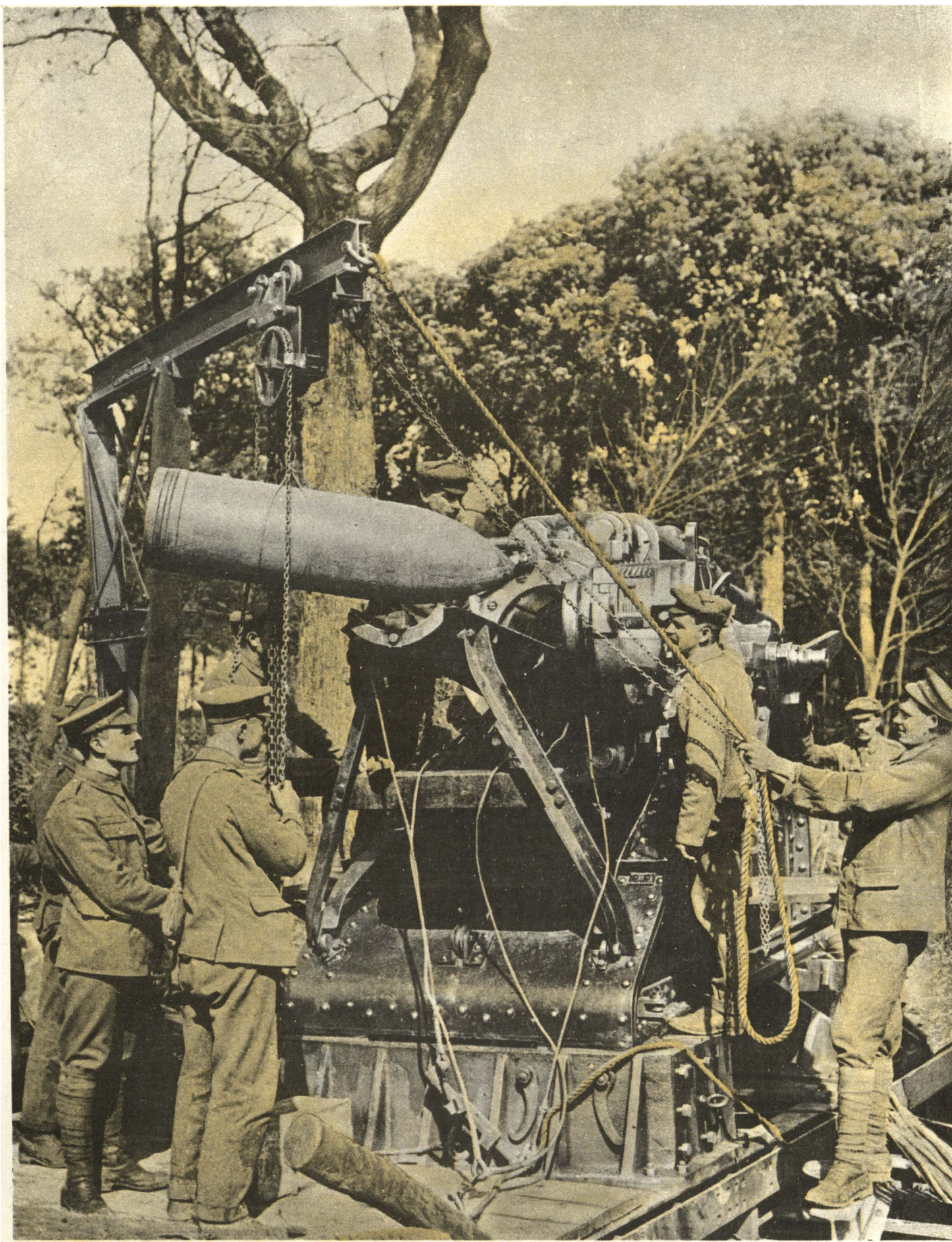


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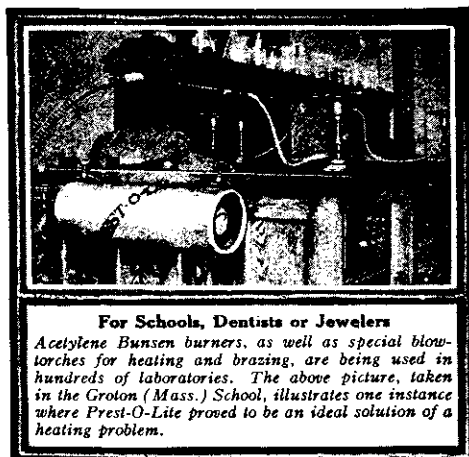
LOADING ONE OF THE BIG BRITISH HOWITZERS, ON THE WESTERN FRONT—[See page 527]

December 9, 1916

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

Price 10 Cents

You may be surprised to learn how Prest-O-Lite Gas will meet a real need for You



For Schools, Dentists or Jewelers

Acetylene Bunsen burners, as well as special blow-torches for heating and brazing, are being used in hundreds of laboratories. The above picture, taken in the Groton (Mass.) School, illustrates one instance where Prest-O-Lite proved to be an ideal solution of a heating problem.



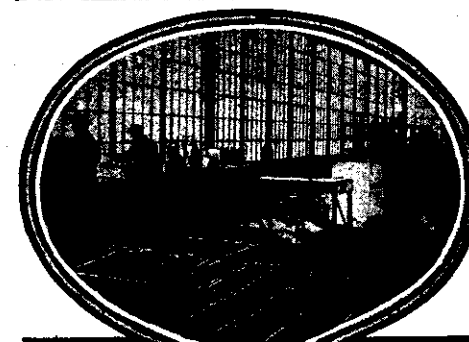
Blow Torches for Brazing and Soldering

Wherever a gasoline blow-torch is used, a Prest-O-Lite acetylene blow-torch will usually save time and money because of its greater speed, efficiency and convenience. Acetylene torches are used for soldering and brazing by thousands of factories, dentists, jewelers, plumbers, etc. The Mott Wheel Works at Utica, N. Y., braze wires in solid tires without injuring the rubber. The torch shown costs 75c (Canada 85c).



A Convenient Portable Light

Prest-O-Lite with an inexpensive stem-and-burner attachment furnishes an economical, efficient light for indoor and outdoor use, contractors, railroads, fire departments, and in almost every case where temporary illumination is desired. In the illustration a large coal company is loading wagons at night during the rush season.



Acetylene for Lead Burning

Acetylene fills a real need among lead-burners, providing an inexpensive fuel gas in convenient form—everywhere obtainable. Used in storage battery work, joints in lead and block tin pipes (instead of "wiped joints"), etc. The illustration shows its use in the manufacture of lead-lined vats.

Prest-O-Lite

Dissolved Acetylene

(Ready Made Carbide Gas)

"The Gas of a Thousand Uses"

Do you know, for instance, that many manufacturers of metal products have made sweeping changes in their methods of production and even radical changes in design, so as to reap the economies and advantages of welding with Prest-O-Lite Gas and compressed oxygen?

Do you know that in thousands of factories, mines, railroad shops, construction companies, gas companies, oil companies—in fact, in nearly every leading industry in America—this same oxy-acetylene welding process is reducing the use of the bolt, the rivet and the threaded joint, and is also reclaiming millions of dollars of valuable material from the junk pile and saving other millions in the quick repair of defective castings, broken machinery parts and tools?

Do you know that brazing and soldering are being done with Prest-O-Lite Gas in an acetylene blow-torch more quickly, conveniently and economically than with the gasoline blow-torch or other devices?

There are literally hundreds of vital, convenient, profitable uses for this remarkable gas, which, of all gases, has the highest possibilities of intense heat or brilliant light.

Prest-O-Lite Acetylene Service

Prest-O-Lite Gas—extensively used in the familiar "gas tank" for automobile lighting—is purified, dissolved acetylene, furnished in portable cylinders containing from 10 to 300 cubic feet. The Prest-O-Lite System insures the prompt exchange of empty cylinders for full ones—universal and perpetual service. Prest-O-Lite is the most convenient and usually the most economical kind of acetylene.

Oxy-Acetylene Welding

The oxy-acetylene welding flame fuses two pieces of metal into one piece, with all the strength that perfect fusion implies.

Any average workman who understands metals can quickly learn the work. We furnish high-grade welding apparatus for \$60 (Canada, \$75); acetylene service and special metal-cutting blow-pipe at extra cost.

The cost of installation and use is trifling when compared with the savings it can effect.

Portable Heat and Light

Among hundreds of other uses, Prest-O-Lite Gas is employed for lighting churches, schools, tents, tractors, magic lanterns, boats—used for big flare lights for railroads and contractors, and smaller lights for scores of other purposes. It is used for priming cold engines, for paint burning, for removing defects in monument stone, and used in blow-torches, small hot plates and special burners for scores of other heating operations.

Complete details on any contemplated use—for heating or lighting—will gladly be sent on request.

The Prest-O-Lite Co., Inc. 53 Branches and Charging Plants in the Principal Industrial Centers

U. S. Main Factory and Office, 810 Speedway, Indianapolis, Indiana
Canadian Main Office and Factory, Department L, Merriton, Ontario



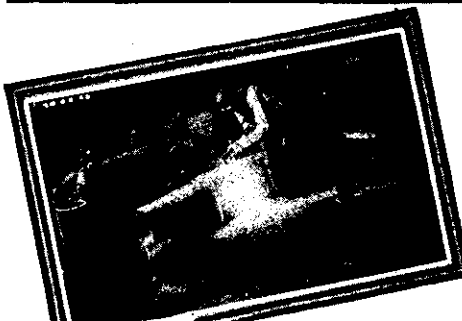
Welding in Motor Car Manufacture

In the production of a great many metal products, from massive engines down to ear-rings, the oxy-acetylene welding process is simplifying construction, increasing strength and decreasing costs. Used by thousands of American industries, large and small. Illustration shows the Prest-O-Lite Process used in the manufacture of rear axle housings for Marmon motor cars by the Nordyke & Marmon Co., Indianapolis. Practically every automobile and parts maker is utilizing this welding process.



Welding for Reconstruction and Repair

The Terre Haute, Indianapolis & Eastern Traction Company is welding together 30-ft. channel steel sections for reinforcing underframes of interurban cars instead of using 60-ft. lengths, which require special rolling at mills, cost more and must be shipped on two flat-cars at greater expense. Job welding shops and garages use this process for repairs to broken parts, machinery, etc.



Metal Cutting by Prest-O-Lite Process

Oxy-acetylene cutting in destructive and constructive work is fast and economical. The above illustration shows a 50 per cent saving in time effected by "nicking" 18-in. ingots with the oxy-acetylene cutting torch preparatory to breaking, in the East St. Louis plant of the American Steel Foundries.

WORLD'S LARGEST

DISSOLVED ACETYLENE

SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXV.]
NUMBER 24

NEW YORK, DECEMBER 9, 1916

[10 CENTS A COPY
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A WEEK'S SUPPLY OF FOOD FOR A FAMILY OF FIVE. AN ECONOMICAL AND BALANCED DIETARY. [See page 529]

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

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

Goethals' Defense of the Panama Canal

COLONEL GOETHALS has made a final report to Secretary of War Baker upon the slides in the Panama Canal, which must carry conviction to everyone who reads it with an open mind. He states that the various schemes which have been proposed for preventing any further slides at the Culebra Cut have received careful consideration, and that the methods which he has adopted for dealing with this troublesome problem were laid before the National Academy of Sciences, which made no suggestions that modified the plan in any particular.

Anyone who has made a careful study of the conditions at Culebra Cut must have realized that much of the criticism which has appeared, during the past two years in the public press has been careless, confusing and altogether wide of the mark. Particularly is this true of the statement which has been made more than once in England, that the bottom of the Canal in the region traversed by the Culebra Cut is a bog, and that this material is continually being pushed up by the downward and lateral pressure of the material forming the sides of the cut. Colonel Goethals reiterates what he has so often stated before, that the slides are breaks in the banks resulting from the deformation or crushing of the underlying strata, which, under the changed conditions due to the excavation, were unable to bear the weight of the superimposed mass. Final rest, or equilibrium, will be secured when all the material that is in motion has been removed.

We remember that, several years ago, when the slides began to come down into the cut on the present large scale, we asked Colonel Goethals what was the solution of the problem. His reply: "Patience and digging" proves that he thought then, as he still thinks, that there is nothing for it but to keep digging out the material until the banks have reached that angle of repose which nature demands.

United States' and World's Railways Compared

THE comparative railway statistics of the United States and foreign countries issued by the Bureau of Railway Economics cover some 38 countries or States having a total railway mileage, for the year 1913, of 591,000 miles. The most cursory study of these statistics reveals certain striking economic facts which cannot fail to interest any American reader.

Perhaps the most interesting point revealed by these tables is that, despite the high wages paid in the United States, we are carrying freight at a lower rate than any other country, except India. The average rate per ton mile in this country is 0.729 cents, which is not much more than 60 per cent of the average rate for similar service in the leading countries of Europe. In India the rate is 0.7 cents; but in that country the wage, which ordinarily is the highest item in the expense list, is so low as to be almost negligible. Brazil has the highest rate 7.04 cent per mile. The rate for France is 1.18 per mile and in Germany it is 1.24 per mile.

The average receipts per passenger per mile in the United States, 2.008 cents, is higher than that of any country except Brazil and Cuba. In Austria the average receipt is 1.079 cents, in France 1.068, and in Germany 0.908 cent. The density of traffic in the United States is 143,067 passenger miles per mile of line. In Germany the density is 693,317 passenger miles per mile of line, while Belgium has a density of 1,046,614. A line upon the important question of accommodations can be had by a study of the tables showing the average number of passengers per train. In the United States it is 55; in France, 70; in Germany, 84; in Japan, 108, and in India, 182. Having these figures in mind it is not surprising to find that the passenger revenue per

mile of line on our railroads, which is \$2,871, is exceeded in 16 other countries, the passenger revenue in Germany being \$6,292; in Holland, \$6,373; in Belgium, \$7,347, and in Great Britain, \$9,684.

The low rate at which our railroads are able to carry freight is due chiefly to the large capacity of the individual freight cars, the great power of the individual locomotive, and the consequent length and carrying power of the trains. We haul more freight per car, per train and per mile than the railways of any other country. Thus, the average capacity of the freight car in the United States three years ago was 38 tons, as compared with 14.3 in Austria; 14.1 in France and 15.9 tons in Germany. As was to be expected, it is in the New World only that we find cars approaching in capacity those of the United States, the Mexican cars carrying 35.4 tons and those of Canada 32.1 tons. The load of freight carried per train in the United States is far greater than in any other country, the average in 1913 being 435.4 tons. In Canada it was 342 tons; in Germany it was 239 tons, and in France 147 tons.

Our railroads hauled the greatest amount of traffic per mile of line, the amount in 1913 being 1,245,158 ton miles per mile of line. In Germany it was 1,119,983 tons, and in Russia 1,033,254 tons. But the freight revenue per mile of line in this country was only \$9,048, which must be compared with \$13,950 in Germany.

We find, as was to be expected, a great difference in the average wage paid in this country and in Europe, the average wage of our railroad employees being nearly double that paid in the leading European countries. In the United States the average compensation is \$756.83; in Germany it is \$408.97; in Holland \$341.52, and in Russia \$211.40.

The earnings per mile of line in the United States are low compared with those of other countries. In 1913 the average revenues per mile of line in the United States, were \$12,859. In Germany and Great Britain they were about twice as great, those for the latter country being \$28,645 per mile of line. The average capital per mile of line is for the United States, \$65,861; for Germany, \$120,049; for France, \$150,439, and for Great Britain, \$274,027.

Distortion of Ships

THE expansion and contraction of metals when subjected to varying temperatures is well known and generally adequate provision is made in the design and construction of machinery to permit this expansion and contraction to take place without stress or strain. In marine engineering many striking examples of such provisions can be found.

Where integral parts of machinery are subject to varying temperatures, the designer's provisions for the free expansion and contraction of the metal prevent distortion and troublesome consequences; but where the integral parts are subjected to uneven temperatures, the expansion and contraction is not uniform and distortion is inevitable. Even in such cases the distortion produces little or no harm provided ample clearance is allowed and such machinery is intelligently operated. Cylinders and cylinder heads of reciprocating engines, and turbine casings and rotors are most striking examples of machinery subject to such distortion.

The hull of a ship, unlike its machinery and piping, is not designed or constructed to permit freely the uneven expansion and contraction of its frames and plating other than by the general flexibility of the structure itself. As the varying and uneven temperatures to which the frames and plating are subjected are of comparatively small range, little thought is given to the distortion which may occur; and as casual investigations reveal no evil physical effects it is assumed that such distortion as may occur can be considered as negligible. This is quite true where the ship is water borne and the under-water portion of the hull is subjected to the practically uniform temperature of the sea water. When the ship is in a drydock, however, conditions are quite different; and the distortions that take place daily prove at times very annoying.

In aligning long sections of shafting in drydock, the alignment is often found to be seriously deranged upon undocking. This condition was formerly attributed either to the improper placing of the keel block, or to the poor workmanship of aligning the sections, or to both. Undoubtedly in some cases the improper placing of keel blocks is principally responsible, and, to a certain extent, the poor workmanship; but in general such derangement is primarily and most frequently caused by the daily distortion of the hull wrought by the sun's rays while the ship was in drydock. Obviously, with the top deck, especially if of steel, and one side of the ship exposed to the sun, these portions will expand more than those portions not presented to the sun. Distortion occurs; both stem and stern will droop and at the same time be forced out of their normal vertical plane and away from the sun. Recent investigations have shown that these distortions are frequently of such a value that they cannot be ignored. A series of in-

vestigations was conducted on ships in and out of drydock and the following general results were obtained:

Ships in drydock.

(a) Greatest deflection of stem and stern in a horizontal plane when ship's heading was at or near right angles to the sun.

(b) Greatest droop of stem and stern where sun was on or near the meridian and at high altitudes.

(c) In every case under investigation where the ship was steel decked the droop was much greater than the deflection.

(d) Investigations on days when the sky was overcast revealed no deflections.

(e) No deflections were permanent.

Ships out of drydock.

(a) Practically the same results were obtained on ships out of drydock, except that deflections in general were of very small values, although in some cases the droop was found considerable.

In the foregoing no values are set forth, as the figures obtained depended upon the type and size of ship and the difference in temperature to which the various portions of the ship were subjected. Deflections of 3-64 inch were common in the horizontal plane and as high as ¼ inch in the vertical plane. Greater deflections were found on larger ships.

From these investigations the following conclusions were drawn:

(a) Where exact alignment of long shafting must be done in drydock, all boring and alignment should be done on days when the sky is overcast.

(b) Where this is not practicable, allow increasing clearances as bearings approach either the stem or stern of the ship.

(c) In so far as possible line shafting should not be coupled up until the ship is undocked. Such derangement in the alignment as is then found can be eliminated in the couplings and spring bearings.

