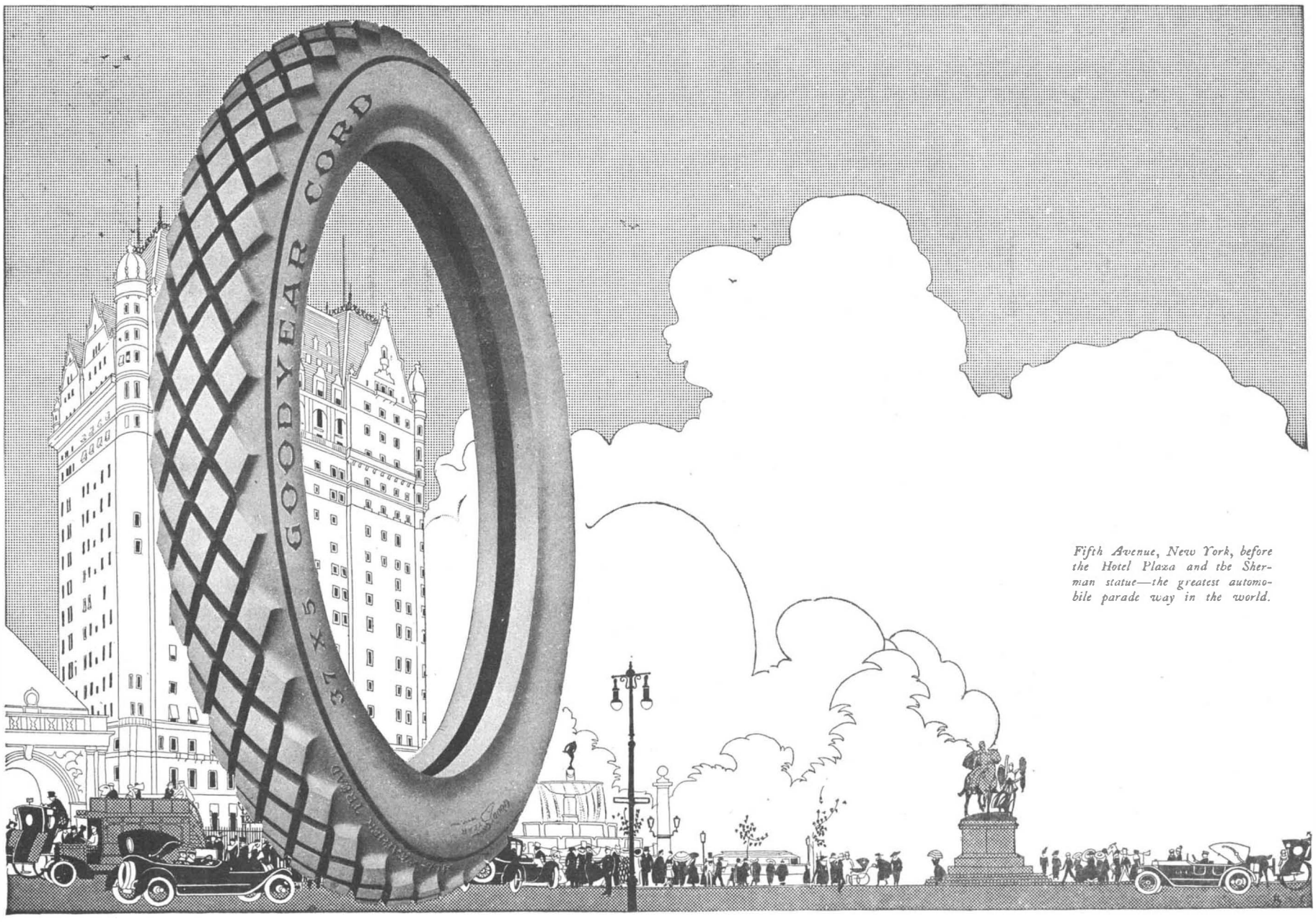
SCIENTIFIC AMERICAN

DETERMINING THE HEAT VALUE OF FUELS TO THE ONE-THOUSANDTH PART OF A DEGREE—[See page 457]

November 18, 1916

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

Price 10 Cents



These Are Better Tires; They Are Strong and Supple Both

Goodyear Cord Tires are supple—pliant—yielding. They do not fight the road.

