and simplifies the construction and operation of wrenches of this character so as to be reliable and efficient in use, comparatively inexpensive to manufacture, and so designed as to be easily and quickly applied to an object to be turned, and to grip such object with great power.

TAG FASTENER.—E. R. BURGESS, Brookfield, Mass. This fastener is more particularly intended for use in fastening a tag to the cord or wrapping material of packages of merchandise, although the device is capable of use in



TAG FASTENER.

other situations. It provides a fastener of simple form which may be produced cheaply, having at the opposite ends thereof members adapted to be quickly and securely engaged in the fastened condition.

Heating and Lighting

PLUG SWITCH BOX FOR SERIES CIRCUITS.—R. W. BRODMANN, 12 Lincoln Ave., Rockaway Park, L. I., N. Y. This invention has reference to switch boxes especially adapted for use in pits or other places, in car barns, work shops and the like whereby drop or extension lights or equivalent translating devices may be connected with the supply circuit as required.

INCANDESCENT LAMP.—T. J. SHONLEY, corner of Vilas and Girard Sts., Leavenworth, Kan. An object of this invention is the provision of an incandescent lamp which gives a light of such whiteness and quality that the light may be used for matching colors, where the ordinary electric light cannot so be used.

HEAT CONSERVING DEVICE.—C. H. LAND, 64 W. Elizabeth St., Detroit, Mich. This inventor provides highly refractory objects or articles to be used in connection with furnaces which generate a high heat. The type of furnace with which these articles are primarily designed to be used, is that in which the heat originates from combustible substances more especially coal gas, petroleum or any of its products, and the like.

LAMP SHADE.—R. L. CLARK, Union, W. Va. The improvement relates to a shade particularly intended for use on incandescent lamps, and provides a shade that may be rapidly applied to a lamp or removed therefrom, and so arranged as to be readily manipulated to shade the lamp or to expose the same.

Household Utilities

TUMBLER.—EARL W. NEWTON, Chicago, Ill. These tumblers are not only constructed so that it is impossible to nest them but the construction is such that their edges cannot come into contact with one another when several tumblers standing side by side on a table are moved together. It will therefore be seen that when the tumblers are used there is much less danger of breakage than is the usual case.

FILTER.—E. SEAVEY, 116 W. 102nd St., New York, N. Y. This improvement provides a filter more especially designed for household use and arranged to permit convenient attachment to or removal from the spout of a faucet, to insure thorough purifying of the liquid to be filtered, and to retain the sediment or other extraneous matter contained in the liquid.

HANDLE ATTACHMENT.—C. HAUF, JR., 1055 E. 55th St., Brooklyn, N. Y., N. Y. In this instance the object is to provide a simple, convenient and inexpensive attachment which forms a holder for the handle of a utensil for the shanks of cutlery or any other

(*Concluded on page* 334)

Government Experts Discourage American Drug Plant Farming

German Thymol Now Produced from American Horsemint

By L. William Thavis

HUNDREDS of letters are being received every week by the United States Department of Agriculture asking about the growing of plants from which spices, drugs and oils are made. The unprecedented volume of inquiries is attributed by the Department to the high price of the ingredients due to the interruption of imports by the European War.

The drug plant specialists of the department are advising, in most instances, against an inexperienced grower taking up this work, pointing out that skill and exact knowledge are necessary if the venture is to be a success. Another cause for the practical discouragement of such an industry is the fact that comparatively small amounts of these crops are used, so that if the planter cannot get a drug manufacturer to buy his product it goes to waste; whereas if a food crop is being cultivated, what isn't sold can generally be used at home.

For example, it is entirely possible, the experts say, to grow belladonna, from which is derived atropine and other alkaloids very valuable in medicine. The total amount of belladonna plants the entire country uses, however, could be grown on a few hundred acres. Because of the present interruption in the supply of belladonna, a few domestic growers have made a profit recently from this crop. A slight expansion of the industry, however, would quickly increase the supply beyond the demand, and this, together with importation, when resumed, would soon glut the local market and leave little or no profit to the raiser, unless an export market were developed.

Again, thymol, widely used for antiseptic purposes, is a drug manufactured in Germany from a seed grown in India. A few days after the interruption of imports the price leaped from two to seventeen dollars a pound. The Department of Agriculture, however, had been experimenting with a common weed known as horsemint, which grows readily in the South, and yields this substance. This horsemint was brought into cultivation, its drug-bearing quality improved, and a simple process for manufacturing thymol from it developed, with the result that last year there was produced commercially a small quantity of this drug. The industry, however, cannot be widely extended because the total consumption, as indicated by previous reports, is only about 17,000 pounds a year, an amount which can be produced probably on less than 1,000 acres.

The exports of the Department of Agriculture have pointed out that red pepper, used both as a drug and as a condiment, seems to offer one of the most promising fields for replacing an imported by a domestic article. In 1915 in South Carolina 118 acres, yielding 152,000 pounds, were harvested. There is indication, according to reports being received, that this year nearly 500 acres may be devoted to the crop. As one acre produces nearly 1,300 pounds and our total imports in 1914 were only 8,829,487 pounds, it can be seen that a limited acreage would provide all the pepper this country ordinarily consumes.

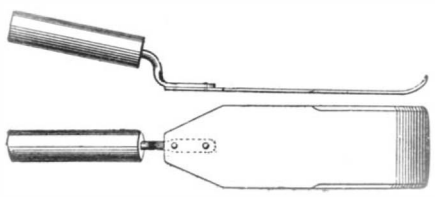
In addition to the products mentioned, there are hundreds of other drugs, oils and spices which are imported and which it is possible for this country to produce for itself. In the aggregate the value of these imported articles is rather imposing, as the figures indicate that we have been bringing in and using about $25,000,000 annually of various drugs, oils and condiments. Much of this money undoubtedly can be kept at home, the experts say.

The mistake made by most people who consider raising these crops is that they are inclined to regard them as staple crops, whereas the domestic demand for them is relatively small, and no foreign market has been developed for them by Americans. It is pointed out also by drug specialists that prices for the articles prevailing under present disturbed conditions are abnormal.

(*Concluded from page* 332)

article used with the utensil, provided the same has a shank.

LARD PADDLE.—M. S. DANNER, Tuskegee, Ala. In removing a quantity of lard on a paddle, the lard has a great tendency to slip from the paddle or blade usually employed, and the prime advantage of the invention is to provide



LARD PADDLE.

a device which will separate a portion of the lard by direct insertion into the mass, and will retain the same on the blade so that the lard may be readily lifted without slipping. The blade is formed for the proper scraping of the curved sides of the tub or barrel.

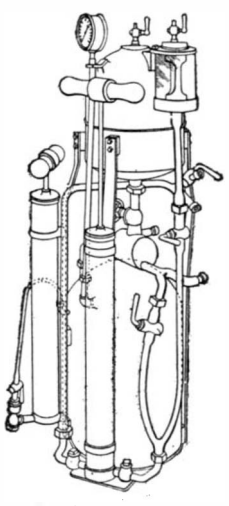
Machines and Mechanical Devices

TRAP.—R. N. INK, Amelia Apt., 10th and E Sts., San Diego, Cal. This invention provides a device capable of use in runs for rats and the like, or in any desired position, wherein a pair of resilient jaws is provided, together with a latch for holding them in operative position, and a bait pan having catches for holding the latch in operative position when the pan is horizontal or vertical.

FIRE ESCAPE.—L. SPIRO, Clarksburg, W. Va. This invention provides a device by means of which a person may descend a rope with perfect safety. It provides a device in which a person may descend a rope at any desired speed, which speed is under control of the person descending.

TURRET ATTACHMENT FOR LATHES.—F. P. MILLER, care of The Crosby Reamer Co., Meadville, Pa. An object here is to provide a new and improved turret attachment for lathes arranged to carry a number of differently shaped cutting tools, any one of which can be quickly moved into cutting positon relatively to the work to be turned at the time.

PIPE CLEANING MACHINE.—W. COHEN, 68 N. 17th St., Bayonne, N. J. This invention relates particularly to means for cleaning beer pipes, and has for an object, not only the construction of a device, but the arrangement of various inter-acting pipes and other parts



PIPE CLEANING MACHINE.

which will produce an improved circulation for thoroughly cleaning and sweetening the pipes. It provides an arrangement of circulating pipes and means for switching the various pipes into operative connection, so that the different mediums may be forced through the pipes to be cleaned.

PRINTING DEVICE.—ASHLEY G. OGDEN, Baltimore, Md. This improvement has reference to printing devices for reproducing a multiplicity of prints arranged in symmetrical relation, from a single negative. It provides a device whereby a multiplicity of prints may be made on a sensitized plate in a minimum of time.