Compressed Gas as a Motor Fuel

THE use of compressed coal gas as fuel for motor cars has been pondered in many quarters during the last ten years, but so long as gasoline and its substitutes were fairly plentiful, the proposition was not considered good enough to warrant money being spent upon it. Today, in view of the scarcity of all liquid fuels, there is a good deal more in its favor, and the Municipal Corporation of Glasgow has been carrying out some tentative investigations into the question. The results, while anything but conclusive, show, at any rate, that a motor vehicle can be worked successfully on gas, and point to the desirability of further experiments.

The initial disadvantage under which compressed gas labors, as compared with liquid fuel, is the space it occupies, and the weight of the cylinders required to contain it. A cylinder containing 100 cubic feet of oxygen at 1,800 pounds pressure weighs 120 pounds and measures 4 feet 7 inches in length. The cylinders for motor car use should be of large dimensions, so that the pressure can be kept as low as possible; hence the balance between pressure and volume must be very nicely adjusted, so that there shall be no undue sacrifice of reservoir capacity to lightness of load, or of carrying space to cruising radius. Two cylinders of not less than 8 cubic feet capacity could be placed one on each side of the chassis, below the footboards, between the front and rear wheels; but three cylinders would be even better, and the third might be placed at the back of the rear wheels, across the chassis. The greater the capacity of the gas cylinders, the lower the pressure required for a given quantity of gas; and, on this principle, the cylinders could be made much lighter and the working cost reduced all around.

A good deal of difficulty was experienced in devising a governor which would permit the training down of the gas cylinders so that the gas should issue at the outlet side of the governor at constant atmospheric pressure; allow for the passing of any quantity of gas up to 200 cubic feet per hour; and work without variation despite the jarring and jolting of the roughest roads.

This was at length accomplished. In the governor adopted the bell is of rubber, and the high pressure counter-balance on the valve stem is of leather. Between the high pressure storage cylinders and the motor a low pressure expansion cylinder was found to be necessary. The ordinary fuel tank was found to answer this purpose very well. As regards replenishing the storage cylinders with gas, it is proposed to use the car motor for the purpose, the pump to be operated from the gear box or connected up to the motor by a special clutch-gear.

It is hardly to be expected that compressed gas will ever complete with liquid fuel for cars traveling long distances, but there is no reason why it should not be cheap and satisfactory fuel for town vehicles working on comparatively short rounds. If the car can be made to do its own charging without unduly complicating the mechanism, or adding too much to the weight, the provision of charging stations would be simplified.

Automobile Notes

Mixtures of Gasoline and Kerosene.—Those who are inclined to experiment with mixtures of gasoline and kerosene should remember that the two liquids are liable to separate if left standing over night; and as the kerosene, which is the heaviest, settles to the bottom of the tank, there would be a difficulty in starting under the circumstances. After the liquids are well mixed by agitation, the vibration of a moving car would suffice to keep them well mixed.

How English Speed Laws Are Administered.—The workings of the British legal mind are often peculiar, and frequently are more suggestive of Berlin than of London. The driver of an army transport car recently exceeded the legal speed limit, under orders, that he might catch a special train with a load of shells, and for this he was fined three pounds by the local magistrate. The matter was brought up in Parliament, but the Home Secretary did not see any sufficient ground for remitting the fine!

Misdirected Labor.—Some owners of cars keep their drivers so busy polishing up the outside of their cars that he has no time to devote to the internals, and although the car of to-day appears to be nearly "fool proof," the results of neglect are bound to develop sooner or later. Where a large and expensive car is kept, which the owner requires to be maintained in a spotless condition, an extra man should be employed solely for that work, and the driver should be made responsible for the condition of the mechanical parts alone. It is an open question if the saving on repairs, and loss of use of the car, would not outbalance the cost of the second man. Where an elegant carriage and pair of horses were formerly kept it was never expected that one man could take care of the entire outfit, including the stable.

A Motorcycle Keeps Motorcars Going.—In the British Mediterranean expedition it became necessary to establish a repair shop to keep the numerous motor cars of all kinds in order; for the army was almost entirely dependent on these vehicles for supplies and provisions. A lathe was with difficulty procured, and the question of power to drive it arose. This problem was solved very successfully by requisitioning the power plant of a five-horsepower, water-cooled motorcycle. The frame of the machine was bolted to a solid foundation, and the rear wheel, with the tire removed, made an excellent belt pulley. The motor had a two-speed gear, which provided nicely for varying the speed of the lathe; while for charging batteries the transmission clutch was thrown out, and a dynamo was belted direct from the flywheel of the motorcycle engine.

Illuminating Gas for Fuel.—A firm of garage proprietors in England is making use of coal gas for motor vehicle purposes. Gas bags made of canvas with rubber insertion, and holding 450 cubic feet of gas, are secured to the roof of the *char-à-banc*, and is filled from the gas main. According to the *Commercial Motor*, the fuel is conveyed to a point just above the engine throttle. An ordinary cock close to the engine controls the supply, and this is regulated by a lever directly coupled to the throttle valve lever, so that the gas supply is increased or diminished in accordance with engine speed. The firm pays 1s. 4d. per 1000 cubic feet for gas. The mileage varies largely with the efficiency of the drivers, but averages 30 per 1000 cu. ft., the equivalent of 1/4d. per mile. Calculating on a basis of 8 miles per gallon of petrol—a conservative estimate with much stopping and starting—this means that to compete petrol would have to be obtained at 4d. per gallon.

Protection at Railroad Crossings.—It is difficult for the saner members of the community to understand the attitude assumed by a large proportion of automobile drivers in regard to protective measures at railroad crossings, for they persistently resist every proposal by the railroad officials tending to their safety. It is not questioned that there should be no grade crossings, and ultimately such menaces to highway travel will be abolished; but on the other hand, it cannot be expected that millions of dollars will be spent at once for the gratification of a purposeless craving for mere speed, for there is not one case in a million where a delay of a few seconds at a crossing is of the least importance, or could be detected at the end of a day's run. Time and again impatient drivers have smashed their way through closed crossing gates, and rushed in front of fast trains, only to meet with fatal accidents. If it were only the driver who suffered in these insane performances the public could look on with equanimity; but too often it is the innocent and helpless passenger that is killed or injured. It is the fashion to rail at the railroads, but as long as grade crossings, which have been authorized by the representatives of the public, exist, no means that will compel the reckless driver to protect his passengers should be overlooked.

Science

A New Arctic Meteorological Station, equipped with wireless telegraphy, has been established on Dickson Island, at the mouth of the Yenisei, and will send daily reports to the Central Physical Observatory in Petrograd.

Dearborn Observatory was originally established in Chicago in 1866 through the efforts of the Chicago Astronomical Society, which raised funds for the purchase of what was then the largest refracting telescope in the world. The great Chicago fire of 1871, though it did not destroy the observatory, wiped out the assets of the society, and the director was forced to seek employment elsewhere. In 1887 the observatory was moved to Evanston and became a branch of the Northwestern University. The fiftieth anniversary of the observatory's foundation was celebrated on April 11 of the present year with a program of addresses, abstracts of which appear in *Popular Astronomy*.

Controlling the Spinach Aphis.—The U. S. Bureau of Entomology reports that it has practically completed the research work on the control of the spinach aphid and other aphids in Tidewater Virginia by means of ladybeetles, begun in 1909. These pests were formerly a serious menace to the cultivation of spinach, cabbage and various other crops in that important trucking region, but the convergent ladybird and the spotted ladybird have proved, under normal conditions, to be almost complete checks. Conditions in Tidewater Virginia are peculiar, since the extensive cutting down of trees and removal of underbrush for planting truck crops left no available places for the ladybirds to hibernate, with the result that when the bureau's work was begun it was found that the ladybirds were so scarce as to be absolutely useless in controlling aphids. They have now been fully established.

Mottled Teeth.—Drs. F. S. McKay and G. V. Black have made a study, under the auspices of the Colorado State Dental Society, of a mysterious malady of the teeth ("mottled teeth") which occurs endemically in restricted areas of the United States; viz., the Salt River and Gila Valleys, in Arizona, the territory affected extending into Old Mexico; a considerable region in Colorado, including the city of Colorado Springs; and small areas in other widely-scattered parts of the United States, both eastern and western. The condition appears to be identical with that described from the vicinity of Naples, Italy, in 1901 by Dr. J. M. Eager, under the name "denti di chiaie," though a milder type prevails in America. It consists of an absence of the cementing substance occurring normally between the enamel rods in the outer part of the enamel layer of the permanent teeth, with or without the deposit of a coloring matter which Dr. Black calls "brownin." The condition does not affect the general health, but is so disfiguring that recourse is frequently had to the cutting away of the crowns of affected teeth and the substitution of artificial crowns. The defect originates only in childhood, during the enamel-forming period, but persists throughout life. The cause is suspected to be some element in the drinking water, not yet revealed by chemical analyses.

Bird Census of 1915.—A recently published bulletin of the U. S. Department of Agriculture, from the pen of the lamented Wells W. Cooke, presents the results of the second annual bird count in the United States, carried out in 1915. It is based on 315 reports, from every state in the Union except Utah and Nevada, and shows a gratifying agreement with the results obtained the previous year. "When an enumeration of birds was first suggested," says the author, "the project was the subject of much good-natured banter and some criticism from those who declared the scheme utterly visionary," but these animadversions were based upon misunderstanding of the methods to be employed and the objects in view. The average bird population of that part of the northeastern United States devoted to agriculture has been determined with sufficient accuracy to furnish data having various practical and scientific applications, and some useful general information has been obtained in reference to the rest of the country. The average in the northeastern states is about 800 pairs of birds to the square mile. It is not yet possible to estimate the population of each species, except for a few of the commonest and most widely distributed, such as the English sparrow and the robin, for which the reports are sufficiently numerous to permit an approximate estimate. The most elaborate report received in 1915 was that of the campus of Cornell University. Its 256 acres were divided into six blocks, and the survey of each was made by a different person, the whole being in charge of Professor A. A. Allen, of the university. The densest bird population was found on a small private estate near Washington, D. C., with 135 pairs nesting on five acres, and the most varied bird population in the bird sanctuary and park known as Woollen's Garden, near Indianapolis, with 62 species on 44 acres.

Industrial Efficiency

Welding Aluminum to Dissimilar Metals.—It is only recently that there has been evolved a welding compound for aluminum, which successfully joins that metal to copper and brass, without the use of flux. It is claimed for this compound that it does the work of welding aluminum in one fourth the time and cost of acetylene welding. No special tools are required aside from the usual gasoline torch.

Wood Distillates.—It is estimated by the New York State College of Forestry that over 640 cords of beech, birch and maple wood are used every day in the wood distillation industry in New York State. The industry has been greatly stimulated by the European war, inasmuch as acetate of lime, one of the principal products of the industry, is used in the manufacture of high explosives. The price of wood alcohol, another product of the industry, has also risen very largely as a result of the war.

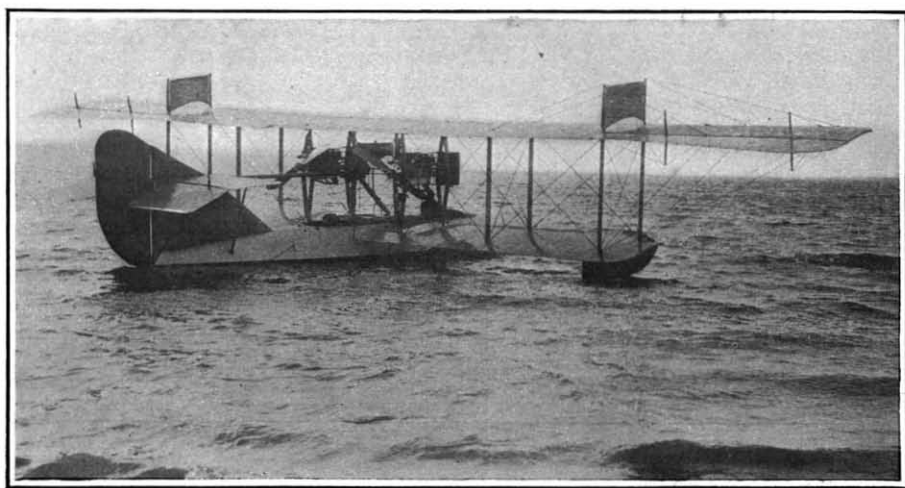
Shift in the Pencil Industry.—The Eastern Red Cedar or Juniper is becoming so scarce and valuable that the pencil manufacturers are turning to the California Incense Cedar for a source of their supply. This Incense Cedar resembles the Eastern Red Cedar more closely than any other wood. It is somewhat lighter in color, however, and a chemical process is being used to stain the wood to resemble Eastern Red Cedar. A large percentage of our pencils are now being made from California Incense Cedar. The tree is felled and cut up into large planks. These planks are again sawed into small slats a little wider than the diameter of a pencil.

The Re-Inking of Typewriter Ribbons by office help is now made possible by means of a simple re-inker recently introduced on the market. It is a handy, compact device no larger than a fountain pen, which will re-ink the typewriter ribbon in a few moments' time without the necessity of removing it from the machine. The re-inker consists of a barrel which contains the ink, and a re-inking head or cap which also serves to retain the ink in the barrel. The cap is fitted with a felt wick which feeds the ink to the re-inking roller as required. With the aid of this device the life of the average typewriter ribbon is increased several times its normal duration.

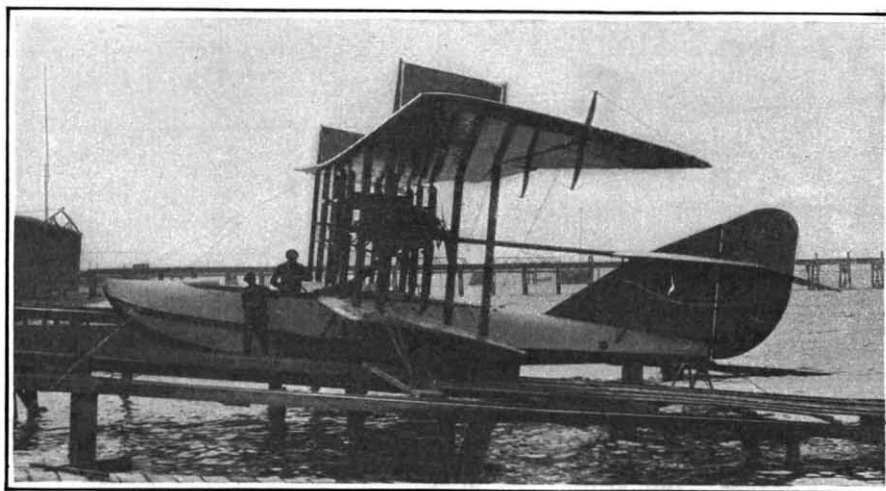
Daylight-Saving in Austria-Hungary.—At midnight on September 30th, last, all the watches and clocks in Austria-Hungary were put back one hour, and the first period of "Sommerzeit" (summer time) was ended. This began at midnight April 30th, when the timepieces were advanced one hour. The plan, whose purpose was the securing of additional sunlight in working hours, has proved successful in the highest degree, according to reports. For the health of the people it has been of the greatest advantage. In the saving of lighting it has also been most satisfactory. It is calculated that in Vienna alone the people consumed 4,500,000 cubic meters (158,915,200 cubic feet) less of gas and saved 700,000 crowns (\$142,000), while the city itself required 400,000 cubic meters (14,125,800 cubic feet) of gas less for street lighting.

Reclaiming Waste Molding Sand.—An ingenious method of reclaiming waste molding sand has recently been introduced in an American foundry, which, at the same time, serves as a means of loading the large accumulation of foundry sand into a gondola car. The equipment consists of a combination of two portable belt conveyors, and a magnetic separator which is employed to remove the ferrous metal from the waste molding sand. In operation the refuse is shoveled into the shorter conveyor and passes over a magnetic pulley having the magnetic coils on the inside of the pulley. The metal, as it passes over the pulley, adheres to the belt, while the sand is discharged upon the second conveyor, from which it is dumped into the car. Meanwhile the metal is carried partly around the magnetic pulley and is dumped into a chute at the point where the belt leaves the pulley. The equipment, it is reported, has a capacity of a ton per minute.

Doing Away With Waiters.—The one great drawback to quick service in restaurants where one waits upon himself is the fact that many patrons are apt to loiter in front of a counter and thus delay those who are awaiting their turn. To eliminate this feature a shop restaurant has recently installed a 45-foot cotton belt conveyor, which is electrically-driven. As each employee approaches the moving belt he picks up an aluminum tray on which an attendant places bread or biscuits, and places the tray on the conveyor belt. From that moment he must keep moving at the same rate as his tray, which is carried along in front of the long counter in back of which are the attendants who place on the tray the dishes that are ordered by the employee. A railing running a short distance in front and parallel to the counter prevents anyone from getting into the line at any other place but the beginning. Thus there is no loitering or confusion, and the system operates with marked precision.



Measuring 76 feet from tip to tip of the top plane, this flying boat is an aerial counterpart of an express cruiser



Side view of the huge flying boat. Note the two mechanics at work as compared to the size of the craft

Yachting in the Air

Huge Air Cruiser that Carries Eleven Passengers

WHEN the hydro-aeroplane first appeared it was predicted that hydro-aeroplaning would be a popular form of sport in the no distant future. The prediction was correct, as events have since proved. Starting with the modest single- or double-seater hydro-aeroplanes of the early days, which, it is interesting to note, were more aeroplane than boat, there has been developed a type of craft which compares most favorably with the modern express cruiser and can carry several passengers in addition to the pilot; in fact, the hydroaeroplane has given way to the flying-boat, which is more boat than aeroplane.

For the time being at least, the consummation of advancement in hydro-aeroplaning is presented in a huge Curtiss flying-boat which has been recently inspected by a prominent gathering at Port Washington, Long Island. For here is a craft that is the counterpart of an express cruiser, with a carrying capacity sufficient to accommodate the owner and several friends for an air journey of several hundred miles, in utmost comfort.

The air cruiser de luxe, for such it truly is, has a wing spread of 76 feet and a body length, from the bow to the tip of the rudder at the extreme rear, of 54 feet. The body, it will be noted in the accompanying illustrations, is gracefully shaped and suggests the lines of a speed boat equipped with a pair of wings. The driving engines, of which there are two of 100-horsepower each, are mounted between the wings and drive individual propellers at the rear. The engines are of the 8-cylinder, V-shaped design, and are started with a special electric self-starter. The roar of the engine exhaust has been eliminated by the use of mufflers, adding further to the comfort of the air yachtsman and his guests.

