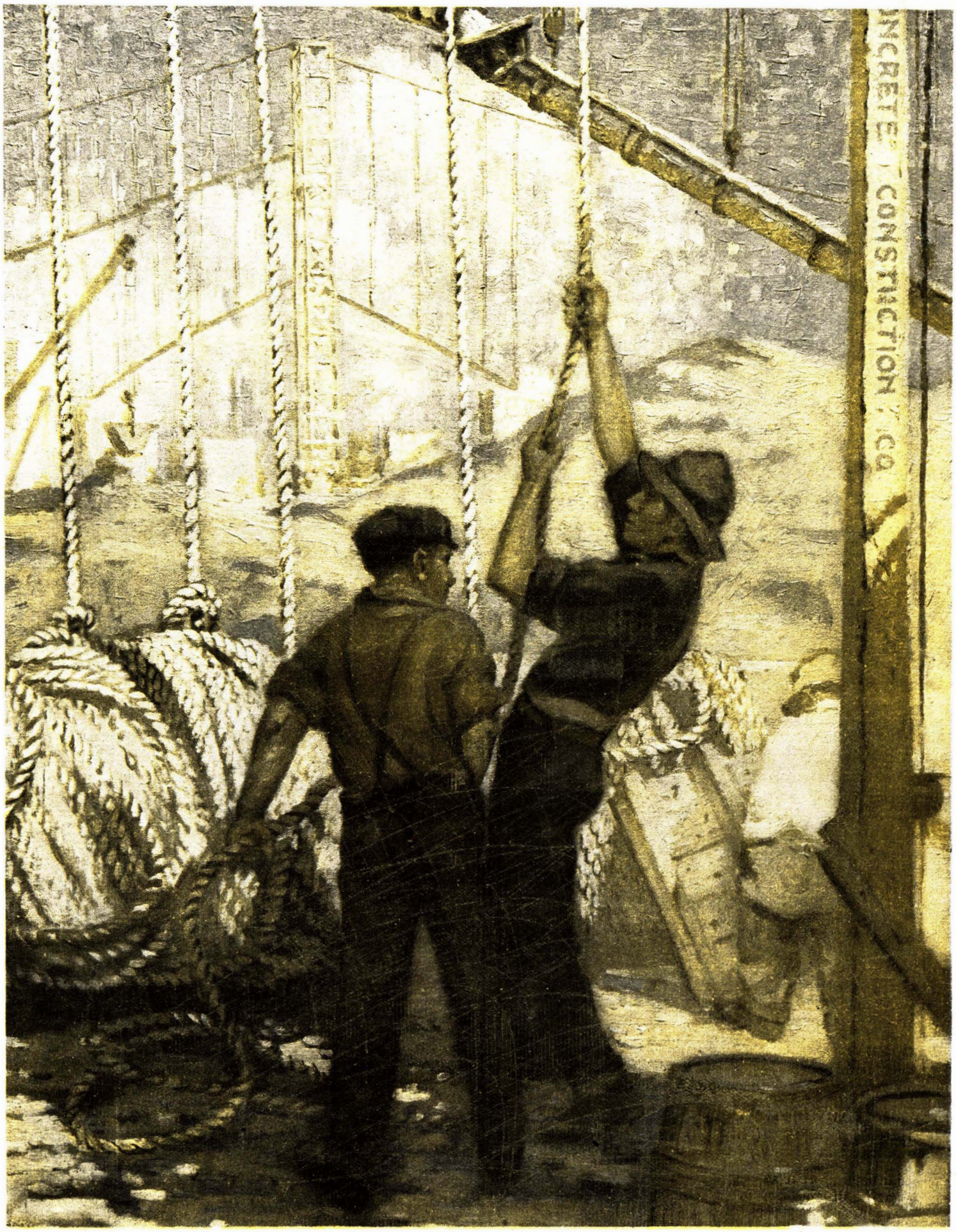
SCIENTIFIC AMERICAN



DISTRIBUTING CONCRETE THROUGH GRAVITY CHUTES IN BUILDING OPERATIONS [See page 368]

October 21, 1916

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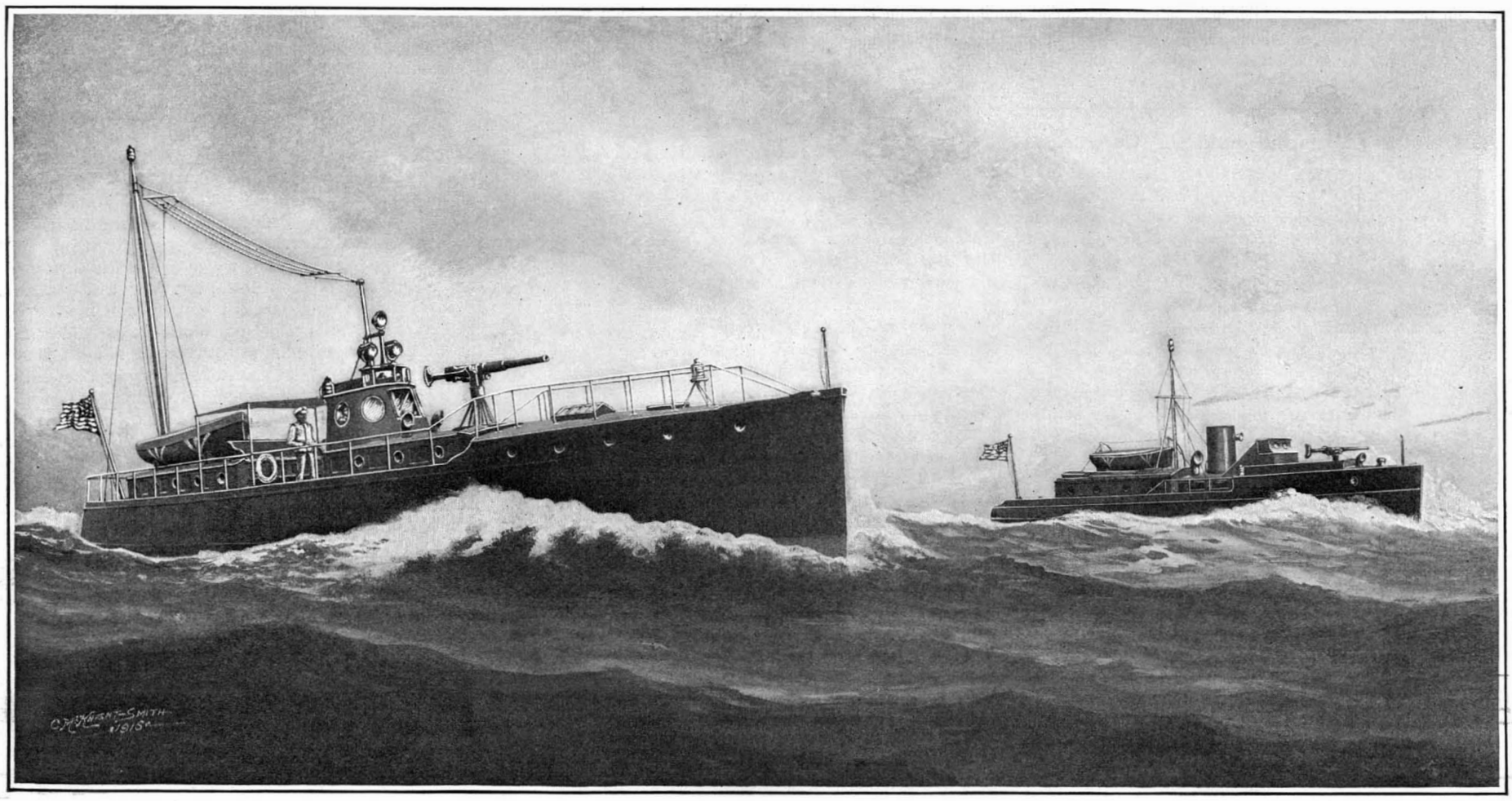


The two types of combination pleasure and war craft, as standardized by the Navy Department

The Privately Owned Naval Scout

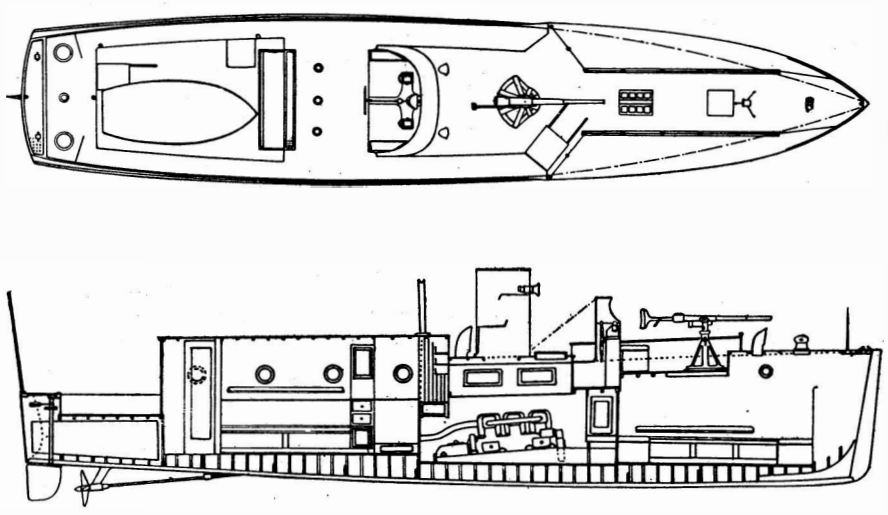
MUCH interest has been taken in the efforts to establish coöperation among boat clubs and owners of small power boats, as well as between such parties and the Government, to the end that an efficient reserve of privately owned vessels may be quickly available for the use of the Navy. Of the various steps taken in this direction, certainly none is of more promise than the action of the Navy Department itself in standardizing such vessels by adopting official plans for several types. As the result of the submission to the department of competitive plans for scout cruisers of two sizes—45 and 66 feet—an award has been made in each class and construction begun of single vessels from the accepted drawings.

The prime consideration brought to the attention of the designers of these craft was the fact that when not required by the Navy the boats will be used by the owners essentially as pleasure yachts. They must, therefore, embody a combination of the desirable features of express cruiser and motor scout-boat, with ample living quarters and deck space, and at a cost not too much in excess of that of normal pleasure vessels of comparable dimensions. They must be capable of a sustained speed of 30 miles per hour for four hours and 26 miles per hour in a moderate sea for six hours. They must have space for a full supply of fuel, stores and ammunitions, and present a good point of vantage for the mounting of a rapid-fire gun.

The larger of the two types now standardized by the action of the Navy Department is 66 feet overall by 13½ feet beam, with a draught of 4¼ feet. The boat has a hull of the hollow bottom, wave-collecting type, with raised deck forward, and a pronounced flare to her bow.

The machinery is placed amidships, dividing the living quarters into two distinct suites. The main saloon is in the after deck-house, being 8 feet long and extending clear across the boat. The forward saloon is less commodious, but in connection with the forecastle affords ample accommodation for the small crew required, whether on a pleasure or on a war footing.

The power plant consists of two 12-cylinder motors of about 400 horse-power each, with independent motors for lighting and wireless systems. An extremely large fuel capacity is demanded by the great radius of action—500 miles at 25 miles per hour—and is secured by means of three 600-gallon tanks amidships, behind the engine-room, and a reserve tank of 300 gallons at the extreme stern of the vessel.



Plan view and side elevation of the 45-foot Naval scout

The aerials for the radio outfit are carried from a mast stepped well aft to the conning tower amidships over the engines. The latter serves also as a pedestal for the searchlights. Just forward is mounted the 3-pounder rapid-fire gun.

Similar to the larger boat in its general features is the 45-footer. It has, however, a round bottom, like the vessels of the patrol squadron that have given such good account of themselves during the past season. The beam is 10 feet and the draught 3 feet. As before, the engine room is about amidships; forward are the quarters of the crew, aft the owner's stateroom, which in war service automatically becomes the officers' quarters, accommodating four persons.

Two 6-cylinder motors of 125 horse-power each are provided. Four fuel tanks, with a capacity aggregating 500 gallons, are located beneath the after deck, and make the operating radius equal to that of the 66-foot vessel.

The one notable deficiency of the smaller boat lies in the absence of wireless equipment, there being insufficient space in which to string the aerials. The gun, a 1-pounder, is mounted forward of the conning tower as in the 66-footer.

Construction of both types of these vessels is extremely strong, with adequate ventilation throughout the ship, and steel bulkheads dividing the interior space into water-tight compartments. Altogether an admirable boat is provided for the man who wishes to cruise for pleasure, to take an occasional hand in the war-game, and, when occasion presents itself, to be of real service to his country.

Scientific Meetings in Argentina

THE Sociedad Argentina de Ciencias Naturales has inaugurated this year the plan of holding biennial meetings in different towns of Argentina, after the plan of the annual meetings of the British and American Associations for the Advancement of Science. The sessions of the present year will be held the last week in November at Tucuman, and there will be nine sections, representing the various branches of science.

SCIENTIFIC AMERICAN

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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.

The German Submarine Raid Off Our Coasts

THE great war has certainly not been lacking in the element of the dramatic, and the latest evidence of this has come in the form of a sudden and most spectacular raid by German submarines, right under the very eyes of our Atlantic fleet, and almost within vision of the late visitors to that quaint and peaceful summer resort—Nantucket Island.

The first and only suggestion of the mischief that was brewing came in the shape of a German U-boat that steamed quietly into Newport Harbor, dropped anchor, mailed a letter to the German ambassador, and, after receiving Admiral Knight, Commandant at the Newport Training Station, steamed out to sea, submerging as she reached the three-mile limit.

Admiral Gleaves, Commodore of our Destroyer Fleet in the Atlantic, was another caller on the unannounced visitor; and, as he stepped from her hospitable gangway to his own launch, it is safe to say that of all the possible happenings of the immediate future, the very last that could have entered his mind was that within the next 24 hours he would be dispatching his destroyers at full speed to the vicinity of Nantucket lightship, in the hope of picking up the survivors of several merchant ships which had been sent incontinently to the bottom by his late visitor.

When the merchant U-boat "Deutschland" turned up in the Chesapeake, we stated that the chief interest of the craft for Americans lay in the fact that she showed how easy it would be for the larger and swifter submarines of the German Navy to cross the ocean and make swift descent, fully armed and well provisioned, upon our coasts.

What was a suggestion then has become in part a fact to-day; and that it is a belligerent and not the United States that has been attacked in no wise detracts from the sinister significance of the lesson.

The press representative that boarded the submarine at Newport was told by her captain that she had supplies for a three-months' cruise. This is perfectly possible; for it is the practice for submarines, on setting out for a lengthy voyage, to fill their ballast tanks with fuel oil in place of water, replacing the oil with water as the former is consumed. By doing this and crossing the ocean at a low cruising speed, a U-boat of 800 to 1,000 tons, such as this Newport visitor, would reach American waters with ample reserves of oil for a cruise of several weeks.

If we are to admit, as our State Department seems to have done, that dumping a ship's passengers into open boats, and setting them adrift at the mercy of such wind and weather as may come along, is a compliance with the laws of search, so far as they are designed to protect human life—the raid of the submarine calls for no protest from the United States Government. The work was done well outside the three-mile limit, and therefore in neutral waters.

That so many ships should have been sunk so quickly is not surprising. The bulk of the transatlantic shipping passes close to Nantucket lightship, and a U-boat that lay in wait in that busy thoroughfare would make a big bag as surely as a concealed hunter in the duck-hunting season. The raid serves to show, in very dramatic fashion, how valuable an asset in submarine warfare is the element of surprise.

In conclusion we draw attention to the very grave possibilities of a break with Germany to which she exposes herself by boldly opening an indiscriminate submarine warfare in crowded American waters. The wholesale "Lusitania" murder included the killing with deliberation of over 100 American citizens. The memory of that crime is as fresh to-day as a year ago—and atonement by Germany has yet to be made. If the loss of so much as one American life should occur almost within sight of our shores, it is doubtful if the wave of indignation which would sweep the country could any longer be controlled within the limits of diplomatic correspondence.

Spirit and Purpose of the Hay Army Bill

THERE are certain problems among the many which become the subject of deliberation by Congress, which call with strong emphasis for the exercise of a spirit of the purest patriotism, both in committee and on the floor of the House and Senate; and never was the demand for the suppression of party politics and the exercise of a broad national point of view more urgent than in the recent legislation for the reorganization of the land forces of the United States.

And never, surely, in all its history did Congress substitute politics for patriotism with such cynical deliberation as in the framing, debate, and final passage, of that notorious measure, known as the Army Reorganization bill—or, more descriptively, as the Hay Bill

Seldom has a measure been subjected to such searching and unanswerable criticism as this bill; and it is significant that the most convincing attack has been made by officers of the Regular Army and, what is more significant, by many of the great political and financial beneficiaries of the bill, the National Guard. It is also significant, that some of the bitterest opposition to the bill has come from that ever-growing circle of civilians who make a close study of our past military history and the present deplorable conditions.

The opposition of the SCIENTIFIC AMERICAN to the Hay Bill is well known to our readers, and it is with particular emphasis that we direct attention to the searching analysis of its defects by Eric Fisher Wood, which appears in the current issue of the "Century Magazine."

As regards the provisions for betterment of the Regular Army, it is shown that, although the bill authorizes an increase, it is an increase on paper, which will prove to be largely fictitious—this for the reason that the bill makes no attempt to abolish the scandal of multitudinous and widely-scattered army posts (created for political reasons), and to concentrate the men by divisions (20,000 men) in a few large cities, as is done in European countries. So small is the army and so many these isolated posts, that the enlisted man spends a large part of his time in "fatigue" duties—sweeping up, cutting grass, shoveling snow. If Mr. Hay had set his heart more upon the betterment of the army and less upon the betterment of the political fortunes of his party, these "pork barrel" posts would have been abolished, and the prospects of securing an enlistment of 140,000 men greatly enhanced.

The keynote to the attitude of Mr. Hay is to be found in Section VIII; and we agree with Mr. Wood that this amazing section cannot be too often called to the attention of the American public. So let the patriotic American take note of the following extract: "Provided further, that of the vacancies created in the Judge Advocate General's Department by this Act, one such vacancy, not below the grade of major, shall be filled by the appointment of a person from civil life, not less than 45 nor more than 50 years of age, who shall have been for ten years a judge of the Supreme Court of the Philippine Islands, shall have served for two years as a Captain in the Regular or Volunteer Army, and shall be proficient in the Spanish language and laws."

Regarding which the *Evening Journal* of Richmond, Virginia, has this to say: "Just one person in the world can comply with these conditions. This person is Judge Carson of Virginia, a resident of Mr. Hay's district. The clause was drawn obviously and shamelessly to make a job for Judge Carson and to make it impossible that anybody else, under any administration, could be placed in that job. Mr. Hay, on the floor of the House, avowed his responsibility for this clause and practically acknowledged that its purpose was to provide for one of his own friends and constituents."

We repeat that this section strikes the keynote to the whole spirit of the vast new political system, which Mr. Hay, through his measure, seeks to make of the National Guard.

For one hundred and forty years, it is pointed out by Mr. Wood, we have consistently and wisely refused to grant political power to our professional army. Until now they have not been allowed to hold office; sit in legislative bodies; serve as councilmen, mayors, or governors; participate in civil business; or practice any profession other than that of arms. The situation is such that they can rarely vote. Furthermore, we have denied to the officers of our Regular Army the right of free speech, even in matters of vital national importance.

Now by his bill, Mr. Hay would not only transform the National Guard from a civil to a professional army by the payment to it annually of the sum of $50,000,000, but he leaves these professional soldiers in full possession of all that political power of which we have, hitherto, so carefully and completely divested the officers and men of our Regular Army.