TYPEWRITER ATTACHMENT.—G. H. PACKWOOD, SR., Fort Dade, Fla. This invention has reference to typewriting machines, and one of the main objects thereof is to provide means, located at the keyboard, for releasing the carriage from its escapement to permit it to be automatically carried to any desired point by means of its spring.

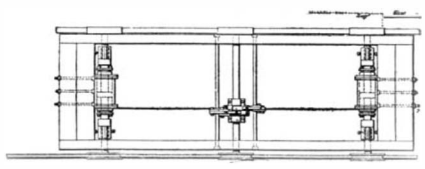
ADJUSTABLE NEEDLE GUARD FOR FINGER PROTECTION.—A. W. PETERSON, 737-8th Ave., Astoria, L. I., N. Y., N. Y. This invention relates particularly to an adjustable guard for sewing machines, and has for an object the provision of an improved construction which may be quickly and easily adjusted to guard the fingers against being struck by the needle, or adjusted to be positioned out of the way.

CAN LABELING MACHINE.—J. F. WRIDE, Sodus, N. Y. In the present invention the improvement has reference to can labeling machines, and the object thereof is the provision of a simple, efficient and inexpensive can-labeling machine which is automatic in its action and which is operable by the gravitational displacement of the cans to be labeled.

LAUNDRY EXTRACTOR.—I. W. CADWELL, 3920 Sheridan Boulevard, Denver, Colo. This invention avoids the present necessity of loading the clothes from the washing machine into a truck and from the truck into the extractor, the truck and extractor basket of this invention constituting a unit and, because of a jack, a presser plate, and the truck guides, the extraction occurs with one handling of the clothes instead of two as at present.

MEANS FOR CLEANSING THE INTERIOR OF BARRELS, JARS, AND LIKE VESSELS.—H. A. COUCHMAN, Shobnall Grange, Shobnall, Burton-upon-Trent, England. This invention comprises the combination with the jet forming nozzle or like element which is introduced to the interior of the vessel to be cleansed, of a motor actuated by the water supply to the said element, for effecting the rotation of the latter, and also the introduction of compressed air to the interior of the vessel for the rapid ejection of the cleansing water therefrom.

OFFSETTING DEVICE FOR SAWMILL CARRIAGES.—E. A. HARRIS, Box 285, Warren, Ark. The invention relates to a mechanism for offsetting the log carriage from the saw when the carriage returns from the cut-



OFFSETTING DEVICE FOR SAWMILL CARRIAGES

ting operations. It provides an automatically controlled steam operated mechanism for offsetting the log carriage from the cutting saw in a sawmill when the carriage returns after having carried the log against the saw to cut off a board.

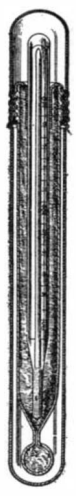
BRICK HANDLING APPARATUS.—W. W. DICKINSON, JR., 1612 Battery St., Little Rock, Ark. An object here is to provide a suspended brick carried in connection with a traveling crane having load discharging means of such nature as to permit of movement of the carrier and crane with respect to the load, in the discharging operation, and thus admit of spotting the load directly over the space upon which it is to be deposited. Mr. Dickinson has invented another brick handling apparatus in which he provides a simple and effective carrier having means whereby to support and carry dried, unburnt brick without clamping engagement therewith and without otherwise endangering crushing or breaking the brick in the then comparatively fragile state.

BOAT LOWERING DEVICE.—J. PHILIPPI, 1235 2nd Ave., Manhattan, New York, N. Y. This invention relates to lowering devices for boats, such as life boats on a ship, and provides a construction and arrangement whereby the boat is normally held properly in position on the ship but continually in condition for quick lowering regardless of the degree of listing of the ship.

WINDMILL.—I. J. MASON, Osceola, Iowa. The wheel consists of a frame, the blades supported by the frame for oscillation on axes radial to the wheel to permit a greater or lesser amount of the surface of the blade to be exposed to the action of air currents, with means for simultaneously oscillating the blades, said means permitting the automatic control of the speed of the wheel in accordance with the velocity of the air currents, also means, manually operated, for permitting the angle of the blades, with respect to the direction of the air currents, to be varied.

Medical Devices

GERMICIDAL THERMOMETER HOLDER.—LEON MARTOCCI-PISCULLI, 235 2nd Ave., Manhattan, N. Y., N. Y. This invention provides a holder which enables the thermometer to be kept absolutely sanitary without using the unreliable methods commonly employed, the holder consisting of a tube of glass or other material which is lined with a tubular pad of



GERMICIDAL THERMOMETER HOLDER.

wool or other porous material which is impregnated with a powerful liquid germicide, the bore of the pad being somewhat smaller than the diameter of the thermometer, so that when the latter is inserted, the liquid is forced to the surface of the bore and thus in contact with the thermometer at all points, whereby a reliable germicidal effect is obtained.

CHIROPRACTIC TABLE.—E. BISHOP, 34 Washington Ave., Endicott, N. Y. Mr. Bishop provides a table arranged to permit of readily positioning the patient without discomfort to the same and with the least physical exertion on the part of the attendant, to allow of adjusting the table to suit the stature and weight of the patient, and to enable the attendant to readily apply the desired treatment.

Musical Devices

APPARATUS FOR CUTTING GROOVES IN RECORD DISKS.—R. SCHIFFMAN, 1462 Fernwood Ave., Toledo, Ohio. This invention provides means for adding a circular groove to a record disk, and means for rapidly transferring the needle of the talking machine from the record groove to said circular groove; provides means for adjusting the apparatus to record disks of different diameters; provides means for regulating the diameter of said circular grooves; and provides means for facilitating the cutting of said circular groove and a switch groove connecting the same and the record groove.

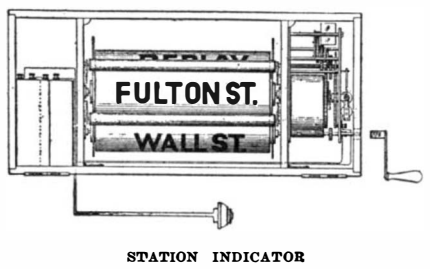
RHYTHMOMETER. — W. B. PARKINSON, care of Camp Ground, Des Plaines, Ill. This invention provides a device by means of which the rhythm of a given example of musical notation may be indicated by means of the pawl and ratchet mechanism, the accent by a bell or other suitable sound producing device, while an indicator shows to the eye the visible results in musical notation.

Prime Movers and Their Accessories

GASIFIER FOR INTERNAL COMBUSTION ENGINES.—G. A. DUBOIS, care of Mottu & Co., Norfolk, Va. The purpose here is to provide means whereby liquid fuel, more particularly kerosene or other heavy carbon oil may be vaporized, and then transferred into a gas for operating internal combustion or hydrocarbon engines or motors.

Railways and Their Accessories

STATION INDICATOR.—F. HEALY, care of M. C. Railway, St. Thomas, Canada. The invention relates to indicators for use on street cars or other railway coaches, and has particular reference to means for indicating to



STATION INDICATOR

the passengers the name of the next street or station, means being provided whereby the conductor or operator of the car, by pressing a button, will indicate by means for changing the indicator so as to present to view the name of the next station.

RAIL FASTENING AND TIE.—G. W. FAIRMAN, R. F. D. Box 1, Plainfield Township, N. J. This inventor provides a fastening and tie structure which will co-act for holding rails properly in place, and which will allow the rails to be quickly and easily applied and removed at any time, or will allow any of the ties to be disconnected from the rail without molesting the next adjacent ties.

BLOCK SYSTEM.—R. C. SUTPHIN, Corydon, Ky. This improvement relates to block systems of that type in which a signal is energized when a train enters a block, and the condition of the entered block is determined by the continuance or discontinuance of the signal. The construction of the system is so designed as to be entirely automatic in operation.

CONCRETE RAILWAY TIE.—L. DUNCAN, Box 985, Butte, Mont. This invention improves the construction of cross ties with respect to the composition of the main body thereof and the means for attaching the rails thereto, the main portion of the ties being made of reinforced concrete and the attaching means providing for cushions of wood or the like to deaden the noise and to increase the life or durability of the ties.

Pertaining to Recreation

FISH LURE.—G. W. BLACKBURN, Sarasota, Fla. In this case the invention relates to means for attracting fish, particularly tarpon. The object of the improvement is to provide a simple and inexpensive contrivance which, when in water, has a tendency to wabble and produce the effect of a wounded minnow.