While the air cruiser has flown with eleven people on board, it has a seating arrangement for only five people, four in the bow section and the mechanic in the rear, just below the top plane. The seats in the boat body are arranged two behind the other, not unlike the arrangement in a conventional touring car, with a convenient door between them. The seats are upholstered in pigskin and the entire cockpit is in mahogany, while the

hull is finished in white on the sides, green below the water-line, and a deck of mahogany. The designer did not intend this air cruiser as a fair-weather craft, hence it is built to start from and alight on rough water; also, it has a cabin top that is placed over the cockpit to protect the passengers in rough weather.

The equipment of the air yacht, aside from the self-starter, muffler, electric lights, searchlights, the regulation lights for night flying, anchor, and other regulation equipment for yachts, includes the Sperry automatic pilot which controls the air cruiser in flight, relieving the pilot of the constant strain of banking, checking

Sturdiness appears to have been the keynote in the construction of this craft, for a most careful examination of the air cruiser reveals careful selection of materials and good designing even down to the smallest parts. The workmanship is particularly commendable. The mechanic, normally sitting in his individual cockpit between the engines, can walk about on the bottom planes on rubber matting provided for that purpose, and inspect and adjust the engines while the cruiser is in flight. Every important part of the power plant appears to be readily accessible to the mechanic.

The Port Washington aerial station, it will be recalled, was established by Mr. Rodman Wanamaker as part of his plans to inaugurate a transatlantic air line. It is said that this luxurious air cruiser is a step towards carrying out this plan, which was halted by the war. The next step will be a still larger air cruiser, which may be the true transatlantic type. For the present the air yacht is at Port Washington, although it will probably be flown to Florida in the near future.

An Association of Mountaineering Clubs

THROUGH the efforts of Mr. LeRoy Jeffers, librarian of the American Alpine Club, there has been formed a "Bureau of Associated Mountaineering Clubs of North America," designed to serve as a connecting link between the various mountaineering clubs and geographical societies of the continent. The bureau is to publish an annual bulletin giving information concerning the membership, officers and activities of the affiliated organizations, which already number eleven, and is to preserve files of the publications of these societies. One of the chief results of the undertaking will probably be the rapid upbuilding of the collection of mountaineering literature and photographs which is accumulating at the New York Public Library, where the library of the American Alpine Club is already deposited.

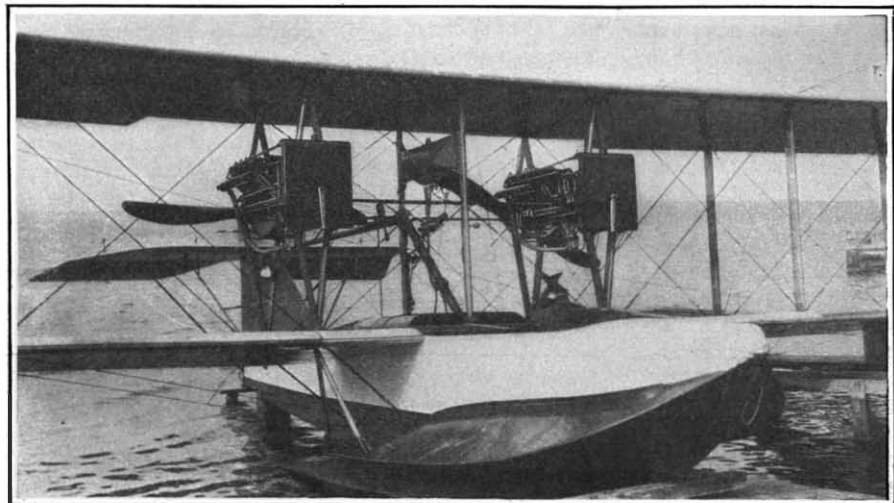
The combined collection promises to become one of the most important of its kind in the world, according to present indications.



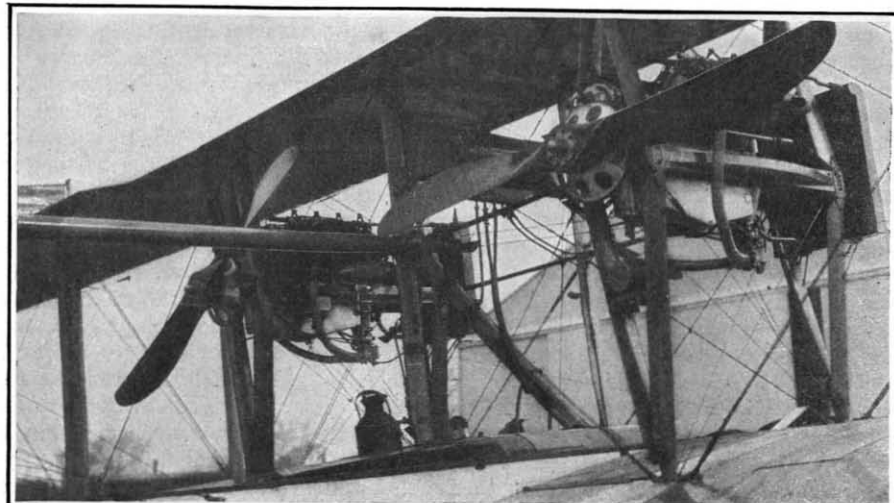
What one sees when sitting in the upholstered seats of the cockpit. Note the dual steering wheels

wind variations, and other similar phases of aerial navigation. The automatic stabilizing equipment is mounted in the bow of the cruiser, while the dual steering wheels and other controls, as well as the switchboards and various meters, are mounted on a dashboard in front of the forward seats.

The air cruiser draws 18 inches of water and is said to leave the water in 30 seconds. It has a cruising radius of 300 miles when fully loaded. With only the five passengers and no additional load the cruising radius is about 500 miles. The speed of the air cruiser with full load is 60 miles an hour.



Bow view of the air yacht, showing the two eight-cylinder engines and the method of mounting



Twin 100-horsepower engines of the air cruiser, which are started with an electric self-starter

Sir Hiram Maxim

IN the death of Sir Hiram Maxim on November 24th, at his home near London, England, the world has lost one of its most famous engineers and inventors. Sir Hiram was an American by birth and training, and the story of his life marks him as essentially an inventor of the American type. He was born on a farm in Sangerville, Maine, in 1840, and was descended from one of the early settlers of that State. His education was such as could be obtained in the public schools of that day, and he left school at the age of fourteen to be apprenticed to a carriage builder. Later, he entered his uncle's engineering works at Fitchburg, Mass., and his strong inventive genius, which developed very early in life, here began to find practical expression. The story of his life as given in his autobiography shows that he was very active during the years which saw the early development of the electric motor and the electric light; although his inventions in this field did not bring him the fame which came to him as the result of his work in the "eighties" in connection with the development of his automatic machine gun.

In 1883, he removed to England, and, in 1884, opened a small workshop in Hatton Garden, London, where he set himself resolutely to the development of the gun, which was destined to place him in the front rank of successful inventors. As the result of a successful demonstration before a Board of the British Army, he received an order from the British government, and on the strength of it formed a company and built a large factory. He now realized that to render his gun fully successful, it would be necessary to produce a smokeless powder, and he succeeded in doing this in 1884, producing a powder of the nitroglycerine type. This was followed by a suit for infringement brought by the Nobel Cordite Company. The litigation ended when the House of Lords decided that Mr. Maxim was the inventor of this type of smokeless powder.

Although the machine gun occupied the greater part of his time and energy, Mr. Maxim was a careful student and experimental investigator in many different fields. No greater tribute to his ability as an inventor and practical mechanic can be found than the remarkable work which he did in the then new and comparatively untried field of aviation. As far back as 1887 he tells us, he was approached by several wealthy men who asked him if it was possible to make a flying machine. He said that it certainly would be possible, that it would cost \$500,000 and would require his undivided attention for five years. He built a laboratory at Baldwyn's Park, Kent, and proceeded to make an investigation which for its high, scientific quality, its wide range, and the vast amount of useful data secured, must be reckoned as one of the finest efforts of its kind. He built a large whirling table with which he tested a number of planes of different form and he also built a wind tunnel and experimented with scores of propellers. The steam engine, designed for high pressures, was a remarkable combination of light, weight and strength. The aeroplane was a huge affair with a total surface of 6,000 square feet. In a trial run, with the engine developing 360 horsepower, his machine, which weighed 8,000 pounds, lifted from the running rails and pulled so powerfully against the upper holding-down rails, which were designed to keep the machine near the ground, that it bent the shaft of the guide wheel and the machine was wrecked. Had he not restrained the machine from rising, it is probable that he would have had the honor of being the first to make an extended flight in a man-carrying machine.



The Prince of Wales, later King Edward, examining the first successful Maxim machine gun; Sir Hiram Maxim standing

Mr. Maxim was Knighted by Queen Victoria in the year 1901. Other tributes were in store for Sir Hiram. He was given the Legion of Honor by the French Republic, and he was the recipient of medals and decorations from the principal countries of Europe.

supports resting upon the ground. The object of this is to relieve the car of the heavy stresses set up by the recoil, which, when the howitzer is firing at a steep angle, reach a very high figure.

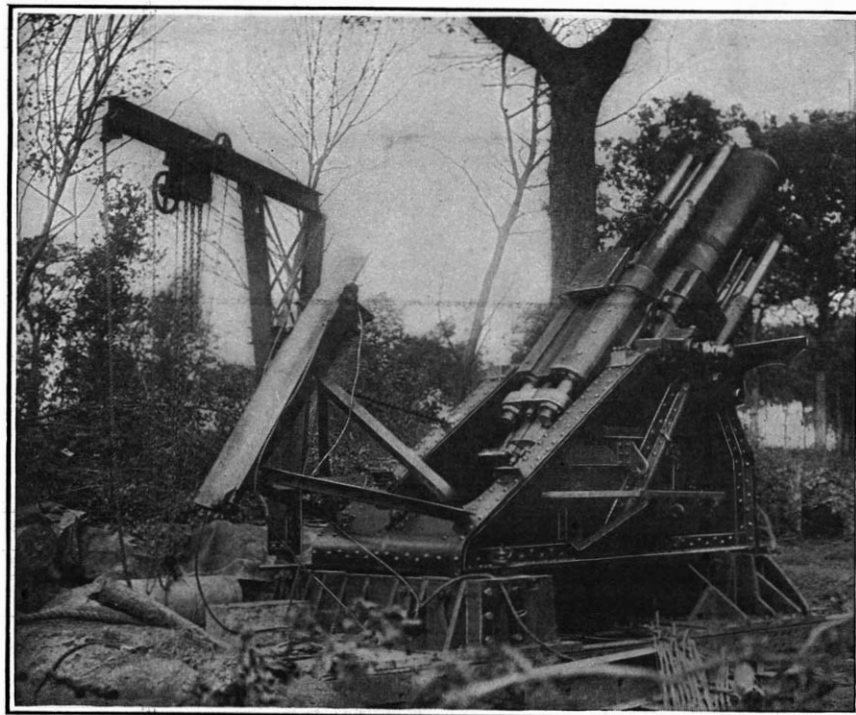
The howitzer which is shown in a fixed position, has a crane mounted at one corner of the base plate, which is used for lifting the shells from the ammunition car and depositing them on the shell-tray back of the breech of the gun. In the illustration this tray is thrown back out of position. The gun is loaded in the horizontal position and when the tray is in service, it is swung forward into the horizontal position pivoting on the angle-iron yokes shown in the illustration. The four long cylinders, arranged in pairs, two above and two below the gun are the recoil cylinders, for checking the recoil of the gun and bringing it gradually to rest. The cylinders are filled with glycerine, which passes from the rear to the front of a piston, the flow being controlled by choking valves. The gun is returned to battery by means of coiled springs located within the cylinders.

The Freezing Point of Mercury

THE Bureau of Standards has just completed a very careful determination of the freezing point of mercury, using platinum resistance thermometers to measure the temperature. The result of this work gives -38 deg. 87 Cent. (37.97 deg. Fahr.) for this temperature.

It is interesting to note that as far back as 1862 the English government, recognizing the importance of an accurate knowledge of this point, appropriated £150 to have it determined. The value then obtained, -38 deg. 85 Cent (-37.93 deg. Fahr.), is in good agreement with that obtained at this Bureau. However, other determinations made previous to and after this early work cast some doubt as to its accuracy. It can be seen that a knowledge of the freezing point of mercury is of great importance to thermometer makers as it marks the lower limit to which a mercurial thermometer may be used and furnishes a method for calibrating or pointing the scale below 0 deg. Cent. (32 deg. Fahr.).

It is also interesting to know that the old and generally accepted mark for the freezing point of mercury was lower than the above, or 40.5 deg. below zero Fahr.



A big howitzer ready to be fired. Our cover illustration shows the same gun being loaded



Heavy gun on a railway mounting; ramming home the charge

Strategic Moves of the War, November 28th, 1916

By Our Military Expert

THE events of the past week in Rumania again bring into prominence the admirable efficiency of the German General Staff, as well as the many advantages possessed by the Central Powers, by reason of their geographic position, their splendid system of communications, and their wonderful transportation facilities.

The situation is about as follows: Mackensen, leaving a sufficient number of his troops to hold his line in the Dobrudja, took the remainder of his army and, with or without reinforcements from the west (most likely without), has succeeded in crossing the Danube at or near Somovit, at or near Sislova, and, three or four days later, at Rustchuk, capturing, apparently without much trouble, the towns of Turnu-Magurele, Simnitz and Giurgevo on the Rumanian side of the river.

Having taken a firm stand near Alexandria and having extended his lines in a northerly direction in order to connect with Falkenhayn's advanced forces, Mackensen is now preparing to face towards the north-east, in the direction of Bucharest, his right flank resting on the Danube.

General Krafft von Delmensingen, advancing down both sides of the Alt river, has compelled the Rumanian army to retire to a line "a little towards the east," so Bucharest reports on the 27th instant.

It is now evident that the attack in the direction of Kimpolung was not to be pushed until after the main Austro-German armies had invaded the plains of Wallachia. Kimpolung being the terminus of an important railroad line and being also much nearer to Bucharest than the other points attacked, a threatening drive in that direction probably had the desired effect of causing the Rumanians to assemble in that sector a much larger force than was necessary at the time. It is evident also that this concentration was made at the expense of other points where the pressure, for the time being, seemed to be less dangerous than it appeared to be to the north of Kimpolung. This danger to Bucharest by way of Kimpolung was emphasized in nearly all the comments on daily bulletins coming to us by way of London. These may have reflected the Rumanians' feelings of apprehension in that direction and, on the other hand, they may have been a factor in influencing them to adopt the course they pursued. We are not in a position to express an opinion as to that, but we feel positively certain that the German General Staff was in close touch with every phase of the situation as it developed and was prepared to act when the right moment had arrived.

For a period of nearly a week we were without definite reports concerning operations on the Dobrudja. From other sectors in Rumania, both sides reported indifferent successes, attacks and counterattacks, slight gains and losses, but very little, apparently, of importance. Then, almost without warning, we are told that the Alt and Topolog rivers are in the possession of Falkenhayn's army and that Mackensen has crossed the Danube in two, and possibly three places; that he has captured several important towns on the Rumanian side of the river, among which are Alexandria and Giurgevo, and that he has effected a junction with the Austro-German armies advancing from the north and the west. We now hear that these armies are preparing to march on Bucharest and should arrive before the walls of that city not later than the end of this week.

We do not know just where Mackensen left his advanced line in the Dobrudja, but I feel quite sure that it must be somewhere north of the Cernavoda-Constanza line. If he found it impracticable to use the Cernavoda bridge to invade Rumania, he would not allow the Rumanians to use it as a short cut to reinforce their line against him in the Dobrudja. It was with this in mind that I recently suggested that at this particular point, strategy demanded that the Russo-Rumanians should drive Mackensen eight or ten miles south of the Cernavoda-Constanza line and that they should hold him there until the tide had turned in their favor in Wallachia. Being under the impression that the Russo-

Rumanians controlled the lower Danube east of Orsova, I felt quite sure that Mackensen could not cross the river at any point west of Cernavoda and east of Rustchuk. It seemed to me very doubtful indeed, that he should think of attempting, much less that he should succeed in effecting a crossing at any point east of Orsova. It is evident that his flotilla of river gunboats must have been destroyed or withdrawn below Silistria, but on this we are absolutely without information.

The crossing of the Danube at the points and at the time selected, is a very good example of sound and far-seeing strategy and successful coordination. Mackensen might have made his first move across the Danube at Rustchuk instead of Samovit, with equal facility, two or three weeks ago, and he would have been much nearer Bucharest; he would have had a direct line of railway into the capital and two lines of railways, one from Tirnova, the other from Varna, to bring supplies for his army as far as the right bank of the Danube.

Let us suppose that Mackensen had selected this crossing point in the early part of November, when the Teutonic forces were still a long way from Cralova and the Alt river. What would have been his chances of making a successful "drive" on Bucharest? In the

What really did happen is a complete antithesis of the foregoing suppositions.

The crossing points and the time of crossing appear to have been selected to secure, within a very short time, the complete tactical and strategical junction of three separate forces advancing from as many different directions.

The importance of the success achieved is even more apparent when we refer to the map and see that the center of the new line can be fed and supplied by a direct railway line through Orsova; that the right wing can be supplied either by river transports or by rail from Sofia, or, in the event that the control of the river passes into the hands of the Russo-Rumanians, supplies can be brought in by rail from the center line; the left wing can be supplied by rail either from the north or from the center line.

The Austro-German line, as we are able to locate it from the daily bulletins, appears to be in a very good position, with all its component parts within easy supporting distance of each other, and all ready to begin direct operations against Bucharest. It is quite evident that the military occupation of western Wallachia by the Austro-German troops is an accomplished fact. The advance eastward across the valleys is a different proposition and may be found more difficult.

The river Vede is still to be crossed; beyond that runs the Ardjis or Ardshih river as well as several other streams less important, yet sufficient to impede the advance of an invading army; all running from northwest to northeast, or practically straight across the direct line of march.

The Austro-German armies, even if ultimately successful, should not be within striking distance of Bucharest either this week or next unless the Russo-Rumanian army of defense has completely collapsed.