Peculiarly, however, Goodyear Cord Tires combine this suppleness with unusual strength.

They meet obstructions easily, giving readily under their impact, fairly absorbing them.

Their recovery is instant and positive.

But—supporting their flexibility, guaranteeing their staying power—is stubborn stamina, inbuilt and invariable.

As a consequence, Goodyear Cord Tires offer very real advantages—in greater comfort, in surer security, in longer wear.

These advantages are directly due to the Goodyear Cord Tire construction.

In Goodyear Cord Tires several layers of light, strong, pliant cords are laid diagonally one upon the other, without cross-weave.

Around each cord and on each side of each layer is a cushion of quick-gum rubber.

The cords are allowed easy play in any direction; the tire walls are supple and strong; the tire as a whole is lively, fast and enduring.

All the natural elasticity of rubber is united with the cords' enormous strength.

Speed is knit to safety.

Goodyear Cord Tires are better tires—your car will prove it. They are better tires largely because of the Goodyear method of construction, we know.

But they are better tires chiefly, we believe, because of the Goodyear intention to make them so.

For the cause must precede the effect.

And the cause in this instance, we like to think, *is* the Goodyear intention—coupled with the Goodyear ability to carry it out—of putting full value into every product bearing the Goodyear name.

Full value—in money, materials and miles—you'll find it in Goodyear Cord Tires.

Their quality makes them higher-priced—and *better*.

On any car, and over any road.

The come in No-Hook and Q. D. Clincher types, in both All-Weather and Ribbed treads, for gasoline and electric cars.

The Goodyear Tire & Rubber Company, Akron, Ohio.

Goodyear Tires, Heavy Tourist Tubes and "Tire Saver" Accessories are easy to get from Goodyear Service Station Dealers everywhere.