TOY MOVING PICTURE MACHINE.—A. S. FERGUSON, care of Ferguson Parlor Mirrorscope Co., Springfield, Mo. This invention relates to mutoscopes or moving picture machines in which a series of films are disposed about a core mounted to rotate, constituting a picture wheel. It provides a pad, a means of securing the pad to the core, and means for mounting the core in bearings in a manner to be readily accessible for changing the pad.

PUZZLE RATTLE.—AMELIA MORSE, Rite Specialty Co., 35 W. 36th St., New York, N. Y. This invention provides a child's plaything comprising a holder and a plurality of rotary elements supported along the holder and movable independently of one another into different positions, said elements having on their faces portions of nursery rhymes, pictures or other matter, which, because of the relatively movable nature of the movable elements are adapted to be so arranged as to make complete pictures or readable legends.

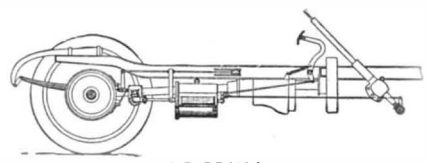
PLANETARY AMUSEMENT APPARATUS.—C. ENGEL, 217 E. 25th St., New York, N. Y. This inventor provides an amusement apparatus more especially designed as an educational medium to familiarize the user with the planets and their movements around the sun, together with their relative sizes and the forces that hold the same in space.

SNOW SKATE.—J. J. TRITZ, 6022 Houz St., Benson, Neb. This invention provides improvements in connection with the ordinary skates to adapt the same to such a use, and particularly to such improvements as are capable of manufacture and sale either as a permanent integral part of the skate, or in the nature of an attachment for the ordinary skate, including the usual ice blade, in order to adapt the same to the present purpose in addition to its normal use.

TOY.—C. E. KEFFER, 610 Alabama Ave., Memphis, Tenn. This invention provides a toy involving figures representing two negroes in a butting match, having simple and effective means to carry the figures to and from each other, and arranges the figures to give the impression of the figures taking a step to and from each other.

Pertaining to Vehicles

AIR BRAKE.—R. SCOGGIN, 661 W. 1st St., W. Eugene, Ore. This improvement provides a brake especially designed for use with automobiles and like vehicles, wherein the brake



AIR BRAKE

is operated by fluid under pressure controlled by the driver, having separate and independent operating and releasing means for the brake, and wherein the pump is operated by the motor of the vehicle for compressing air and storing it for use in operating the brake.

STEERING DEVICE.—F. A. CRANDELL and J. H. HEAVRIN, care of the latter, Bloomfield, Neb. The invention relates to improvements in steering devices for vehicles, such as automobiles. The object is to provide a steering mechanism which is free from the jars ordinarily incident to devices of this kind, but which will positively actuate the wheels with a minimum of effort.

VEHICLE WHEEL.—G. G. JOHNSON, 853 Gibson St., Muskogee, Okla. This invention has reference to vehicle wheels and one of the objects thereof is the provision of means

VEHICLE WHEEL.

for quick and easy assembling a wheel in such a manner as to produce a light, strong, and comparatively inexpensive wheel, and in which the load is carried by the upper portion of the felly as well as by the lower portion.

COMBINATION VEHICLE TRUCK.—H. W. CLARK, West Vienna, New York. This invention relates more particularly to a combination cutter and wheel truck, by which the vehicle may be changed from a wheeled vehicle to a cutter dependent upon the presence of the necessary snow or ice, and provides a flexible device having connections, the nature of which admit of locking the wheels in raised or lowered position, and of the interchanging during continuous movement of the vehicle in use.

LEVER.—C. SMITH, care of Smith Wagon Brake Co., Houghton, Mich. This invention has particular reference to an emergency brake lever employed on automobiles. It includes a novel locking device in the form of a clutch pivoted to the main portion of the lever and normally held in locking engagement with a pivoted bar by spring members secured to said main portion and adapted to be actuated to release said locking device.

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A Serum for Typhus Fever

SUCH excellent results have been obtained in our own Army, as well as in those of various European countries, by anti-typhoid vaccination, that it is encouraging to learn that there are prospects of similar benefits for the more dreadful scourge of typhus which has so recently been ravaging Serbia and other portions of the continent. Two French bacteriologists, Messrs. Nicolle and Blaizot, have lately made public the results of their experiments to this end.

It was first proved that the serum from persons and animals who have recovered from exanthmatic typhus possesses for a short time (from six to ten days after defervescence) preventive properties with reference to inoculation with the virus, though it has no positive curative value.

The next step of the experimenters was to prepare emulsions of the spleen and the suprarenal capsules of guinea pigs which had been experimentally infected with typhus, these organs being chosen because the typhus microbe is specially abundant in them. Since the horse and the ass support excellently inoculations with such emulsions they can be readily hyperimmunized by this means. Hence they were used for the next stage by the investigators. A large number of inoculations, extending over a period of about eleven months, were made in an ass with emulsion of the infected spleen. The ass was bled and the serum used for experiment after the thirtieth, the sixtieth, and the eightieth inoculations.

It was found that when monkeys and guinea-pigs were inoculated with typhus virus and at the same time with the hyperimmunized serum, the latter prevented the development of the typhus. It was further proved that the development of typhus in guinea pigs could be checked if the serum was used at any time during the period of incubation of the germ. The essential point was that such intervention should take place soon enough.

Messrs. Nicolle and Blaizot next tested the serum on human beings, the results of 19 cases being recorded. All were cured; and the earlier the inoculation the more rapid the cure. While this is too small a number to be conclusive, the results are so promising as to give a strong hope that the researches now continuing will soon place the efficacy of the remedy beyond doubt.

New Russian Export Regulations

AMERICAN importers of Russian goods will be interested in the following announcement by the Imperial Russian Minister of Finance.

If an American importer desires to purchase in Russia commodities for shipment to America, he must get in communication with the nearest Russian Commercial Attaché, and supply this official with the following:

(1) Statement from the National City Bank of New York City to the effect that there has been deposited with it, to the credit of the "Section Etrangere, Ministere Finances," the value, in dollars, of the shipment. This is in order that the Minister of Finance may make payment to the exporter, and presumably is in the interest of convenient collection of a war tax on foreign business.

(2) Full particulars as to the quantity and value in dollars of the shipment.

(3) The name and address of the Russian exporter, without which license for shipment will not be issued.

These regulations apply to all transactions in which payment was not made prior to May 14th, 1916.

A Valuable Cement for Pipe Joints

A CEMENT which has stood the action of sixty pounds of steam in a pipe connection where rubber gloves and white lead have failed is made of ten parts fine iron filings and three parts chloride of lime, with enough water to form a paste.

So tough is this cement that when two joints of three inch cast iron pipe, which had been secured with it and left one night were broken apart the cement scaled off a portion of the solid iron of the flange on one of them.

Scientific Annihilation of the Tobacco Beetle

(*Concluded from page* 319)

of 15 minutes. This secondary action is obtained by employing a steel lining inside of the enveloping rectangular casing which covers the lamps and the cigars during sterilization. Beneath this lining is a barrier of lead, and, finally, to check the emanation of the characteristic soft rays issuing through the lead, there is an outer coating of thin steel. This effectually removes all risk to operatives continually engaged about the machines. No expert attendance is necessary. All that is required is to throw the switch and to have a man place the boxes of cigars on the conveyor at one end and another to take them off as they come out of the apparatus. Adjustable platforms at either end facilitate the loading and unloading of the belt.

Mechanically, the machine is extremely simple and the cost of operation is so low that it makes it well worth while for the manufacturer to equip his plant with a sterilizer of this description. In fact, it is probably no exaggeration to say that apparatus of this sort is in a fair way to alter the seasonal methods of the cigar manufacturer and to make it possible for him to work the year through upon a fairly regular schedule. This will also mean steadier employment for his trained operatives. At the same time, there will be removed that uncertain element of loss represented in the ravages of the *Lassioderma serracorna.*

How Fire Conditions are Reproduced in the Laboratory

(*Concluded from page* 319)

break through it, or the sudden quench cause its material to crumble.

The testing plant is housed in a steel-frame building without siding. The panels are 12 by 16 feet in size, and are built within heavy movable steel frames. These frames are designed to permit the moving of the panels from one part of the plant to another, and also to resist the lateral expansion of the panels when heated, thus simulating actual conditions found in building construction. This restraint usually is present when a partition or wall forms part of a building, and under this condition the tendency to expand when heated may cause buckling. It is of course desirable to be able to study this effect in the tests.

One end of the building is devoted to the storage of panels in their frames, and of empty frames. The frames are suspended from I-section trolley beams, and storage trolley beams for 12 frames are provided. In the center of the building is a twenty-five-ton traveling crane, carrying a similar trolley beam. This crane can be used to convey the frames from the storage beams to a trolley beam in front of the furnace, or to support the frames during the construction of panels, or during the application of the stream of water after heating.