Making Roofing and Wall Paper from Waste Tanbark

A METHOD of using waste hemlock tanbark to replace partially expensive rag stock in the manufacture of felt roofing has been developed at the Forest Products Laboratory and is now being used commercially by cooperating mills, according to an announcement made by the Forest Service. It is stated that, in these mills, from 20 to 30 per cent of the rags is being replaced by waste bark and that the quality of the finished product is equal to that manufactured solely from rags. Members of the Forest Service who have been conducting the experiments say that the utilization of the bark

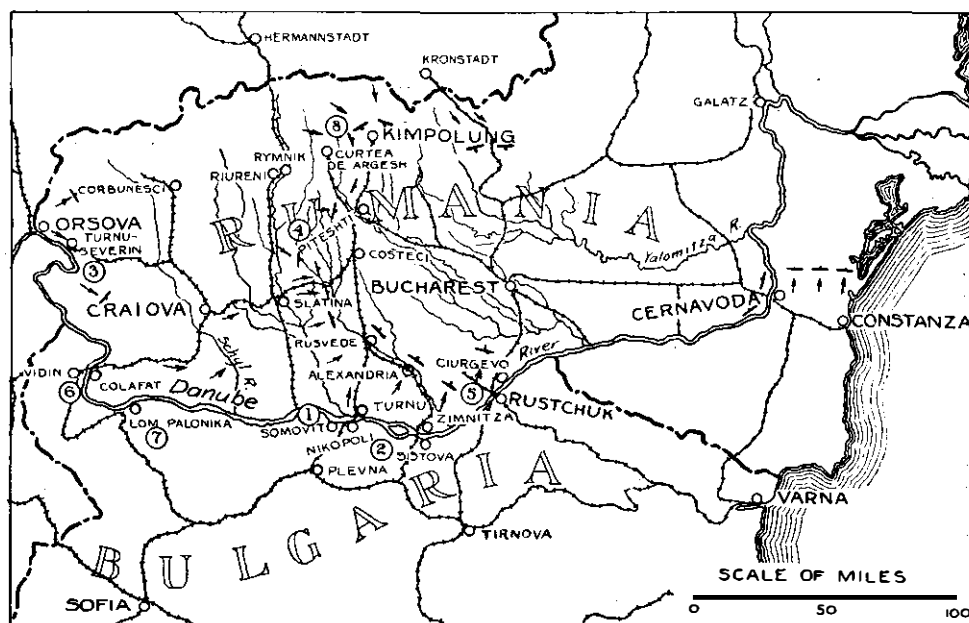
will make it possible to effect a considerable saving in the manufacture of felt roofing.

According to the census of 1909, over 698,000 tons of hemlock bark were produced each year in the United States. After the tannin is extracted this bark is used for fuel purposes, for which it is said to have a value of 60 cents per ton.

The extent of the savings rendered possible by the new methods is pointed out by the fact that the roofing mills of the United States have a total estimated annual production of 237,000 tons of finished roofing of all kinds, equal to about 11,300,000 "squares." By a square of roofing is meant 100 square feet. The utilization of the waste bark in this industry should, it is said, enable the mills to reduce their manufacturing costs appreciably.

In addition to the use of bark in roofing, papers made by the Forest Products Laboratory on the basis of 80 per cent of waste tanbark, have been successfully printed on a commercial twelve-color wall paper printing machine, and give promise of being entirely satisfactory. Other paper of the same make-up has been made into fiber conduits by a commercial manufacturer.

Other possible uses of waste bark which suggest themselves, say the Forest Service paper experts, are the use of bark mixed with ground wood for the production of wall board, or with sulphite screenings in the manufacture of car liners. Studies already made at the Forest Products Laboratory indicate that it may be possible to use waste hemlock and oak tanbark in making a large variety of pulp products.



The Teutonic drive at Bucharest

Short arrows, ——— indicate the location (approximately) of the Austro-German lines of advance; the heavy broken line, - - - the probable location of Rumanian troops. (1) Somovit (2) Nicopoli, towns on the Bulgarian side of the Danube, near which the forces under Mackensen invading Rumania are reported to have crossed the Danube. (3) Turnu Severin, where, according to Berlin reports, the Austro-German Army, on November 27, inflicted severe losses on the Rumanian troops retreating from Orsova. (4) The Alt and Topolog sectors which Bucharest admits having given up to the advancing Austro-Germans. (5) Giurgevo, Rumanian town opposite Rustchuk, captured by Mackensen after crossing the Danube at that point. (6) Vidin, where Bulgars are reported to have crossed the Danube and captured the Rumanian town of Calafat or Kalafatu. (7) Lom-Palanka, another point where Bulgars are reported to have crossed the Danube. (8) Curtea de Argesch, which Berlin reports as having been captured on the 28th of November.

first place it would have been necessary for him to detach a much larger force from his Dobrudja expedition than he probably has with him at this time, this necessity being due to the fact that he would have been acting practically alone. Assuming that his crossing was accomplished as safely then as was the case later at Samovit, he would no doubt have found himself facing a force of Russo-Rumanians, equal, if not superior in strength, to his own, having in addition a free line of communication to its natural base. Mackensen's position would have been precarious to say the least. His nearest supporting troops, Falkenhayn's advancing columns, were then some hundred or more miles to the north and west, with a hostile country in the interval. His bridge across the Danube might have been destroyed at any time by the flotilla of river gunboats, his only line of communication cut in two, and the destruction or capture of his army almost certain. But even if his bridge across the Danube was not destroyed, it is more than probable that his depleted line in the Dobrudja would have been unable to resist the attacks of the Russo-Rumanians from the north (under the circumstances, strategy would have demanded a vigorous attack on their part), and in the event of being obliged to retire beyond Rustchuk, Mackensen would have been compelled to abandon his invasion, and to recross the Danube long before the retreating line had reached that point, or find himself in danger of being cut off on the wrong side of the river. The result would have been the same as if his bridge across the Danube had been destroyed.

The Economical Ration for the Times

By Charles Bolduan, M.D., Director, Bureau of Public Health Education, Department of Health, City of New York

THE low cost balanced ration is now an economic necessity in many families. The increased cost of living is much more than commensurate with salary or wage increase. How then can this often unnecessary increase be combated? Without going into the general cause of rise in price such as the European War, an attempt to feed conquered peoples, the alleged cornering of supplies, cold storage and other aids to a barometric increase, we still have to look for a remedy. This can be found in a properly constructed, low-cost dietary. Our engraving shows a week's food supply for two adults and three minor children. This family budget was worked out by the Bureau of Public Health Education, Department of Health, City of New York, and the figures may be accepted as reliable. The Department of Health does not try to produce an impossible bill of fare, but has risen to the emergency showing how a family of five can live, on a pinch, until the law, public opinion and the economics of supply and demand adjust themselves so as to force prices to a lower level, although probably never again as low as before the war, but as comparable to it. The Board of Health does not advocate an adherence to a budget of this kind, if it can be avoided, but it is better to face a financial crisis, as many families must do with knowledge, than without it. It is better to struggle along for a few weeks on a diet prescribed by expert physicians and dietitians than to spend money on canned goods, canned soups, pies, buns and other attractive foods of little nourishment. The figures in the table are based on retail prices prevailing in localities where the poor do their marketing and could not be duplicated in better neighborhoods where the stress of circumstances is not so great. The articles in this table are selected because of their food value. It may be of interest to our readers to know that this diet supplies about 9500 calories (heat units) and 430 grammes of protein a day. In other words there is ample nourishment for two adults and three minor children for one week.

1 lb. oleomargarine.....	\$2.28
1 bag sugar (3½ pounds).....	.29
1 lb. rice.....	.08
1 lb. dried peas.....	.09
1 lb. beans.....	.09
1 lb. farina.....	.06
1 lb. oatmeal.....	.05
1 box cocoa (¼ pound).....	.12
1 lb. prunes.....	.15
1 lb. onions.....	.05
6 lbs. potatoes.....	.24
1 head of cabbage (medium size).....	.08
1 lb. cheese.....	.33
2 doz. eggs.....	.80
2 lbs. of meat daily at 20 cents lb.....	2.80
2 loaves of bread daily at 8 cents each.....	1.12
2 qts. of milk daily at 9 cents.....	1.26
	\$7.86

If butter is substituted for the healthy, clean and nutritious oleomargarine, add 17 cents more to the \$7.86, making \$8.03 in all. For better neighborhoods add 5 to 15 per cent more to these prices for the same goods, to allow for greater rentals, but it is assumed that everything is bought for cash and is not delivered—two potent causes for increased prices. The words “fresh eggs” on the egg boxes, mean little as this article of food is about as scarce as radium at the present time. An allowable license is given to the artist in showing a “standing roast,” as it is portrayed on butchers’ wagons from time immemorial instead of the useful and economical but less attractive looking flank steak.

The New York Association for Improving the Condition of the Poor has just completed the following table of actual retail prices of food in quantities such as are commonly bought. The table shows the prices of a year ago and of last month and the percentages of increase:

Food.	Quantity.	Nov., 1915.	Nov., 1916.	Per ct. Inc.
Codfish.....	1 lb.	\$0.10	\$0.15	50
Eggs.....	2 doz.	.62	.98	58
Butter.....	2 lbs.	.66	.86	30
Cheese.....	1 lb.	.20	.23	15
Bread.....	17 lbs.	1.13	1.36	20
Barley.....	½ lb.	.03	.03	00
Oatmeal.....	4 lbs.	.10	.20	25
Macaroni.....	1 lb.	.06	.08	33
Rice.....	1 lb.	.05	.06	20
Molasses.....	1 pint	.10	.10	00
Sugar.....	5 lbs.	.33	.40	21
Beans.....	2 lbs.	.18	.30	67
Cabbage.....	1 head	.11	.15	36
Carrots.....	6 lbs.	.15	.24	60
Onions.....	6 lbs.	.24	.30	25
Potatoes.....	18 lbs.	.42	.60	44
Tomatoes.....	1 lb.	.10	.10	00
Apples.....	12 lbs.	.30	.60	100
Raisins.....	1 lb.	.18	.23	28
Coffee.....	½ lb.	.10	.10	00
Tea.....	¼ lb.	.07	.07	00
Cocoa.....	½ lb.	.13	.13	00
Chuck steak.....	2 lbs.	.44	.44	00
Bacon.....	1 lb.	.22	.22	00
Milk.....	21 qts.	1.89	2.10	11
Totals.....		\$7.97	\$10.33	29.6

The increases thus average from 11 per cent in cost

of milk to 114 per cent in potatoes. There is no item in which there was any decrease.

With eggs at their present high level it is, perhaps, not well to recommend them as a substitute for meat, but if the law and public opinion serve to produce the expected fall, we shall have in connection with milk, an excellent substitute for meat in the shape of eggs. Divorcing present prices from the argument, we can show the relative value of meats compared with eggs and milk as follows:

The following tables, which represent changes in the dietary at the Municipal Sanatorium at Otisville, N. Y., are based on wholesale prices for large quantities of food. These changes have not only resulted in economy, but have also added to the attractiveness of the menus. The prices of meats are becoming almost prohibitive so that eventually all but the very well-to-do of our population may be compelled to use substitutions for part of the meat content of their meals. The tables here given illustrate the relative difference in price and quantity of some of the substitutes for meats:

TABLE 1—SAVINGS FOLLOWING SUBSTITUTION OF EGGS FOR MEATS AT BREAKFAST COVERING A PERIOD OF FOUR WEEKS.					
No. of Meals.	Variety of Food.	Per Meal.	Total.	Price, cts. (1914).	Cost.
8.....	Steak.....260 lbs.	2,080 lbs.	20	per lb.	\$416.00
8.....	Chops, loin...145 lbs.	1,160 lbs.	19.3	per lb.	223.88
	Chops, rib...125 lbs.	1,000 lbs.	10	per lb.	100.00

Total for meat.....					\$739.88
16.....Eggs.....80 doz.	1,280 doz.	23.6	per doz.		302.08

Total savings for period of four weeks..... \$437.80

TABLE 2—COMPARATIVE FOOD VALUE AND COST OF MILK AND EGGS.					
	Protein.	Fat.	Carbo-hydrates.	Total Cal-ories.	Cost per Capita per Diem.
Eggs, 2 per portion:					
{ Grams.....13.50	10.54	{ (Eggs 26 cts. per	
{ Calories.....55.31	105.46	161	{ dozen), 4.33 cts.	
Milk, ½ pint per portion:					
{ Grams.....7.48	9.08	11.34	{ (Milk at 6 cts. per	
{ Calories.....30.66	84.44	46.49	162	{ qt.), 1.5 cts.	
Savings per capita per diem, when milk is substituted, 2.83 cents.					

Cereals, such as corn meal, hominy, and, especially, oatmeal, are rich in nourishment and are much cheaper than the package cereals.

American cheese, dried beans and peas, are comparatively cheap and contain a great deal of protein, which is the most important food element found in meat.

Oleomargarine is a very satisfactory and economical substitute for butter. Unfortunately its use in public institutions is prohibited by law in New York State.

Rice is a very cheap food and can be served in many different styles. It should be used more frequently than it is in the dietary of those of moderate means. It contains a very high percentage of carbohydrate, one of the very necessary forms of nourishment. Everyone knows how extensively it is used among the peoples of Asia, where it has served as the chief article of diet from time immemorial.

It is not necessary to state that bread, preferably of whole wheat, a form which is rich in very important food elements called “vitamins,” also sugar and potatoes, should occupy prominent places in the dietary of the working man and woman.

There are many other cheap foodstuffs, a notable one being macaroni and cheese. When these are used judiciously, they serve to lessen the cost of the dietary without in any way impairing its food value.

The great European War has taught many lessons of economy to the peoples involved, and it is hoped that these lessons will be not lost upon us. Buy Economically—Cook the Food Properly and Avoid all Waste. This is the true way to help combat the high cost of living.

The Current Supplement

IN our craving for novelty we are apt to lose sight of the importance of many things which we hear of so frequently that they have become familiar. This is the case of the Smithsonian Institution, at Washington, which is one of the most remarkable agencies for the promotion of knowledge in the world. There is a brief review of the many lines of its activities in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2136, for December 2nd, which is accompanied by photographs showing the old and the new buildings, together with a large number of interior views. An article of special interest in this issue is *Bergson's Theory of Intellect and Reality*, which discusses our limitations and powers. *Animals of Blown Glass* describes the method of making some of the wonderful models of animals, plants and flowers in colored glasses that can be seen at the American Museum of Natural History, and is illustrated by several beautiful photographs. *The Raw Materials Used by the Rubber Manufacturer* gives much useful information relating to an important industry. *The Uses of Ozone* tells of applications of this important gas in

chemical research and the industries. *The New Science of Nematology* is a most interesting article dealing with minute animals that pervade the universe. It is accompanied by several striking illustrations. *The Honey Ants* describes an insect of curious habits that is found in Mexico and parts of California. There are a number of shorter articles of merit.

Combating the Attacks of Termites or “White Ants”

METHODS of combating termites or “white ants” and guarding against their destructive activities in woodwork, books, stored papers and other material, trees, nursery stock, and garden and field crops are explained in “Farmers’ Bulletin No. 759,” recently issued by the United States Department of Agriculture.

The insects, which are not ants and only superficially resemble them, primarily attack woodwork and cause greatest damage by weakening or destroying portions of buildings and other wooden structures in contact with the ground. On recently cleared land or any other soil containing decaying wood, however, they may prove destructive to growing plants. The insects also eat into numerous articles stored on damp, wooden shelves or under conditions otherwise attractive to them. Articles attacked in this way may include books, documents, objects made of pasteboard or wood pulp, cloth, clothing, leather products, and food substances.

Termites may cause damage about the home for long periods without the knowledge of the owner. They live in colonies in dead stumps or in other decaying wood and enter the woodwork of buildings under ground where timber is in contact with the soil or through cracks in concrete. They often destroy large portions of the interior of pillars and other wooden members without giving any indication of their presence.

When termites are found to be present it is usually through noticing the annual emergence of the flying members of the colony at swarming time in the spring. The place of emergence should be noted, as this indicates the approximate location of the infested timbers. The presence of small branching tubes of earth on stone or metal, serving as passage ways to wood, may be another indication that termites are at work in a building.

Either preventive or combative measures may be taken against the inroads of termites. In all new building operations care should be taken that no untreated timber is in contact with the ground or is set in wet concrete. The latter condition is not a protection, since the concrete often cracks and the insects may gain entrance through the crevices. If wood must be placed in contact with the earth, only timber treated with some such substance as coal-tar creosote should be used. Cellar floors of concrete should join the walls in a curve to guard against cracks. If buildings are constructed without cellars the wooden flooring should be raised well above the ground.

If termites are discovered in woodwork it will be necessary usually to remove the damaged timbers and replace them by stone or brick work, or treated wood. The ground at the approximate entrance passage of the insects and any earth tubes discovered should be drenched in kerosene oil. Infested timbers also may be drenched with the oil.

Books, documents, and other stored material can be insured against attack by the termites by keeping them away from warm, moist locations while in wooden containers. The insects may be driven from such material by spreading it in the sun. If all connected between the storage place and damp earth is cut the insects will not return.

Termites are especially likely to attack the wood of greenhouses where warmth and moisture are the rule. Steps similar to those described for other buildings should be adopted to rid infested greenhouses of the insects. Supports for flower benches may be sawed off near the ground and made to rest on bricks or stone. If the termites are in the soil they may be killed in many instances by applications of carbon bisulphid. Plants may be sprayed effectively with a 5 per cent solution of kerosene emulsion. In order to prevent attacks by termites on living trees, the tree surgery method of treating scars and dead limbs and spots is recommended.

Nursery stock may be attacked by termites if planted on recently cleared ground. Such locations, therefore, should be avoided. Care should be taken not to permit the roots of young trees to dry out before planting, as such weakened stock is liable to attack. Damage to field crops by termites may be prevented by late fall plowing and crop rotation.

Exploring a River Bottom from the Under Side

Unique Investigation of a Water Power Site

IN last week's issue of the SCIENTIFIC AMERICAN we published a plea for the utilization of our water powers, in which attention was called to the discouragements which the promoter of water powers has to face, due to the unsatisfactory character of Federal and State laws covering the acquisition and use of such powers. Reference was made to the amount of work that is sometimes involved in surveying a water power site. This often requires a considerable investment which can hardly be obtained unless encouraging legislation is provided.

An unusual example of the amount of preliminary work that must sometimes be undertaken is to be found on the Pend O'Reille River. This river has its source in the State of Idaho and cuts across the extreme northeast corner of Washington, joining the Columbia River just beyond the international boundary. The only site available for a dam is in a canyon where the river runs 100 feet deep at low water and over 150 feet in time of flood. A dam with an extreme length of about 250 feet at the crest, and rising about 375 feet from the bed of the river, would furnish an excellent head of water for power purposes. Such a dam, however, would be the tallest in the world, 25 feet taller than the Arrow Rock Dam, which now holds the record with a height of 348 feet.

Before raising the funds necessary for such a construction it is obvious that exact information must be had concerning the character of the river bottom. Several years ago a syndicate was formed to exploit this site. Immediately difficulties were encountered. The current here is so swift even at low water, that it would be impossible to make borings which would disclose the character of the rock under the water. Nevertheless, the effort was made to promote the project. It is said that \$135,000 was spent in the effort to interest the requisite amount of capital, but the project failed merely because there was no positive evidence that the rock underlying the river was sound.

After this failure the site received the attention of another prospector who undertook to investigate the river bottom, realizing that information on this subject was absolutely essential to success.