GOODYEAR
AKRON
CORD TIRES

SEVENTY-SECOND YEAR

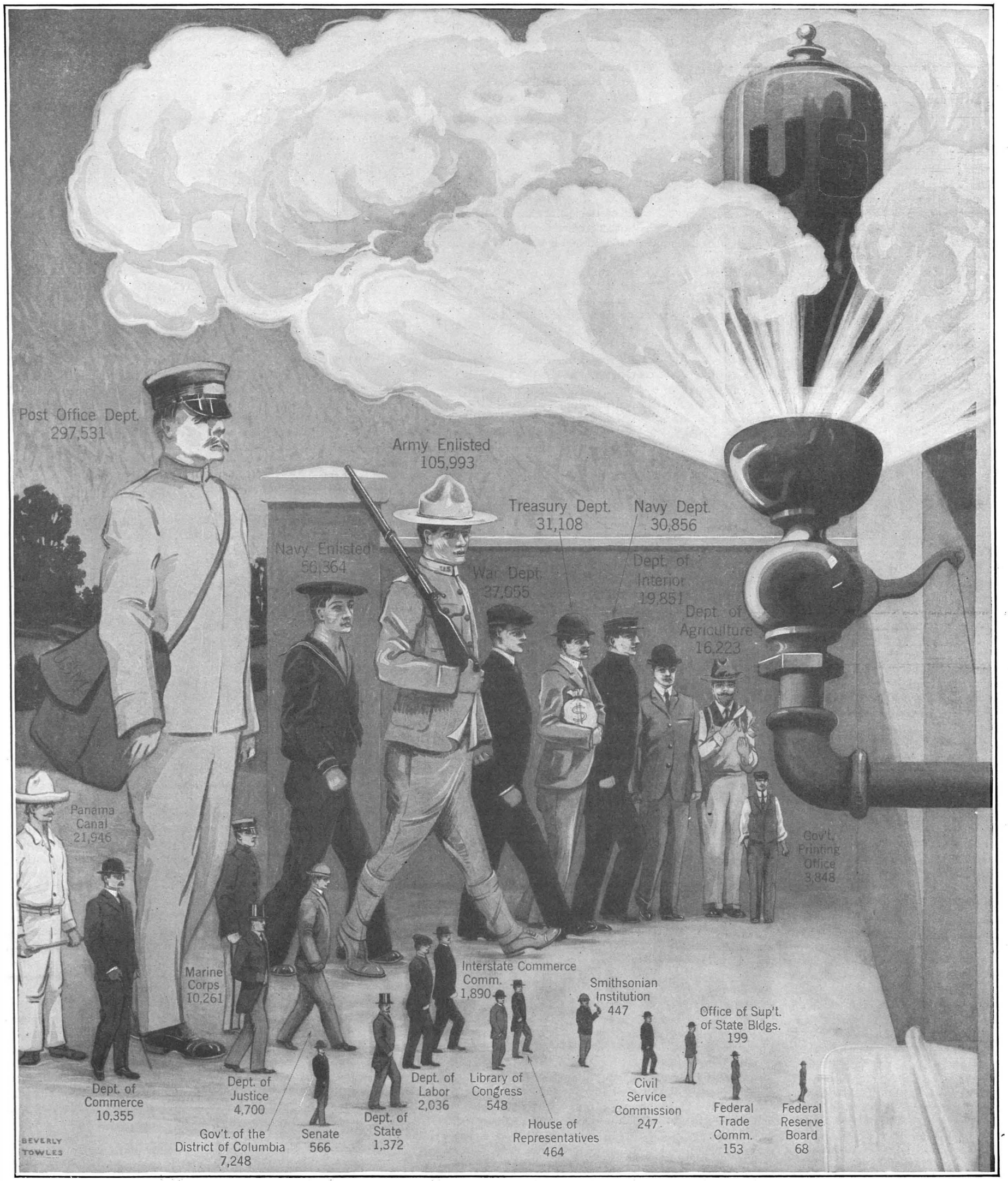
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXV.]
NUMBER 21]

NEW YORK, NOVEMBER 18, 1916

[10 CENTS A COPY
[$4.00 A YEAR



WHEN UNCLE SAM'S WHISTLE BLOWS

The total number of persons in the legislative, executive and judicial services of the Federal Government on July 1, 1915, was approximately 488,711, of whom 42,064 were employed in the District of Columbia and 446,647 outside of the District of Columbia. The total number of officers and enlisted men in the Army, Navy and Marine Corps is 172,618.

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, November 18, 1916

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

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

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

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

The Big Gun in the Big Ship

THERE is nothing of the freakish or the phenomenal in the extraordinary growth in size of the battleship and the gun it carries. In every branch of engineering construction it has been proved that size—bigness—carries with it both economy and efficiency. The fifty-thousand-ton merchant ship shows a greater earning capacity per ton of displacement than two ships of twenty-five thousand tons. The twenty-story office building gives a larger return on the investment than two ten-story buildings on separate plots. The mammoth freight engine of 1916, equal in weight to three such of twenty years ago, will haul freight at a fraction of what it cost per ton when three units were necessary to perform the same duty.

Therefore we must be prepared to see a steady increase in the size of the battleship of the future and in the weight and power of its guns. The theory (always attractive, not merely to the layman but to many naval experts) that many small ships would prove superior to a few large ships, has been disproved both in theory and practice. The present war has laid that illusion, if not for all time, at least for the present era.

Size, thick armor and the big gun, as combined in the modern dreadnought, constitute the supreme, controlling factor in naval warfare. The bigger the ship, the thicker her armor, and the more mighty her guns, the more completely will she dominate the naval situation.