The rear wall of the furnace away from the testing panel is constructed of reinforced concrete with a lining of 18 inches or more of fire brick. The open face of the furnace is about 16 by 20 feet in outside dimensions. The inner face of the panel is 17 inches distant from the rear wall of the furnace, so providing the necessary inclosure in which the fire is carried. Two mica-covered observation holes are provided at each end, to permit observation of the inner face of the panel during the test.

The furnace burns fuel oil, which is not previously heated. The oil is blown in by a steam jet at a single burner, which is placed in a pit behind the rear wall of the furnace. The flame passes in through a broad low arched opening under the rear wall of the furnace, spreading out as it does so, and then rises through the furnace. A motor-driven rotary blower delivers the necessary air directly below the burner. The furnace is designed to give nearly uniform temperatures up to about 1,300 deg. Cent., and can be heated up very rapidly. The temperatures are measured by seven thermocouples inserted through holes in the rear wall of the furnace, and extending to within 2 inches of the test panel. Under ordinary circumstances base-metal thermocouples will be used and will be connected to a multiple recorder in an instrument room in a corner of the building. When the highest temperatures are employed, platinum thermocouples will be used.

A pump capable of furnishing a stream of water under 80 pounds pressure through a 1⅛-inch nozzle is provided for the hose stream test.

In carrying out a test, a panel in its frame is conveyed by the crane to the trolley beam in front of the furnace, which is cold at the beginning of the test. When the panel is in place, the furnace is heated at as nearly a predetermined rate as possible, while a record is kept of the furnace temperatures and of the temperatures on the outer face of the panel. After being heated for a definite length of time, the panel is swung away from the furnace, and drawn quickly by a winch onto the traveling crane; and while it is still hot, the water stream is played upon it, unless there is nothing left of it after the fire test.

Besides the tests for which it was originally intended, this equipment will provide excellent means for other fire tests, such as fire doors, theatre curtains, etc.

Can We Put the Sun to Work?

(*Concluded from page* 329)

logical result will be that soon the bureau will be telling the farmer that such-and-such a section gets so many calories of heat per day, instead of saying so many hours of sunshine. Thus the farmer will have an accurate heat record on which to base the raising of crops.

At the Nebraska university farm the pyrheliometer records are now being used in a series of experiments to test the amount of water consumed by corn plants. To get at the experiment accurately it was necessary to know exactly how many heat units the plants received.

"We do not know when we have got hold of something really significant," said the assistant in charge of the Lincoln laboratory. "The reason is that we have no previous records with which to compare. After the plant has been in operation for several years and an average established, we will know more about what is normal and what is not. We do not yet know just how, but we are certain that some day the sun's power now going to waste will be capitalized and marketed."

A Tractor for the Walking Job

(*Concluded from page* 330)

of a cutting edge or point which he chooses to attach to it. It should be expressly noted that the walking engine of itself is simply an engine, and not a farm tool; the farmer has to supply the tool. And whether it be a hoe or set of hoes, a weeder, cultivator teeth, rakes, plowshare, or what not that he attaches to it, is a matter of indifference to this hardy little engine. Any field labor which the farmer habitually achieves by hand labor transferred from point to point by leg power, this machine will do for him with no expenditure of labor on his part except in starting it and steering it. It is just what its name says it is, an engine for all the walking jobs on the farm.

But that is not all it is. Just as the engine from the runabout can be dismounted and made to run the churn and the washing machine and the mill, so this little motor can be moved from place to place and used on all the stationary jobs. And it is vastly more convenient for such work than any other engine we have seen, for it will run itself, as a walking engine, to the scene of its work, even if that be upstairs or downstairs, and can then be placed, with a minimum of effort, in the most convenient location for the job in hand. There are a hundred little chores about the farm that this device will perform. If there ever was a machine developed to take the drudgery out of farm work, we should agree that it is this one.

Motion Pictures and the Chinese Theatergoers

THE motion picture business in China is practically confined to the treaty ports, and more especially to the large commercial centers such as Shanghai, Tientsin, and Hongkong. It has developed almost exclusively in the higher-priced theaters charging from 50 to 75 cents per seat. In Shanghai there are probably six such motion picture houses, while Tientsin and Peking have smaller numbers. Many Chinese frequent these theaters, and special inducements are offered at Sunday exhibitions by reductions in prices.

The films displayed in the theaters prior to 1914 were almost entirely of French manufacture and furnished by French firms. Subsequent to the outbreak of war several American film companies succeeded in creating a demand for their films among the picture theaters of the Orient. So far as the foreign populations in China are concerned, and this may be interpreted also to include a certain number of the wealthy Chinese, there is probably not much opportunity for increased business.

It is believed, however, that there is an excellent opportunity to work up a motion picture business for the Chinese population. In order to do this, prices of admission would have to be very low. The Chinese people are great theatergoers and are extremely fond of theatricals. The native playhouses are money-making institutions and the Chinese sit for hours enjoying the native melodramatic productions. Their theaters are on the order of cafes, tables being provided and tea and Chinese delicacies served. The price of admission is nominal; in fact, many charge no fee for admission, but depend entirely on the profits from the sale of drinks and food products.

It is evident that the motion picture is especially adapted to Chinese audiences, as many of their plays have the character of pantomimes. They also have a species of crude motion picture which was introduced centuries ago and might be called a transparency. Chinese figures are painted on an oiled transparent silk and manipulated behind a screen in such a way as to produce a motion picture effect. These are on a miniature basis. They are very popular and are used universally throughout China.

The Chinese are essentially an agricultural people and live in villages rather than in cities, although there are some large cities. The largest cities are provided with buildings erected for theatrical purposes. They have not developed the idea of scenery for use on their stages, so that the Chinese actors may often be seen standing on a chair frantically grasping at some imaginary object which the audience has been taught to understand indicates the scaling of a precipitous mountain. Armies are depicted by a single file of soldiers walking in one door and out of another. The dress of the Chinese actors is very spectacular, and in a way makes up for the lack of scenery and other decorative features on their stages. They are very fond of melodrama, applaud their heroes, and rejoice in seeing the villain get his just deserts.

There is a big field in China for the development of native films, and it is along this line that the greatest opportunity undoubtedly exists for American film producers. A few foreign films will always find a place in the Chinese motion picture show, but it is doubtful indeed if the Chinese public would continue to patronize these theaters if they exhibited foreign film only. In fact, Julean Arnold, the United States Commercial Attaché in China, strongly recommends that about two thirds of the performance be given to native films and one third to foreign productions. At present a few Chinese theaters are displaying motion picture films, but, generally speaking, the films are badly worn, the machines poor, and the exhibitions not creditable. If the business of producing native films for Chinese audiences is to be made a success, the

Chinese public must be given good pictures, projected by good machines, at cheap prices.

It has been reported that an American is engaged in producing Chinese films at present, and that after great difficulty he has succeeded in surrounding himself with a company of skilled native actors. The Chinese have a superstitious dread for cameras of all kinds and the American producer has had a hard time of it overcoming this feeling. As to whether his efforts are meeting with success, it is still too soon to find an answer.

Giant Fish Incubators

(*Concluded from page* 326)

ing. Fry hatched under five days generally prove to be weaklings. The average run of shad fry measure less than half an inch in length. They grow very rapidly—strangely enough, much more rapidly some years and in some streams than in others. Fry hatched in the spring will ordinarily measure about 4 inches in the fall.

The youngest fry swim about with astonishing vigor. From the moment they are mechanically hatched they appear highly independent and quite capable of battling with the world. They are so minute that several hundred newly hatched fry are difficult to see. For some time they are without color and transparent. They resemble tiny specks of animated gelatin.

The men who ransack the seas and rivers for the eggs of fish are necessarily those who have had training and experience along that line. Strength and vigor are indispensable to them, for they are subject to the severest exposure. While collecting the eggs they spend most of their lives in open boats. These Government spawntakers go to the fishing grounds and from the market fishermen buy the various spawning fish, taking them directly from the nets.

Reaching the station and before they go to the hatchery, the eggs are put through a fairly fine sieve, which releases the eggs, but retains the fish scales and other foreign matter. A change of water of the same temperature as that in hatchery or river is deemed advisable at this time. Before removal to the regular hatching jars the eggs must be "water-hardened," and when in this condition they swell perceptibly and form a mass more or less compact.

The apparatus for hatching of eggs is used only a short time each year, usually two or three months.