The conditions that faced him were unique in the history of engineering. Being unable to make his soundings from the surface of the water, he demon-

strated his resourcefulness by carrying on his exploration from the under side. Accordingly he drove a shaft on one side of the river to a depth of 200 feet, or 50 feet below the indicated bed of the river. Thence he ran a tunnel under the river for a length of 150 feet and used this tunnel as a drilling chamber from which diamond drill borings were made up through the

river bed and into all of the territory underneath the proposed dam. The prospector was rewarded for his enterprise with the absolute assurance that the rock at this point is perfectly sound. Eighteen hundred feet of diamond drill borings were made without disclosing any fissures or faults.

The accompanying drawing shows the exploration shaft and tunnel and the direction in which the borings were taken. The mouth of the exploration shaft, it will be observed, is lower than the high-water mark of the river. After the shaft and tunnel had been completely excavated the water rose sufficiently to drown out the work. Operations were stopped for several weeks until the water dropped again. Evidence of the soundness of the rock was then manifested by the fact that the level of the water in the shaft did not change, while the water of the river dropped 20 feet. The shaft was then pumped out and work on the borings proceeded.

The work at the dam site, together with detailed surveys over a territory 300 miles in extent, had to be carried out during a period of two years, involving an expenditure of \$175,000, before the question of whether there was any water power available at all could be determined.

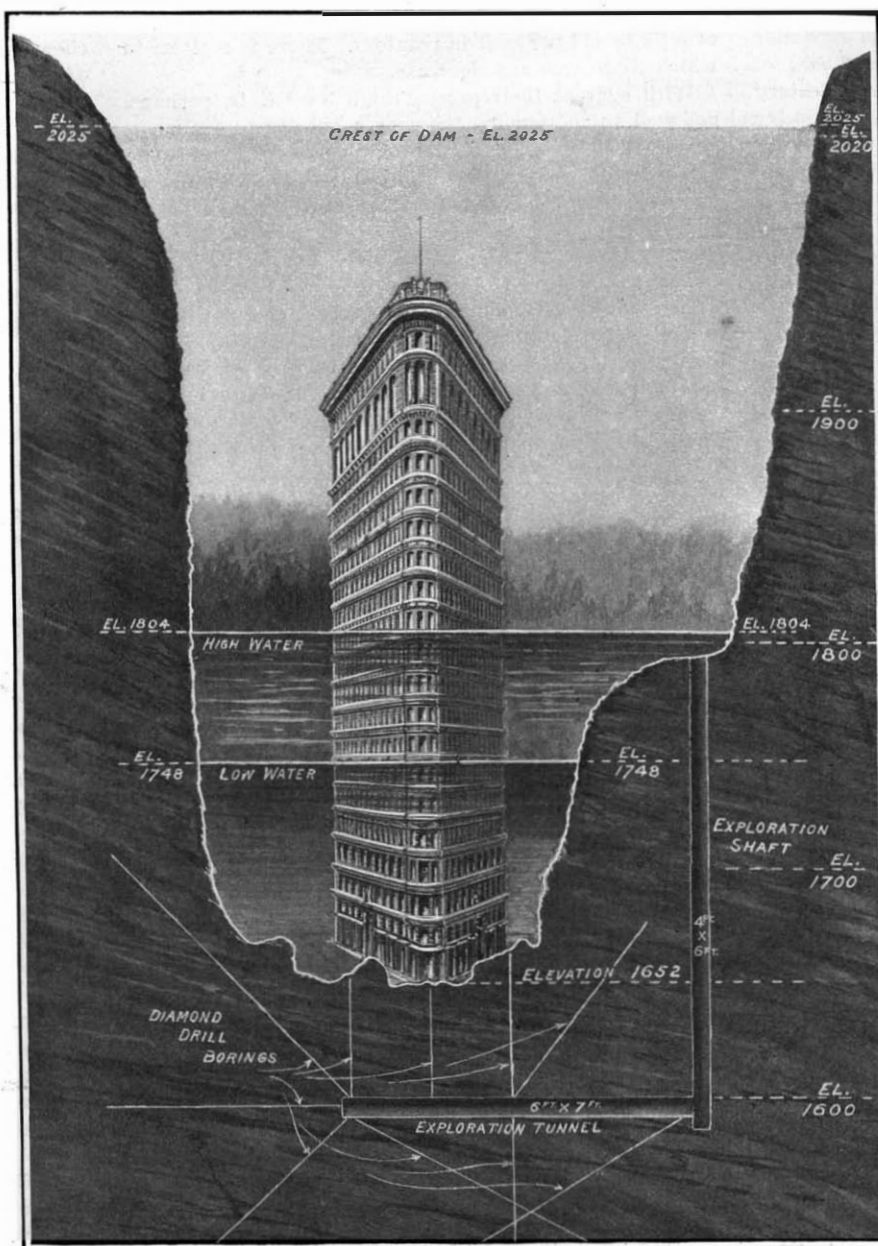
In our illustration we have endeavored to show the depth of the water and the approximate height of the dam proposed by representing the Flatiron Building placed in the canyon. This building, which is 286 feet high, falls nearly 100 feet short of the crest of the dam, which will be 373 feet high.

To be sure, the exploration work on the Pend O'Reille River is very unusual, but to some degree investigations of this character have to be undertaken with every water power site before the value of the site is determined. Surely if we are to make any progress in the development of our hydraulic resources, our Government must show a more encouraging attitude than it has in the past.

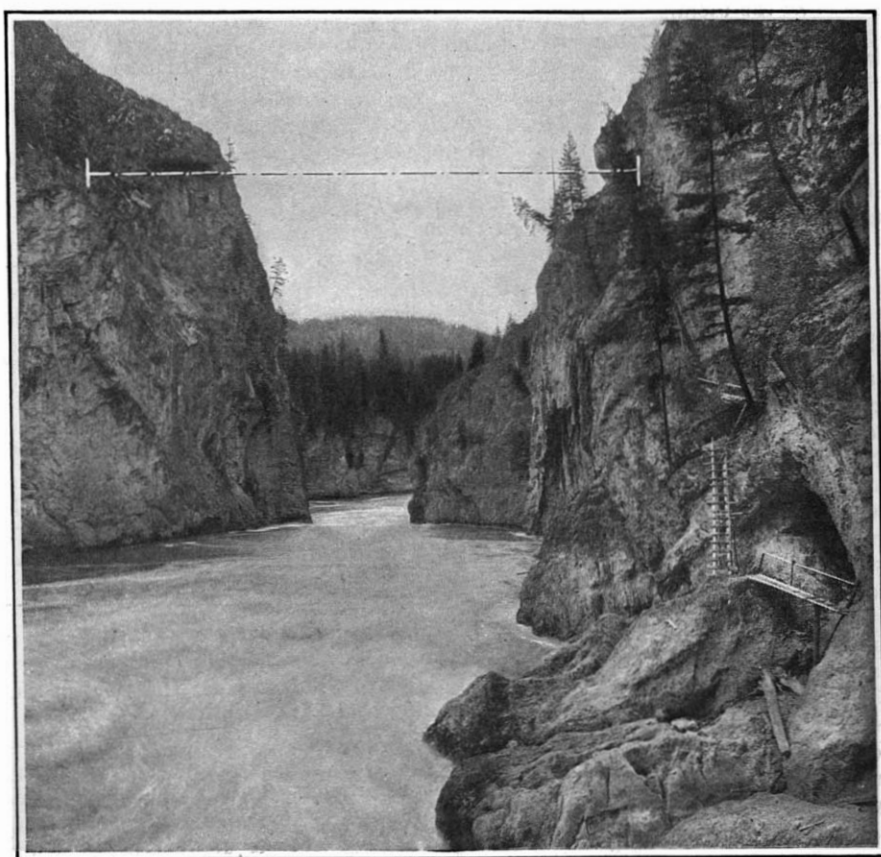
Old-World Jewelry Made in America

(By James Anderson)

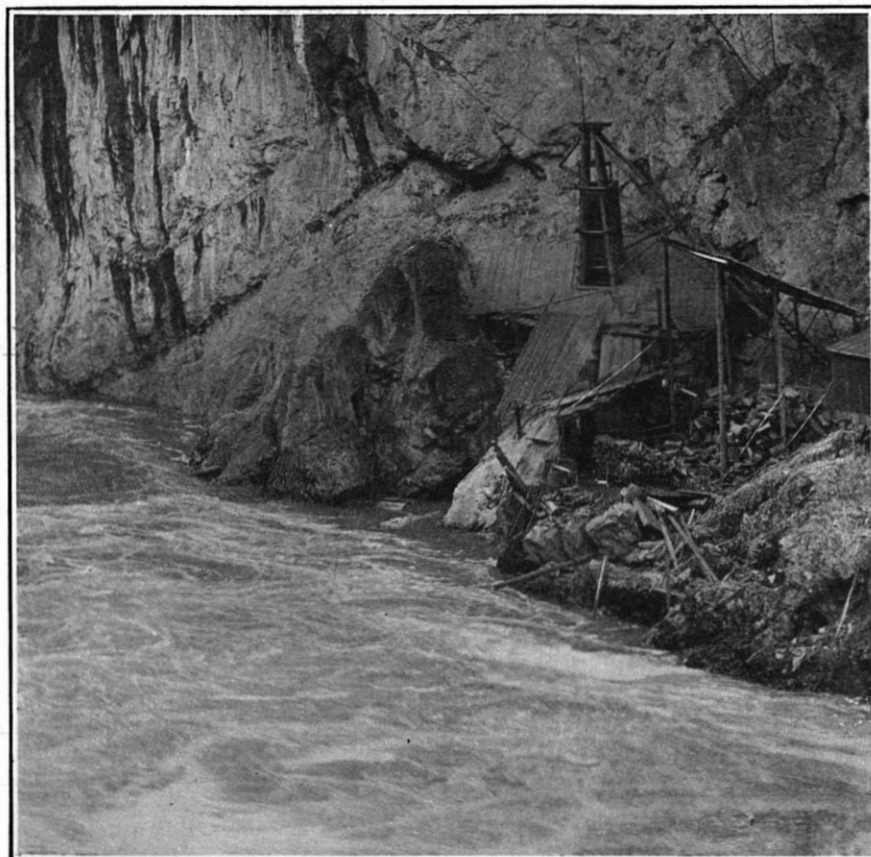
CAMEO cutting, perhaps the most antique of all occupations which have survived to our day, has recently been introduced into the United States. Previous to the outbreak of the war, one could count on the



How the rock exploration was conducted from the underside of the river
The Flatiron Building used to indicate the enormous height of the proposed dam.



The Pend O'Reille river; crest of dam indicated by broken lines



Head works of the exploration shaft on the brink of the river

fingers of one hand all the cameo cutters in this country, practically all cameos sold in America being imported from Torre de Greco and Santa Lucia, the great cameo towns of Italy. To-day we are producing our own cameos, and there are in New York alone between 50 and 60 men whose trade it is to cut landscapes and pretty ladies in the shell, coral, or other stones used for this popular and comparatively cheap style of jewelry.

All of these men work at home in the Old World style, a small bench and chair, four or five engraving tools, a few files and some polishing brushes making up the necessary paraphernalia, except for the pencil-like sticks, or "holders," upon which the cameos-to-be are cemented with a brownish sealing wax. With this simple equipment and the craftsmanship which he has acquired by years of apprenticeship on the other side, the average cameo cutter can make from six to ten dollars a day—much higher wages than he ever received in Italy for the same work.

Just at present there is a great demand in the United States for cameos of all grades and descriptions, and especially for the smaller stones of passable workmanship, which wholesale for twenty-five cents to five dollars each, according to the size and quality of the shell. These medium grade shells are wanted by the manufacturing jewellers for the inexpensive but genuine jewelry. They are set in light weight, graceful mountings that are turned out by machinery. Scarfpins, brooches, rings and pendants are turned out by the thousands in this manner, and so can be sold at remarkably small prices. There is a smaller but steady demand for the finer grades which are set in heavier and more elaborate mountings, but they are none the more genuine. The smaller shells of passable quality are very quick sellers.

In the cutting of cameos there are many trade secrets and these are guarded with the greatest of care. There are three kinds of shells used by cutters, the pink shell from the West Indies, the queen or brown shell from Singapore, and the cornelia shell from the Aegean Sea.

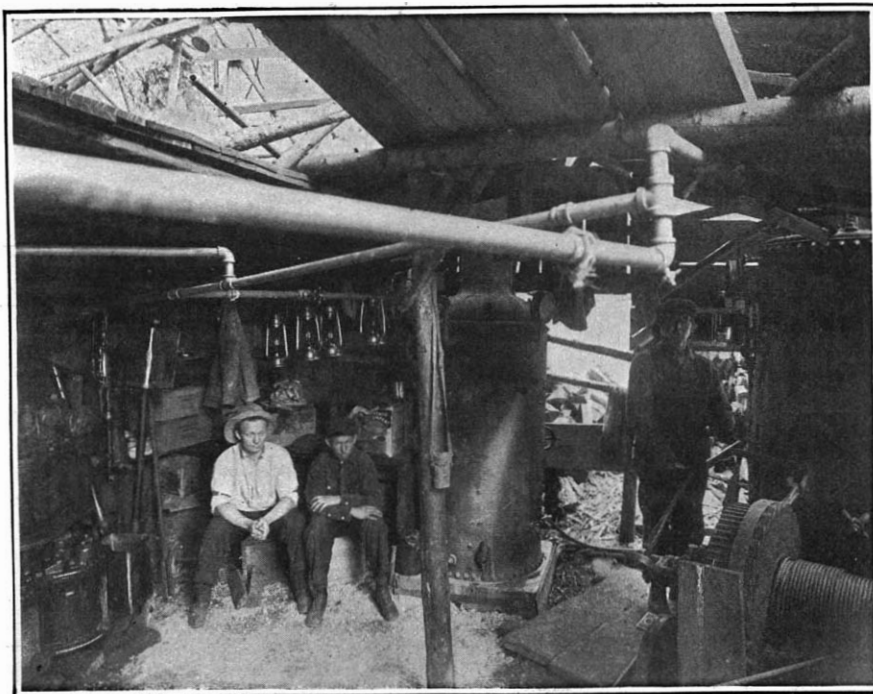
From each shell the lip or flange at the opening is sliced off by a toothless circular saw. It is next cut into little mosaic-like blocks about an inch square, then sent to the cutter, who shapes it into the desired circle or oval and fastens the cameo-to-be on the holder. The highly colored part is embedded in the sealing-wax, for that is to form the background of the picture, while the whitish chalky part is carefully chipped away, leaving only as much as is necessary for the relief of the design.

The cameo cutter who can produce a really good "Three Graces," or a chariot bearing aloft a company of angels, has something to be proud of, and may be recognized as a master of his craft. These particular groups are the hardest of all the usual designs which the stock cutter is called upon to execute.

A Ten-Ton Torsion

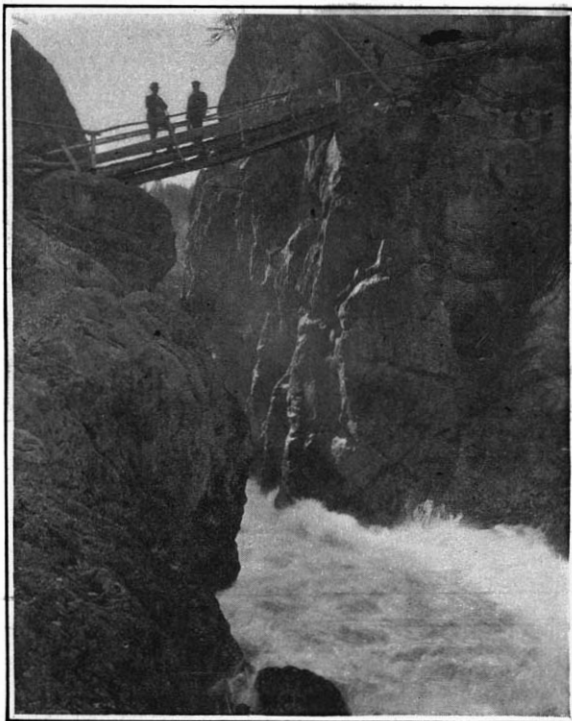
A MOST conclusive demonstration of the practical utility of the motor truck and the strength of construction obtained in these vehicles was given recently at Mount Wilson, Cal. The bottom section of the new 100-inch Carnegie Observatory telescope, cast in one piece and weighing ten tons, was trucked up the narrow, steep, and tortuous trail to the summit in a single day and with complete success.

Not only did the truck carry a load of almost three times its rated capacity up this grade, but it stood up



Interior of the shaft house beside the Pend O'Reille

under an accident which might well have plunged the truck and its load down the mountain side if the rear axle had not been able to withstand tremendous torsional stress. For at one point of the journey the outer wheel crashed through the parapet and hung suspended



Where the rock walls close in on the river

over the edge, throwing the entire load upon the inner wheel. It was a matter of five hours before the truck could be restored to the roadway. In spite of the continuous and terrific strain to which it was subjected, the axle did not buckle, and no repairs or adjustments were necessary; once back on a firm base, the truck resumed its journey as though nothing had happened.

It is notable that this performance was not staged as a "stunt." The huge casting had to be

got to the top of the mountain, and the motor truck was called in to do the job.

The Standardization of Industrial Plant Buildings

EVERY manufacturer of a standardized product knows what standardization has done for him. It has absorbed the cost of preliminary experimentation and development. It has reduced individual jobs to aggregate production, and made it possible to apply to that aggregate the advantages of capital and equipment. It has made a better product at less cost; and it has brought output and manufacturing costs to an approximately stable basis by permitting the purchase of materials when prices are low, to be manufactured during dull seasons for the future.

It has been with a view to securing the numerous advantages of standardized design and construction that a firm of industrial builders has evolved a line of standard factory buildings, despite the fact that such a feat seemed at first impossible of commercial realization. Yet

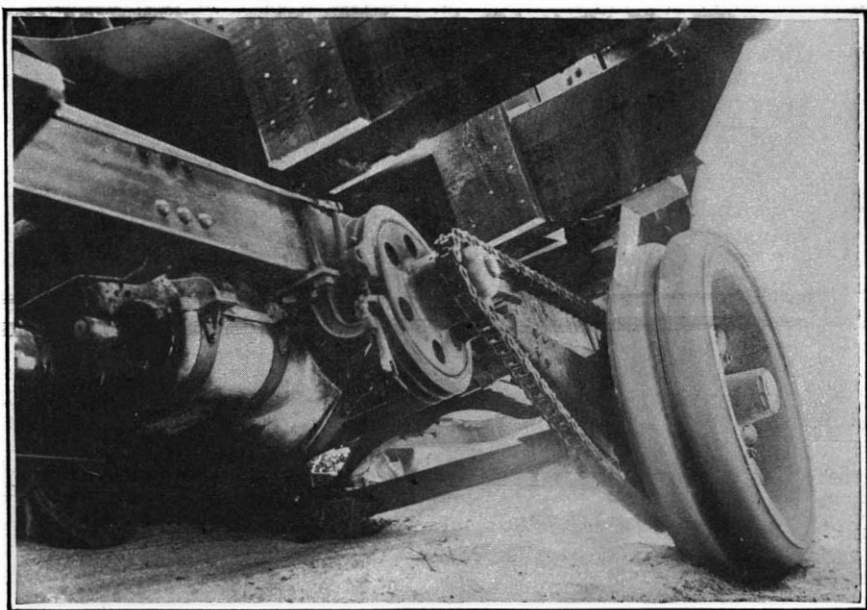
analysis of the accumulated experience of more than 40 years in factory building all over the country showed that seven types of buildings would accommodate a great variety of industries.