The fundamental defect of our present militia organization, as we have frequently pointed out, is that it really consists of 48 separate organizations, each under the control of its own State. Hence the "*Sine qua non*" of any scheme of reorganization is the removing of the militias from State control and placing them directly under Federal control. Mr. Hay would have us believe that he has done this—as a matter of fact, the sole federalization, says Mr. Wood, that he has brought about is the payment of funds to 800 hand-picked constituents in each congressional district.

The Hay bill *pretends* to accord control over the militias to the Nation by authorizing the President to appoint militia officers and prescribe their duties while they are in State Service, and by empowering him to train the militias, even when they are not in national service. But the Constitution of the United States specifically reserves all these rights, together with prior authority over the militias, to the Governors of the several States. Governors, acting in accordance with Constitutional law, have, in the past, kept their troops at home in time of war, as in the cases of Vermont in 1812 and Massachusetts in 1861, to say nothing of the action of the Governor of Massachusetts in 1916.

Undoubtedly the most sinister effect of the bill will be seen in the creation in our midst of that very military-political body against which the Nation has so carefully and wisely guarded the Republic in the 140 years of its existence.

For it is pointed out that not only will the Governors continue to control the militia, but they will doubtless in the future receive from the politicans much "acceptable" advice as to the appointment of officers and the distribution of this $50,000,000 of federal funds. Mr. Hay has set up 48 separate, professional standing armies of small military value, but of great prospective political power. For the members of these 48 armies, be it remembered, can hold public office; are, indeed, many of them, already councilmen, mayors or governors; participate in civil businesses, and practice the professions, and, hence, can be made by their leaders to wield a powerful influence over the press. Each moreover, is a voter.

Is it not evident that, in almost any congressional district, their 800 collective and organized votes will constitute a political balance of power?

War's Wastage in Shipping

IN glancing over the new volumes of *Lloyd's Register of Shipping* there are to be found no startling evidences of the effect of two years of war at sea on the merchant tonnage. However, when the statistics contained in the second volume of the *Register* are carefully examined and analyzed it slowly but surely becomes obvious that the extent of wastage in the number of British oversea carriers has been great indeed. The *Shipping World*, in commenting on the subject, remarks that while the war may superficially benefit one country, if we balance the gains of the first against the losses of the second, it will be found that there is a general shrinkage in numbers and carrying capacity, and perhaps even more in the average quality of the tonnage now employed in the merchant service.

Simple Test for Dyes

IN the Pinatype system of color photography it is often difficult to obtain the proper dyes, and especially in the present condition of the dye industry.

These dyes must be absolutely soluble in water, and a saturated solution used in most cases in order to obtain uniform results. The nature of the solution can be seen by dropping some of the dye on a piece of filter paper; if after a short time the water is seen outside the dye, the solution is not completely soluble, or there is not sufficient dye in the solution. Dyes may be found suitable in this respect, but when applied to the bichromated gelatin the color (in some cases) is changed on account of the dye becoming oxidized. If a strong reducing agent, such as a sulphurous acid be added to the dye this will not happen, as the reducer has greater affinity for the oxygen than the dye, and thus the color is unchanged. Methylene blue is a good example of this class of dyes. After the film has been dyed the yellow bichromate must be withdrawn from the gelatin so that the parts to be white will be clear, and the color of the dye remain true. This is ordinarily done by washing the print which destroys the detail and leaves the print with a washed appearance that makes the finished picture comparatively dead.

The washing process can be done away with by bathing the print when dry in sulphurous acid. This being a strong reducing agent and the bichromate a powerful oxidizer a transformation takes place which leaves the gelatin absolutely clear. The bichromate is withdrawn in the reaction and is in solution as chromic oxide with diluted sulphuric acid. The results are beautifully clear and sharp in detail and possess great brilliancy

Electricity

An Electric Street Sprinkler.—There are being operated in the streets of Boston several electric sprinklers by a contractor working under the direction of the Street Department. The street sprinklers are mounted on a 3.5-ton electric chassis, and include an 800-gallon water tank. Instead of placing the sprinkling apparatus in the rear as is usually the practice, they are placed in front of the vehicle where they can be seen by the operator.

Purification of Swimming Pool by Ultra-Violet Rays.—It is claimed that the leading summer resort of St. Louis, Mo., was the first to install in its 400,000-gallon outdoor swimming pool a water-sterilizing system approved by the Government public health authorities. Water entering the pool is passed through a battery of filters and carried to the top of an ornamental cascade, where the sterilizer is located. The ultra-violet rays of the sterilizer are produced by a mercury-vapor arc inclosed in a quartz tube.

An Attractive Electric Sign.—Among the latest advertising novelties is a window sign which is so arranged that it permits an advertiser to display a moving message 30 feet long in a three and a half foot space. The moving message is carried on a strip of tracing cloth which winds through a train of rollers that are driven by an electric motor. The sign is illuminated by four 10-watt lamps placed behind the tracing cloth. It is claimed that the current consumption of the device is only 60 watts.

Dry Heat and Rubber Insulation.—The United States Bureau of Standards, in collaboration with the testing department of the Pennsylvania Railroad, is making numerous tests in connection with an investigation to determine the effect of dry heat on the physical properties of the rubber insulation of wire. Other laboratories identified with the American Society for Testing Materials are also collaborating in the work, the object of which is to develop an accelerated test for insulated wire that will indicate the probable life of rubber insulation under normal service conditions.

Automatic Rewinder for Films.—For the use of motion picture theaters and exhibitors there has recently been developed an automatic-stop, motor-driven rewinder, taking reels of all sizes up to 2,500 feet. The reel of film to be rewound, as well as an empty reel, is placed in the proper compartment. The film is only rewound while the doors of the container are closed, thus eliminating all danger of fire through carelessness. The attention of the operator is not required at the end of the rewinding, as the machine stops automatically. Further, should there occur a break in the film, the machine stops automatically at the point where the film is torn, to allow of splicing.

A Table Stove with a Multiplicity of Uses.—An efficient and practical stove to be used at the table for quickly preparing breakfast or luncheon, has recently been introduced. It is provided with two shallow pans, one deep vessel with a grid for broiling, and an egg poacher with four egg cups. The shallow pans are used as griddles, as covers for the deep vessel, and as heat reflectors. Toasting is done in a wire drawer which is between the two heating elements, so that both sides of the toast are at the same time exposed to the intense glow of the heating elements. The deep vessel is used above the heating chamber for boiling, poaching, steaming, creaming, etc., just as a stew pan is used over a coal or gas fire. The deep vessel is used below the heating chamber for broiling and for all cooking operations where heat is applied from above. Eggs can be fried in the griddle on top, toast can be prepared in the toaster drawer, and bacon or chops can be broiled in the deep vessel below, all at the same time. The current consumption of the stove is about 575 watts.

A 300,000-Volt Testing Transformer.—For the purpose of testing insulators and insulating material, there has recently been installed in the electrical engineering laboratory of the University of Minnesota a 300,000-volt transformer, designed by C. H. Thordarson of Chicago, Ill. "The new transformer will mean much to the university," says Prof. Springer, "for it will bring us in closer touch with the commercial side of the business. Hitherto it has been impossible to make such tests as these without going either to Pittsburgh, Syracuse, or Springfield, Mass. The transformer took two years to construct. The same company made the 1,000,000-volt transformer on exhibition at San Francisco last year. Some idea of the power of this transformer may be had when told that if 3,000 men could be placed in a circle, taking hold of hands and all of them insulated from the ground, and then two of the men should take hold of the two terminals, all 3,000 would be killed instantly." The transformer is submerged in 14 barrels of insulating oil contained in a steel tank. The latter measures 7 feet long, 5 feet wide, and 7 feet high. The weight of the transformer, complete and ready to operate, is in excess of 5 tons.

Science

Fluorine.—According to Messrs. A. Gautier and P. Clausmann, fluorine is found in all animal and vegetable tissues, and appears to be indispensable to the living cell. In animal tissues having little vitality, such as epidermis, enamel of teeth, hoofs, hair, etc., the proportion of this substance is far greater than in the actively, vital tissues, such as muscles, glands, etc. It is always accompanied by phosphorus. In plants fluorine is most abundant in leaves.

The Progress of the World's Surveys between the years 1860 and 1916 was set forth by Mr. E. A. Reeves in his address as president of Section E at the last meeting of the British Association. Of the total land surface of the globe, estimated at 60,000,000 square miles, the proportion mapped from accurate topographical surveys in 1860 was about 1/30, while in 1916 it is 1/7; mapped from less trustworthy surveys, chiefly non-topographical, in 1860 1/30, in 1916 1/12; mapped from route traverses and sketches, in 1860 2/5, in 1916 2/3; entirely unsurveyed and unmapped, in 1860 1/2, in 1916 1/7.

Larkspur Poisoning has been found by the Department of Agriculture to be, next to loco poisoning, the greatest cause of loss in western cattle herds. According to a recent bulletin, its destructive effects are experienced in all mountainous regions from the Rockies westward. Sheep are immune, and horses rarely eat enough of the plant to produce any ill effects. Where the plant is abundant it is advisable to use the ranges for sheep rather than cattle, or to combine sheep grazing and cattle grazing in such a way that the areas infested with larkspur shall first be eaten down by the sheep. Poisoned cattle are benefited by hypodermic injections of physostigmin salicylate, pilocarpin hydrochlorid and strychnin sulphate. These treatments may be followed by hypodermic injections of whiskey.

Growing Pineapples in Manganese Soils.—One of the troubles of pineapple growers in Hawaii has been the fact that the islands contain extensive tracts of soil heavily impregnated with manganese, in which the fruit either fails to mature or is of very poor quality. Investigations at the government agricultural experiment station showed that the effect of the manganese was to render the iron in the soil insoluble, and the failure to obtain the latter element was the reason why the pineapple plants failed to develop properly. Experiments were accordingly undertaken to find means of supplying the plants with iron. The process finally adopted was to paint or wet the leaves with a solution of copperas (ferrous sulphat), and this has proved highly successful, enough of the solution being absorbed through the leaves to supply all the needs of the plant.

Internal Structure of Apple Varieties.—Prof. E. J. Kraus, of the Oregon Agricultural College, has published a preliminary account of some novel investigations of the internal structure of different varieties of apples. Sections made through the middle of mature specimens of each variety studied were dehydrated with alcohol, and then placed in a mixture of xylol and cedar oil, in which they became as clear and transparent as glass, with the complete vascular structure beautifully outlined. They were then photographed. A long series of admirable photographs accompany the text. The differences in the flesh as well as the cores of the different specimens is very striking and appears to be constant for a given variety, regardless of the place where it was grown. In fact, this procedure seems to furnish taxonomic data of great value, and may help to clear up many questions of relationship between varieties. Prof. Kraus also shows sections of certain pear varieties, to illustrate the fact that the same method may be applied to this fruit.

A Pharmaceutical Exposition.—The Philadelphia College of Pharmacy has just held, in celebration of the fiftieth anniversary of its alumni association, an exhibit to illustrate the progress of scientific pharmacy during the last hundred years. The exhibit included a drug store of 1812 and a model pharmacy of to-day; the latter being equipped with a refrigerator safe for the keeping of biological products, a chemical laboratory for the systematic examination of chemicals and their preparations, a pharmacognostical laboratory for the examination of drugs, a bacteriological laboratory for the detection of bacterial contaminations and the control of solutions and medicines, and a manufacturing laboratory for the production of the forms of medicine that can be prepared economically in a modern drug store. A model collection of the books that should be found in every pharmacy was shown in the dispensing-room. The exhibit also comprised a complete set of the pharmacopœias of the United States, a representative set of those of foreign countries, and a complete set of the United States Dispensatory. The University of Minnesota contributed a fine set of photographs of drugs and growing plants from its drug garden, emphasizing recent progress in the cultivation of drug plants.

Automobile

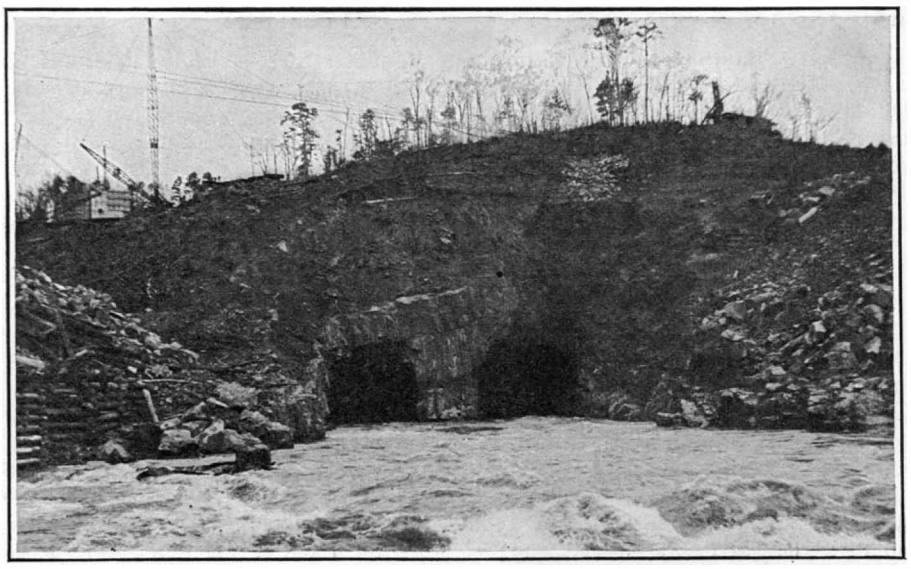
Automobile Nomenclature.—The Society of Automobile Engineers has done a good bit of work in standardizing the names of car parts, and the report of the special committees in charge of the matter was adopted on Aug. 1. The list given in the report includes the more important parts throughout the whole car, and definitions of different types of construction have been included. The work has apparently been well and thoroughly performed, and the list will not only tend to the convenience of everybody interested in the manufacture and sale of automobiles, but also to correct considerable misuse of language by writers on automobile matters.

Calling Taxis in London.—It appears that it is the custom in London to blow a police whistle to summon a taxi cab, and now that the city is in darkness at night, owing to all lights being extinguished from fear of Zeppelin raids, the demand for taxis, with the accompanying whistling, has grown to such a degree that the whistles have become a decided nuisance. The noise that a single irascible and impatient old gentleman, anxious to get home after an evening at the club, can create can be imagined; and when this is multiplied by thousands it is little wonder that the whistle has been voted a public nuisance. It is to be hoped that this London fashion will not be permitted to invade this country.

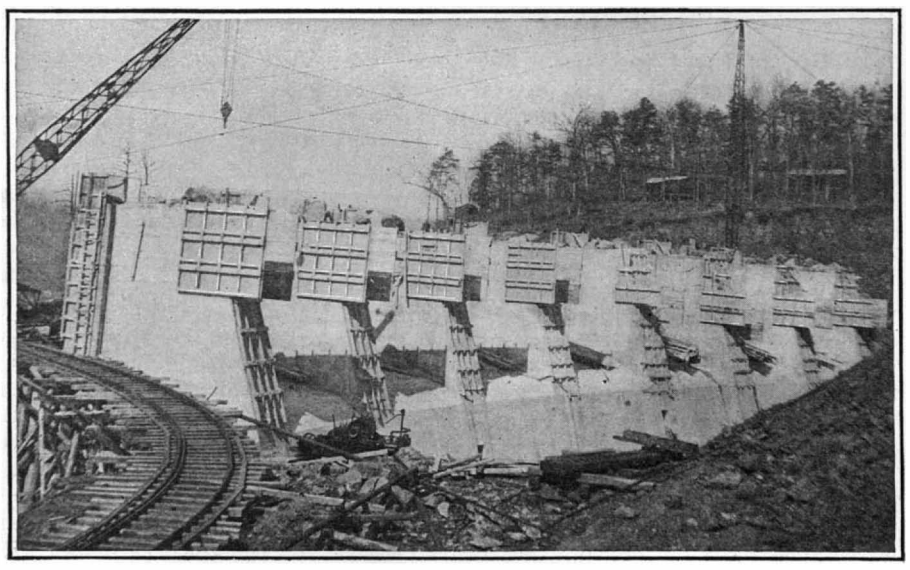
Road Regulations in England.—Owing to the prohibition of bright lights in England, as a precaution against German Zeppelins, the dangers of driving at night have greatly increased, and to meet this condition regulations have been promulgated in some districts making it incumbent on automobile drivers to keep as close to the legal side of the road as possible at all times. The benefits of such a regulation in preventing accidents are so obvious that it ought to be retained even after the restrictions on lights have been removed; and it would be a good thing to adopt a similar rule in this country as it would afford an additional means for controlling the road hog, and the reckless joy rider, who are responsible for so many catastrophes.

Autobus Recommenced in Paris.—The autobus service is recommencing in Paris, and two of the principal lines are now in what appears to be a normal condition—one running along the Grand Boulevards from the Madeleine to the Place de la Bastille, and the second from the St. Lazare railroad depot to the left bank of the Seine. Both these lines carried a good traffic before the war. It will be remembered that just after the extensive city service with its numerous autobus lines had been finally organized, the war came and as a result the autobuses disappeared completely from the streets, they having all been impressed into the war service. New cars have now been built, however, and on a somewhat improved design which allows of two seats on each side of a central passage. The fact that military exigencies permit these cars to be used for civil purposes is certainly significant.

Short Measuring Gasoline.—Automobile owners have known that they are frequently given short measure when buying gasoline at the garage, but they are usually in such a hurry, and so good-natured, that they have proven easy prey for the dishonest dealer. Few, however, know how the trick is done, or realize the possible extent of the frauds. At the recent Conference on Weights and Measures of the United States F. J. Schlink, of the Bureau of Standards, told some of the tricks of the trade. In the first place all pumps show a tendency toward undermeasurement, as any defect in construction or installation tends in that direction. In pumps of the piston measuring type a leaking foot valve will diminish the amount delivered. The same results from an excessive suction lift, or a leaking pipe; and this is particularly so in the case of "casing head" or "blended" gasolines on account of the vaporization that takes place under the piston. Pumps that have been standing for some time do not give a full measure on the first stroke, owing to leakage or vaporization, and two or three strokes should be made before the measurement is taken. All these are "incidents" that may occur even at the "honest" garage; but there are other causes of short measure that are entirely intentional. First is the habit of not operating a piston measuring pump to full stroke; then there is the convenient long hose, with a shut-off cock at the filler end, and sometimes this hose is long enough to hold a full gallon that has been measured at the pump, but not delivered. Another fraudulent device is that which returns undelivered gasoline to the dealer's storage tank, and it is sometimes so attached that it operates at the same time that liquid is being delivered to the customer—in other words, it diverts a substantial percentage of the measured gasoline back to the storage tank. The only safeguard for the buyer is to have his gasoline run out into certified measures and then poured into his tank. This takes more time, but it pays.



Outlet of diverting tunnels



Putting in the overflow gates

An Industrial Giant of Recent Birth

The Importance of Aluminum in Modern Technology Necessitates Immense New Plant in North Carolina

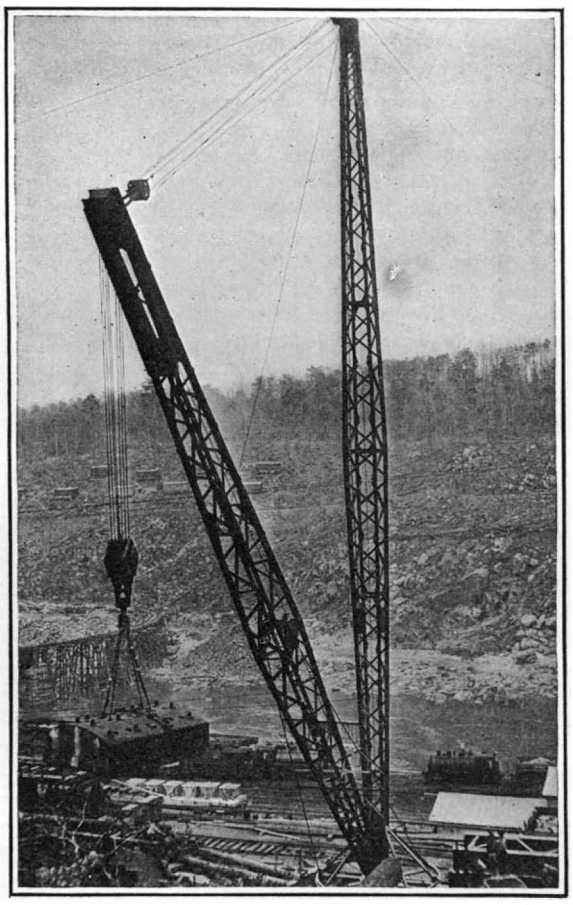
THE history of the aluminum industry is the story of the transformation of a chemical curiosity of 1883 into a prime commercial necessity of 1916. In the year first named, the total American production of this light, white metal was eighty-three pounds, while in 1914 the output amounted to eighty million pounds, and for 1916 expert opinion predicts a production passing two hundred million pounds.