A Fire Escape for the Horse

(*Concluded from page* 326)

attend most stable conflagrations will be averted. The device consists of a normal stall with feed box, manger and hay rack with the apparatus incorporated. The front of the stall is a door hung on gravity hinges which allow the door to swing open by its own weight when the latches that secure it are released. The latches at the top and bottom of all the doors are controlled by a small wire cord which extends throughout the building and is joined in many places by links that melt quickly in slight heat. No matter where the fire breaks out in a stable, one of these links will fuse in short order and immediately all the doors fly open. For fire drill purposes the apparatus may be set in motion by a watchman.

By the action of the swinging doors, several other operations take place at once. A gate drops behind each horse, closing what is usually the approach to the stall, the entrance from the interior of the stable; this prevents the horse from backing in a panic and getting farther into the burning structure. Simultaneously with the opening of the outer doors, the mangers collapse, releasing the rope which ties the horse. Normally the rope with knotted end is held between two sections of the manger, which are notched in such a manner that the two edges meet and form a round hole of one-inch diameter. When the manger collapses, the two edges fall apart and the rope with its knot at the end slips out.

Thus in a single operation occupying a few seconds, the door to each stall is opened, the horse is loosed from its rope and the retreat to the interior of the stable is prevented. There is enough noise attending the falling of the gate, manger, etc., to startle the horse, so that seeing a way to freedom it will run outside.

In many stable fires there is much loss of time involved in trying to release the animals, which often resist and struggle in terror so that it is impossible to get them out-doors. This precious time might be spent in getting the fire under control if an animal fire-escape were installed, and thus in many fires the loss of the building might be averted, while the stock would be all saved. Thus, altogether aside from the humanitarian motive, the automatic fire release for animals is an excellent device to install in the stable, as it would pay for itself many times over in case of fire.

The Vindication of the Battle-Cruiser

(*Concluded from page* 315)

structure being reduced to a minimum.

It would perhaps be well for America to build her first four battle-cruisers considerably faster and more powerful than contemporary vessels, thus endeavoring to anticipate the development of the type. Otherwise, in about eight years' time the bulk of her battle-cruisers might possibly be somewhat out of date.

It is recognized that in naval design Italy takes a very high place, and that she has foreshadowed future naval construction with great accuracy.

Colonel Ferretti, the designer of the new Italian super-dreadnought, of the "Cristoforo Colombo" class, read a masterly paper recently to the International Engineering Congress in which he dealt with the trend of modern warship design. He also suggested a type of battle-cruiser, involving many improvements and innovations, based on experience gained in this war.

Of the mass of detailed information given by Colonel Ferretti it is only necessary here to draw attention to the stringent reduction of all superfluous superstructure; the low freeboard; and the protection given against aerial attack by the turtle decks, and the armored hoods over all searchlight platforms and funnels.

No doubt the ship presents a rather bizarre appearance, and many experts would condemn the five-gun turrets as crowded and unwieldly. Nevertheless, one of the greatest naval designers of the day has pronounced these feasible, and there are many points which will doubtless find place in future designs.

The sides slope inwards towards the keel so as to deflect a shell striking it, and the 12-inch belt provided amidships with this property is estimated to easily withstand a 15-inch shell.

The whole internal protective system is arranged in elaborate and ingenious detail. An exceptionally deep double bottom is provided amidships, independently framed, and special protection devoted to all vital parts.

The displacement is estimated at 32,000 tons and an armament is provided of 10 15-inch, 12 7.5-inch in four three-gun turrets, and 28 4-inch guns, 18 of the latter being on disappearing mountings and having an exceptionally high arc of fire for use against aircraft. In addition to these, 8 submerged torpedo tubes are carried.

The designed speed is 26 knots, to be increased by 2 knots in emergency. This is obtained by 20 water tube boilers connected with four turbines, working four screws.

Other details of note are the 20 searchlights in twin mountings, and the range-finders mounted in the roof of each large turret.

Taking a broad view of this ship, it would appear that naval construction is traveling in a large circle which will eventually lead us back to a vastly bigger, faster, and more powerful monitor!

Conservation in the Manufacture of Coke

ONE of the effects of the European war on American industry which has especially aroused the interest of technical and business experts of the Government, and of which they are willing to admit that they are proud, is the marked increase in the production of "by-product coke." To the layman this might seem a humdrum thing to wax enthusiastic about, but to the initiated the statement that there has been an increase in by-product coke, or coke from by-product ovens, is most significant. It is from the by-products obtained in such ovens that are made some of the things that America has been practically without as a result of war conditions—dyes, chemicals and rare drugs. In the past most of the coke turned out in this country has been in the "beehive" ovens, from which all of the priceless potential by-products literally go up in smoke.

Recent compilations by the United States Geological Survey show that more than 14,000,000 tons of by-product coke were produced in this country last year, an increase of 25 per cent over the preceding twelve months and 10 per cent over the greatest amount ever before produced in United States. This is taken as significant by the mining experts, for the total production of coke last year was not so great as the record output of 1913. More than 65 per cent of the coke is still made in the wasteful beehive ovens, the Geological Survey finds, but the percentage is constantly decreasing as the more scientifically produced by-product coke increases. Since the end of last year, the Survey has learned, there have been few, if any, additions to the beehive ovens while a sufficient number of by-product plants are in process of construction to add 200,000 tons of by-product coke each month to the country's output.

While the means for giving America a home supply of materials for manufacturing the innumerable coal tar derivatives are constantly being increased, the plants for utilizing these invaluable raw materials in various ways are also springing up. Numerous additional dye plants are already in operation, turning out the more usual coloring materials, while chemists in the laboratories of these concerns are patiently working out processes for producing the rare colors which now are made only in Germany.

The dye industry is not the only one which is being benefitted by the increased production of coke by-products. Manufacturers of explosives are making use of tons of the material, and other tons in the form of ammonium sulphate are being used as fertilizer—practically our only nitrogenous fertilizer produced at home in large quantities.

Hardening Tools for Cutting Castings Containing Chilled Spots

SOME iron castings, when put on a planer or shaper, are so very hard, having a number of chilled spots on the surface, that it is a difficult and tedious matter to keep the tool sharp enough to do good work. Continual trips to the emery wheel are necessary, causing annoyance and wasted time. In cases of this kind, the writer uses a tool hardened as follows:

Heat a good quality of tool steel (not the high-speed variety) to a cherry-red; plunge into salt water until cold; pull out and hold over the fire until a drop of water will evaporate when placed upon it. Then plunge into cold water. This takes the hardening strain off the tool and prevents the edges from breaking out. In practice, a tool of this kind will work well on chilled spots and keep a sharp edge.

America's Second National Exposition of Chemical Industries

SOME time during September of last year there was held at the Grand Central Palace in New York City the First National Exposition of Chemical Industries—a distinctly notable event in the evolution of American industrial life. Expositions of this branch in other countries have been of the greatest value in developing a solidarity of interests among chemical manufacturers, in bringing them more closely in touch with producers of raw materials, with novel devices and perfected methods, with designers of improved mechanical accessories, and finally, with the consumers of finished products. Such occasions have been stimulating, suggestive, and inspiring; showing where national resources have been neglected, where the needs of domestic consumption have been overlooked or only inadequately met, and, on the other hand, where difficulties and obstacles, physical, technical, or commercial, have been vanquished by the intelligent application of pluck, daring and skillful adaptation.

The first gathering of America's technical chemists for a comprehensive presentation of their achievements in meeting the nation's demands for an enormous variety of products that fall ordinarily into the category of chemicals was unquestionably highly educative. It showed marvelous accomplishment in certain fields; in others it revealed a lack of enterprise in utilizing effectively and fully the magnificent treasures of our mines, forests, fields, and streams.

The Second National Exposition, held at the same place during the week beginning September 25th of the current year, was fully as noteworthy. The number of exhibitors was tripled, and while over 50,000 visited the exposition of 1915, an attendance ranging from 100,000 to 200,000 must have visited the more recent exposition during its life.

No branch in the cycle of American industries has presented such a marvelous rate of expansion during the past two years as chemical technology. The degree to which this nation was dependent upon foreign sources for the greater part of its chemicals, drugs, and dyes was revealed to Americans in a brusque, uncomfortable manner, as the rapid succession of embargoes consequent upon the great European conflict suddenly threatened a multitude of manufacturing activities dependent upon regular supplies of certain chemicals with dislocation or paralysis.

The recent exposition has been a barometer, as it were, showing in a vivid, picturesque way the wonderful progress and adaptation characteristic of these past few months, how American enterprise, skill, science, and capital have united to lay broad and deep the foundations of a comprehensive and self-contained national chemical industry. While the genius and energy of European chemists have been concentrated upon means and methods of destroying life and annihilating armed power, American chemists have been equally active in synthetic, constructive fields, swiftly evolving, one after another, various branches in industrial effort destined to emancipate us from a foreign commercial yoke.