So it was that the firm of builders proceeded to standardize the seven types, fixed as to unit cross-section, but variable as to length, in multiples of the distance between columns. Each design has been made to utilize standard materials which are readily procurable at low cost and utilizable without waste. Structural steel, lumber, cement—the materials most likely to show big advances in price—have been contracted for when the prices were at their lowest. Construction units, such as steel columns, roof trusses, beams, sash, have been pre-fabricated and held in stock at the firm's depots, ready for quick assembly on the factory owner's land.

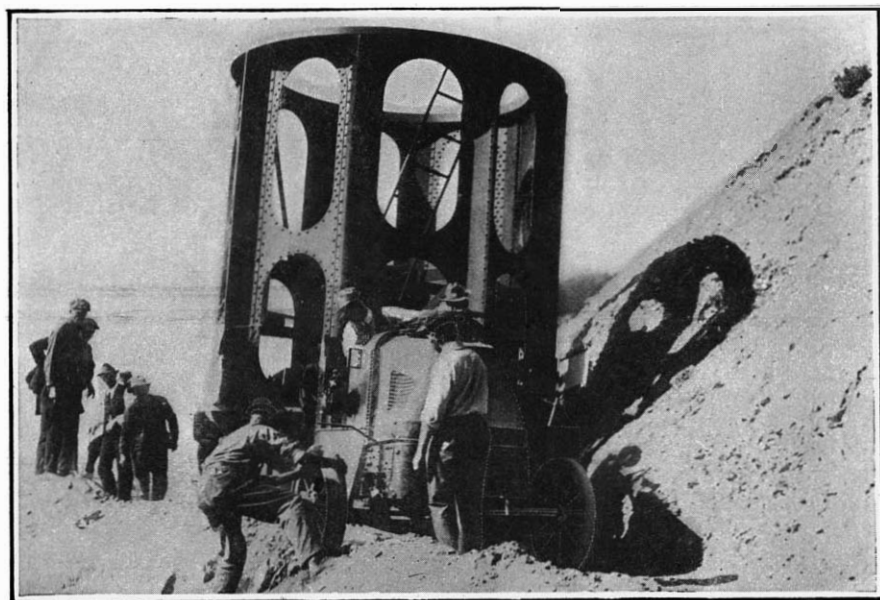
It is said that the standardized factory buildings are the irreducible minimum of good construction—every needless detail eliminated, every essential retained. They are claimed to represent a country-wide average of the best engineering practice and purchasing power. The construction is good and allows for maximum daylight, ventilation, and floor space at minimum expense. Pre-designed, pre-fabricated, bought at low cost and carried in stock subject to the factory owner's order, the standardized buildings can be quickly and economically erected not only for immediate needs, but for future additions as well.

Most Heavily Loaded Train in Europe Hauled by an American Locomotive

A KHARKOF newspaper states, under date of August 30th, 1916, that Prof. Lomonosof, a member of the engineering board of the Russian Ministry of Ways and Communication, has established a new European record for the most heavily loaded train. With the American locomotive of the decapod type he brought over the Nikolaief division of the Southern Railway a train with a load of 4,424 tons. The length of the train was 2,800 feet. The signaling was done with flags, as is the custom in the United States. The trip was purely experimental. A Russian engine was tried out against the American engine, and the superiority of the latter was clearly established.



Position held by rear axle for five hours and under a pressure of ten tons



Bringing the truck with its ten-ton load back to terra firma

Eliminating Guesswork in Cinematography

A Motion Picture Laboratory Installed in a Rebuilt Pullman Car

NOTHING could be more true and more applicable than the exclamation of surprise of a well-known business man who had spent several weeks surveying the activities of a number of motion picture companies: "It is a surprise to me that they ever get their product to the marketable stage, and that the product is of such high quality." This remark was immediately followed by another, equally true and equally applicable: "The wonder of it is that they make any money at all, considering the inefficiency-run-riot methods in the studio and the laboratory."

The reflections of this man are those of everyone who has looked into a motion picture studio and laboratory from the outside. For guesswork has always occupied a predominant place in the motion picture industry, from its inception up to the present day. It is a fact that from the time the negative is exposed in the camera to the moment the finished positive is projected on the screen, scientific methods seldom, if ever, enter into the multitudinous processes: the exposure of the negative film is largely a matter of rule-of-thumb; the developing of the negative is little more than guesswork and such judgment as one can exercise in viewing an indistinct image in a dim red light; and the printing of the positive is again a case of guesswork, or at least the wasting of considerable positive stock until the desired printing density is obtained. As a natural consequence there is much waste of time, labor, material, and money, which could be avoided if guesswork were entirely eliminated.

All the more reason there is for the introduction of scientific methods in cinematography, when it is recalled that the industry is a most fertile field for the efforts of the chemist, the mechanical engineer, the optical expert, the photographer, and other trained minds.

In view of these conditions, the highly developed road equipment of a new motion picture venture has recently created no little commotion in the industry, since it has served to expose, by comparison, the antiquated methods prevalent in the average studio and laboratory. In fact, it has been said by men in the industry that this road equipment marks the dawn of a new era in picture-making—the scientific cinematography era.

The road equipment in question has been installed in a Pullman car which was bought by the new motion

picture company, and made over to accommodate the various departments of a complete cinematograph laboratory. Recently the car left Boston en route for Florida, where it is to handle the developing and printing of natural-color films of the company. These projected films, it is claimed, will represent the last word in color photography; and the several disadvantages which have heretofore prevented the color motion picture film from replacing its black-and-white competitor, have been entirely eliminated. Owing to a number of patent applications which are still pending, a detailed description of the new process is not possible at the present writing.

The usual procedure for a motion picture company in the field is either to erect a small laboratory at the site

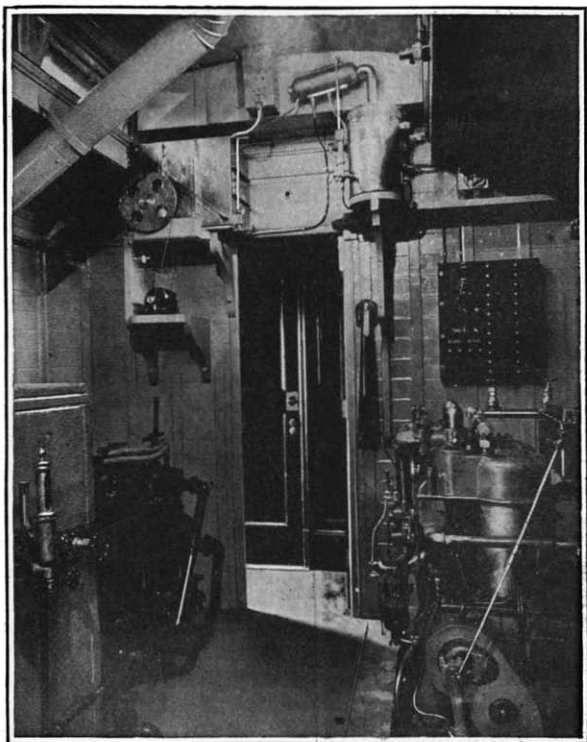
hundreds and even thousands of miles away, that the laboratory on wheels has been built. It is always with the company in the field; yet it is complete in every detail. Its facilities permit of the carrying on of every phase of motion picture work, including the preparing and testing of negative; developing of negative; fixing of negative; washing of negative; drying of negative; printing of positive; developing of positive; washing of positive; fixing of positive; drying of positive; washing and conditioning the drying air; filtering and cooling the wash water; distilling the water; examining and splicing the film; projecting the finished positive film, and all forms of standardizing and measuring work.

The new organization, which has been formed for the purpose of producing photoplays in natural colors, has a staff which consists for the most part of Massachusetts Institute of Technology graduates. Much of the research work which has led to the perfection of the color-photography process is due to Dr. Herbert T. Kalmus, formerly a member of the Institute staff and more recently a professor at Queen's University, Canada, and in charge of the technical research department of the Canadian government; Dr. Daniel F. Comstock, at present a professor in the department of physics of the Institute, and W. Burton Wescott. C. A. Willat, a well-known film man, is associated with them. These trained minds, surrounded by a staff of capable workers, have succeeded in placing the handling of film on a truly scientific basis, which they considered the first step in insuring

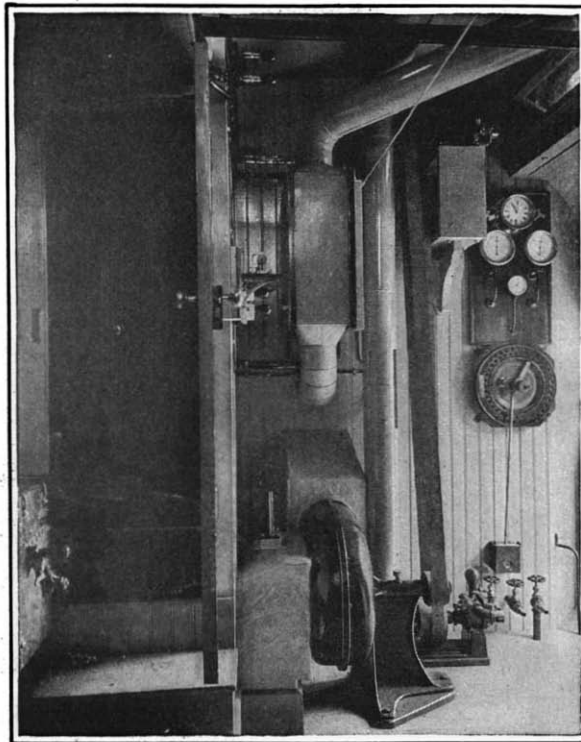
the success of their process. For in color-photography the exposure of the film and its subsequent developing and printing require precision if the correct color values are to be secured, whereas in black-and-white photography the need for extreme care is not imperative. However, this is not an excuse for the crudeness with which the usual film is handled, considering that the industry has been steadily growing in size for the past decade and more.

Scientific handling of the film starts with the testing of the raw negative, and its subsequent exposure. Accompanying the cameraman is an expert on photographic light, whose sole duty is to test the strength of the light, both in the highlights and in the shadows of the scene to be photographed, by means of an optical

(Continued on page 535)



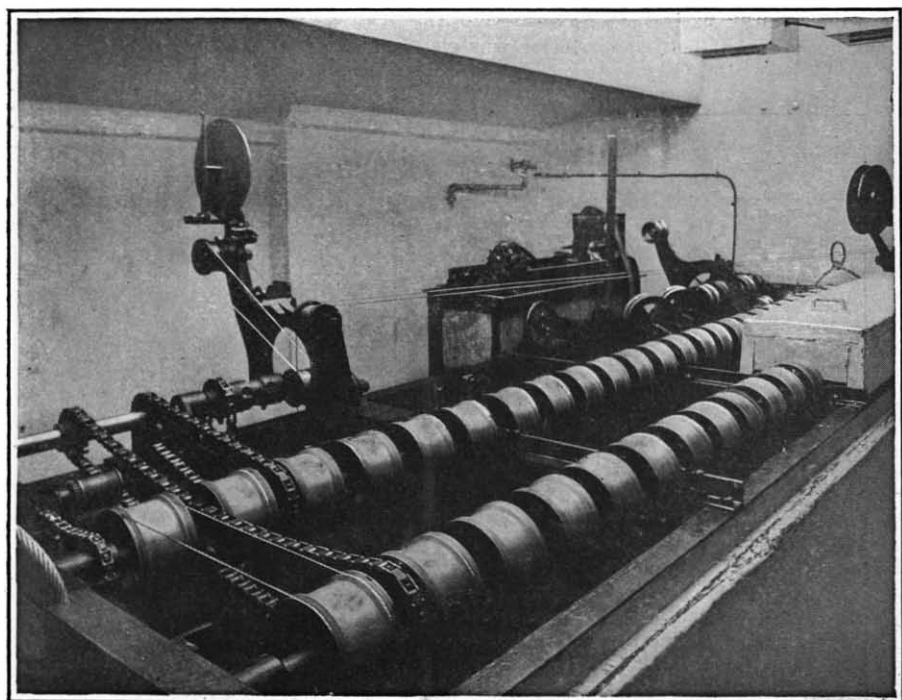
The electric generating plant of the laboratory. Note the electric still above the door



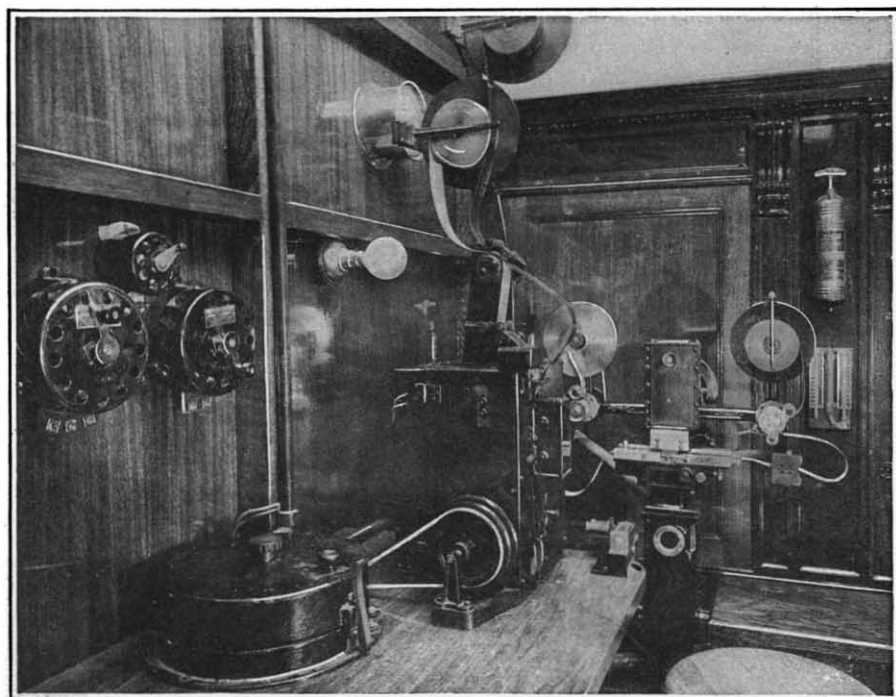
Electric blower and heater for conditioning the air used in drying the film

of operations, or to send the undeveloped negative film to the home laboratory. In the latter instance many difficulties arise. For example, a negative film when developed at the home laboratory may turn out to be under- or over-exposed, or otherwise imperfect, necessitating the retaking of the scene. Meanwhile the company in the field may be miles away from the original location, or it may be that the set erected for the unsuccessful scene has been destroyed. Thus the retaking of scenes is often a difficult and expensive matter, and almost as often the producers prefer to let the poor photography stand than to go through the trouble of a costly "retake."

It is to avoid the limitations of a small, poorly equipped laboratory, and the numerous difficulties arising from sending the work to the home laboratory



A developing, rinsing, fixing, and washing machine for the efficient handling of motion picture film



The printing room, with the printing machine in the center and the perforator at the right

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Which Way Will the Rings of This Mechanical Paradox Turn?

IT is a curious fact that, until recent years, the Ferguson Paradox has stood as *the* Mechanical Paradox for a period of some hundred and fifty odd years. The mechanism, it will be recalled, is attributed to James Ferguson, a Scotch astronomer and mechanic, born in 1710. Of more than usual interest, therefore, is a recent improvement over the Ferguson conception, coming as it does after so many years of non-activity in this field, and having several characteristics that stamp it as truly paradoxical.

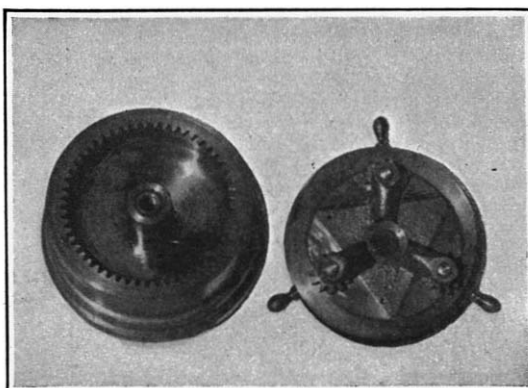
The new mechanical paradox was designed about the year 1890 by Francis C. Osborn of Detroit, Mich., although this is the first time that it has come to the attention of the reading public. While the Ferguson Paradox (see description in "Mechanical Movements, Devices and Appliances," by Garner D. Hiscox), depends for its paradoxical character on illusion, or merely carelessness of observation in noting that the gears have different numbers of teeth, and, of course, will move at different speeds, the Osborn Paradox has several meshing gears of which some not only turn in the same direction at different speeds, but one stands absolutely still and another turns in an opposite direction, although all are driven by the same integral cone having constant speed in one direction.

The accompanying drawings clearly depict the mechanism of the new paradox, which in this particular instance is in the form of a paper-weight for exhibition purposes. It will be noted that when the handle-plate is revolved, the pinions on its underside meshing with the fixed internal gear in the base, will revolve the cones on the upperside of the plate at the same speed that the pinions are revolved, as the pinions and cones are fast upon the same shafts. The direction of this revolution, considering the outer side of the cones, will be opposite to that of the handle plate. One of the cones only is toothed, for the other two are used only as guides to keep the rings in place and might be fixed to the handle plate except that the rings turn more readily when these guides revolve with them. The six rings, made of different widths so as to be more readily observed and handled, are toothed at the bottom end and mesh with the steps of the tooth stepped cone. Ring 6 meshes with the large step of the cone inside and will revolve quite rapidly in the same direction that the handle plate is revolved. Ring 5 will mesh with the next step of the cone, also on the inside, and will revolve at a slower speed in the same direction. Similarly, ring 4 will revolve at a still slower speed in the same direction. Ring 3 meshes with the outer side of the small step of the cone and might be expected to revolve in the opposite direction to that of ring 4; but quite to the contrary, it revolves in the same direction although more slowly. Ring 2 stands absolutely still, no matter how fast or in what direction the handle plate is revolved. Ring 1 revolves in the opposite direction to the others.