The electric furnace has been the means of the wonderful progress in the manufacture of metallic aluminum. Bauxite, the ore from which the metal is extracted, and known to chemists as hydrous aluminum oxide, is ground up fine and mixed with caustic soda under steam pressure. After several highly technical processes, this mixture is placed in shallow vats containing charged electrodes, whence it finally goes to the electric furnaces. From these it emerges as the white metal itself, in the form of ingots.

The bauxite ore is produced chiefly in Arkansas and Tennessee. There is a region in the former state where it is mined direct from surface railroad tracks, with steam shovels, just as is the iron of upper Michigan.

Side by side with the increase in the production of metallic aluminum have kept step the numerous uses to which the white metal is put. Aluminum is now used in literally hundreds of ways. Its greatest field is probably the manufacture of kitchen ware, but it is being more and more applied for surgical appliances, jewelry, fancy articles, machine bearings, automobile parts, etc. The powdered metal is used in printing, lithography, and the manufacture of explosives. Aluminum foil is in many cases replacing tin foil. As an alloy in certain types of steel aluminum is indispensable. It is supplanting copper and glass almost entirely, on the ground of price as well as that of service, for large vessels in breweries, varnish and sugar factories, soap and candle works, dye and explosive plants, in fact in all industries where the use of acids, alkalies, or other highly active chemicals necessitates containing vessels of considerable chemical inertia. It is used in the production of hydrogen peroxide, citric acid, glycerin, and a number of less known chemicals. Being the lightest metal known—only two and a half times as heavy as water—and possessing admirable physical properties in addition, it is in many respects exceedingly valuable for a variety of uses too numerous to mention here.

The largest single factor in the production of aluminum is cheap electric current; for only by this means can this comparatively inactive element be separated from its compounds. Electric current in large volumes



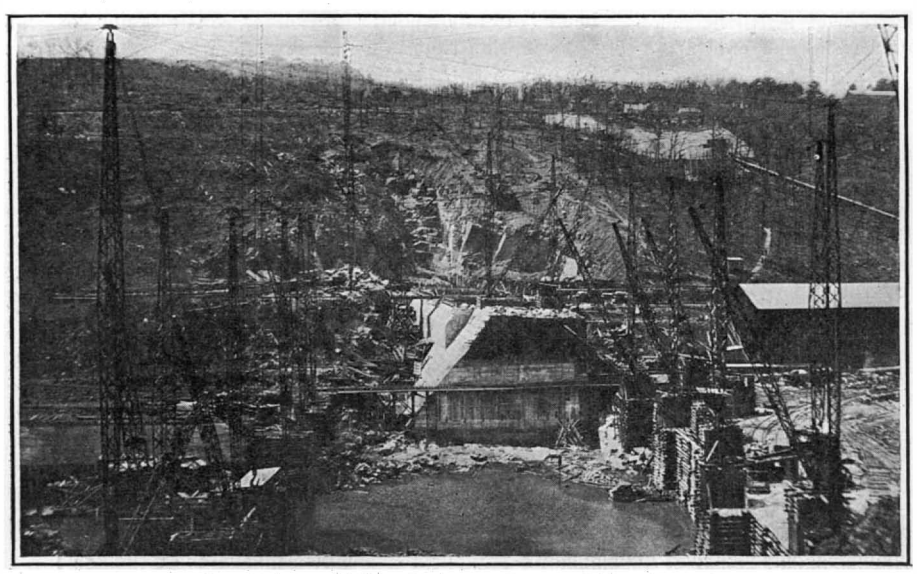
Forty-two ton crane at work

and at low cost can only be had where there is unlimited water power. At various points in the United States and Canada where this condition is met plants for the manufacture of this metal have been located; but the greatest of all aluminum developments is now under way in North Carolina, along the Yadkin River near Albemarle.

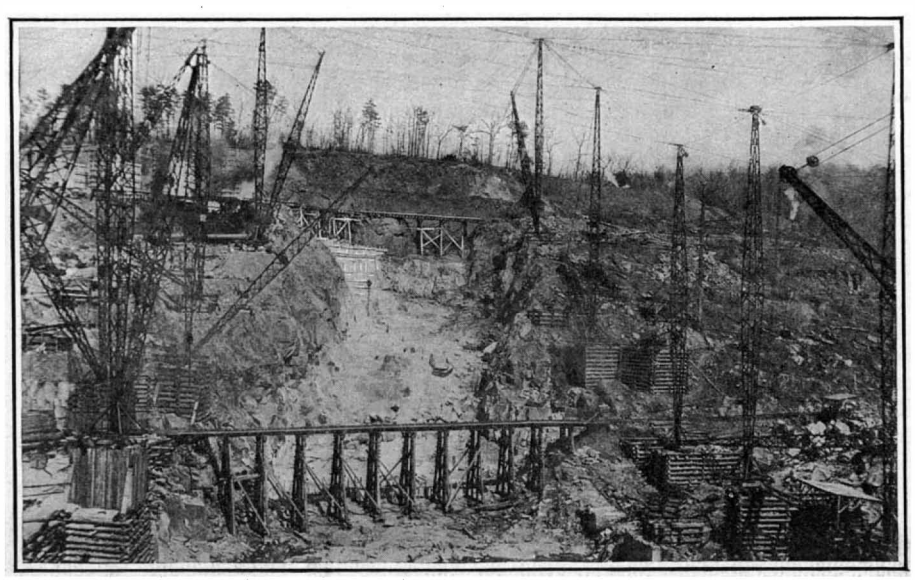
It is a curious coincidence that less than one hundred and fifty miles from this point, as the crow flies, another industry consuming thousands and thousands of units of horse-power was born. It was at Wilson, back in the nineties, that a chemist since grown rich and famous was carrying on experiments with a small electric furnace in his search for a cheap process of manufacturing this very aluminum. One day he put into his furnace a mixture of lime and coke, turned on the current, and awaited results. He was disappointed to find only an uninteresting grayish substance, which he disgustedly threw into a bucket half filled with water, before going on with another experiment. About twenty minutes later, lighting a cigarette, he threw the burning match into this bucket and was utterly dumbfounded to see the latter burst into a mass of flames. On investigating the mystery, he found that the substance he had discarded as worthless was calcium carbide, which is now universally used in the making of acetylene gas for illuminating purposes. Thus was recorded the birth of the carbide industry, in which millions of dollars are to-day invested.

But to return to our story, we find that at the narrows of the Yadkin, near Badin, a dam is being thrown across the river 1,300 feet long, 229 feet high, and tapering from a thickness of 160 feet at the base to 20 feet at the crown. Its completion will create a lake eight miles long, furnishing at least 100,000 horse-power, all of which will be used in the giant aluminum smelting plant. Construction on dam, smelting plant, and village for the workers is progressing at a feverish rate, induced by the extraordinary price of the metal, which remains firm at sixty cents per pound, in spite of the greatly increased production.

As offering some indication of the magnitude of the work of construction, it is stated that twenty miles of standard gage track has been laid in connection with the dam alone, and that over thirty 110-foot cranes are in constant use. To supply the material there have been installed the two largest concrete mixers in the world. Each machine weighs 46,000 pounds and has an inside diameter of nine and a half feet. Their capacity is 108 cubic feet of mixed concrete at a filling, more than double that of any of the mixers used in the construction of the Panama Canal.



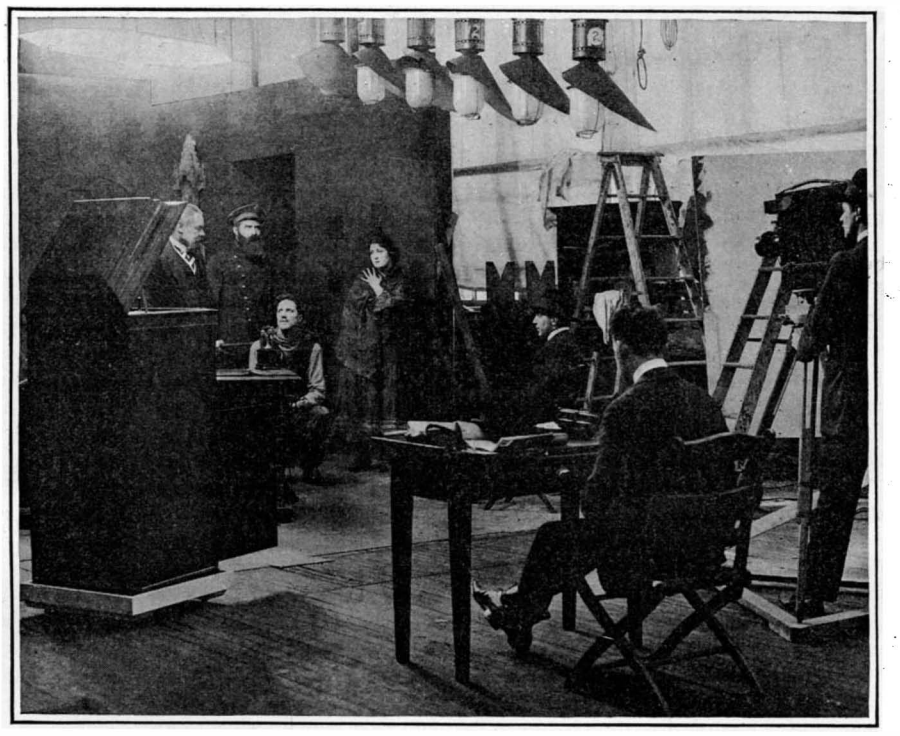
Laying foundations for the cofferdam



At the base of the dam

The Phonograph as a Coach for Motion Picture Actors

THE lot of a "movie" star has its hours of trial and tribulation, as well as of satisfaction. The sharp call of the director to "Register joy!" or "Register terror" or register any one of the thousand and one human emotions which are displayed upon the film must be obeyed, whatever the emotion which happens to be uppermost in the actor's mind at the moment. It is not easy always to have such facile command of the face as is demanded for this work, either from the camera artist or the worker in the "legitimate" and for the former it is perhaps even harder than for the latter, since many of the accessories which go to throw the actor on the stage into the spirit of his work are absent in the studio. It cannot be easy to register longing in the midst of a babel of directors and property men and disengaged performers, with the camera grinding away in front of one and a half dozen strange "sets" being noisily erected on all sides.



Music—phonograph music in this instance—helps the motion picture actors to concentrate their thoughts on the work at hand, irrespective of the many distracting factors of the studio

To assist the actor in this thankless task the phonograph has been called into play. Picture the sweet country maid dreaming of her lover in a far-off land. The director tells her to look wistful, longing, melancholy or what you will. He gives the command "Go!" which is the signal for action, the talking-machine is started, and the strains of "I Hear You Calling Me" are heard. A sympathetic note is struck in the heart of the actress; her facial expression is indicative of the effect of the music, and the proper mood is called forth more quickly than any amount of mental concentration could accomplish.

"We know how much music enhances the effect of the motion picture as presented in the theater," says the director responsible for this innovation. The audience does not often realize the importance of the musical accompaniment, but omit the music and they will feel the difference in a moment. We know that music has been a great factor in the development of the silent drama, and we have seen the added importance given to music by producers of motion pictures. The effect that music has upon the spectator is analogous to its effect upon the actor. He responds readily to the musical stimulus.

So it is with the actor. There is no thought of fooling him, of imposing upon him, willy-nilly, a given mood. The intention is merely to extend to him a valuable aid in assuming that mood. He may have come in "cold;" he may not even know the whole story of the picture. The machine helps him to work himself into the correct emotional state for a realistic and convincing portrayal.

Bringing Scientific Methods to the Dairy of To-Day

By Irvin J. Mathews

SLOWLY, stealthily, yet surely, science has made herself felt in all the industries of the world, but in all this march of progress the operations of the farm have presented the greatest obstacles to scientific analysis. Nevertheless, after the trenches of ignorance and guesswork were taken, sane thought and careful methods wrought great changes in every branch of agriculture. But in many departments of farm economy the conquest has been a difficult one; and in none more so than in the dairy.

Ex-Governor Hoard of Wisconsin has truly said that the inside of a dairy cow is the darkest place on earth. By this statement he meant that it has been harder to interpret the body processes of the dairy cow than those of any other farm animal and until the invention of the Babcock test and the use of the milk scales, the dairy cow absolutely defied all efforts at an accurate estimate of her value. Not knowing the weight of feed consumed, it was supposed that each cow ate the same quantity; yet reason should have dictated that this conclusion was incorrect. The full pail constituted the sole criterion of dairy value; whether the pail was full for three months only, or whether there were 2 inches of foam on top of the milk, were questions to which no thought was given.

All this is now changed. The dairy cow is no longer able to defy the methods of the scientific agriculturist. Her every act is checked and assigned a monetary value. Her milk is weighed, then tested for butterfat. In conjunction with every well-equipped dairy barn there is a milk room which, with its usual equipment, is the first crucible in which each animal of the herd is tried. Emphasis must be placed upon the single animal. In many dairies it has been discovered that if three unremunerative cows are thrown out, the annual profit on the rest of the herd will be from five to ten dollars more per cow.

The most essential tools for the preliminary test are the milk scales, the milk sheet and the cupboard for composite samples. It will be noted that there are two hands on the milk scales and both are adjustable. One is red, the other black. By so adjusting these that the red one points to zero when the empty pail is on the hook, this hand is made to indicate the net weight of milk in the pail when returned, filled, to the scale, while the black hand records the gross weight of the pail plus milk, in the normal way. On the inside of the cupboard there is a milk sheet ruled in such a manner that each cow in the herd is included, spaces being left for recording the weight of each milking for 31 days. A pencil accompanies this sheet, attached by a string, and when the milker notes the weight produced by the particular cow, he turns to the sheet and records this weight in the proper space. In this manner a permanent record is established which may be filed, thus making it possible to tell how much a certain cow has produced during any period over which records have been systematically kept.

If we had only the milk record, we would be almost as helpless as with no record at all, since the richness of the milk of different cows is so variable. Jerseys and Guernseys may give milk testing as high as six per cent of butterfat, while good Holsteins may run as low as two per cent butterfat. Of course butterfat constitutes only a portion of the nutrients in milk; the skimmed milk is also valuable. But its food value is in proportion to the butterfat of the given sample, therefore it is customary and fair to use the amount of cream on milk as an index to how much it is worth as food. During a month of 31 days, each cow gives 62 different messes of milk, no two of which would contain the same identical percentage of butterfat. Despite this fact, it has been found that if four successive milkings are tested and an average is struck, this average will be identical with an average of all the milkings in 95 cases out of every hundred. The two-day method of sampling is followed almost exclusively—it is the one used by all the breed associations in their conduct of semi-official tests.

Milk is a typical emulsion, consisting of tiny spherical particles of fat that are free to go wherever forces pull them in the fluid. It will be readily seen that the time between the commencement and finish of the act of milk drawing is sufficient to give the droplets of lighter fat a chance to collect on the heavier fluid so that when the milker gets the pail and contents to the milk room, the top milk is richer than the milk in the bottom of the pail. In taking a sample of milk for testing, an attempt is made at even distribution of fat; the milk is thoroughly stirred before the sample dipperful is ladled out into the particular cow's sample jar, and the jar is sealed to prevent the evaporation of water. This sampling is carried on for four milkings or through two days each month, then the milk from each sample bottle is put through the Babcock test and the resulting per cent is placed on the milk sheet beneath the total quantity of milk delivered by that cow during the month.

With these data in hand for an entire year, each cow's gross earnings are fully known. But net earnings alone can tell the story of profit and loss. Dairy cows are like so many factories; some of them are efficient, many of them are wasteful and go bankrupt. The intelligent manufacturer compares the cost of production including raw material and labor with the selling price; if the selling price is the greater, well and good. In the same way, the dairyman must balance the cost of producing milk with the returns obtained through its sale. In order to do this, the raw materials consumed by the individual cows must be definitely known.

Under careful management, cows eat both roughages and concentrated foods. Roughages most used are corn silage, alfalfa and clover hay. Many different forms of concentrated foods are fed, but chief among them are bran, ground oats, corn, barley, and linseed and cotton-

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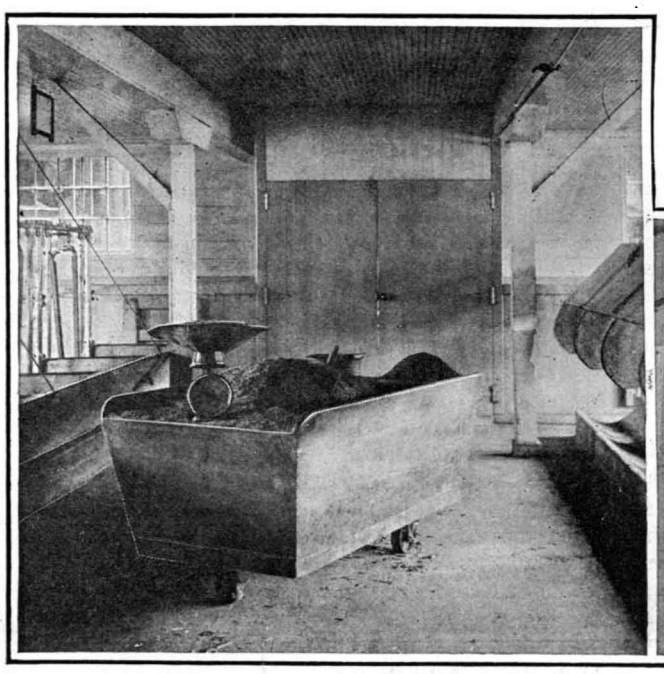
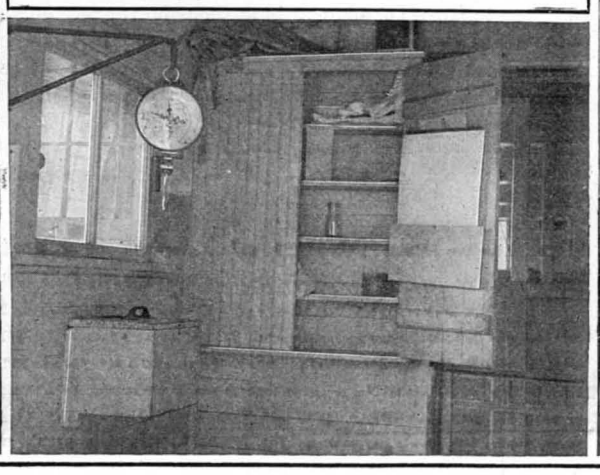
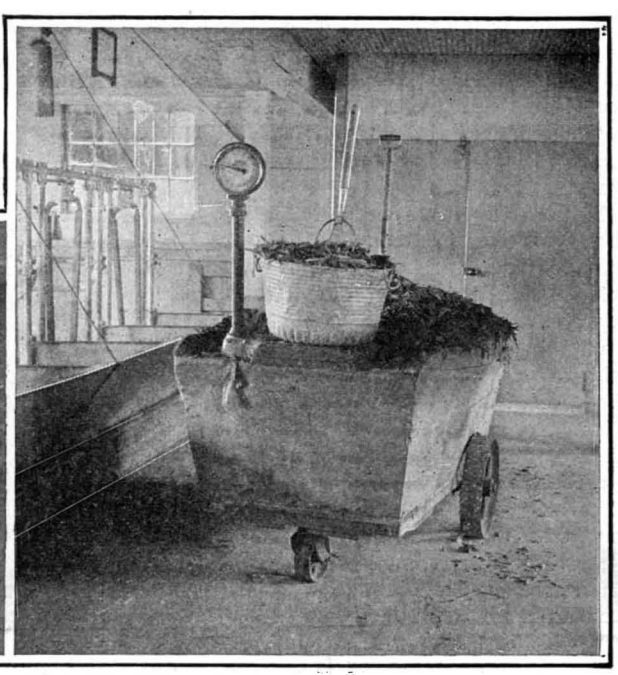


Concentrate cart of a modern dairy, with separate compartments for each different feed



The milk room, showing the scales, milk sheet, and cupboard for composite samples



The roughage cart and the scale which it carries for weighing the food given out to each cow

A few of the many scientific methods that are replacing guesswork in the dairy

Strategic Moves of the War, October 12th, 1916

By Our Military Expert

WITH the operations on the Western front again reduced for the moment to local nibblings, consolidations and rectifications, we are granted a breathing space in which to glance about and take in the general situation of the combatants. And in doing this our attention is at once drawn to the Roumanian front, where developments of considerable significance have reached a point which makes possible an intelligent estimate of what has happened and what is happening.