One of the most dramatic and instructive phases of the present naval war occurred during the battle of Jutland, when the steering gear of the Warspite (of the Queen Elizabeth class) gave way and she swung over toward the German battleship line and began to circle. The Germans were quick to appreciate the situation, and seized the opportunity to sink this crack ship. They turned upon her every gun from half-a-dozen of their dreadnoughts, and immediately the salvos of 11-inch and 12-inch shells began to straddle her. Such was the fury of this attack, that an officer of the ship declares it was impossible to see the enemy because of the masses of water thrown up by such shells as fell short, the whole sea around the Warspite being lashed by heavy projectiles. She was hammered unmercifully, and by all the rules of the game should have gone down, a hopeless wreck. But the Warspite did not sink. Very much to the contrary, under that tremendous fire her engineers set right the steering gear and she reached a home port practically intact so far as her vitals were concerned, and before long she returned to take her place in the first line.

Contrast this with what happened to three of the lightly-armored British cruisers, whose 9 inches of steel failed to keep out the German 11 and 12-inch shells. Three of these ships were sunk before the fight was many hours old; and they were put down, not by the torpedo but by the gun. Compare this with the way in which the heavily-armored (11 to 12-inch Krupp plate) German battle-cruisers stood up against the fire of the 13.5-inch guns carried by the battle-cruisers of Admiral Beatty's squadron.

It begins to look as though the type of ship developed by the experience of the war will be a combination of battleship and battle-cruiser, possessing the gun-power and heavy armor of the one and the high speed of the other. Manifestly the first, absolutely the first requirement in a ship of the first line is that she shall stay afloat; and this means armor, thick and plentiful and elaborate subdivision. It was this that saved the German battle-cruisers and it was her 13½-inch armor that brought the Warspite through. But not only must the battleship stay afloat—she must put the other ship under; and this calls for a gun so heavy that no armor that the enemy can carry will stop the shells that strike.

But armor of maximum thickness plus guns of maximum power spells a ship of maximum displacement. Hence we are disposed to credit the frequent statements by correspondents who have visited the British dockyards, that Great Britain is rushing to completion a division of ships which will mount a battery of 18-inch guns, will be protected by armor and a system of subdivision far exceeding that of any ship now afloat, and will displace forty thousand tons. Such a ship would be the logical outcome of the experience gained during this war. Her 3000-pound projectiles, carrying not less than 300 pounds of high explosive (equal to that of the modern torpedo) would be capable of penetrating any armor now carried, and its wrecking effect inside the ship would be conceivably greater than that of the torpedo.

It is too late to change the plans of the four United States battleships of this year's program, which will mount ten 16-inch guns; but prudence suggests that we should at once build a test gun of 18 to 20 inches caliber, and get out designs for a ship that shall carry at least eight and preferably ten of them in her main battery.

Fair Play for American Shipping

THE principle of protection for infant industries, or established industries which are laboring under crippling conditions of foreign competition, is both sound and well established as an element of the economic policy of the United States. Under the active work of this principle, as exemplified in the tariff, we have seen industries which were struggling for a bare existence take on new life and vigor and grow to such lusty strength that they were able to hold their own against world-wide competition.

For certain reasons, which are even to-day somewhat obscure, Congress, which has most carefully protected our manufacturers, has refused any form of protection to our struggling merchant marine—an institution which half a century ago led the world in the quality of its ships and the magnitude of the trade which it carried on.

Surely if ever there was an American industry which needed assistance, it is this. Not only does it, in normal times, cost more to construct ships in American than it does in European yards, not only are the wages of the crew much higher, but, as if that were not sufficient handicap, Congress has recently imposed upon our merchant marine by the Seaman's Act certain legal restrictions which add enormously to its difficulties. The difference in cost of construction is gradually being wiped out, but the difference in cost of operation is inherent. It is a liability which now confronts, and for many a decade will continue to confront, the American shipbuilder.