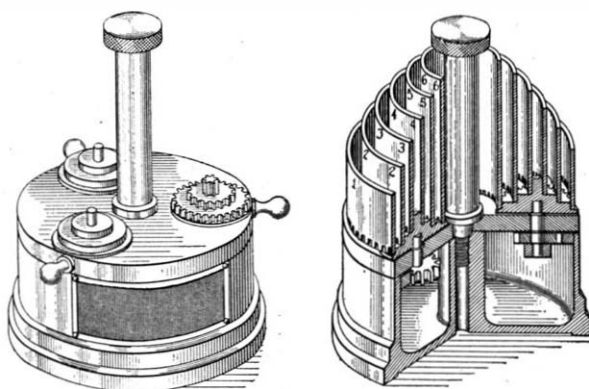
It will thus appear that there are at least two paradoxes involved in the movement of these rings. Rings 4 and 3, having direct contact with the opposite sides of the same driving gear would, under ordinary conditions, revolve in opposite directions. Why do they not in this case? Ring 2 stands perfectly still although in mesh with a revolving gear forming a part of a cone which revolves similar rings. It certainly appears paradoxical to watch this ring, when alone in place, standing still, irrespective of the direction or speed of the handle plate. Rings 1 and 6 mesh with the same step of the cone but upon opposite sides (as do rings 4 and 3), but they revolve in opposite directions, whereas rings 4 and 3 revolve in the same direction. This may be considered an addi-



The mechanical paradox completely assembled



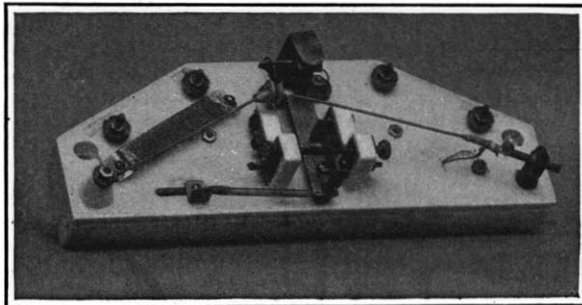
Base of the mechanical paradox and view of the underside of the handle plate



The mechanism of the newly-devised mechanical paradox, showing the relationship of its components

tional reason for regarding the whole mechanism as truly paradoxical.

The explanation is comparatively simple, yet even mechanical engineers have been known to falter in giving a clear explanation. To begin with, the rings are affected by two motions or forces acting at the same time—a motion of translation (through the handle



This electric flasher operates two circuits alternately

plate), and a motion or movement of rotation (through the driving cone mounted on the plate); and when these two forces act on the rings in the same direction, as in the case of the rings having contact with the inner side of the cone (rings 4, 5 and 6), the resultant is the sum of the two movements. When they act in opposite directions, as in the case of the rings having

contact with the outer side of the cone, the resultant movement is the difference of the two movements. In the case of ring 2, these movements exactly balance, for, by construction, the pinion meshing with the stationary internal gear is the same size as the step of the cone meshing with ring 2, and ring 2 does just what the stationary internal gear does—stands still. In the case of ring 3, the movement of translation is greater than the movement of rotation and ring 3 revolves with the handle plate; while in the case of ring 1 the movement of rotation is greater, and ring 1 revolves in the opposite direction to that of the handle plate.

This ring paradox is thus seen to be a clever adaptation of the epicyclic train, and appears to possess enough of the paradoxical to warrant a prediction that it will, for some time to come, stand as the highest example of the mechanical paradox.

An Electric Flasher that Operates Two Circuits Alternately

THERE has lately been developed a simple form of flasher that can be employed to close and open two separate circuits alternately, thus making possible the securing of startling electric sign effects without the usual and costly motor-operated flasher.

The new double-circuit flasher, which is shown in the accompanying illustration, relies for its operation on the usual principle of causing the electric current to heat a coil of wire, which in turn results in the buckling of a rod because of the unequal expansion of two dissimilar metals used in its construction. The temporary buckling causes the movable contact member to be thrown over to one circuit, disconnecting the first circuit as well as the heating coil. As the rod of the device becomes cooled off again it regains its normal shape, causing the movable contact member to be brought back in contact with the first circuit and to again pass current through the heating coil, repeating the cycle of operations again and again. It is said that the operation of the new flasher is positive, it being impossible for the switch blade to leave one contact without going to the other; in other words, it cannot stay in the center and become inoperative as is sometimes the case when magnets are used. The flasher can be used for flashing colored sets of lamps alternately; for switching on and off two portions of a sign; for illusions where the face lights up first and then the back of the sign; and for innumerable effects which the ingenious electrician can contrive, without fear of being obliged to employ costly apparatus for the switching operation.

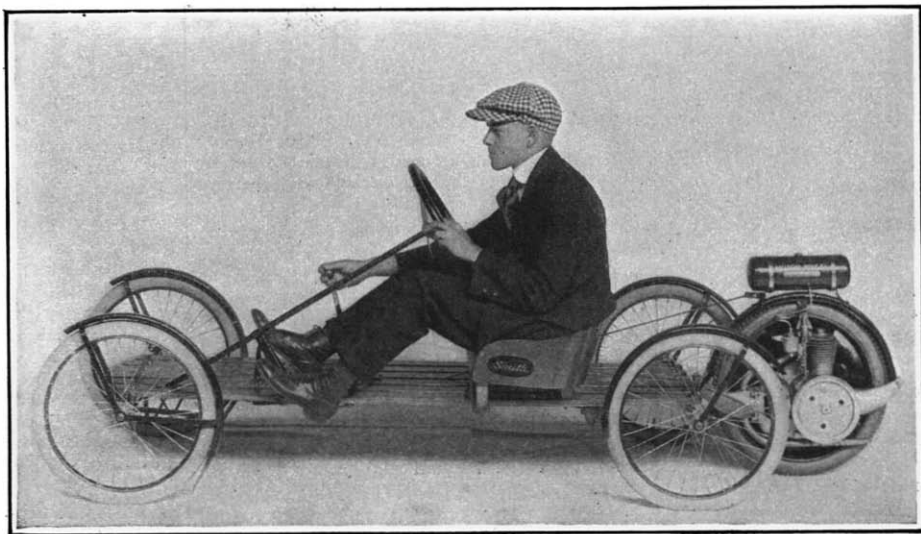
Where the Fifth Wheel Belies Its Reputation

WE have seen innumerable combinations of motor-cycle and automobile in the effort to obtain a self-propelled vehicle of extreme lightness and low cost; but up to the moment of writing perhaps the most ingenious development is that illustrated herewith, in which the motor is taken off the "car" altogether, and attached to an extra wheel behind. Chugging merrily along at a speed which the manufacturer states may reach 20 miles per hour, and shoving the light buck-

board ahead of it, this device gives the laugh to the old proverb which sets forth the complete superfluity of a fifth wheel.

The vehicle itself consists of four bicycle wheels connected by metal axles and wooden buckboard frame. It has two seats of bucket type, side by side, and is furnished with the conventional steering wheel, foot brake and clutch lever. The motor wheel, a

(Concluded on page 535)



The motor buckboard with its fifth wheel



Rear view of the buckboard

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.

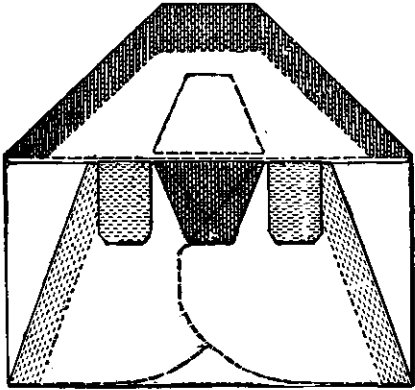
Of Interest to Farmers

HEN'S NEST.—F. S. SPENCER and J. R. LENTZSCH. Address the former, 1273 74th St., Brooklyn, N. Y. The invention relates to nests adapted to trap the hen. It provides an inexpensive and sanitary nest which contains few movable parts and, therefore, is not apt to get out of order, and which resets automatically after it is once set. The hen is not trapped until an egg has been laid.

EGG TURNING INCUBATOR.—J. H. WHAN, Plains, Kan. This improvement provides an incubator wherein the eggs are continuously rolled while being subjected to the incubator heat; provides means for transferring the chicks from the incubating trays to an observation chamber; and provides means for so transferring without injury to the chicks.

Of General Interest

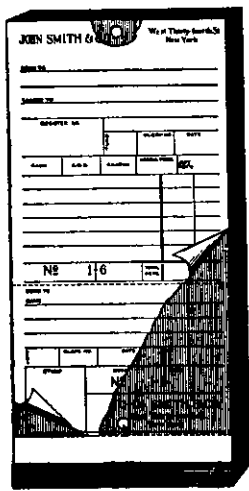
SAFETY ENVELOP.—J. BORRO, 60 Watts St., New York, N. Y. This invention relates to stationery and has particular reference to envelopes or other analogous wrappers for letters or the like. It provides an envelop of such a nature that it is practically impossible for it to be surreptitiously opened without de-



SAFETY ENVELOP

tection. It provides an envelop which will automatically hold the contents of the letter spaced from the line along which an ordinary letter-operating machine operates, whereby it is practically impossible for said contents to be damaged while the envelop is being opened.

DUPLICATE SALES CHECK TAG.—A. GREENSTEIN, 1120 Woodcrest Ave., Highbridge, New York, N. Y. This invention relates to shipping devices and particularly to facilities for the billing and delivery of packages or other articles in or from retail stores or the like. It comprises a duplicate salesbook having record slips and beneath each of which



DUPLICATE SALES CHECK TAG.

is a leaf or sheet adapted to receive the duplicate record, but which leaf is formed of tough paper or its equivalent and having a hole at either or both ends whereby the duplicate sheet may be treated as a tag and readily adapted to be tied to the package coincidentally with the wrapping of such package.

Hardware and Tools

LATCH.—C. L. CRAIG, Washington Court House, Ohio. This invention relates more particularly to a latch for connecting members to be joined, of a nature adapted to clamp the members tightly together in firm, even contact, which may be readily manipulated to either clamped or released position.

TWINE HOLDER.—J. HILL, 99 Irving St., Jersey City, N. J. This apparatus has particular reference to take-ups for the free end of wrapping twine. An object of the invention is to simplify and cheapen the construction of this device without detracting from its efficiency. Another object is to facilitate the means for threading the twine through the device preliminary to its use.

EXPANSION ANCHOR.—A. SMITH, JR., Fort George Wright, Wash. The object here is to provide an anchor, including a member which, when once secured in position, will remain, and a threaded member for seating

the first member which may be either designed solely for this purpose or in the form of a screw constructed to cooperate therewith.

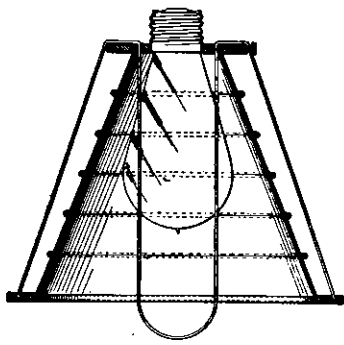
CARBID CAN TOP.—W. I. CASE and I. B. CROWE, Graham, Ky. The present invention is an improvement upon the carbid can for which the inventors have received Letters Patent, No. 1,164,465, dated Dec. 14, 1915. The improvement pertains particularly to the means for locking the top or discharge spout of the can to the body of the latter detachably.

MATCH COVER.—J. F. O'MALLEY, P. O. Box 585, Meriden, Conn. This invention relates to covers for bunch matches, and the main object thereof is to provide a specially designed cover adapted for normal or conventional use. It is designed particularly for match holders shown in Letters Patent of the United States Nos. 1,066,311, and 1,144,509 granted to Mr. O'Malley, though the book of matches so formed may be carried in the pocket in the manner of conventional books.

Heating and Lighting

WARM AIR FURNACE.—N. FROST, Bloomington, Ill. The furnace is especially designed for use in churches, schools and other large buildings and arranged to provide large heating surfaces for the air to pass over with a view to increase the efficiency of the furnace, to relieve the parts of undue strain and to prevent unequal expansion and contraction in the fire box.

LAMP SHADE.—R. L. CLARK, Union, W. Va. The improvement relates to a shade particularly intended for use on incandescent lamps,



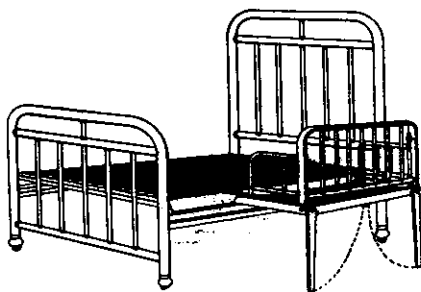
LAMP SHADE

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

WATER COOLER.—L. J. BERKELEY, care of Berkeley Furness Co., Madison, Wis. This invention has for its object the provision of a sanitary water cooler, which will take a solid cake of ice instead of the broken ice which is now necessary to use with water coolers provided for dispensing bottle water.

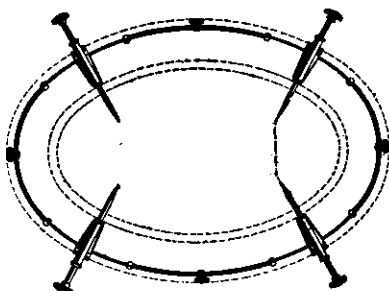
DISAPPEARING BABY BED.—J. L. HALPERT, 126 Marcy Ave., Brooklyn, N. Y., N. Y.



DISAPPEARING BABY BED.

This invention is an improvement in a type of folding crib attachments for ordinary beds, the same being constructed of foldable parts, and permanently attached to the main frame and slidable thereon in such manner that it may be pushed under the latter and supported by it when not in use.

FOOD AND PLATTER HOLDER.—J. LANG, 116 W. 59th St., New York, N. Y. This invention relates to holding devices for dishes and various articles to be placed thereon and particularly to an improved arrangement for holding a platter for meat, fowl and the like, so that the same will not become accidentally

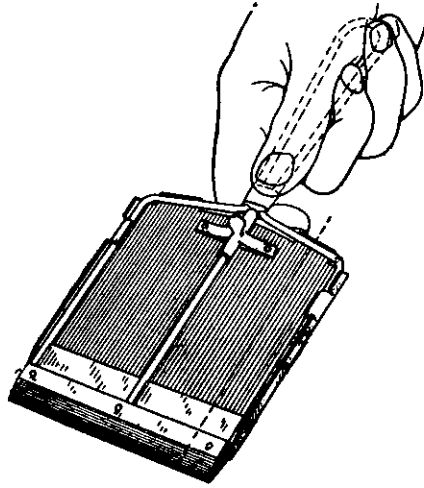


FOOD AND PLATTER HOLDER

displaced. It provides a construction for holding the platter against movement while holding the article on the platter against movement. Means support the platter above the table and by its adjustability, will accommodate different

sized platters and large or small articles of food.

SINK CLEANER.—P. H. MURRAY, 43 Bufington St., Fall River, Mass. The prime object here is to provide a device involving a scraper and a movable shovel element mounted

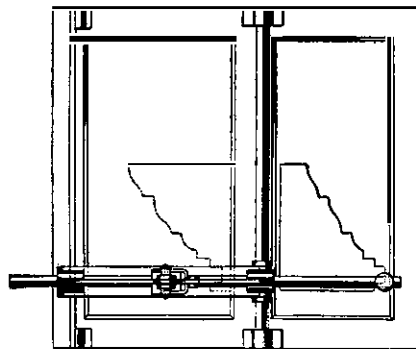


SINK CLEANER

to be moved to a retracted position to afford no interference with the use of the scraper, or to a position projected beyond the scraper for shoveling the material gathered by the manipulation of the scraper.

Machines and Mechanical Devices

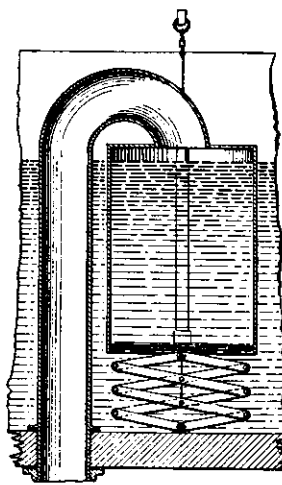
INSTRUMENT TO MARK PATTERNS FOR MOLDING CUTTERS.—D. B. MACKENZIE, 407 W. 2nd St., Muscatine, Iowa. This invention relates to a device for finding the exact shape of cutters to form any given design or pattern of molding made on wood-



PATTERN MARKER FOR MOLDING CUTTERS.

working or similar machines. The prime object is to provide an effective and convenient mechanical means for simply and correctly obtaining the exact shape of any cutter to form a given molding merely by tracing the outline or profile of the molding wanted.

SIPHON VALVE.—W. MUIR, 532 9th St., Brooklyn, N. Y. Among the principal objects which the present invention has in view are: to provide means for inaugurating the flow in a siphon in a flushing tank employing a siphon;



SIPHON VALVE

to provide means for avoiding leakage in flushing tanks by perforating the lining thereof; and to provide an actuating mechanism easily operated and one that is durable and requires little attention after installation.

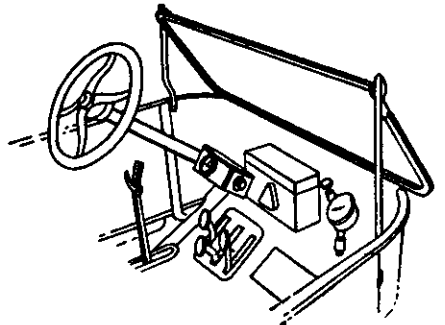
VALVE.—O. J. MCGOWAN, 518 55th St., Brooklyn, N. Y., N. Y. This invention provides means for effectively sealing a valve after the port-closing members have been disposed in line with the parts of the valve; provides means for balancing the pressure on the valve; provides a valve for exposing full opening by a minimum movement of the valve; reduces the operating strain on the valve seat and stem; and provides a valve for automatically relieving the load thrust thereon in correspondence with the manual manipulation of the valve.

AUTOMATIC VALVE OPERATING MECHANISM.—C. G. EIDSON and T. DAVIS. Address The Auto Air Appliance Co., Industrial Bldg., 501 E. Preston St., Baltimore, Md. This invention provides a device by means of which valves may be operated which control the flow

of air into and out of a pressure tank, the device being so arranged as to cause the operation of the valves when the pressure reaches a predetermined minimum and afterward to cause the reverse movement of the valves when the pressure reaches a predetermined maximum.

Pertaining to Vehicles

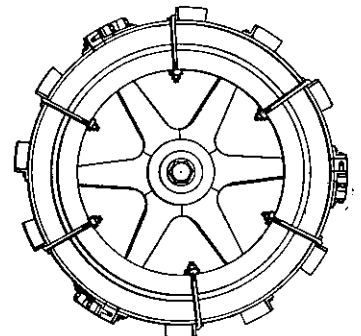
TIME LOCK.—E. C. COX, care of Hotel Norris, Easton, Md. This improvement pertains more especially to locks for automobiles. It provides a lock which will prevent the operation of an automobile by securing the steering rod so that the latter cannot be turned, and



TIME LOCK

at the same time breaking the ignition circuit. It provides a device in which an ordinary alarm clock is used for the time piece and is so arranged that at any given time it will automatically unlock the device and close the ignition circuit, thereby permitting the operation of the machine in the normal way.