Such an estimate is far from favorable to the intelligence which is directing the Allied strategy. It seems to be in the very nature of things that the Allies attain to the correct way of doing a thing only by a tedious process of trial and error; that it is only after having experimented with every erroneous line of procedure that they ever hit upon the right one. This fundamental unpreparedness of her foes is Germany's greatest asset in the present struggle. It must make the most rabid partisan tremble when he reflects upon what would be the result of the war were Germany's resources of men, money and material on a par with those of her foes.

There was some excuse for the state of mind of which we speak at the beginning, when France and, a few days later, England, were plunged almost without warning into a conflict which they were hoping to evade. Russia's unreadiness, too, while perhaps not very excusable, is at least understandable in the light of all we know of her. But why Roumania, after two years presumably devoted to careful preparation for an ultimate entrance into the war, with the decision as to time and place absolutely in her own hands, should not have known exactly what she ought to do, and how, when and where she ought to do it, paralyzes the ingenuity of the observer who tries to account for what he sees.

The fact remains, however, and is brought out with vivid clearness by the events of the first two weeks of October, that the Roumanian powers knew none of these things. The faculty of initial mental preparedness remains a German monopoly. Just as, in the beginning, France allowed the thought of Alsace to divert her, from the quarters in which she was faced by a deadly menace, into a costly and blundering effort to gain one of her ultimate objects right at the start, so the thought of Transylvania misled the pan-Roumanian enthusiasts into a completely analogous blunder.

The one danger to which Roumania's entrance on the side of the Allies exposed her was the thrust from the South. The possibility of an Austrian offensive against her frontier did not exist; an attack from the same quarter by German units was not of extreme probability and if it came could have been held in the mountains by a decidedly inferior force. But Roumania's southern border was from the start in a critical position. Several divisions of good Bulgarian fighting men, commanded by the redoubtable Mackensen and with their effectiveness brought to a maximum by a liberal leavening of German heavy artillery, were within convenient striking distance. And even aside from the presence of this particular force, the most ordinary intelligence should have foreseen that before Roumania could safely sew up large forces in the Transylvanian mountains she must effectually dispose of Bulgaria. Indeed, Roumania's assistance to the Allies against Germany would have been hardly worth purchasing. It was her aid against Bulgaria and Turkey that was wanted, and, it was supposed, had been secured.

Moreover, serious reflection would have made it clear that operations by Roumania in Transylvania were no part of the general Allied plans, and that even from a selfish point of view they would afford Roumania no advantage. They would contribute in no way to the eventual general defeat of Austria by which, and by which alone, Roumania could hope to gain permanently the coveted territory. From a military point of view, Vienna, even Budapest, is no nearer to the heart of Transylvania, for such forces as Roumania could muster, than to Turnu Severin, Piatra, and Botosani. Even if complete occupation should result, the Transylvania enterprise would continue to absorb large Roumanian forces. And far from having any tendency to detach Hungary from the Teutonic cause, the manifestation of Roumania's designs upon one of her fairest provinces has attached her even more firmly thereto.

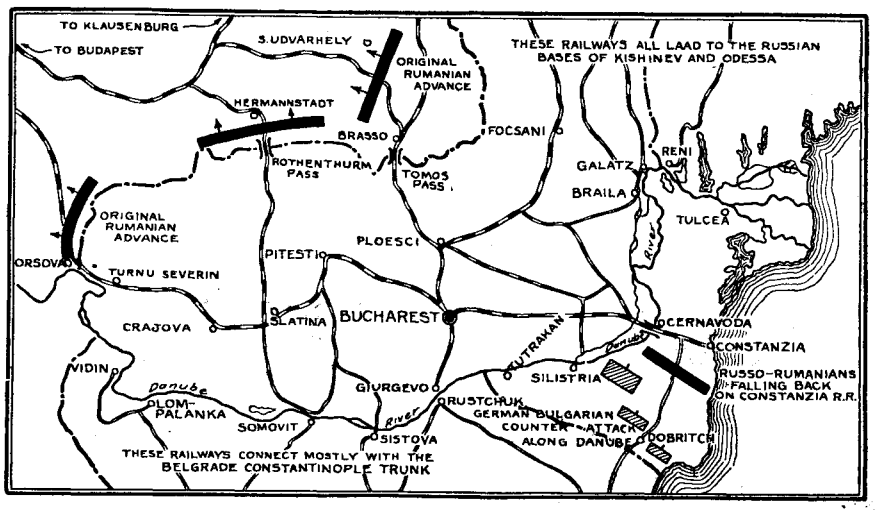
But in spite of all this, in spite of the obviousness of the correct course, in defiance of all the urging of her new Allies, Roumania made the old mistake of allowing political considerations to overrule military ones. In all the military history of the world, Verdun affords the only instance which comes to mind of a case where such policy has in the long run been profitable. It appears now that the entire Roumanian army, with the inconsiderable exception of one or two divisions at Turtukan and Silistria, was hurled across the mountains into Hungary; and, as crowning blunder, Roumania exercised undue haste in her final steps, so that the Russian forces, upon whose presence she had counted to redeem her from the consequences of her rash action, were not yet in the Dobrudja at the critical moment.

The result was inevitable. Mackensen advanced into Dobrudja, destroyed one Roumanian force and routed another, and established himself in strong positions menacing Bucharest and its railroad communications with Constanza on the Black Sea—positions which, with proper strategy by Roumania, he could never have reached. So after a few days of success the Roumanian onslaught upon Transylvania was brought to an abrupt end, the armies rushed back to the southern front, Russian troops hurried from the north, and Mackensen finally checked and actually driven back a short distance.

In the meantime, the Austrian retirement in Transylvania had spurred Germany to send to this quarter a new army group under Falkenhayn. The Roumanian check became a rout. All the territory occupied had to be evacuated, and after heavy defeats of the now very inferior Roumanian forces an invasion of Roumania itself was among the immediate possibilities.

So now the operations on the Roumanian front, instead of becoming an active menace to the Teutonic cause, have degenerated into the same old game of frontal push, which has been played to repletion in the east and the west. Even so, there is some cheer for the Allies. Mackensen is being kept busy; and in the meantime the unfortunate Sarrail may at last get some attention paid to his demands for sufficient equipment to warrant a serious advance from Salonika. He is, in any event, safe, for the present, against attack from the north.

Then, too, there is the mystery of Falkenhayn's army. Where did it come from? It appears that this force must have been in the making for a considerable time, with the object of springing a little surprise, perhaps in the west, much more probably in the east. The Roumanian fiasco has at least diverted it from such use; and if Falkenhayn be checked as Mackensen was, if a large German army with which it was intended to overwhelm the Russians be held in suspension for any length of time in these mountains, or even in an invasion of Roumania, the net gain to the Allies will have been considerable after all. The line whose shortening becomes more and more a prerequisite to German success will have been again lengthened by several hundred miles, and a further strain put upon all the German resources.



The strategic position of Roumania

The Up-to-Date Method of Pouring Concrete

THE most casual observer cannot have failed to note that we are living in the age of concrete. No class of construction seems immune from its inroads. The dingy old-fashioned factory, with its forbidding exterior of smoky brick, cut by a few smokier windows, is giving place to the six-story pile of concrete and glass that measures its floor space and its window space alike by the acre with no more certainty than is the trim concrete culvert crowding out of existence the collections of rotting planks and cobblestones which used to carry our country roads across the gulleys cut by the spring freshets.

Everywhere we go we see concrete being put to old and new uses. Everywhere we see the technique of concrete construction being improved and standardized. Where the amount of material to be used and its cost are so nearly fixed as they are in this case, the efficiency engineer's attention must be directed mainly upon the methods of working, and it is right here that we can draw a sharp contrast between what has been and what is.

It is obvious that in erecting a building, or a tall viaduct, or any other structure of considerable altitude, the concrete must be poured from many different levels and from many different points. There was a time when the raw materials—gravel, crushed stone, cement and water—were conveyed separately to the various pouring stations, there to be made into concrete on a small scale and poured direct from the mixers. This was expensive. It required an excess of equipment, an excess of skilled labor to man the equipment. As competition grew and expense became more of an object, as knowledge grew and engineers knew better what they could do with concrete, methods were changed, until finally a standard technique has been developed to a high point of efficiency, with centralization as its moving idea.

Nowadays, there is one mixer to a job. The bigger the job, the bigger the mixer; aside from this, the magnitude of the operation is a matter of no concern. Here alone is a great saving in labor and cost of equipment, but even greater is the saving effected by the manner of conveying the concrete to its final resting place, one phase of which we illustrate on our cover. At a convenient point—or, if the size of the job warrants, at convenient points—a huge tower is erected to the ultimate height of the finished structure itself. Inside this tower a great bucket runs up and down, propelled by a donkey engine. At the tower's foot stands the mixer. The raw materials go into one end of the latter, and from the other concrete is delivered direct to the hoisting bucket. The latter flies up to the desired level, is capsized by a touch from below, and its charge delivered into a long metal chute.

These chutes are really the key to the whole situation. They are sectional and movable. They may be adjusted to any desired length, rigged upon the tower in any desired position, and moved about at will. As fast as the particular point in the molds to which a chute has been directing the concrete is filled, the chute is raised or swung about or shortened so as to direct the concrete to a new destination.

Our cover shows a typical scene on a large concrete construction job. A tower is seen in the background with a number of chutes in position. As the loaded bucket travels upward in the tower, it can be emptied into any one of these. In the foreground is shown the operation of hoisting a chute into position upon another tower, a corner of which appears beside the hoisters.

The combination of flexibility with unity of operation afforded by this procedure is a notable one. In few lines of engineering have the small operating details been worked out to such a fine degree of standardization, and with such excellent results.

Fighting the Chinch-Bug

A DESTRUCTIVE outbreak of the chinch-bug began in Illinois in the autumn of 1909 and ended in the spring of 1915, resulting in damage to the corn, wheat and oat crops estimated at $13,000,000. A voluminous report on this outbreak and the methods used in controlling it has been published by the state entomologist. The principal measures adopted were the burning out of the insects in their winter quarters and their destruction at harvest time by means of impassable barriers and lines of post-hole traps placed beside infested wheat fields. Coal tar has long been used in making such barriers, as its adhesiveness and its offensive smell both prevent the passage of the insects, but it has several disadvantages, and efforts were made in Illinois to find satisfactory substitutes. A particular kind of road oil was found to last from five to ten times as long as coal tar without renewal, but it is made at only one place in the United States and cannot generally be obtained without serious delay. During the latter part of the outbreak creosote was used with great success, its powerful odor effectually repelling the insects.

Correspondence

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

Increasing Speed of Ships

To the Editor of the SCIENTIFIC AMERICAN:

Recently there has been much discussion in regard to the best methods of increasing the speed of ships. The old and standard way of applying more power, seems to have nearly reached its limit, when engines aggregating 70,000 horse-power are placed in a single hull. Doubling the amount of power adds but a small percentage to the speed. Skin friction is probably 75 per cent of the whole resistance to motion. Experiments point to a rapid increase in this element as the speed increases. Skin friction is a great obstacle to be overcome in building fast ships. The hydroplane is an effectual way of getting rid of it in small boats, but it requires a large horse-power for vessels of any considerable displacement, and as yet the hydroplane boats have not proved exactly seaworthy. Whether the system can be effectually applied to large tonnage appears to be a doubtful question. Its fundamental principle is the reduction of immersed, or wetted surface, and in this way getting down the skin friction.

More than 35 years ago the writer, in conversation with a mechanical engineer, suggested compressed air as a lubricant for vessels. He was told in reply that the idea was not new. Years before a man had the idea of placing a perforated pipe on the stern of the vessel and carrying it down and some distance along the keel. Air was to be discharged from this pipe against the hull. The idea was to form a coating of air between the water and the skin. Upon experiment it was evident that the vessel went considerably faster when air was discharged through the pipe. The result was so promising that government experts were called and made careful tests. The horse-power required for the compressor, power of the main engine, the speed attained, and all the other items were carefully observed. The final results as observed at that time seemed to show that the horse-power saved was very nearly equal to that used in compressing the air. At that day there was nothing to be gained by the invention.

It seems probable, however, that a different result would be attained to-day. Then almost nothing was known in regard to the economical compression of the air. Practically, the art of compression was not even in its infancy, for it did not exist. With modern machinery for supplying air, a very different result might be expected. It was an idea far ahead of its age. Those who remember something of the old-fashioned air pumps or compressors, built 35 or 40 years ago, would feel tolerably certain of being able to supply the outside of the ship with a film of air at a tenth of the cost of power used in the early experiments. It has been suggested that an oil film might be applied to the vessel's hull to reduce the skin friction. Racing yachts, by using suitable bottom compounds, make a considerable gain in speed. Whether "pot-leading" can be automatically and continuously applied, is a question that might well be considered by inventors. Nature applies such a coating to fish and an imitation of Nature's process does not seem altogether impossible.

W. E. DE PERTRECHE.

[Referring to the writer's suggestion that 70,000 horse-power is the limit for ships, it should be noted that our new 35-knot battle-cruisers are to have at least 175,000 horse-power. Experimental tests in the touring tank do not give promise of any economical reduction of friction through the use of an air film.—EDITOR.]

Unsinkable Ships

To the Editor of the SCIENTIFIC AMERICAN:

In these days of destruction by means of torpedoes and mines the question must often arise, whether it is possible to devise some method by which the effect of explosion, as applied to the bottoms of ships, might be modified, if not entirely counteracted.

In the case of a vessel constructed with two bottoms with an air space between, the force of the explosion shatters the outer shell and is conveyed to the inner bottom which also suffers from the force of the confined gasses, to a less degree than the outer shell, but sufficiently to allow the influx of water and cause the sinking of the ship. If in the case of the "Lusitania" the "Ancona" the "Ville de la Ciotat" or the "Persia" the space between the two bottoms, instead of being an air space had been packed with a tough, fibrous, resilient substance, it is quite conceivable that one or other of the following conditions might have arisen: (a) The explosion would have shattered the outer hull, but the disruptive effects would have been neutralized by the resilience of the packing and the inner bottom would have remained intact, or (b) The force would have exerted itself through the resilient matter to the extent of breaking the inner shell, but the expansion of the resilient substance, following its compression by the force, would have prevented, or at least retarded, the influx of water.

Of course, these propositions depend upon (a) the energy of the explosion and (b) the resilience of the interposing material; but upon the presumption that the latter was sufficient to modify the former it appears to be self-evident that the sinking of the steamer might have been delayed if not prevented.

The question is, Is it possible to find a material possessing the qualities of toughness, resilience, and (comparative) cheapness, that would have the effect of neutralizing, to a greater or less degree, the effect of high explosives as applied to the bottom of a ship?

After investigating a number of materials I have formed an opinion that *scoured wool* possesses those qualities in a marked degree and the theory I put forward, for others to test, is that if the double bottom of a steamer were packed with scoured wool, or other equally tough, fibrous, resilient material, it would be difficult, if not impossible, for that vessel to be sunk by explosives so rapidly as to prevent the saving of life and possibly also, of the ship herself.

LOUIS E. HORNE.

"Hale House," Bishops Grove, Perth, W. A.

[Judging from the press reports that have come from abroad, the above system has been applied in the monitors built for the British Navy since the beginning of the war.—EDITOR.]

Another Explanation

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of September 9th an account is given of An Unusual Aurora, by Walter H. Eager, and the description tallies almost exactly with a phenomenon that is rather common at this place. The nebulous spots in the sky, as we observe them, are caused by the blast-furnaces which are located north of us and can be seen only during a certain condition of atmosphere. The blast furnaces are rather plentiful in this section and we observe that these luminous spots in the sky are always located in the exact direction of the furnaces. The shaft of light is always vertical, and appears and disappears at irregular intervals, caused no doubt by certain vapors floating in the air over the stacks of the furnaces. It is likely too that the light shown in the sky is refracted at certain definite angles, similar to the rainbow. It is my opinion that the light originates in the heat or fires at hot-blast stoves of the furnace, and is projected into the sky through the smoke-stack in the form of a vertical shaft. It is likely too that these illuminations could be faintly seen for great distances. We can see them very distinctly here, from furnaces 20 miles distant.

ELMER HARROLD.

Leetonia, O.

More on the Chemical Barometer

To the Editor of the SCIENTIFIC AMERICAN:

Mr. S. Leonard Bastin's article, "Curious Hygrometers and Barometers," published in your issue of September 16th, informs us that "the chemical barometer was invented by the meteorologist Admiral Fitzgerald."

Perhaps not many readers will recognize under this novel disguise the versatile British hydrographer and meteorologist Vice-Admiral Robert FitzRoy—the same who commanded the "Beagle" in the famous voyage in which Darwin participated. But FitzRoy did not invent the "chemical barometer" (also known as the "storm glass," "camphor barometer," "camphor-glass," "chemical thermoscope," "chemical weather-glass," and "paroscope"), and in his "Weather Book," p. 443, he declares that the device had been in use more than a century before his time. His name has been connected with this scientific toy because of his belief that its indications were actually controlled in some way by the electrical state of the atmosphere.

Mr. Bastin will find the history of the "chemical barometer" fully set forth in Dr. C. Kassner's article, "Das chemische Wetterglas oder Paroskop," published in "Naturwissenschaftliche Wochenschrift," October 18th, 1908.

C. FITZHUGH TALMAN.

Washington, D. C.

A Boon for Autoists

To the Editor of the SCIENTIFIC AMERICAN:

It has been my misfortune in the past six years to be in communities where the commercial lighting companies did not use electric trucks in their service, but had this been otherwise it has long been my plan to interest them in a magnetic drag attached to the rear of their trucks to gather the enormous quantities of steel particles that litter our paved streets and highways, doing thousands of dollars damage annually to automobile tires and draft animals.

It is my purpose in this bit of correspondence to give to any public spirited firm using electric vehicles this idea, which could be developed with very little expense and operated at a very low cost, and the data it would furnish would be very valuable in many directions.

Again, I have no doubt that any local automobile club or society would gladly meet the operating expense attached to such an arrangement, and this without a great deal of urging.

Yours Respectfully

G. H. PEIFER.

The Naval Bill

To the Editor of the SCIENTIFIC AMERICAN:

Allow an old reader, who has not missed reading a number for more than 30 years, to make a comment upon our Naval matters. The bill just passed by Congress is, at last, an answer to what your paper has been calling for all these years, viz.: a Navy bordering on our needs. It is the greatest vindication of your editorials that has yet happened, and I wish to have the SCIENTIFIC AMERICAN receive some measure of appreciation at least for its great work in that direction.