Among the many interesting features illustrative of this evolution were such exhibits as the following: The barium industry, now utilizing to the fullest extent the boundless deposits of barytes; the contact sulfuric acid process, now unsurpassed in volume and perfection of method; chemical glassware and porcelain, equal to the finest products of Germany; bleaching powder of the highest grade, of which, two years ago, but one quarter of the country's needs was of domestic origin; the numerous sodium compounds, such as ferrocyanide and the chlorate, now effectively and satisfactorily replacing the corresponding potassium salts formerly imported in large quantities; a large group of medicinal chemicals hitherto secured exclusively from across the Atlantic, and many other similar instances of America becoming her own chemist.

There were instructive exhibits showing how American ingenuity is seeking to solve the nitrogen problem and free us from further dependence upon Chile's swiftly vanishing stock of nitrate. Also there were exhibits revealing the ways in which our potash problem is being worked out—slowly, but surely. The great feldspar deposits in many sections of the land, the vast supply of alunite in Utah, the waste gases of cement works and iron furnaces, all are contributing to the insistent appeal of American agriculture and industry for the customary rations of potash. Most important of all is the intelligent exploitation of the kelp along our Pacific littoral. Ordinarily, we have imported annually over 1,000,000 tons of potash salts from Europe. We have neglected the enormous supply of potash which the waters of the Pacific offer us, involving no other outlay than that of harvesting a crop worth annually $90,000,000 for its potash content, but containing in addition combined nitrogen, suitable for fertilizer purposes, valued at $60,000,000.

The most striking feature of the exposition was to be found in its revelation of the astonishing rapidity with which an American coal-tar chemical industry is being created. Formerly most of the coal-tar, benzol, and ammonia liberated by our by-product coke ovens was allowed to go to waste. Now it is recovered.

There has been an almost mushroom growth of the industries producing dyestuffs, explosives, photographic chemicals, and synthetic medicinals, flavors and perfumes from prosaic coal-tar. And yet there is little of the mushroom about the spacious factories and jungles of machinery which have so swiftly appeared upon the scene. They are substantial, permanent assets in our industrial arsenal.

Two years ago a single firm made aniline on a small scale, while six companies produced artificial dyestuffs from intermediates imported from Europe. To-day 18 companies are producing synthetic carbolic acid, and over 40 are producing aniline and other intermediates. Over 30 companies are making coal-tar dyes. The total number of operatives in this branch two years ago was 400; now single establishments employ 1,000 workmen. In 1914 we made one tenth of the synthetic colors consumed in the United States by "assembling" foreign semi-manufactured material. To-day we produce three quarters of the amount of artificial colors normally required by our textile, paper, and other industries, and every pound is made from American coal-tar! The production is largely concentrated upon a few staple colors used in great amounts. The variety of shades available is, however, being rapidly increased. A few years will see the American industry able to supply the great bulk of the domestic demand both in quantity and in variety. Most of the new companies engaged in building up the American coal-tar industry displayed their products in the exposition.

The National Government early recognized the importance of furthering in every possible way the evolution of the chemical industry, and this was attested to by the varied and extensive exhibits made by different Governmental bureaus at the exposition. They were eminently interesting and instructive. However, instead of grouping the exhibits together, as was done at the first exposition, the authorities decided to locate the separate exhibits of the various bureaus at different parts of the building, in order to avoid the formation of large groups of visitors, as was the case last year with the combined exhibits.

Concluding, it may be said that the Second National Exposition of Chemical Industries carried this message to those who had the good fortune to visit it: Americans are well along the road to commercial independence from foreign purveyors of chemicals, drugs, and other similar products. Much still remains to be done; for industries that have taken years for Europe to build up cannot be emulated in the space of one or two years.

NEW BOOKS, ETC.

SYNCHRONOUS SIGNALLING IN NAVIGATION. By J. Joly, M.A., Sc.D., F.R.S., Professor of Geology and Mineralogy in the University of Dublin. London: T. Fisher Unwin, Ltd. 8vo.; 64 pp.; illustrated. Price, $1.40 net.

Synchronous signaling is based upon the theory that if two signals are simultaneously sent out from a coastal station to a vessel at sea, one signal taking no appreciable time to reach its objective, while the other—say, a sound, traveling through a medium for which its rate is known—reaches the objective after a recorded interval, it should be easy for observers on the vessel, equipped with suitable instruments, to determine with a fair degree of accuracy their distance from the signal station. This principle, with certain modifications and by the additional aid of an instrument called a "collision detector," might be applied in the case of two vessels hidden from each other by darkness or fog. Dr. Joly had written his extremely interesting paper before he learned that experiments of this nature had been carried out some five years ago by our own Hydrographic Department from the Nantucket Shoals light ship. Such an exact method, if it can be properly developed—and there seems no good reason to doubt its feasibility—would mean not only increased safety, but also increased speed and more efficient operation of marine service.

DYKE'S AUTOMOBILE AND GASOLINE ENGINE ENCYCLOPEDIA. By A. L. Dyke, E. E. St. Louis: A. L. Dyke, 1916. 8vo.; 822 pp.; illustrated. Price, $3.

The fifth edition of this handbook is much improved by careful revision and judicious enlargement. No pains have been spared to make every detail intelligible to the student; the fifty different sections of this work cover everything connected with the assembly of the car, the engine, the electrical equipment, and carburetion. As all owners and drivers soon realize, the automobile and the gasoline engine have a physiology and a pathology all their own. Just as a physician might carefully explain the body and its diseases to a layman, so the author, a pioneer in the field, lays before the reader the entire make-up and working principles of the automobile, and of marine and stationary internal-combustion engines, furnishing visual instruction by the lavish use of illustrations and charts. Excellently as the volume takes upon itself the functions of a teacher, it is no less useful as a work of reference. It includes a dictionary of motoring terms, sections on tires and tire repairing, and a digest of troubles that concisely points out causes and applies remedies. Three supplements treat with much particularity of three popular makes of cars; but the general instructions so embody practical principles that, once these have been learned, the mastery of constructional details should be a comparatively easy matter.

ELECTRIC MOTORS. Direct and Alternating. Principles, Construction, Operation and Maintenance. By David Penn Moreton, B.S., E.E. Chicago: Frederick J. Drake & Co., 1916. 12mo.; 241 pp.; illustrated. Price, $1.

ELECTRICAL TABLES AND ENGINEERING DATA. By Henry C. Horstmann and Victor H. Tousley. Chicago: Frederick J. Drake & Co., 1916. 12mo.; 331 pp.; illustrated. Price, cloth, $1; leather, $1.50.

"Electric Motors" presents the fundamental principles of the electrical and magnetic circuits; common methods of measuring current, pressure, resistance, and power; armature windings for both direct-current and alternating-current motors; and the various types of these motors. The treatment is such as to offer the greatest assistance to the practical man, and frequent examples illustrate the application of relations and principles. In "Electrical Tables and Engineering Data," all who are interested in electrical work will find a dependable handbook that conveniently fits the pocket, and one rich in information of the sort that is in daily demand but seldom accessible in the moment of greatest need. A wide range of problems is covered, and reference is greatly facilitated by the alphabetical arrangement, while the numerous tables will often make unnecessary many long and time-consuming calculations.

HEADACHES AND HOW TO PREVENT THEM. By W. H. Riley, M.D. Battle Creek, Michigan: Good Health Publishing Co., 1916. 8vo.; 144 pp.

Dr. Riley starts out by emphasizing the facts that headache is merely a symptom, not a disease, and that the best cure, indeed the only permanent cure, lies in the formation of hygienic habits. After devoting several chapters to the various kinds of headache and their causes, the important matter of diet is taken up; it is maintained that dietetics is no longer a matter of guess-work, but that the housewife of today may, if she will, prepare the right food in such a way as to make for the health of the family. The diet list given is based upon the findings of the Department of Agriculture, and the patient is given a clear idea of the way to plan an ideal dietary. A succeeding chapter is devoted to hydrotherapy. The final chapter reviews the general rules of health, and offers the comforting assurance

that five-sixths of all headaches are preventable. No complicated or dangerous treatments are advocated, and the common-sense recommendations of the work are supported by common-sense reasons.

GRAY'S PLUMBING. Design and Installation. By William Beall Gray. New York: David Williams Company, 1916. 8vo.; 559 pp.; illustrated. Price, $4.