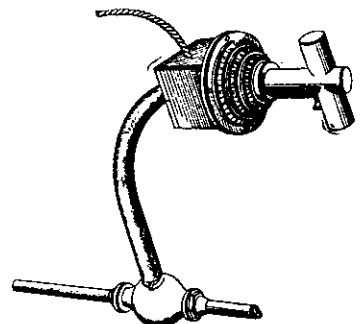
TRACTOR ANTISLIPPING DEVICE.—T. E. BEHAN, 524 W. 173rd St., Bronx, N. Y. This invention relates to anti-slipping or anti-skidding devices for wheels and has for an object the provision of an improved arrangement which may be clamped in place on



TRACTOR ANTI-SLIPPING DEVICE

any form of wheel. It provides a device arranged in sections so as to be clamped in position on any suitable wheel and adjusted so as to fit tightly against the wheel. It provides a device for tractor wheels which are provided with bolts and clamping bars for engaging the under part of the wheel fully so that the anti-slipping structure is secured in place at a large number of points over the wheel.

LOCK.—O. L. VANCE, Decatur, Ind. The present invention relates generally to locks and more particularly to a lock of the permutation type, adapted for general application to the uses to which locks are adapted, and particu-



LOCK

larly useful for locking the operative parts of an automobile in either operative or inoperative position. The engraving shown herewith gives a perspective view of the lock with connections for using the same in an automobile.

Designs

DESIGN FOR A RAG DOLL.—JANET B. ROWLAND, care of Mrs. A. H. Burd, 27 Cedar St., New York, N. Y. In this ornamental design for a rag doll the article represents a figure of sturdy mold with heavy facial and limb characteristics which make an altogether attractive baby.

DESIGN FOR A DISPLAY STAND.—E. L. BEHRING, Wykoff, Minn. In this ornamental design the openwork stand takes an attractive conical form and is intersected at the top center and base by shelf-like extensions beveled to hold articles.

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

LEGAL NOTICE



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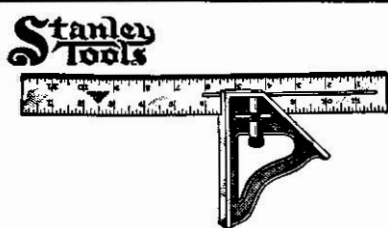
A Free Opinion as to the probable patentability of an invention will be readily given to any inventor furnishing us with a model or sketch and a brief description of the device in question. All communications are strictly confidential. Our Hand-Book on Patents will be sent free on request.

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Where the Fifth Wheel Belies Its Reputation

(Concluded from page 533)

unit in itself with motor, carbureter and gasoline tank, is pivoted to the rear of the frame. The entire apparatus weighs about 135 pounds, and sells for little more than the price of a good motorcycle.

For starting, the entire motor wheel is pulled clear of the ground by means of a wire (plainly visible in the side view) running to a lever in front of the driver's seat. The motor is then put into action, after which the unit is lowered to the ground to start the vehicle.

Eliminating Guesswork in Cinematography

(Concluded from page 532)

instrument designed for that purpose. The light expert informs the cameraman as to the opening to use for the lens. To eliminate still further the uncertainty of the human element, the camera is provided with an electric motor which turns the crank at a constant speed. Current is furnished to the motor from a portable storage battery.

The reason for these extreme measures become more obvious when it is stated that the process makes use of a specially sensitized negative. The latter is said to have a speed between six and eight times that of ordinary film.

With an accurate knowledge of the exposure given to the negative, its developing is a matter of using a certain strength of solution at a fixed temperature and for so many minutes. The darkroom workers, in the case of this ultra-modern laboratory, are told how to develop the negative, and it is a foregone conclusion that if they follow out instructions the film cannot be anything else but perfect. The workers have little to do with the film except to start it through the developing, washing, and fixing machine, and to remove it when it comes out dry and ready to print at the other end.

The developing machine of the motion picture car is a most ingenious piece of equipment. As will be noted by studying the illustration of this machine, it consists of two rows of grooved pulleys above the tanks and corresponding rows in the tanks, over which runs a continuous cable belt. The negative film is fastened to the cable belt by means of a clip, and is carried in turn through the developing solution, the rinsing bath, the fixing solution, the washing bath, and the drier, coming out in finished form at the other end of the machine. The duration of the developing process is regulated by causing more or less of the loops of film to dip in the developer. The various solutions are kept at a constant temperature—cold in warm climates and warm in cold climates—by water circulating through the jacketed walls; and the air for drying the films is maintained at the desired temperature by means of electric heaters. Whereas the practice has been to supply a constant flow of fresh air—washed, conditioned, and of any desired temperature—to the drying chamber of the conventional studio, in the present laboratory nine tenths of the air is recirculated and one tenth of fresh air is introduced at a time in the drying operation. The results are said to be just as satisfactory, while a considerable economy is effected in operating costs.

With the negative in finished form, the next step is to test it for density in order to obtain a reading for the printing machine. The operator of the printer is then told how to set his machine so as to expose correctly the positive film, which is perforated just prior to its being used so as to ensure accurate perforations. The positive is then developed, fixed, and dried in the same manner as the negative film, and is then ready for polishing and inspection. It is planned to project the film of every scene the day it is photographed, so that the few "retakes" that may occasionally be necessary can be executed with the minimum of trouble and expense.

Electricity is made to do the greatest share of the work in the motion picture car. A ten-kilowatt generator, driven by a gasoline engine, supplies the current

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carrying out the work on a special frame, the fabric having been previously provided with metallic eyelets to avoid tearing it.

The development of the colors is accomplished with better regularity by exposure to electric light. The method is recommended by its authors as more especially applicable in the treating of articles de luxe of the sort that can not well be printed by machine.

American Chewing Gum in China

AMERICAN chewing gum is becoming popular among the Chinese in Hong-kong, and it is believed by the representatives of the American manufacturers there that if the product can be especially packed for Chinese consumption the sales will increase considerably. There should be some indication on the retail package in Chinese characters as to what the product is and as to particular brands and flavors. It has been found also that the Chinese prefer a package smaller than the usual 5-cent package common in the United States, one retailing for 1 cent gold being preferred. It is a well-established Chinese custom to buy all such things in small quantities.

One of the characteristic features of street life in a Chinese village is the large number of small tables or stands along the street kept by vendors of peanuts, cakes, confectionery, fruits, and the like on which goods sold are arranged in small piles for sale at a small price—a handful of peanuts for 10 cash, for example; a handful of liches for 10 cash, or a cent; and so on. Passers-by put down their 10 cent cash or cent pieces, pick up their purchase, and proceed to consume it. It is to meet just such habits and trade that the smaller package of chewing gum and of all similar products is desirable.

NEW BOOKS, ETC.

RADIODYNAMICS. The Wireless Control of Torpedoes and Other Mechanisms. By B. F. Miessner, Expert Radio Aide, U. S. Navy. New York: D. Van Nostrand Company, 1916. Svo.; 206 pp.; 112 illustrations. Price, \$2 net.

Since the most recent development in radiodynamics are concerned with its applications to military purposes, it is fitting that this volume should be mainly devoted to such aspects of the subject. The author begins with an interesting historical review, whence he proceeds to a consideration of the telegraphic transmission of signals without the aid of conducting wires, passing on to practical wireless telegraphy and its systems, with descriptions and explanations of sound waves, heat waves, and visible and ultra-violet waves. Electrostatic and electromagnetic induction is discussed, and we then come to that portion of the work which deals with military applications. The first radiodynamic boat is shown, and the reader is initiated into the mysteries of selectors, American and foreign control systems, and the accomplishments of the Hammond Laboratory. Considerations such as protection from interference and means for obtaining selectivity are explained, and the concluding chapter on recent developments cites most fascinating experiments that promise much for the future, among these an orientation mechanism known as the "electric dog," which seems endowed with uncanny intelligence, and indicates that the torpedo of the future will be self-directed, following its prey until its charge is exploded by contact.

THE PASSING OF A GREAT RACE. By Madison Grant. New York: Charles Scribner's Sons, 1916. Svo.; 245 pp.; seven maps and charts. Price, \$2 net.

The author states that in this work an attempt is made to elucidate the meaning of history in terms of race; that is by physical and psychological characteristics instead of by political groupings, or spoken language. In the opening chapters hereditary traits and tendencies are commented upon as they appear to-day under the varying influences of social and physical environments, with some particular reference to conditions in this country; while in the remainder of the book, constituting the larger Europe are traced as far back as records exist, with. Here the various races that have peopled Europe are traced as far back as records exist, their progress, expansion and disappearance as governed by the basic influences of heredity. It is a new field of study, and the work contains much that will be found of deep interest to every student of history and of psychology. There are a number of colored charts specially prepared by the author that explain his theories as to the movements of the various races that populated Europe at various periods.



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Or you will get \$50 a week as long as you

are disabled by a railway, steamship or burning building accident. \$25 a week if disabled by an ordinary accident. If you are killed in an accident or lose two limbs or both eyes, you will get from \$5,000 to \$15,000, depending on the character of the accident and how long you have carried the insurance. Half as much for loss of one hand, foot or eye.

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"Back home for Christmas"—remember? Most of us can't leave our Tickers and Tots to shake hands with the old customs as we'd like, but we can gather around us the genuine, old-time reminders. There's a treasure-trove of memories in every box of good, old Richmond Straight Cut Cigarettes. The first high-grade cigarette made in the United States, they have a staid charm and quaint old-time delicacy unknown to "commercial" cigarettes. Your guests will appreciate them after the Christmas dinner.

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These cigarettes are also packed in attractive tins, suitable for Christmas gifts, 50 for 40c; 100 for 75c. Sent post-paid if your dealer cannot supply you.

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Your own face must be the judge. The nerves of your face are the jurors.

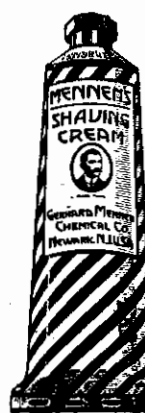
If the shaving soap you now use gives you a swift, smooth, firm, and copious lather free from froth or lumps of undissolved soap; if it lathers equally well whether the water is hot or cold, hard or soft; if it softens your beard without rubbing-in; if it remains moist and rich without re-lathering; if it smooths the path of your razor; if it leaves your face cool and refreshed—then your present shaving soap stands absolutely acquitted of the Mennen indictment.

BUT—if you have to rub it in and re-lather; if your lather dries while you are shaving; if it is obstinate in cold or hard water; if your razor-blade pulls, hurdles or skids; if it leaves the slightest sting or smart—then your shaving soap is guilty of high facial crimes and grievous misdemeanors.

Mennen's Shaving Cream obeys every law of modern shaving. There's never a slip 'twixt the blade and the lip.

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Enclosed is tag for which please send me a medium-sized tube of Mennen's Shaving Cream and, free, a trial can of Mennen's Talcum for Men.

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Notes and Queries.

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

(14170) W. C. P. asks: Has the strength of an egg shell ever been carefully measured? Conflicting statements are made in your columns as to this matter. A. Certainly, the strength of an egg shell both outwardly to resist pressure from within, and inwards against pressure has been carefully measured. Of course to place an egg between the hands and press upon it even if held between the knees is not a method by which the strength of the shell can be determined. Careful and mechanically correct methods of measurement were applied to this problem several years ago and the results were published in the "American Machinist" of August 28th, 1902. The surprising results were attained that an empty egg shell would resist a water pressure up to 65 pounds per square inch from within, and a water pressure applied over the outside to crush it up to 675 pounds per square inch. Against a pressure applied lengthwise with the drill press in the same manner as when an egg is held in the hands between the knees the shell broke at about 60 pounds per square inch. The contact pieces were only 5-8th inch in diameter cut from a soft rubber eraser. Doubtless the small area of contact accounts for the low pressure at which the shells gave way, since a strong man can exert a much greater pressure with his hands, but as his hands cover a larger surface of the shell, the shell has a better chance in this case, and is not broken. A most ingenious arrangement was employed to obtain the outward pressure. The shell had a thin rubber bag placed in it and a pressure pump forced water into the shell till it gave way at pressures varying from 30 to 65 pounds. The uniform pressure over the outside was obtained by covering the shell with thin rubber and placing it in a water tight cell, into which water was forced. In this test the shell broke under a water pressure of 675 pounds. To appreciate the reliability of these results one should read the details of the tests and note the beauty of the arrangements. The work was evidently that of a skillful engineer.

(14171) R. J. H. asks: Question 1.—Can you give me reliable data in regard to the planet Venus, i. e., as to whether it rotates on its axis relative to the sun, and also the inclination of its axis to the plane of the ecliptic or that of its own orbit? "The World the same face toward the sun, the planet rotational period of 23 hours and 21 minutes; is this correct? Chambers' "Astronomy" gives the inclination of its axis 37 deg. from the plane of its orbit, or the ecliptic. On the other hand, some modern writers seem to take it for granted that the planet always turns the same face toward the sun, the planet rotating once during a revolution around the sun. Other writers express doubts as to the rotation of the planet. Question 2.—Can you give me the latest ideas as to what causes the twinkling of fixed stars (distant suns)? A. 1. Astronomers are very well agreed that the planet Venus presents always the same face toward the sun and that her day and year are of the same length. The inclination of the equator of Venus to its orbit is given in Young's "Manual of Astronomy" as "small." This cannot be easily determined because of the absence of spots and markings on the surface of the planet. This accounts largely for the difference in the statements of the various authorities. We will send Young's "Manual of Astronomy" for \$2.50. It is the latest advanced text book of astronomy. 2. The twinkling of stars is quite fully discussed in Young's "Manual." Two causes are recognized, one the unsteadiness of the air, especially near the horizon, the other the interference of the light, as it comes through the air, by slightly differing paths, from the star which is a shining point. The only planet to twinkle very much is Mercury. That planet shows a very small disk and is always seen near the horizon, both of which conditions favor twinkling.

(14172) J. H. asks: Have you any information as to the way of making Geissler tubes and the liquid therein? A. A Geissler tube is a vacuum tube from which all but about 1/1000 of the air has been pumped. A good air pump will produce so low a vacuum as this without any difficulty. A Geissler tube would not have any liquid in it. Sometime a tube is placed outside the vacuum tube and a fluorescent liquid is placed in this tube. When the electric discharge is sent through the tube the liquid glows with a color peculiar to the liquid. Various liquids are used in this way. The word Geissler is simply a designation for a tube with a low vacuum, just as a Crooke's tube is a tube with a very high vacuum in it. You will find these matters in Thompson's Light Visible and Invisible, which we will send for \$1.90 postpaid.

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NINETEENTH ANNUAL

MOTOR NUMBER

of the

SCIENTIFIC AMERICAN

January 6, 1917

The SCIENTIFIC AMERICAN can justly claim to be the oldest automobile journal. It started writing the history of the motor car in 1845 and has consistently kept pace with the progress of the power-driven vehicle ever since.

For some years past a special automobile number has been published each year devoted to the progress of the motor car and forecasting its future development. The next annual issue will be the nineteenth of the series.

The subject has been by no means exhausted. Recent progress in the automobile industries has been simply stupendous. We are sure that our readers will be astonished at the number of cars now in use and the large proportion of the total represented by cars purchased during the past year. Public endorsement of the automobile, as represented by the amount of money invested during 1916 in the purchase and operation of motor cars, is startling. The figures are so vast that we have shown them in the form of a graphic comparison which will enable the mind to grasp them.

Following the usual custom there will be an article on the pleasure car of 1917. An expert will dissect the car and point out the improvements and novel features. In a companion article the commercial car of 1917 will be described minutely in this SCIENTIFIC AMERICAN way.

The Bureau of Standards has recently been investigating gasoline pumps and has found that many of these pumps do not deliver full measure. The trouble is not always due to dishonesty, but is very often attributable to faulty design. An illustrated article on this subject has been prepared for our Motor Number, which gives the construction of various forms of pumps, placing the motorist on his guard, and showing him where to look for faulty design or dishonesty.

Motorists will be interested to know just what work is now being done, or what is proposed to be done in the immediate future, toward the betterment of roads under the new law which provides for Federal aid. It has probably not occurred to the general public that not only is the automobile responsible for good roads, but good roads are responsible for the number of automobiles in a State. Some interesting statistics have been prepared on this subject.

"Attacking the Motor's Mightiest Enemy" is the title of a very interesting article by an automobile engineer. It deals with the problem of getting rid of carbon accumulations in the most efficacious way.

As in previous Motor Numbers, there will be the usual charts of gasoline and electric pleasure and commercial vehicles, in which the names of manufacturers and the prices of cars will be given. The material will be arranged in such form as to constitute a valuable price list and reference table for prospective purchasers of motor vehicles.

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**Covering 3710 miles— through 12 States
Mastering every hardship—and without a single repair**

"The cross country GMC arrived New York in fine condition, having crossed from coast to coast over National Parks Highway, 3710 miles in 31 days actual running time. This is the first time the Northern Route has ever been travelled by a motor truck."

covered more than 2000 miles on the return trip.

The record of this remarkable trip means much to every prospective truck buyer. It is a test such as no truck would ever get in ordinary day-in-and-day-out work.

Back of this simple telegraphic report to the GMC factory is a story of gripping interest—the story of a man's wonderful pluck and perseverance, supported by the ruggedness and ever ready power of a modern motor truck.

You may never wish to force your truck from coast to coast, but there's a lot of satisfaction in knowing that **your** truck has the reserve power and ruggedness to withstand such hardships—to bear up under the punishment of extraordinary loads and roads.

Through floods and mud, William Warwick, the courageous driver, accompanied and assisted only by his wife, fought his way through well nigh insuperable difficulties. The truck broke through bridges, was washed down a mountain canyon by a cloudburst, was buried body deep in sand, clay and gumbo, yet it reached New York without a single repair having been made—not even a spring clip was tightened.

The trans-continental GMC is a regular 1½ ton stock model, with standard equipment, and was taken from the show rooms of our Seattle distributor without special preparation for the trip. You can get one exactly like it for your business, with the same superior pulling power, durability, accessibility and low operating cost—in ¾ ton, 1 ton, 1½ ton, 2 ton, 3½ ton or 5 ton size.

And, the truck came through every foot of the way on its own power, unassisted by any motor, team or man, except the driver—William Warwick.

Let the wonderful performance of the trans-continental GMC prompt your investigation—you can get full facts on the trip and on GMC Trucks for your business by communicating with the nearest GMC dealer, or you can get an interesting book of the trip by writing to TRUCK HEADQUARTERS.

At the time this statement is being written, the truck is well on its way back across the continent, having

Study the pictures—they are actual photographs taken en-route by Mr. Warwick, and indicate a few of the many hardships encountered by the GMC Truck during its record breaking trip across the United States.

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