H. E. CARPENTER.

Los Angeles, Cal.

The Current Supplement

IT is said that everything imaginable can be found in New York, and tucked away in corners of the big city are many little shops where the most unexpected things are made and where the most unusual occupations are carried on. In the SCIENTIFIC AMERICAN SUPPLEMENT No. 2129, October 21st, a short account of one of these shops is given in *One of the Curious Trades of New York*, which is accompanied by a number of excellent photographs. At the recent meeting of the British Association for the Advancement of Science the president made an address on *New Archaelogical Lights*, the important portions of which appear in this issue of the SUPPLEMENT. *Determining the Age of Blazes* is an interesting bit of forest lore, accompanied by a series of instructive illustrations. *Dynamic Balance of Machines* discusses a matter of considerable importance where fast running machinery is in question. *Hydrogen for Military Purposes* gives facts relating to the production of this gas, which is required in great quantities for the inflation of airships and military balloons. *Optical Stress Analysis* gives a very interesting description of a method by which a number of important engineering problems may be investigated. The article is illustrated by engravings and diagrams, *Armor Plate* gives a very excellent history of the development of this material, and a brief description of its manufacture, written for the untechnical reader. This number also includes *On the Suggested Mutual Repulsion of Fraunhofer Lines, Bacterized Peat* and other topics of interest.

Relation Between Carbon Content and Welding Qualities of Steel

THE poor workman blames his tools; the good workman assures himself beforehand, not merely that his tool is in good shape, but that it is suited for the end in view. Among other items which he must take into consideration is the matter of carbon content. He may well be guided, in doing this, by the following table:

Carbon content.	Characteristic..	Remarks.
1.58.....	Will not weld...	Seldom used.
1.38.....	Will weld.....	Used for hard tools.
1.12.....	Welds fairly....	Used for chisels, etc.
0.88 to 0.62.....	Welds easily....	Used for files, etc.
0.62 to 0.38.....	Welds readily...	Used for rails and tires.
0.38 to 0.15.....	Will not temper.	Used for boiler plate.
0.15 to 0.05.....	Will not temper.	Substitute for iron.

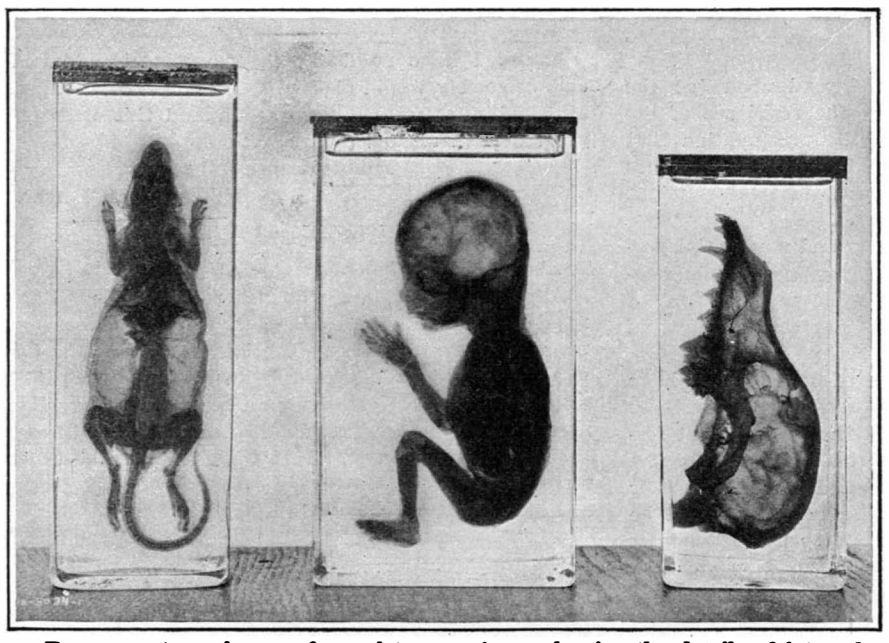
In choosing steel for any purpose it is clear that the information afforded by this table is of value. Thus a crowbar of 1.58 per cent carbon steel, however carefully tempered, would be inferior to one of 0.88 per cent carbon steel, reasonably well tempered. The former would be brittle compared with the latter.

Likewise the content of phosphorus and silicon is of significance. It may be estimated that the effects of phosphorus, carbon and silicon in hardening steel and making it less capable of resisting blows are about in the proportions of 3:2:1.

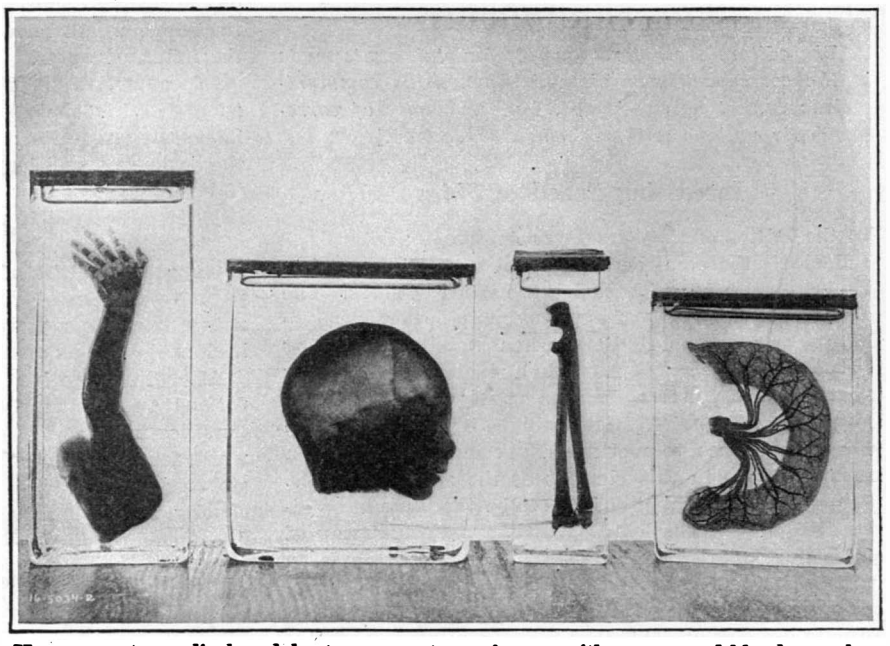
Killing Germs Electrically

A RECENTLY passed Federal law requires a system of drinking water purification to be used on public carriers. An equipment using ultra-violet rays from a mercury vacuum light has proved successful for this work and is being installed on many of the large lake passenger boats. A mercury tube is immersed in a tank or receiver in the water system so that all the water used is at one time or another exposed to the ultra-violet rays from the tube.

Inasmuch as the mercury tubes require 220 volts, direct current, and the lake boats have but 115 volts available, motor generator sets must be provided to operate on 115 volts and provide 220 volts for the lamps. The operation is automatic; if the tubes burn out or the voltage fails, the electrically controlled intake valve of the tank is closed. This is undoubtedly the first time a motor generator set has been used to kill germs.



Transparent specimens of complete organisms, showing the details of internal structure



Human anatomy displayed by transparent specimens, with nerves and blood vessels in distinctive colors

Making Biological Specimens Transparent

A GLASS of cracked ice is quite opaque. But if water be poured in to fill the interstices between the fragments of ice, the combination becomes mildly transparent. Why?

The answer is a simple one. The refraction index of ice is different from that of air. Ice is far from opaque, air is wholly transparent; but in passing through either medium light suffers certain refractions. If we attempt to pass it through a considerable number of alternate thicknesses of ice and air, the combined successive refractions disrupt the light waves completely, and none survives the passage. But if for the air we substitute water, of substantially the same refractive index as the ice, the effect approximates that of a single homogeneous medium, and the light passes through with substantially the simple refraction which it would suffer from such a medium.

Dr. Spolterholtz, of the University of Leipzig, whose major interest lies in the technique of the preparation of biological specimens, recalling the principle on which this induced transparency rests, asked himself whether he could not apply it in his field. He argued that where an ordinary specimen exhibits but one feature of an animal's structure, if all the tissues could be made moderately transparent, a single specimen would suffice to exhibit the entire anatomy of a species, and would show the inter-organic relations in a graphic manner never before possible.

The proposition is not so wild as it seems. Organic matter is far from inherently opaque. There was good ground for the learned doctor to hope that he might resolve the apparent opacity of animal tissues into a matter of refractions, and by some means introduce sufficient homogeneity to apply the analogy of the glass of ice and water. So he attacked the problem with this point of view, and by its solution has established a new school of specimen preservation which has already attained the most startling results.

The method is simplicity itself. The organism to be preserved is treated to a preliminary dehydration similar to that employed for microscope specimens, followed by deflation with an air pump. It is then impregnated with and immersed in a liquid whose refractive index is equal to the average index of the solid matter. At first carbon disulphide was employed for this purpose, mixed with other liquids to afford an adjustable refraction index. This substance is explosive, however; so it has been abandoned in favor of a mixture of methyl ether, salicylic acid, and benzyl benzoate. By varying the proportions of this simple mixture a range of refraction index is obtained quite equal to that of the organisms to be embalmed.

Circular containers are out of the question because of the refraction from the curved surface. Rectangular jars are made of a special glass of variable index, fixed in each case to correspond with that of the contents. These are held in place by suitable supports, and a small air space is left beneath the sealed cover to care for expansion.

The results are extraordinary. Our engravings, while not fully indicating all the shades and tints of the originals, at least give an idea of the degree of transparency. In the case of the mouse it is especially clear that all the creature's internal dispositions are distinctly visible.

It goes without saying that these specimens are far ahead of anything previously developed. Entire human arms and legs are put up by this process, and become clearly transparent, the far side being as distinct as the near one; and at last accounts a jar was being planned to hold an adult human body. The arterial and nervous systems are differentiated by the injection of red and blue fluids of appropriate refraction index; and efforts are under way to develop a workable injection to mark out the nervous system.

At the present time these specimens, like all other articles "made in Germany," are unobtainable here; but the end of the war will doubtless find them still a feature of the German scientific workshops, so that we may expect them to be then available.

Boston's Care of School Children's Teeth

UNLIKE the medical practitioner, the dentist requires a complex equipment in order that he may work effectively. The multiplication of isolated dental units necessitates the duplication of many parts outside the chairs and the instruments of general application. Moreover, no form of professional activity offers more opportunities for the transmission of disease from one patient to another; hence the most rigid asepsis is an essential of dental work. A central plant, where the sterilization of everything that enters a mouth is under the control of an individual whose sole business this is, furnishes a more complete check on infection than the most conscientious divided effort in a multiplicity of small plants can possibly achieve. Then, too, while the physician who devotes two or three hours per day to a public charity feels the income loss slightly if at all, having a large part of the day in which to recoup the time thus spent, the busy dentist who gives of his daylight hours to a charity must take from this a definite loss of income which he cannot make up. On all these grounds a large endowed central dental infirmary is vastly to be preferred to the distribution among hospitals and private dentists of the work which such an organization would properly undertake.

A very interesting foundation of this sort is now under way in Boston. The Forsyth Dental Infirmary for Children is a charity incorporated under the laws of Massachusetts for the purpose of furnishing to the worthy children of Boston that dental care which is more and more being recognized as a fundamental prerequisite of proper physical condition and good mental effort. Its first group of Trustees was made up of leading educators and professional men, together with three competent dentists. The Infirmary has set itself the task of caring for mouth conditions in children under the age of sixteen.

The problem is a large one. About sixty per cent of all school children who are submitted to examination are found to possess defects originating about the mouth, including improper nasal breathing, hypertrophied tonsils, and defective teeth, palate and cervical glands. The trustees of the Forsyth Infirmary have given deep thought to the matter, and have concluded that on all grounds it is wiser and more practicable to bring the children to the dentist than to bring the dentist to the children. The child's time does not begin to be worth as much as the dentist's; and the element of time apparently lost to education can really be ignored, since it is repaid many times in the ultimate outcome.

So the work of the Infirmary was inaugurated by the establishment of a large central dental workshop, in a building constructed for the purpose. At present the equipment comprises sixty-four chairs; but early

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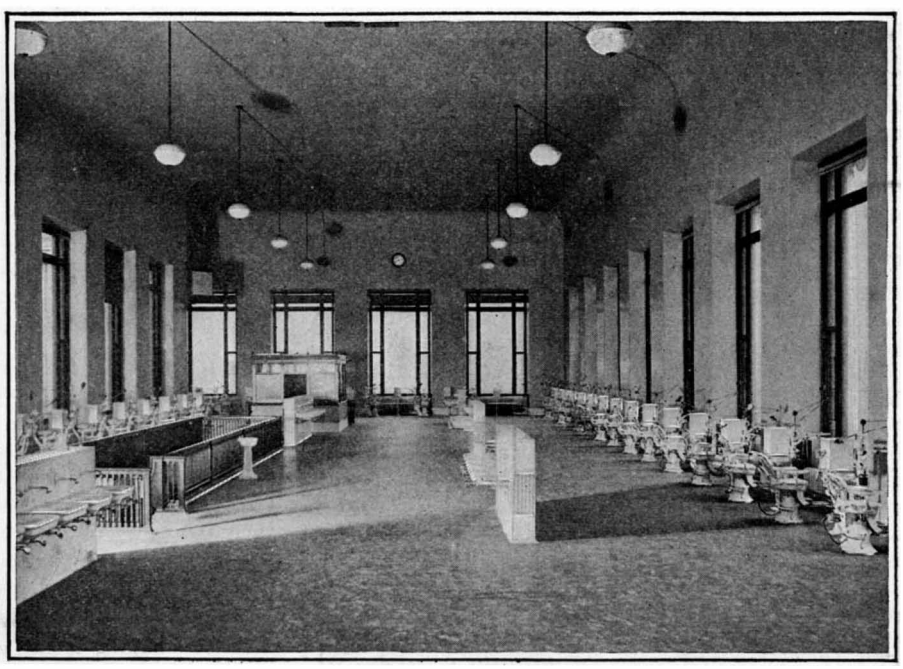
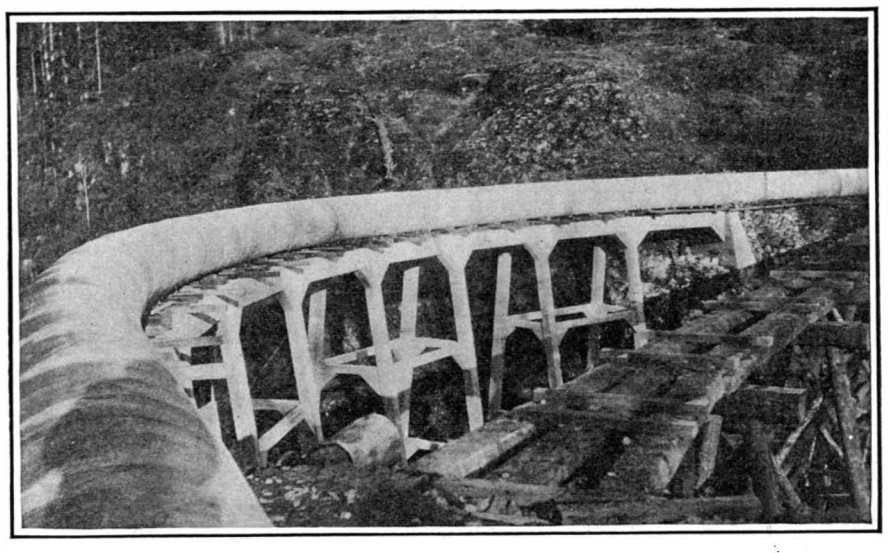
Copyright by Boston Photo News Co.

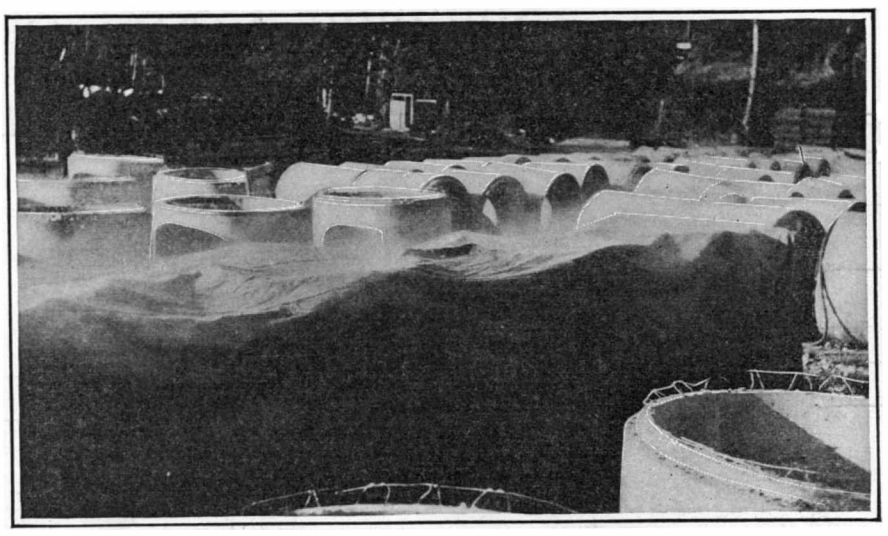
At work in the Forsyth Dental Infirmary



Modern dentistry by wholesale



A section of the finished line, where a deep gully is crossed on a curved trestle



Steaming the concrete pipe sections under tarpaulin covers, to expedite setting

Building a Pipe-Line of Concrete

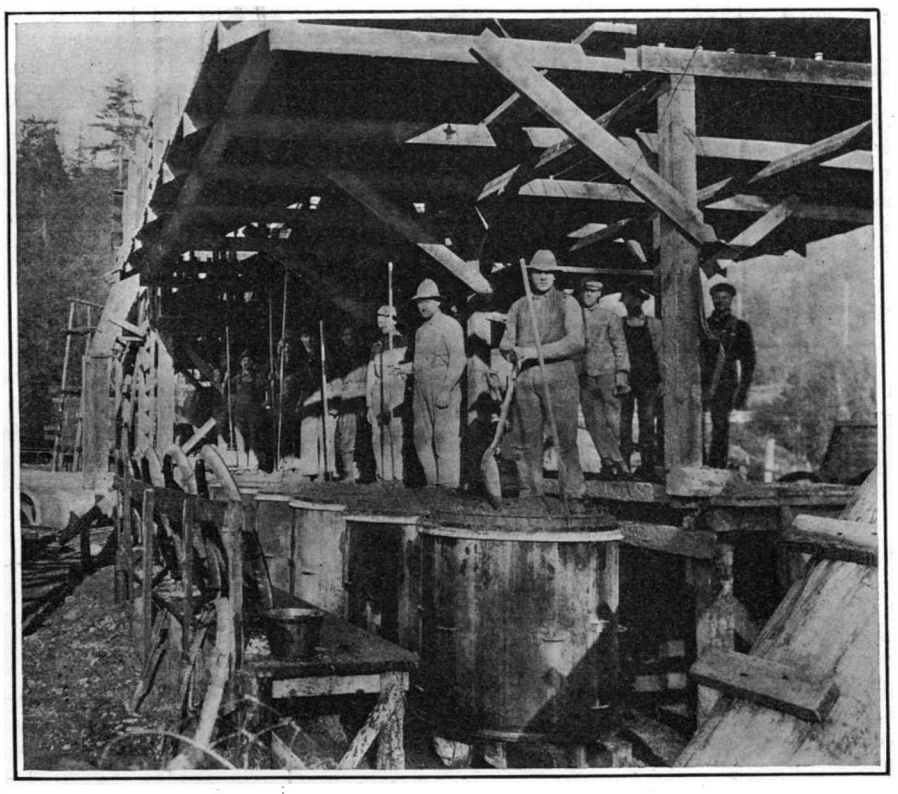
Twenty-Seven Mile Tube Which Indicates a New Field for This Surprising Material

By I. F. Springer

THE city of Victoria, British Columbia, has recently obtained at great expense and effort a needed increase in its water supply. The new supply comes from Sooke Lake, through a conduit or pipe-line 27 miles in length. From a reservoir formed by raising the level of the lake 12 feet, water is delivered to a concrete pipe laid on a grade averaging one in one thousand, which in turn discharges into the city reservoir. It is understood that the supply thus provided amounts to some 21,000,000 gallons per day.