The thoroughness of this work and its convenient arrangement make it truly an encyclopedia of modern practice. Part I is devoted to arithmetic, geometry, and trigonometry for mechanics; Part II takes up water supply work and its installation; Part III treats of plumbing fixtures, their respective merits, and the modes of setting them; Part IV discusses soil and waste systems, sewerage and drainage work, and methods of disposal; and Part V deals with miscellaneous subjects of importance to plumbers and others. The author has both the requisite experience and the ability to express himself plainly, and in this latter task he is aided by five hundred original drawings illustrative of typical problems and their solution. Time-saving tables are included in the volume, which aims to be so comprehensive that other works of reference may, to a great extent, be dispensed with. No methods are described that are not in modern and successful use.

TALKS ON BUSINESS CORRESPONDENCE. By William Cushing Bamburgh. Boston: Little, Brown, and Company, 1916. 8vo.; 246 pp. Price, $1 net.

Many a good business man would be surprised and not a little disgusted if he could see his business letters as others see them. When a man's correspondence gives us the impression that he is an amateur in letter-writing, we are subtly influenced to think that he is also an amateur in business; while this by no means follows, the fact remains that the man's letter has prejudiced us against his ability; so that the letter was undeniably bad business. Mr. Bamburgh's very sensible dissertation sets forth the "ritual of principles, customs, rules and methods" that, in commercial correspondence, result in the conveyance of favorable and clear impressions by honest means. The work also deals with sales campaigns, relations with customers, mail and mailing, and files and filing. These subjects are capably handled, as the author's own wide experience would lead us to expect, and there are very few men who would not be benefited by a careful reading of the book.

ETERNITY. World-War Thoughts on Life and Death, Religion, and the Theory of Evolution. By Ernst Haeckel. Translated by Thomas Seltzer. New York: The Truth Seeker Company, 1916. 8vo.; 173 pp.; illustrated. Price, $1.25 net.

In this little volume, the distinguished German monist philosopher attempts to explain the great war by the laws of natural evolution; he regards the problem of the descent of man from the primates as definitely solved, and he believes that "this solution leads directly and surely to the monistic conception of all natural laws, and to the true estimate of 'eternity.'" The work restates the conclusions of the evolutionist, and is, of course, materialistic in every aspect. Perhaps the greatest interest, or at least the more popular interest, lies in those portions which reveal the attitude of the intellectual German toward the war and what is to follow it. His conclusion on the one hand is that "England alone bears the guilt," and, on the other, that any consideration of peace "must demand a considerable extension of the German Empire."

STRESSES IN WIRE-WRAPPED GUNS AND IN GUN CARRIAGES. By Lieut. Col. Colden L'H. Ruggles, U. S. A. New York: John Wiley & Sons, Inc., 1916. 8vo.; 270 pp., illustrated. Price, $3.

This text, which describes and illustrates the more important principles in the design of wire-wrapped guns and of stresses in gun carriages, was originally printed by the Military Academy Press for the sole use of the cadets. Its re-issue in the present form makes publicly available these principles, together with the methods of Ordnance Department officers who have been engaged in this work. The information from numerous foreign publications is also summarized. The six chapters of the book deal with the elastic strength of the guns, the determination of the forces brought upon the main parts of the 3-inch field carriage by the discharge of the gun, the determination of forces produced under similar conditions in the case of a disappearing gun carriage, the stresses in parts of carriages, toothed gearing, and counter-recoil springs.

PELOUBET'S SELECT NOTES ON THE INTERNATIONAL LESSONS. For 1917. By F. N. Peloubet, D.D., and Amos R. Wells, Litt.D., LL.D. Boston: W. A. Wilde Company. 8vo.; 376 pp. Price, $1 net.

These annual Notes have been in use for forty-three years, and need no introduction to Sunday school workers. The first six months of 1917 are devoted to studies in the Gospel of St. John, and the last six months to Old Testament subjects. The work is a valuable aid to teachers of all grades, with simple explanations of the text, library references, and many subsidiary helps in the form of maps, pictures, subjects for discussion, quotations, and chronological tables.

Power from the Sun

THE sun is no longer regarded as a monstrous ball of fire, burning in the manner of our grate fires at a temperature of several hundred thousand degrees Centigrade. Great as is its mass, it would be consumed with comparative rapidity if such combustion were taking place. The temperature of the surface of the sun has been determined as about 6,000 deg. Cent., far too high to permit the formation of most chemical compounds, without which the production of heat by combustion is impossible. Such a temperature decomposes nearly all compounds into their elements and prevents their reuniting and the consequent production of heat.

Scientists are by no means certain how the sum's heat is produced. One theory is that it is due to radio-activity, another that the energy to keep up the radiation could be supplied by a relatively microscopic contraction of its volume. The latter suggestion is not wholly satisfactory, as it implies that the age of the sun is only about 17,000,000 years, or less than that of the earth.

As to the structure of the sun there is also doubt; but the inner portion may be spoken of as the nucleus and the outer portion as the atmosphere. When the outer layers of the atmosphere get relatively cooler they sink to a lower level, their place being taken by hotter layers, thus actuating a continual circulation of the sun's atmosphere. The weight of an average cubic foot of the sun is only one quarter that of an average cubic foot of the earth. The density of the sun being so small, it has been concluded that it can still continue to contract, getting hotter all the time instead of cooler as is popularly supposed.

The great glowing surface which the sun presents to us, even considered as a flat disk, has the enormous area of 585,750,000,000 square miles, each square foot of which emits the tremendous amount of about 12,500 horse-power. The radiant energy received on the surface of the earth at noon on a clear day is about 5,000 horse-power per acre. Now the quantity of this solar heat per unit area, which arrives in unit time at the outer surface of our atmosphere is called the solar constant, and its value is 1.93 calories per square centimeter per minute or 7.12 British thermal units per square foot per minute.

Owing to the obvious fact that there is a limit to our supplies of coal and oil, the possibilities here implied have attracted many experimentors, among whom were the late Secretary of the Smithsonian Institution, Dr. Samuel P. Langley, and Dr. Charles G. Abbot, now studying this very thing in the Smithsonian observing station at Mount Wilson, California.

Attempts to utilize the heat of the sun date back to De Caux, who in 1615 undertook some solar work, and include the experiment of Buffon, who in 1747 succeeded in setting fire to a tarred plank by solar rays reflected from a combination of flat mirrors at a distance of 150 feet. He did this to show the possibility of the legend that Archimedes thus set fire to the fleet of Marcellus at Syracuse in 212 B. C.

One handicap, so far, has been the fact that the efficiency of solar engines has not been over 4.32 per cent of the heat value received, while that of the ordinary steam engine is about 11.5 per cent, and the gas engine as high as 25.5 per cent. It appears, nevertheless, that with experiments lasting over the number of years through which the coal-fed steam boilers have been improved, sun boilers will be brought to a far better state of efficiency. This view is supported by recent experiments conducted at Meadi on the Nile River, 7 miles south of Cairo, during two years' work. The plant was composed of five 205-foot boilers placed on edge and in the focus of five channel-shaped mirror reflectors of parabolic cross-section, totaling an area of 13,269 square feet. The maximum quantity of steam produced was 12 pounds per 100 square feet of mirror surface exposed to the sun, and the maximum thermal effi-

ciency of the mirrors was 40.1 per cent. The maximum output for an hour was 55.5 brake horse-power, a result about ten times as large as anything previously attained and equal to 63 brake horse-power per acre of land occupied by the plant. These results seem to indicate the great value of solar boiler operation, especially where sunshine is plentiful and coal scarce.

Storm Warnings for Herders of Sheep

DURING the past spring the Weather Bureau established a special storm-warning service for the sheep ranges in Oregon, Washington and Idaho, to enable the owners of some 2,000,000 sheep and lambs to protect them from the effects of disastrous storms. Owing to the great success obtained, the Bureau intends not only to maintain the service, but to extend it.

Unless they can be protected in time, large numbers of lambs and recently sheared sheep are killed by storms, especially those accompanied by snow and cold rains. This is doubly true, because early lambing to meet high market prices is extensively practiced in this section, and because winter feeding is expensive, and sheep are usually shorn and put on the ranges as early as possible. Even before shearing, according to those who know most about the raising of sheep, under especially stormy, snowy and muddy conditions, an ewe will readily succumb to fatigue and starvation, and her lamb may perish with her.

It is said that there have been many instances where the losses have reached as much as fifty per cent of the flocks, when the animals were valued at six dollars each. As a result of such losses, the owners make a practice, wherever it is possible, of keeping their shorn sheep near canyons or other shelters during unsettled weather in the early spring. Later in the spring and early summer the sheep are allowed to graze more widely, and the herders must have warnings of storms sufficiently in advance to enable them to drive the sheep to some nearby shelter. During the springs of 1914 and 1915, according to statistics, many thousands of sheep perished which were beyond the reach of shelter in the severe storms that sweep over the northwest States.