No serious reason is offered to show why the Government which has extended its protection so liberally to the various industries of the United States, should refuse any form of protection to this, one of the most important and certainly the most neglected. Annually, we pay out over $300,000,000 to foreign ships for handling the foreign trade of the United States. Common sense and patriotism both, it would seem, should lead Congress to offer sufficient financial assistance to our merchant marine to enable it to compete on equal terms with ships that fly a foreign flag.

Now, let us see how existing conditions work to our disadvantage and to the advantage of foreign owners. We learn, on the authority of the "Marine Journal," of this city, that more than one half of the orders for ocean-going tonnage placed in American shipyards last month came from owners, chiefly Norwegian, on the other side of the Atlantic; and it goes without saying that, in placing these foreign orders, these foreign ship owners are more confident than American ship owners of their ability to make a profit out of the shipping business after this war is over. They realize, as we do not, that apart from the question of the cheaper cost of operation, they have another cause for confidence in that they are assured that there will be no hostile legislation enacted by their own governments, whose policy, without exception, aims at the furtherance and not the hinderance of the interests of their merchant marine.

According to our contemporary, under normal conditions a ship of Norwegian registry can be operated at a far lower cost than a ship of American registry, and because of the different conditions of employment in Norway, capable officers and crews can be hired under long contracts at a rate about one half that in the United States. The same thing is true of the European as against the American factories; but our factories have been protected by the tariff, while our ships have not. Why is this?

It is understood that, temporarily, because of the war, both the cost of construction and of operation have been equalized as between America and Europe; but, according to the "Marine Journal," every man familiar with the shipping business knows that after the war, when conditions have settled down to a normal basis, the cost of operation will again be heavily against us, and that many ships now under American registry will be transferred to foreign flags. The only policy that would prevent such a transfer would be the application of the protective principle, honestly and adequately, to American ocean shipping—the one American industry to which it has been denied.

A New Phase in the Science of Nutrition

THE word "vitamine" has come into our vocabulary since the latest dictionaries were published. Etymologically it means an amine that is essential to life, and it was coined by C. Funk as a generic name for a group of substances, of unknown chemical composition, small quantities of which appear to be a necessary constituent of a wholesome human diet, in addition to proteins, carbohydrates, fats and inorganic salts. An absence or insufficiency of vitamines in the diet brings on diseases now known as "avitaminoses," or "deficiency diseases," of which scurvy and beriberi are the principal representatives. Science already recognizes two vitamines—viz., antiscorbutic vitamine, which prevents scurvy, and antineuritic vitamine, which prevents beriberi in man and polyneuritis in birds. There may be others.

The investigation of the vitamines has made great strides in the past two years. The subject is beginning to crop up in the newspapers and in general literature; not to mention the small talk of the dinner table, where everything on the menu invites classification from the point of view of the "vitaminologist." Hence we gratefully record the publication in a recent number of the *Journal* of the Washington Academy of Sciences of a comprehensive summary of existing knowledge on the subject, from the pen of Prof. Carl Voegtlin, of the U. S. Public Health Service.

Although the experts do not yet know what vitamines are, they are learning a great deal about the rôle they play in human nutrition, and the facts already ascertained give promise of extremely important applications. The relative abundance of vitamines in a long list of common foods has been determined. The effects of cooking upon these interesting substances has been studied. It is found that the heating of most foods at a temperature of 120 deg. (Centigrade) will destroy most of the physiological activity of the vitamines originally present. Vitamines are fairly resistant to acids; in fact, some acids seem to prevent the deterioration of these substances. On the other hand, strong alkalies, under certain conditions, seem to destroy their physiological activity. The animal body is not capable of manufacturing the known vitamines from vitamine-free food. All of the higher animals, including man, receive their vitamine supply directly or indirectly from plants. Vitamines are available in milk, eggs and fresh meat, but they were originally elaborated in plants.