Of all the features connected with the undertaking, the concrete pipe-line is undoubtedly the most interesting. The line is 27 miles long; the pipe has a diameter of 42 inches; and there are places where the water in the pipe has behind it very considerable heads, running as high as 90 feet. The pressure corresponding to a head of 90 feet is 39 pounds per square inch. At the capacity of concrete to resist the bursting action of such pressures we need feel no surprise; but that it should be sufficiently impermeable to endure continuously such a pressure without serious seepage is an engineering fact of significance.

Another item of importance is the general omission of expansion joints. The coefficient of linear expansion of concrete is about 0.000008 per Fahrenheit degree. This means that a piece of concrete 1,000 feet long will increase in length 1 inch for each 13 degree rise in the thermometer. The internal force exercised in expansion and contraction is doubtless of enormous magnitude. Whatever its strength, we may of course resist it with a greater force; but what then will happen within the material? If, however, the material is free to expand and contract along two directions but not along the third, it is possible that with bodies of simple form there will be in general an adjustment leading to no disastrous results. It is probably by virtue of such action that the Victoria pipe-line seems so far to be meeting, without serious difficulty, all the demands of longitudinal expansion and contraction.



Pouring and tamping the concrete pipe sections, with the forms resting on flat cars

The manufacture of 27 miles of concrete pipe is no small matter under the most favorable conditions. In the present case, the work was done in a wild region to which materials and appliances had laboriously to be brought. A rather crude method of forcing the concrete to set, which was tried in order to expedite the work, had to be abandoned. The freshly cast sections of pipe were subject to contact with steam, with the idea of hastening the setting. It is probable that the poor results here attained should be attributed to the inadequacy of the canvas jacket employed to house the concrete for the steam bath, rather than to inapplicability of the method itself, which was later employed successfully in a modified form.

The pipe was made of 1:2:4 concrete, the gravel employed as coarse aggregate being limited to a maximum size of one half inch. The sections were cast with the axis vertical. Naturally, with this method the lower end is under the pressure of the concrete above, while the upper end is subject to little or none. At Philadelphia, tests made on pipe thus cast showed a difference in permeability between the upper and lower ends. At Victoria hand tamping was freely employed in the casting; and to this fact, and to the extreme care used in the production of the cement itself, we must attribute what appears to be the successful casting of impermeable pipe. It is obvious that the opportunity for effective tamping is far greater with vertical molding than with horizontal; and this example indicates further that such opportunity is sufficient to make this type of construction perfectly trustworthy in every way.

The sections destined for that portion of the line where the water would be under little or no head were 3 inches in thickness, while in those to be used for the inverted siphons this was increased to 4½ inches. The standard length of the pipe sections throughout the line was 4 feet. The non-pressure sections were reinforced with a triangular mesh of ordinary commercial form, supplying, in one linear foot of pipe shell, .043 square inch of material in cross sectional area and .025 square inch in longitudinal section. In the case of the pressure sections, square steel bars were employed as circumferential reinforcement. The variations in the weight of this reinforcement called for by the different heads of water to be supported in the different parts of the line were secured by varying the spacing and the size of these rods. Longitudinal reinforcement consisted of similar bars. To prevent the ring bars from shifting during the tamping operation light longitudinal wires were used in spacing them.

The casting of the enormous number of sections was a big undertaking, requiring a large number of forms and an extensive curing yard. For the non-pressure sections 75 sets of forms with 216 bases were provided; for the pressure sections, 12 sets of forms with 32 bases. It is obvious that here is a case where wooden forms will advantageously be replaced by metal. Each form consisted therefore of four equal steel segments making up the inner cylindrical shell, and three equal segments for the exterior. These segments were held together at the seams by the overlap and by angle bar clamps. The

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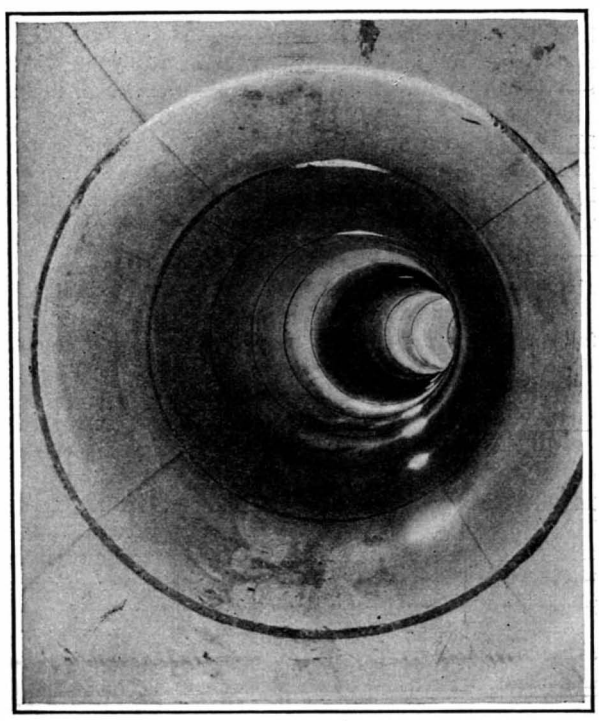
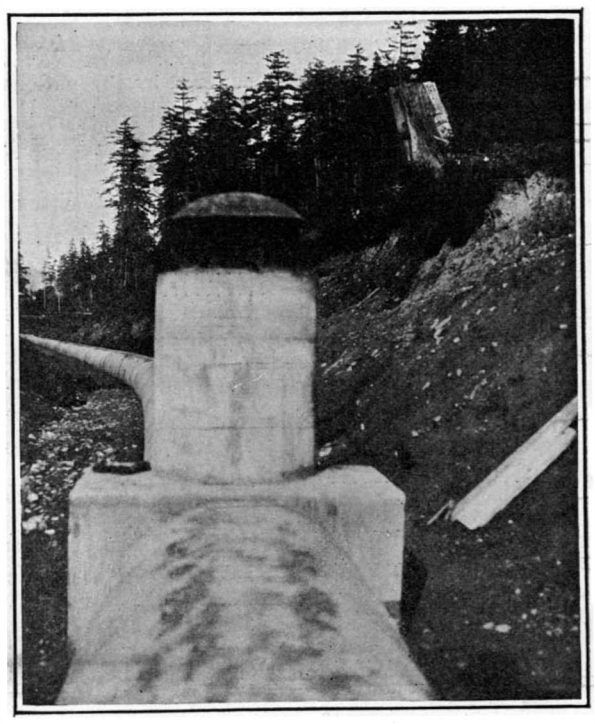


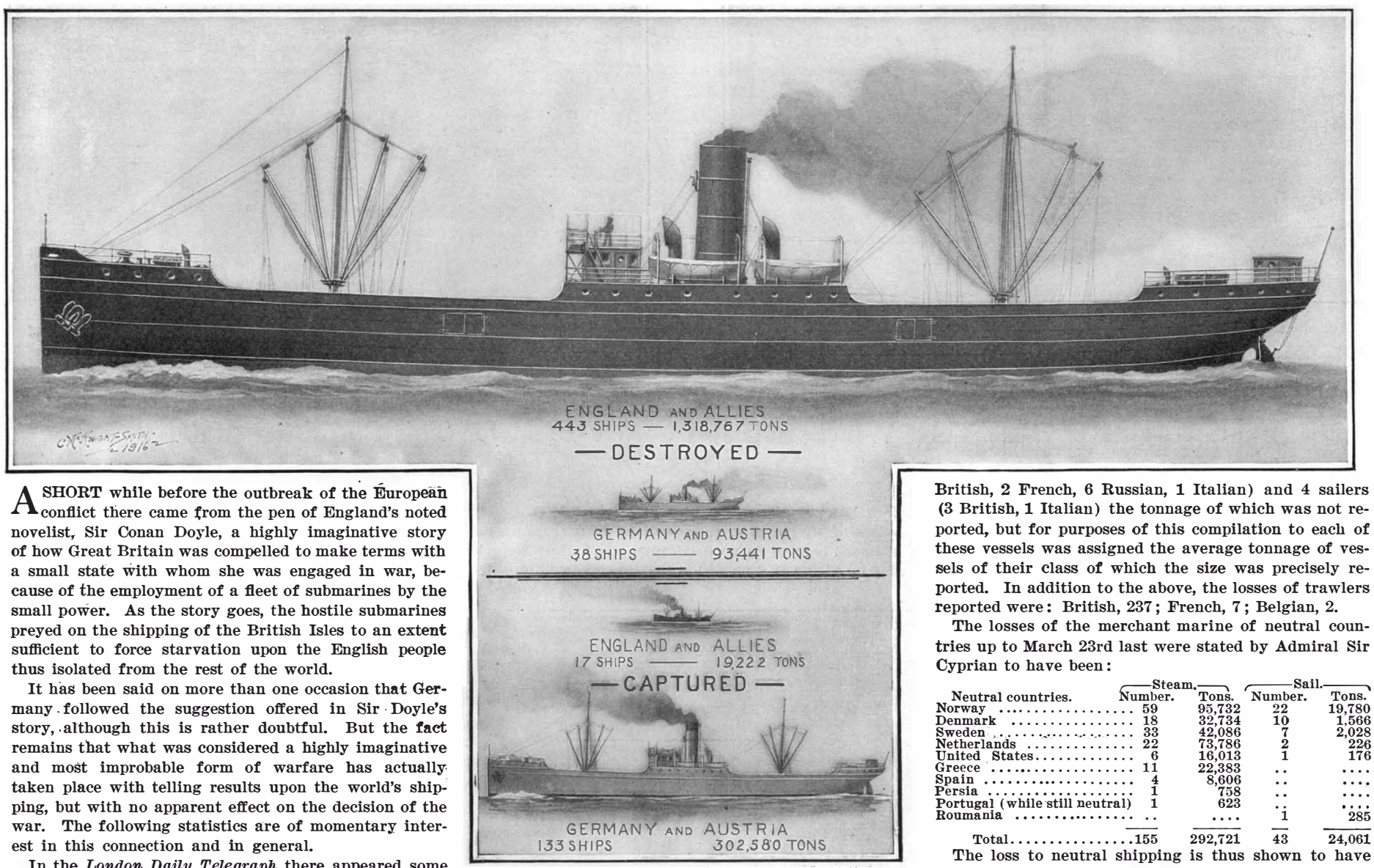
Inside the big concrete pipe. Diameter, 42 inches



The pipe-line in a deep cut, showing manhole

Shipping Losses of the Warring Nations

What the European War is Costing the Belligerents in Merchant Vessels Sunk and Captured



A graphic comparison of the losses in merchant ships suffered by both groups of European belligerents, up to January 22nd last

A SHORT while before the outbreak of the European conflict there came from the pen of England's noted novelist, Sir Conan Doyle, a highly imaginative story of how Great Britain was compelled to make terms with a small state with whom she was engaged in war, because of the employment of a fleet of submarines by the small power. As the story goes, the hostile submarines preyed on the shipping of the British Isles to an extent sufficient to force starvation upon the English people thus isolated from the rest of the world.

It has been said on more than one occasion that Germany followed the suggestion offered in Sir Doyle's story, although this is rather doubtful. But the fact remains that what was considered a highly imaginative and most improbable form of warfare has actually taken place with telling results upon the world's shipping, but with no apparent effect on the decision of the war. The following statistics are of momentary interest in this connection and in general.

In the *London Daily Telegraph* there appeared some months ago a statement by Archibald Hurd on the shipping losses in the present war, which was compiled from material furnished by the secretary of Lloyd's, who is now in charge of the daily issuing of Lloyd's List. The record includes statistics brought down to date of January 22nd, 1916, and the following table lists the ships of every nationality which have been detained, captured, or destroyed to that date:

Nationality.	Number.	Tonnage.
British	485	1,506,415
Allied	167	282,178
German	601	1,276,590
Austrian	80	267,664
Turkish	124	Uncertain
Neutral	736	441,472
Total	2,193	*3,774,319

* Excluding Turkey

These totals emphasize the serious handicap under which the world's carrying trade is now being conducted.

The following table shows the details with respect to British merchant shipping:

Particulars.	Number.	Tonnage.
Detained in German ports on outbreak of war	80	170,603
Detained in Turkish ports	9	12,496
Captured and sunk by enemy	56	234,589
Captured by enemy	3	9,111
Sunk by submarines	225	746,468
Damaged by submarines	27	129,281
Sunk by mines or explosion	53	103,548
Damaged by mines or explosion	28	94,191
Damaged by aircraft	4	5,128
Total	485	1,505,415

The merchant shipping losses suffered by the nations allied with Great Britain are listed as follows:

Particulars.	Number.	Tonnage.
Detained in enemy ports	37	23,481
Captured and sunk by enemy	15	38,161
Captured by enemy	14	10,111
Sunk by submarines	73	178,562
Damaged by submarines	5	11,558
Sunk by mines or explosion	21	17,439
Damaged by mines or explosion	1	2,866
Sunk by air craft	1	.....
Total	167	282,178

There is also appended the following table of the losses of German and Austrian shipping:

Particulars.	German. Number.	German. Tonnage.	Austrian. Number.	Austrian. Tonnage.
Detained in British ports on the outbreak of war	70	84,716	13	37,929
Detained in overseas British ports	90(a)	134,808	7	28,056
Seized on entering British ports	23	95,279	..	.....
Detained in Egyptian ports	18	85,038	3	11,629
Captured in German colonial ports	28	68,870	..	.....
Captured and sunk by British	9	31,424	1	2,223
Captured by British	74	189,402	7	32,688
Detained in Belgian ports	89	163,171	2	5,873
Detained in French and Russian ports	95	142,936	14	48,464
Detained in Italian ports	36	153,866	23	79,777
Captured and sunk by allies	5	6,456	1	1,006
Sunk by submarine	20	49,480	..	.....
Damaged by submarine	9	20,755	1	3,125
Sunk by mine or explosion	4	6,081	4	3,468
Captured by allies	31	44,308	4	13,426
Total	601	1,276,590	80	267,664

(a) Including lighters, tugs, scows, etc.

The statement is also made that Turkey has suffered in its shipping in various ways to the number of 124 ships, the total tonnage of which, however, is uncertain.

Reference is made to the heavy toll which neutral states have suffered, in spite of the fact that they are merely spectators of the war. There follows a list of these losses:

Particulars.	Number.	Tonnage.
Captured by British	40	80,617
Captured by allies	12	18,216
Captured and sunk by Teutons	6	11,259
Captured by Teutons	469(a)	.....
Sunk by submarines	92(b)	122,182
Damaged by submarines	9	24,734
Sunk by mine or explosion	94	125,446
Damaged by mines or explosion	14	59,018
Total	736	441,472

(a) Many of these have since been released. Their nationalities were as follows: Swedish, 346; Norwegian, 57; Danish, 41; Dutch, 15; American, 6; Greek, 4.

(b) Of these, 91 are stated to have been sunk by German submarines and 1 by an Austrian. In two cases the nationality is not stated.

Mr. Hurd, in commenting on these statistics, states that the assembly of figures goes some way to explain why to-day there is a shortage of merchant tonnage. To this record of detention, capture, and destruction let there be added the extent to which the Allies have had to requisition shipping for naval and military purposes and the number of German and Austrian vessels shut into neutral ports, and some conception can be formed of the grave effect of the war on the carrying trade of the world.

In a communication to the London *Times*, Admiral Sir Cyprian A. G. Bridge, R. N., presents a statement of the merchant-shipping losses of the Allies and neutral countries, due to the war, covering the period from the outbreak of hostilities down to March 23rd, 1916. His figures for the Allies are:

Allies.	Losses. Number.	Losses. Tons.	Total merchant marine of the country. Number.	Total merchant marine of the country. Tons.
Steam.				
British	379	1,320,171	10,218	20,830,918
French	41	139,865	1,016	1,909,609
Belgian	10	29,861	....	.....
Russian	27	42,226	744	851,951
Italian	21	70,231	655	1,513,631
Japanese	3	19,267	1,155	1,826,068
Total	481	1,621,621	*13,788	*26,932,177
Sail.				
British	31	19,119	1,135	443,150
French	12	18,323	523	376,119
Russian	8	7,463	512	202,511
Italian	6	3,373	522	222,914
Total	57	48,278	2,692	1,244,694
Grand total	538	1,669,899	*16,480	*28,176,871

* Exclusive of Belgium.

Included in the foregoing table are 12 steamers (3 British, 2 French, 6 Russian, 1 Italian) and 4 sailers (3 British, 1 Italian) the tonnage of which was not reported, but for purposes of this compilation to each of these vessels was assigned the average tonnage of vessels of their class of which the size was precisely reported. In addition to the above, the losses of trawlers reported were: British, 237; French, 7; Belgian, 2.

The losses of the merchant marine of neutral countries up to March 23rd last were stated by Admiral Sir Cyprian to have been:

Neutral countries.	Steam. Number.	Steam. Tons.	Sail. Number.	Sail. Tons.
Norway	59	95,732	22	19,780
Denmark	18	32,734	10	1,566
Sweden	33	42,086	7	2,028
Netherlands	22	73,786	2	226
United States	6	16,013	1	176
Greece	11	22,383	..	....
Spain	4	8,606	..	....
Persia	1	758	..	....
Portugal (while still neutral)	1	623	..	....
Roumania	..	....	1	285
Total	155	292,721	43	24,061

The loss to neutral shipping is thus shown to have been 198 vessels of 316,782 tons. These totals include 1 Dutch, 2 Norwegian, and 5 Danish sailers, the tonnage of which was not reported, but to each of these vessels has been assigned the average tonnage of the sailing vessels of which the size was precisely stated. The losses of neutral nations in trawlers were 1 Danish and 7 Dutch.

Continuing his discussion of the merchant shipping situation, Admiral Sir Cyprian states:

The loss inflicted on the steam shipping of the British Empire down to the 23rd of March—that is to say, in nearly 19 months of war—amounts to less than 4 per cent of the number of vessels and a little more than 6 per cent of the tonnage. The French loss in steamers amounts to a little more than 4 per cent in number and to rather more than 7 per cent in tonnage; the Russian to less than 3¾ per cent in number and less than 5 per cent in tonnage; the Italian, nearly 3¼ per cent in number and over 4½ per cent in tonnage.