The Weather Bureau operated its service this year through twenty-five distributing centers, through which weather reports and special warnings covering the temperature, snow, rain, winds, clouds and clear sky, were distributed to nearly 100 other communities. All of these conditions have a significant bearing on the safety of the sheep.

From these twenty-five points the word was passed along by telephone to several hundred additional stockmen. In this manner the warnings reached the owners of most of the sheep in the States mentioned by noon, or even earlier, of the day of issue. In sections in and around the National Forests the forest supervisors cooperated with the Weather Bureau in distributing these forecasts and warnings. Plans are now being worked out at the Bureau whereby the service can be extended. It is probable that the forecasts will be sent out in the same way as at present, except that they will be much more widely distributed.

Spinning Cotton by Mouse Power

MAN has harnessed the winds, the tides and the cataracts, and disciplined the horse, the ox and the elephant. Long ago he began to earn leisure for himself by forcing nature, both animate and inanimate, to labor for him. David Hutton, an ingenious Scotchman, actually proved that stores of profitable energy were going to waste among the tiny active domestic mice!

We quote his own account of his curious experiments. "In the summer of 1812, I had occasion to be at Perth. While inspecting the toys and trinkets that were manufactured by the French prisoners in the depot there, my attention was attracted by a little toy house with a wheel in the gable that was running rapidly round, impelled by the activity of a common mouse. For one shilling I purchased the house, the mouse and the wheel. But how to apply half ounce power (which is the weight of a mouse) to a useful purpose was the difficulty. At length the manufacture of a sewing thread seemed the most practicable."

Mr. Hutton found that an ordinary mouse would run on the average ten and a half miles a day; he had one mouse that ran the remarkable distance of eighteen miles in that time. A half-penny's worth of oatmeal was sufficient for thirty-five days' food for one mouse, which during that time ran three hundred and sixty-two miles. He kept two mice constantly engaged in the making of sewing thread for more than a year. This thread mill was so constructed that the mouse was able to twist, and reel from one hundred to one hundred and twenty threads a day. To perform this task it had to run ten and a half miles, which it did with ease every other day.

On the half-penny's worth of oatmeal, which lasted for five weeks, one of these little creatures made three thousand, three hundred and fifty threads, twenty-five inches long. Since a penny was paid to women for every hank made in the ordinary way, the mouse at that rate earned nine pence every six weeks. After deducting the cost of food and machinery, there was a clear yearly profit from each mouse of over six shillings.

Mr. Hutton intended to apply for the loan of Dunfermline Abbey, which was empty, where he planned to set up ten thousand mouse mills, and still have room for keepers and several hundred of spectators, but the project was never carried out because of the inventor's sudden death.

Potash as a By-Product

MORE and more the manufacturers of the United States are learning what those of Europe, and especially of Germany, discovered many years ago—that the paying end of an industry is often its by-products. That lesson, which is being taught through the Government's technical agencies, is promising to help in the solution of the recently perplexing potash problem.

When the European war cut off from America its annual supply of $20,000,000 worth of German potash, Germans felt pretty sure that the shipments could be resumed again when peace came, however long the delay might be, because Germany has a virtual monopoly on the world's potash stores. With the German potash not available, Government scientists at first devoted their whole attention to the attempt to find in this country deposits of natural potash salts, and this gave German interests no great alarm because of the known scarcity of such beds. Now, however, the Bureau of Mines is finding that there is great promise of a production of potash as a by-product from more than one of the great established industries of the country and representatives of the German potash trust are really coming to fear for the first time that their best customers will be lost.

Experts of the Bureau of Mines first demonstrated some months ago that potash in paying quantities can be extracted by electrical devices from the fumes issuing from Portland cement plants, and already numerous cement establishments in all parts of the country are installing the necessary machinery to save this hitherto wasted by-product. There was some question whether the cement industry would furnish enough potash for home consumption even if all plants installed the fume-precipitating devices; but recently the Bureau of Mines has found that in another of our dominant industries—steel and iron making—tons of priceless potash are being sent skyward in fumes from blast furnaces. Experiments in the electrical recovery of this potash are being made by one pioneer steel concern and are being watched with interest by the Government metallurgists. If this newest possible source for the fertilizer ingredients so sorely needed by American agri-

culture proves as valuable as early experiments indicate that it may, it is probable that more than enough by-product potash for home consumption can be produced in this country from the two great metallurgical industries, lowering at the same time the cost of iron, steel and cement.

Ammonia Solution in Ore Reduction

A SCHEME for the recovering of copper, silver and gold from certain types of ore, recently developed and put into operation in a California reduction works, merits description on the ground of its broad applicability and simplicity of operation.

The method in question has to do fundamentally with carbonates or oxides; but since sulphites may be converted into oxides by roasting, it applies to ores of this type also. Assuming this oxidation to have been done, the process consists in bringing the crushed ore in contact with aqueous ammonia. This dissolves out all copper salts and any silver which may be present in the form of chloride, iodide or bromide; the tailings, or insoluble residue, thus containing the rest of the silver and all of the gold.

Since the extraction by ammonia represents a process of solution rather than one of chemical reaction, an ordinary distillation suffices to precipitate the metallic residue from the liquid which results. The ammonia, passing off into a cooler, is condensed and used again and again, while the copper and silver are thrown down in the form of a black powder. Any silver remaining in the supernatant fluid left behind by the distillation process is precipitated as silver chloride by an injection of common salt.

To recover the metallic silver and copper from the black precipitate a dissolving bath of dilute suplhuric acid is employed. After filtering, this solution is treated by electrolysis, any silver present collecting in the slimes at the bottom of the vats, while the copper is laid down in the usual fashion. The liquid residue, containing sulphuric acid, is used again and again as solvent.

The silver chloride obtained from the distillation and the silver and gold compounds in the first tailings are recovered by the ordinary cyanide or mercury amalgam processes. The whole operation from beginning to end is seen to be a model of efficiency and economy.

Run Your Car with Molasses!

EXPERIMENTS looking to the production of an inflammable distillate from molasses having reached a climax, a company has been organized in Natal, South Africa, with a capital of $375,000 to build a plant for the manufacture of this substance, with a capacity of 6,000 gallons daily. The recently rising prices of gasoline are doubtless what have led to these efforts to make a distillate at a sufficiently low cost to become a direct competitor of gasoline.

Demonstrations have been made with a 22-horse-power car weighing some 3,600 pounds. The car was tested over several routes, the total distance covered being slightly more than 500 miles. The roads were said to have been heavy during two days and fine during the rest of the time. In this case the amount of this new motor fluid or spirit used was 30.59 gallons, or an average of 16.4 miles per gallon, or 26.2 ton-miles per gallon. The engine on all occasions started easily, whether cold or warm. The valve caps and valve heads were found to be very clean after the trial.

Alcohol has been experimented with for a long time, and in direct competition with gasoline, but in the United States gasoline has been thought to be cheaper of the two products, all things considered. In the present instance, however, better results have been obtained than elsewhere. A large percentage of the alcohol is said to be converted into ether, thereby reducing the density and increasing the volatility. Corrosion was overcome by the use of an alkali, which during the process of combustion neutralized the acids produced by the alcohol and ether.

THE MUSICAL MIRACLE

SUPPOSE your daughter is practising. The composition is Moszkowski's "Concert Waltz" and she is having difficulty. Suppose you could take her place at the piano saying, "Now, this is the way Gabrilowitsch plays it," and that you could instantly play the selection, freely, perfectly, without a moment's hesitation or stumbling.

Suppose your guest of the evening has brought his violin, or perhaps some member of the company sings. Suppose you could go to the piano and accompany them—not falteringly and inadequately, but brilliantly, understandingly, artistically.

Suppose the gathering is a lively one—the rugs have been whisked out of the way and there is a call for dance music. Suppose you were able to respond with one-steps, waltzes, fox trots—an entire program.

Suppose after dinner is over and the papers read, that you could turn to your piano for enjoyment, confident that at your lightest whim you could make it sing to the music of "Martha;" make it weep to "Old Black Joe;" make it thrill to the marches of Sousa; make it hum to "Long Ago;" make it shout to the cry of the Valkyries; make it dance to "Circus Day;" make it chant to "Adeste Fidelis;" make it croon to "Blanket Bay."

Suppose you could do all this at will. Suppose you could do it as easily and as beautifully as a truly great pianist—subduing the accompaniment, lighting up the melody—running the scale with accuracy and perfect rhythm from a liquid ripple in the treble to a thunderous climax in the bass.

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