The vitamine content of most kinds of bread now eaten in this country has been reduced by modern processes of making flour and corn meal, and the prevalence of deficiency diseases in certain regions has been plausibly ascribed to this cause. Corn bread is also robbed of its vitamine by the use of baking soda (an alkali), without the addition of buttermilk or substances of an acid character, such as cream of tartar. Culinary practices now widely prevalent in the southern states stand in urgent need of amendment in view of the above facts. Dr. Voegtlin does not mention pellagra, but other investigators are convinced that this is a deficiency disease altogether analogous in its causes to beriberi. (See SCIENTIFIC AMERICAN SUPPLEMENT, July 15, 1916, p. 43.)

The effects of the various processes of food preservation upon vitamines have not been thoroughly studied, but the subject is of great importance. Drying seems to reduce the content of foods in antiscorbutic vitamines, whereas the antineuritic vitamine is only slightly affected by this treatment. Canning, according to some investigators, appears to destroy the antineuritic vitamine of fresh meat and fresh milk, but, on the other hand, Prof. Voegtlin has been able to show that canned peas and beans retain a considerable amount of this vitamine.

A simple method of determining the vitamine content of cereal products is apparently furnished by the discovery that the distribution of phosphorus and that of vitamines within the grain run practically parallel, notwithstanding the fact that phosphorus does not enter into the composition of vitamines.

Lastly, the author points out that "it is of great importance that vitamine preparations should become available for the practicing physician for the treatment of deficiency diseases. It is quite possible that a number of indefinite complaints and symptoms of adults and infants may be due to a partially deficient diet, and would be benefited by the administration of vitamines."

Dr. Atherton Seidell's success in obtaining a cheap and stable vitamine, in concentrated form, from autolyzed brewers' yeast has previously been reported in the SCIENTIFIC AMERICAN. This preparation is now being tested clinically.

Electricity

Decrease in Chicago's Electrical Accidents.—It is reported that there were 17 fatal accidents from electrical causes in Chicago during the past year, which number indicates a decrease of 50 per cent as compared to those during 1914. Two of the accidents were due to contact with 110-volt and 230-volt alternating current circuits, and two by contact with 550-volt street railway circuits.

Proposed Electro-Chemical Works for Norway.—A French-American syndicate is about to start a large electro-chemical works in Norway, in the Telemarken district. It is stated at present that about 100,000 horse-power will be needed and that the requisite power is to be obtained from the Maar Falls in Tinn. When these falls are fully developed an aggregate of as much as 180,000 horse-power is anticipated.

An Electrically-Operated Cream Whipper is the latest recruit to the ever-growing army of electrical devices. It consists of a one-gallon hopper, which is equipped with a rotating beater or dasher. The latter member is gear-driven by a one-eighth horse-power motor that may be connected by means of a ten-foot cord to the nearest lamp socket. Provision is made for taking out the dasher in order to clean out the cream-whipping parts.

Filament Lamps for Motion Picture Studios.—In one of the leading motion picture studios of Los Angeles there are now being used 646 photographic gas-filled tungsten lamps for filming interior sets. The banks, located on the sides and overhead of the sets, carry nine lamps each and can be tilted at any angle and raised or lowered to any height desired. Each lamp is on an individual circuit and the entire installation is regulated by remote control switches. Work is now being rushed on the remainder of the studio in which 600 additional lamps will be used.

An Automatic Extinguishing Arc Lamp.—An arc lamp is suggested for street lighting in which a plurality of regulating magnets is employed for extinguishing some or all of a series of lamps at a given hour or causing such lamps to burn with diminished brilliancy, reports the *Electrical World*. The inventor, Wilhelm Dietz of Germany, obtains his automatic control by momentarily changing the strength of the current in the circuit. This abnormal current causes the carbon feed regulator directly or indirectly to close a circuit which permanently affects the strength of one of the magnets.