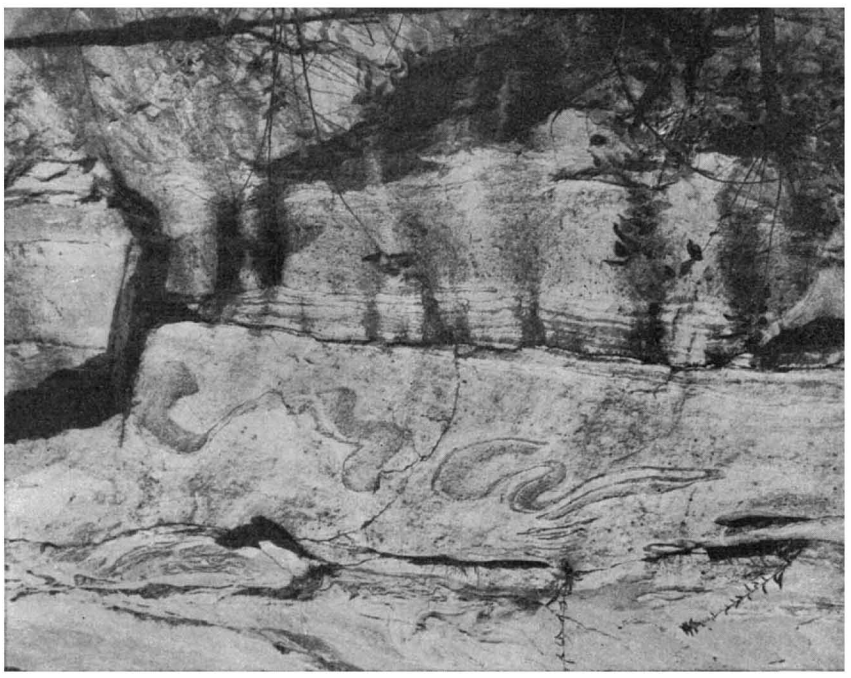
It is known that in the belligerent countries commercial shipbuilding has been largely superseded by building for the purposes of the war, so that the ordinary annual casualties of peace time would seem unlikely to be made up. To think so would be to fall into error. In 1915, after more than 12 months of war, the steam shipping of the United Kingdom increased by 88 vessels and 343,616 tons. France, though 41 of its steamers (139,865 tons) had been destroyed, was at the end of 1915 only 9 steamers and 12,574 tons short of the figures of 1914. The Russian steamers diminished in number by 3, but increased in tonnage by 902. In Italy there was an increase of 18 steamers and of 83,156 tons.

Electric Appliances in Venezuela

ON account of the fact that coal is not now obtainable there at a reasonable price, and that wood fuel is uncertain—it is almost impossible to cut it during the rainy season—the owners of sawmills, grist mills, hat factories, bakeries, printing establishments, and numerous other small industries in Venezuela have shown increasing interest in electric power and heating devices since the electric company has decided to supply power during the day. There is a good opening for all kinds of electrical appliances for domestic and industrial use, such as fans, stoves, irons, large ovens for bakeries, motor-driven pumping outfits for private houses, motors of 1 to 25 horse-power, etc.

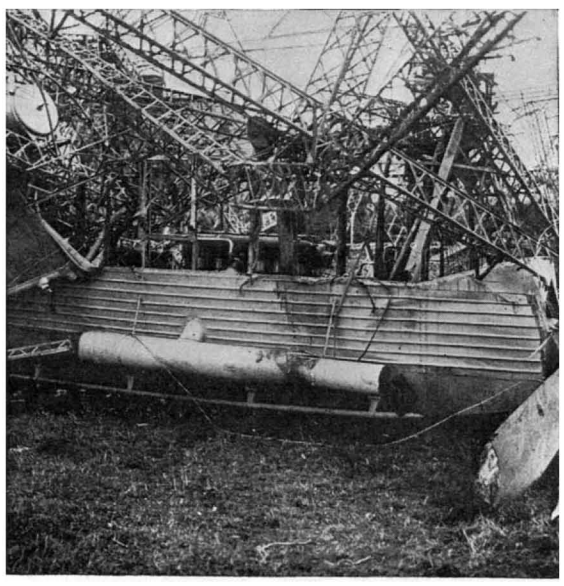
The Maracaibo Electric Light Company will be pleased to receive catalogues and prices of all these lines, and will order through New York commission houses. To get orders in this market, prices must be given in the first correspondence.

TOO many accidents occur annually as a result of the operation of heavy motor trucks in the crowded streets of large cities. It is to reduce this class of casualties that this motor truck fender has been developed, and it has lately been officially tested and approved by the engineers and safety-device experts of the New York Public Service Commission. Here it is seen picking up a life-sized dummy of a man during a test, with apparent gentleness.



ON the surface of a great rock on an uptown street just off Broadway in New York city appears a snake-like imprint which has attracted widespread attention as a fossil. But the geologist is forced to reject this marking as a fossil. He attributes the marking to the extensive crumbling and upheaval of rock during the Taconic Revolution, that caused the sides of many rocks to buckle or fold, and it is these folds that have assumed different shapes in geological history, as in the instance of this most unusual snake-like marking.

PICTORIAL NOTES



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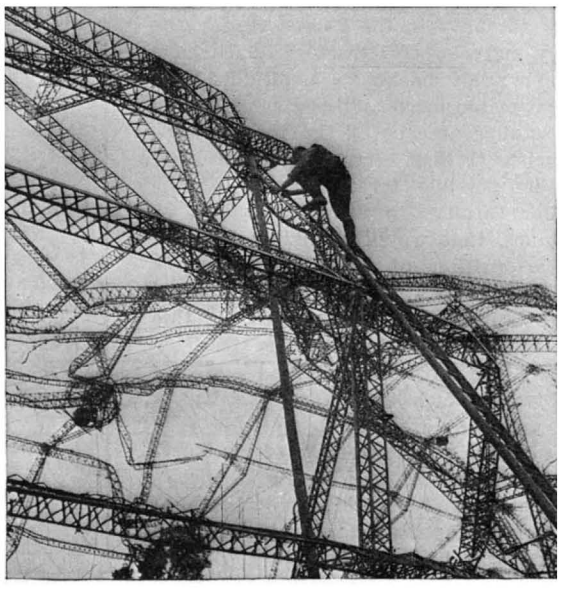
ONE of the gondolas of the Zeppelin which was brought down at Mangold, Essex County, England, on September 23rd last, as a result of effective anti-aircraft gunfire. In the gondola may be seen one of the powerful engines carried by the Zeppelin, with its exhaust pipe running along the side of the body. The end of a propeller blade appears at the lower right-hand corner.

Copyright Underwood & Underwood

MORE modern than its appearance would indicate, this French trench mortar or *crapouillot* is employed in hurling heavy projectiles or bombs into nearby enemy trenches. Crude as this artillery piece is, it is recognized as one of the most deadly war machines. This particular mortar is far heavier than the usual run of trench artillery.



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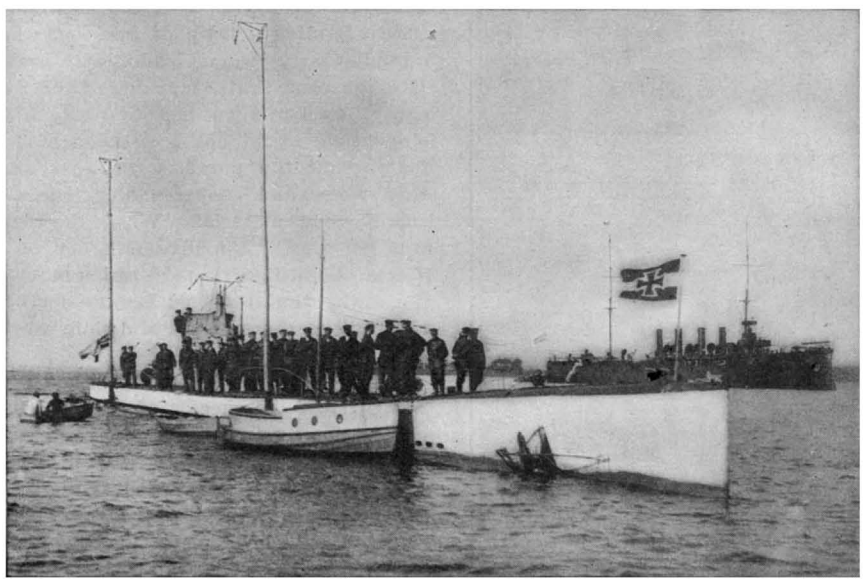
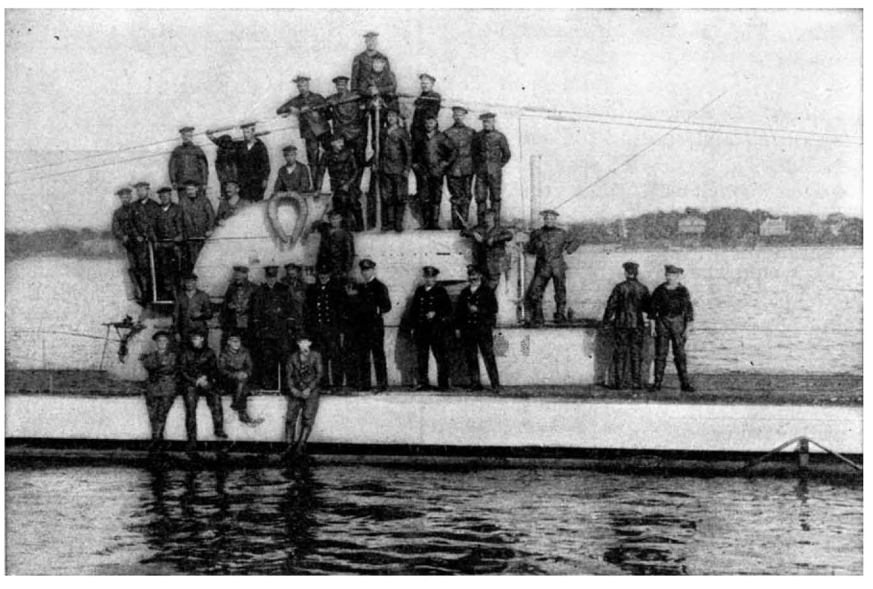
ANOTHER view of the Zeppelin brought down in England on September 23rd, showing a small portion of the huge skeleton of twisted metal which remained after the airship plunged to the earth in a mass of flames. Some idea of the size of the Zeppelin framework is offered by comparison with the mechanic who is climbing up the step-ladder, as well as with the treetops below.





Copyright International Film Service

ENTIRELY unexpected was the sudden appearance of the German submarine "U-53" in Newport Harbor on Saturday, October 7th. The craft put out to sea again immediately after her captain had delivered a letter addressed to the German Ambassador. Then followed the activities of the German U-boats off our coasts, in which the "U-53" probably took part, assisted by one or more German submarines. In these two views appear the German visitor at Newport, and her intrepid crew. The "U-53" is apparently one of the most recently-built craft of Germany's underwater fleet.

The Motor-driven Commercial Vehicle

Conducted by VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Small Motor Plows

THE probable influence of the European war with its withdrawal of several millions of men and hundreds of thousands of horses from the ranks of the agricultural workers on the future demand for agrimotors and motor trucks has been previously discussed in these columns. It is evident that the belligerent nations, especially those in which agriculture forms one of the main industries, must supply the deficiency in live stock with motor-propelled machinery and must compensate for the lack of skilled human workers by the use of special appliances that will permit one man to do the work of several. Authorities concede that there will be a large demand created for motor plows and other machinery used in agriculture and that American manufacturers of such appliances will be called upon to supply most of the tools and motors needed at the conclusion of hostilities and during that period where the manufacturing industries of the various countries must be reorganized.

Inasmuch as many of the European farmers operate farms that are looked upon as very small when compared to many we have in the United States, the heavy and powerful tractors which have found a ready market in our Middle West are much too large and costly for use on the smaller acreage of the foreign agriculturist. It has been suggested that it will be possible for a number of the smaller farmers to form syndicates, or combines, that would be able to finance the acquisition of such machinery as could not be readily purchased from the limited funds of the individual. In this way, it is argued, these groups could obtain all the advantages of the powerful machinery which heretofore has had a field and proved profitable only on very large estates. The attention of the European designer will undoubtedly be turned toward the smaller working units as these can be manufactured cheaply because the demand will be such that they will be built in quantities.

A considerable number of motor plowing machines that are intended to meet the demand of the small farmer have been devised abroad. This, of course, is a much better solution of the agricultural machinery problem than the syndicate method. When a group of farmers in one neighborhood purchases machinery in common there is one factor that the idealist does not take into account. This is a practical consideration that cannot fail to mar the success of the group plan of ownership. The various processes incidental to preparing the ground for the reception of the seed must take place at certain times. In fact, the most favorable time for tilling and seeding the soil may be included in a very brief space of several weeks. Obviously when the machinery is owned by a syndicate, each member of which would be entitled to its use, some would have to start early while others would have to wait until the more fortunate ones had been able to do their work. This means that only a few of the group owning the machinery, all of whom are presumably entitled to the same rights, have really had access to it at the favorable season.

An illustration presented herewith shows the side elevation and plan view of a small motor plow of English design, which is intended for the agriculturist in moderate circumstances. It is not only a type that could be manufactured economically, but that could be operated at small expense. Machinery for the average small farm need not have a large capacity as it would be called upon to replace not more than four horses, in fact, keeping four animals might prove to be a burden for many small farmers. The machine has a single cylinder internal combustion motor of about nine horse-power as a power plant, the propulsive energy being transmitted through a two-speed gear box. The drive is by chain to a jack shaft and from that member to the wheel shaft through the medium of sliding gears. In order to permit either wheel to overrun the other for directive purposes or to drive either wheel alone clutches are provided. The control lever for these movements are found on the plow handles which the operator grasps when walking. As it is sometimes necessary to have one wheel run in the furrow while the other is on firm land, each wheel is mounted on an arm capable of movement around the driving pinion. The wheel on the right side is guided by means of an irreversible screw

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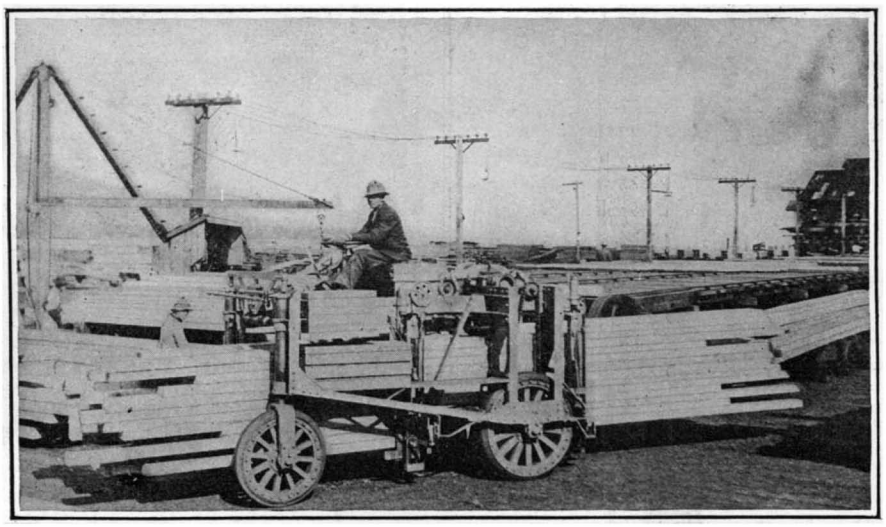
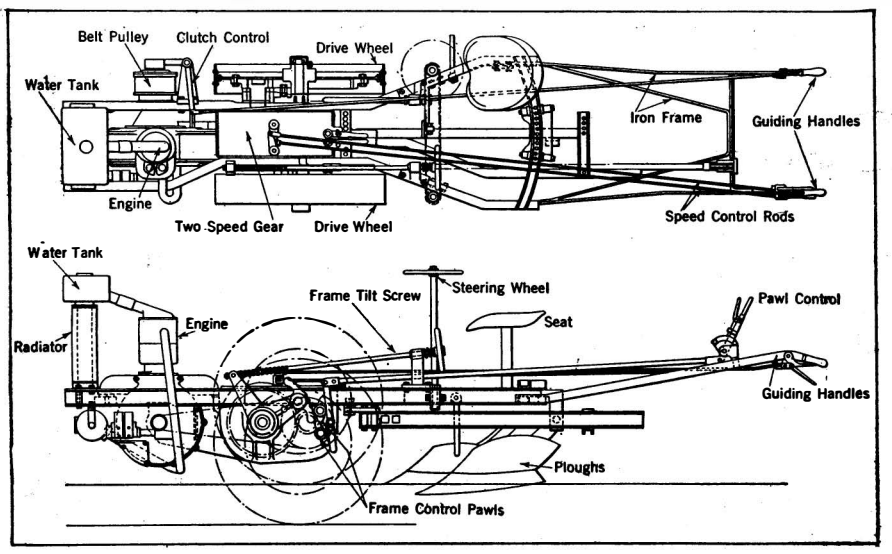
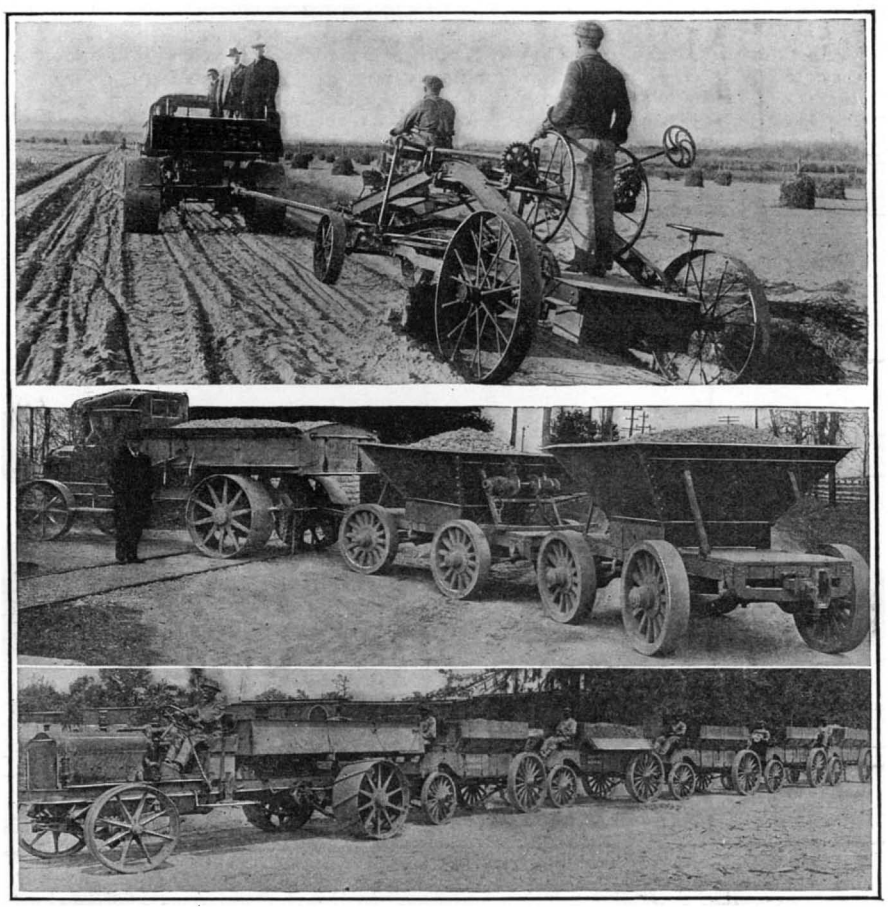


Special purpose truck of unconventional design that moves large piles of lumber



Plan view and side elevation of small motor plow of English design



Three phases in road-building, showing how the truck-tractor may be used in highway construction

In the first view the truck-tractor is hauling a road scraper. In the second view it is hauling two heavy trailers, loaded with road material. In the third view it is seen hauling five ordinary wagons loaded with road-building gravel. The truck-tractor has a d awbar pull equal to about 30 horses

Truck Tractor for Highway Construction

THE greatly augmenting use of automobiles in all parts of the country has created new problems of highway construction and maintenance that severely tax the capacity of the average small town supervisor of roads. As a rule, the utility of mechanical traction is well recognized, but funds are not always available for the purchase of road rollers and motor trucks for hauling the materials for construction. A special form of truck tractor has been devised, which combines in one machine a very satisfactory load carrying capacity in its own wagon body and sufficient draw bar pull to haul all forms of road making machinery or trailers carrying crushed stone, gravel and other materials used in highway building. This truck tractor is built on the same plan as the 5-ton chassis made by the same firm and is similar in power plant equipment, change speed gearing and means of final drive. Special wheels are provided, however, having broad tires of steel. The rear wheels are especially wide in order that they may have a rolling action on the road. Holes are provided in the rear wheel rims so that grouters may be attached for tearing up roads or cleats or traction lugs fitted to increase the adhesion when it is driven on unfavorable highways.

The machine is provided with a special type of draw-bar, which permits of obtaining either a side draft, as is necessary when hauling a road scraper as shown in the upper view, or for the central pull needed when trailers are being hauled. This machine, which has a 60 horse-power engine has an effective draw-bar pull equal to about 30 horses even when it is loaded to capacity. In the center illustration of the group it is shown loaded with road material and is hauling two trailers of large capacity loaded with similar material. In the lower view, the machine is shown hauling a train of five four-wheel dumping body wagons loaded with gravel. It is apparent that a machine of this type can be used to advantage by many townships that would not have enough work to warrant the purchase of a separate road roller and enough motor trucks to supply road material. When the truck was not used for road making purposes, it could be utilized in performing many of the duties that come within the jurisdiction of the department of public works.

Special Vehicle for Lumber Yard

MUCH of the success of the American business man is due to his progressiveness and his readiness to adopt new and money saving devices, even if they are unconventional in appearance. A special power-propelled vehicle of unconventional appearance that has been designed by a Michigan concern to facilitate the movement of lumber in the large lumber yards which abound in that state and neighboring ones is illustrated. As will be evident, it is radically different from the types ordinarily used for industrial purposes because the load, which is carried above

(*Concluded on page* 377)

Building a Pipe-Line of Concrete

(*Concluded from page* 371)

sections were poured with bell end down. As the sheet steel of the forms was only three sixteenths inch thick, more or less trouble was experienced at the beginning from springing at the seams. After considerable experimenting, light wood cross braces set in the annular space between the shells at the seam locations were found to solve the problem. The exact distance between shells at the top was maintained by bent spacing hooks, which were removed later on, before the steaming process. In order to provide for curves, the spigot ends of the pipe sections were beveled off slightly.

The steaming procedure ultimately adopted necessitated two steaming sheds. In the one the pipe sections were steamed for three hours with the forms on; in the other, for four hours with the forms off. A cleverly laid out railway line connected the various units of the pouring and steaming plant. The empty molds were loaded upon short trains of flat cars and circulated through the buildings, all operations being performed without moving them from their places on the cars. This road was so disposed that the train-load of finished pipe sections was returned for unloading to the same platform at which the steel forms had been removed after the first steaming; and these were then replaced upon the cars and shunted back to the pouring shed with a minimum expenditure of time, labor and motive power.

The work of pouring was done very expeditiously from a circular disk of steel arranged on the top of each form to cover the interior opening of the inner shell. The man who did the tamping stood on this cover, which likewise served as a platform upon which the concrete was dumped, to be then shoved into the annular space between the shells. The steaming was done under huge tarpaulins, covering an entire car.

As is well known, steel and concrete adhere strongly. It was therefore very essential to provide for the easy removal of the forms. For this purpose, the forms were greased with a half-and-half mixture of green "skid-oil" and black oil. In the words of the resident engineer who developed this mixture, it must be "thin enough but not too fluid"; a formula strongly suggesting Mrs. Ruggles' celebrated "about once every so often."

After a minimum period of two weeks for curing, the sections were taken out along the line of the pipe and laid in their places. An overhead trolley system for this purpose was rather unsatisfactory, doubtless because of the many curves. A tripod made from iron piping proved more successful, and was used, in connection with a chain block to lift and lower the shells, alike on tangents and curves. The joints between sections were made by pouring cement grout. Both bell and spigot ends were provided with extensions of the wire reinforcing mesh, and these were involved in the grout placed in the joint. An entirely tight and satisfactory junction was thus obtained.

Bringing Scientific Methods to the Dairy of To-Day

(*Continued from page* 367)

seed meals. The roughage cart is pushed through the double doors at the end of the alley where it is automatically filled when the silage is thrown out of the silo. It is then pushed along the alley in front of the cows where it is unloaded, the feeder giving each cow as much as she desires. He carefully observes how many pounds she will clean up each time; and when it has been determined by this means that the cow will take 33 pounds daily, that becomes her allowance and is recorded as such.

The same method is pursued with the concentrates, except that as each animal shows a distinct appetite for a different mixture, the feeder experiments until he gets just what the cow likes. This mixture is then recorded and delivered to her daily. If for any reason, one of the feeds

(*Concluded on page* 376)

cannot be procured, another one is substituted in its place and the amount of substitute given is charged up against the cow in lieu of that which was taken away.

In order that readers may see how expert dairymen compute the value of each of their cows, the following specimen of a single account is given:

1915 Year-Summary.

Cow—Matilda's Jenny 9th—Eight Years Old.

RECEIPTS.

12,561 lbs. of 4.2% milk or 527.56 lbs. butterfat @ 29c	$158.27
Heifer calf born October 12th, 1915	100.00
Total	$258.27

EXPENSES.

Feed and Bedding:	
2 T. alfalfa hay @ $15	$30.00
10,752 lbs. corn silage @ $4.50 per T.	24.19
612 lbs. cottonseed meal @ 1.4c.	8.57
174 lbs. linseed meal @ 1.7c.	2.96
65½ bu. oats @ 42c	27.51
756 lbs. corn meal @ 1.2c	9.07
648 lbs. bran @ 1.1c	7.13
50 bu. carrots @ 40c	20.00
2 T. wheat straw @ $6	12.00
Total	$141.43
Investment and Depreciation Charges:	
6% interest on $250 investment	$15.00
12½% depreciation in value of cow	28.75
Depreciation of barns and equipment used	15.00
Total cost	$200.18
Receipts	258.27
Net profit	$58.09

In the account with this animal, the manure was taken as being equal in value to the care of the cow, therefore the two were equalized and neither item placed in the account. An arbitrary sum is charged for depreciation of barns and equipment, this being based upon the probable life of the barns and equipment. This would, of course, vary with the cost of the barn and the number of cattle kept therein but there should be a limit beyond which the cow could not be charged for this item. Obviously, she should not be asked to pay for fancy buildings or added fixtures that have no value in connection with her work. The sire used was worked—he earned his keep, so no service fee was charged. A charge of ten dollars as a service fee against the cow would decrease the net profit to forty-eight dollars and nine cents.

After all, the milk record, the feed record, the Babcock test—these constitute the jury before which the dairy cow must rest her fate. Failing to satisfy the jurymen by showing a neat sum on the profit side of the ledger, her course lies in a direct line to the canning establishment.

Small Motor Plows

(*Continued from page 374*)

and nut steering gear actuated by the usual hand wheel.

When turning the machine around at the end of a furrow the entire frame structure of the machine must be lifted on the left side in order to prevent the two plowshares with which the machine is provided from sticking into the ground and impeding the action while the turn is being made. A special lifting arrangement has been devised for this purpose. This consists of a double set of ratchet teeth on an extension of the radial arm to which the left traction wheel is attached. Two pawls are operated by a single lever so that one is engaged while the other is released. When the upper pawl is disengaged the frame falls to the required position by gravity. The depth of the plowing is set by the hand wheel and screw provided for the purpose. At the end of the furrow the control lever is thrown over so that the upper pawl is released. The pressure of the teeth engaging with the gear ring of the traction wheel is sufficient to raise the frame as the driving pinion climbs around the gear ring. The movement of the lever necessary to release the upper pawl permits the lower one to fall in place and hold the frame in its elevated

(*Concluded on page 377*)

position while the turn is being made. The plowshares are lifted to the surface of the ground in this manner without stopping the machine.

It is possible to control the speed of each wheel by means of the clutches provided for the purpose so that the plow can be swung around using one wheel as a pivot. The machine may be operated in two ways: the plowman may ride on the seat and control the machine through a duplicate set of levers convenient to the seat, or he may walk at the back of the machine with his hands on the plow handles just as though a horse-drawn plow was used to turn over the soil. The motor, a water cooled type, employing a thermo-syphon cooling system, is provided with magneto ignition and with a conventional form of gasoline carbureting device. An extension of the crankshaft carries a belt pulley at the side of the frame so that the power of the motor may be utilized when desired for running such light machinery as would require no more than eight or nine horsepower. As the machine is equipped with two plows it is evident that it has the same pulling ability as four horses would have. In this respect the machine follows the general rule of having a draw-bar horse-power of about half the value of the belt horse-power. As the speed of the machine is not more than 2 miles per hour when plowing, it will be evident that the plowman will not have to exert himself unduly when he guides the machine by walking behind it.

Special Vehicle for Lumber Yard

(*Concluded from page* 374)

the chassis in most trucks, is in this case suspended below the mechanism. When running without a load, this machine looks as though the usual automobile running gear and the propulsive mechanism were carried on large stilts, provided with wheels at the lower end. It is built in this way so that it can be driven astride a pile of lumber, pick up its load and deposit it at any desired point in the yard. The load is raised and lowered by a special winch arrangement working in connection with suitable lifting mechanism.

As an example of the ingenious way in which the problems of design have been met attention is directed to the mounting of the front wheels in fork members similar to those employed on bicycles. Each wheel is carried in a dirigible fork mounted in the steering head. In fact, the arrangement in the front of the frame looks very much like that of a bicycle when viewed from the side. The two forks are joined together at the upper end where they project through the steering head by a link so that they are turned in conjunction by the hand wheel for steering the vehicle. The driving motor is carried at the rear of the driver and above the load. Its power is transmitted to the rear wheels by chains running over suitable sprockets. The machine is substantially built of structural iron and is readily controlled by one man. Levers for raising and lowering the load and for regulating the speed are conveniently placed at the driver's right.

Experiments in the Rearing of Blue Foxes

AN arrangement has been made between the Bureau of Fisheries and the United States Department of Agriculture, for experimental work in the rearing of blue foxes. The Fisheries Bureau will supply the Biological Survey Bureau this season with six pairs of blue foxes from the Pribilof Islands, Alaska, for use on a fox farm in the State of New York.

The price commanded for blue-fox pelts naturally makes the question of the possibilities in the way of breeding the blue fox in captivity of considerable interest. The problem has been undertaken by various persons in different regions, but the Bureau of Fisheries is not aware that definite results have been obtained. It is hoped that the work of the Biological Survey in this respect will develop methods for successfully rearing this animal in captivity from the standpoint of a profitable fur-producing business.

Boston's Care of School Children's Teeth

(*Concluded from page* 370)

increase to one hundred and six is contemplated. Our illustrations afford such a clear idea of the general features of the work-room that no description appears necessary. It will be noted that the only respect in which the plant differs from the most up-to-date large private dental establishment is in its superlative size and in the absence of partitions isolating the several chairs from one another. In every other feature of organization and cleanliness it offers the last word. And the absence of privacy, in view of the fact that only children are treated, and considering the nature of the simple treatments which their ailments demand, constitutes really no drawback.

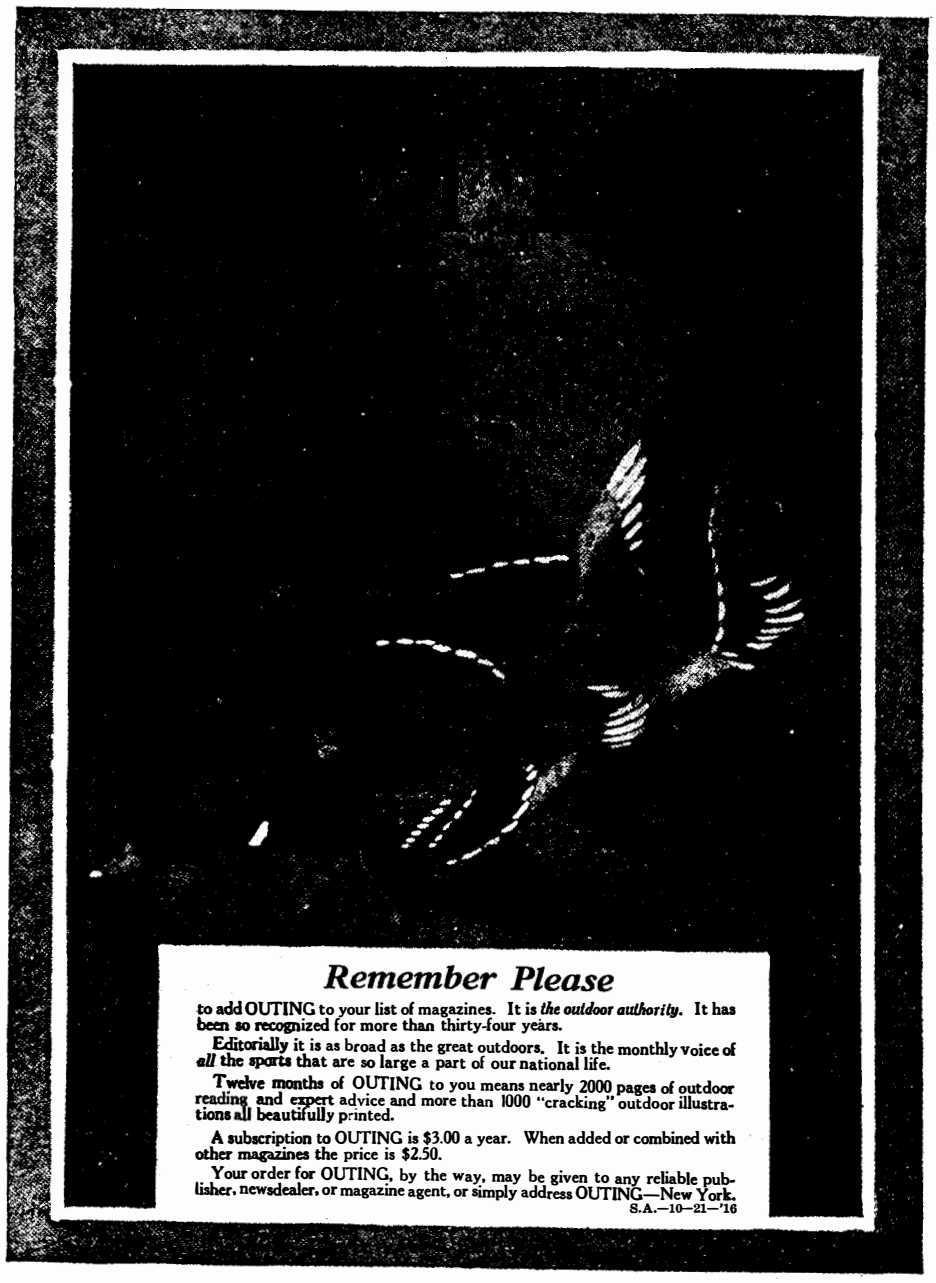
It is estimated that each chair will care for twelve patients in the course of an eight-hour day. This makes allowance for more than a single filling where necessary. On this basis, the Infirmary will give 230,500 treatments in a year; and perhaps it would be a trifle safer to assume that this represents three operations annually upon each of 76,800 individuals, since patients of this sort are very likely to require repeated attention. With the full equipment, this capacity will be enlarged to 381,600 operations, or three treatments per year for 127,000 children.

In considering these figures, it should not be forgotten that a large percentage of the school children will continue to have their dental wants cared for, as now, by practicing dentists at the parents' expense. Whether the Infirmary will be able to cope with the entire residuary body of dental ills remains to be seen. Even if it turns out to be insufficient, however, it may well be accepted as a model for this sort of undertaking, whether endowed or paid for from the public funds.

Motor Truck Queries and Answers

H. G. B. writes: Would a change speed gear of simple form be of any advantage on electric vehicles? What is the reason these are not used?

Ans.—The makers of electric vehicles have used the argument of having no clutch or change speed gears for sometime when speaking of the simplicity of control of these vehicles and are naturally not desirous of incorporating any features in their cars that would modify these claims. Two speed electrics have been made that have given good service. There does not seem to be any practical reason why the electric should be a direct drive vehicle any more than a gasoline car is. The current output from the battery depends upon the load taken by the motor. Under normal conditions, the motor can operate without making undue demands upon the stored charge of the battery. If roads are rough and hilly, however, the demands for current increase and not in direct proportion. It is stated that if the load on a motor is doubled that the current demand is cubed. An electric motor will continue to operate under a large overload, but it does not seem desirable to continue this for long as damage may occur from heating of the windings of the motor and a heavy discharge is not conducive to long life of the battery. It seems to the writer that a lower gear ratio would permit the motor to run faster under a lighter torque and of course draw less current from the battery in proportion to the work it performed. The added complication would be very slight and necessary gearing very simple. A large baking concern in the northwest built its own electric vehicles to cope with the severe operating conditions of that locality and incorporated two-speed gear boxes in the design, because none of the electric vehicle makers would do so. This company now obtains all-year service from its electrics. The writer knows of no electric vehicle on the market that uses variable change speed gearing between the motor and road wheels.



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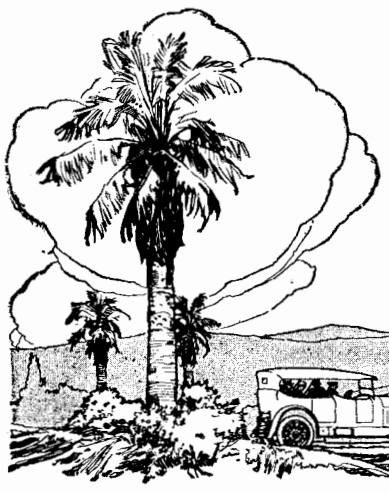
S.A.—10—21—'16

THE DESIGN AND CONSTRUCTION OF INDUCTION COILS

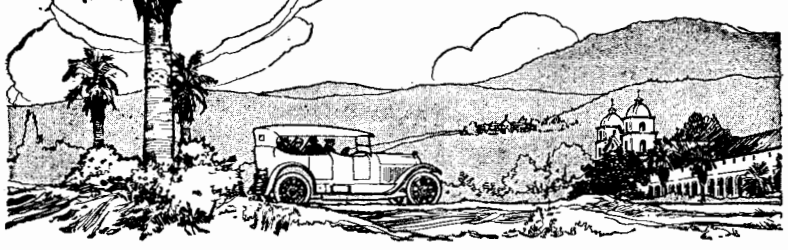
By A. Frederick Collins. 6¼x9¼ inches. Cloth. 272 pages. 159 illustrations, $3.00

This work gives in minute details full practical directions for making eight different sizes of coils varying from a small one giving a ½-inch spark to a large one giving 12-inch sparks. The dimensions of each and every part are given and the descriptions are written in language easily comprehended.

MUNN & CO., Inc., Publishers, Woolworth Building, New York City.



Spend the Winter in California



Motor among the Missions

HAVE YOU EVER HEARD *of* EL CAMINO REAL?

Do you know what it means? It is the romantic Spanish name used by the Franciscans to designate the King's Highway. This highway is now the Coast route of California's great automobile highway system. It links together many of the most beautiful spots in the Golden State and most of the famous old Missions. Dotted along this smooth concrete motor car path are world-famous hotels, ready to show the traveler who enters their doors true western hospitality such as has endured since the founding of the famous Missions themselves.

California is a land of romance and color. It offers more diverse attractions to the world traveler than any other section of the United States. It has capitalized its natural resources and added the comfort and service of wonderful tourist hotels.

Why not spend this winter in America's winter wonderland!

Sunset

The National Magazine of the West

conducts a Service Bureau which is prepared to assist you in obtaining complete information about anything pertaining to the Pacific Slope Country. Write to this Bureau for literature and information about California's hotels, resorts, attractions, highways, etc. Let us help you arrange your itinerary. The coupon will serve to introduce you to Sunset Magazine Service Bureau.

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MARK TWAIN

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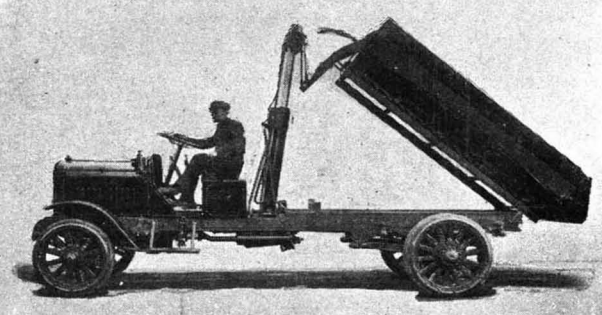

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