Using an Electric Fan During Winter.—Why is it that with the first signs of cool weather the electric fan is relegated to the cellar, the attic, or the storeroom, as the case may be? Simply because the mission of the electric fan is misunderstood. It is looked upon as a device for cooling the air during warm weather, when as a matter of fact it merely stirs the air. If ever there was an efficient way of warming a room during the coldest winter's day it is to place an electric fan near a radiator so that its breeze passes through the heating coils. This results in creating a current of warm air throughout the room; and instead of the heat of the room being confined to the immediate neighborhood of the radiator, it is distributed to the farthermost corners of the room. Why not try it?

Portable Burglar Alarm Safe Deposit Box.—What is considered a clever solution of a long existing problem is presented in a portable burglar alarm safe, which is a strong box made of the finest steel in mahogany finish, fitted with a powerful lock and equipped with a complete electrically-operated internal burglar alarm device. The latter is so constructed that when the alarm has been set, the gong will ring for an indefinite period if the box is either moved or lifted. If the owner wishes to move the box, it is necessary, before moving or lifting, to open it and turn off the switch in the alarm circuit. The apparatus cannot be reached from the outside. Imagine the plight of a burglar trying to escape with a strong box which is clanging continually, and over which he has no power to stop the tell-tale alarm!

Keeping an Automobile Engine Warm.—The problem of keeping an automobile engine and radiator warm during the coldest nights, without the necessity of heating the entire garage, has been solved by an electric engine and radiator warmer which is simply screwed into any lamp socket in the garage and placed down in the hood of the car between engine and radiator. The body of the heater contains a rugged heating element which consumes one tenth of a kilowatt—less than one cent an hour—and gives off just enough heat to keep the radiator from freezing and the engine from causing trouble. The hood of the car, however, should be blanketed in severe weather to hold in the heat. The heating element is inclosed in a black enameled metal shell, of a shape and size not unlike the ordinary dry cell, and perforated to allow for circulation of the heated air from within.

Astronomy

Meteorites in the National Museum.—A new handbook and descriptive catalogue of the meteoric collections in the National Museum, at Washington, shows that this collection now includes specimens from 412 falls and finds out of the 650 known in the whole world. The catalogue is extensively illustrated, and is introduced by a brief treatise of much value on the subject of meteorites in general.

Dr. W. Zurhellen, one of the German astronomers who went to the Crimea to observe the total eclipse of August 21, 1914, has been killed in the war. He was interned for a year in Russia and was then allowed to return to Germany, where he joined the army and was sent to the western front. He was once assistant director of the National Observatory of Chile, at Santiago, and had recently been an assistant at the Royal Observatory, Berlin.

Solar Activity and Planetary Brightness.—A writer in *l'Astronomie* suggests that the variations in the output of solar radiation indicated by the observations of Abbot and others should result in corresponding variations in the brightness of the planets. The author reports observations made on the brightness of Saturn from November 3rd, 1913, to March 28th, 1914, which indicate a very small variation, not exceeding .04 magnitude. No variation in brightness due to the planet's rotation was observed.

The New Van Vleck Observatory of Wesleyan University was dedicated on June 16 of this year. It is the gift of Joseph Van Vleck, in memory of his brother, John M. Van Vleck, who was professor of mathematics and astronomy at Wesleyan for nearly 60 years. The observatory is to possess an excellent 18½-inch refractor, but the completion of the object-glass has been delayed by the war, and the 12-inch lens from the old observatory is to be used temporarily in the new mounting. This institution, which is under the direction of Dr. Frederick Slocum, will be devoted especially to the determination of stellar parallaxes.

Future Use of the Selenium Cell in Astronomy.—This subject is discussed by M. Fournie d'Albe in a recent contribution to *Scientia*. The author finds that a selenium cell having a surface of 100 square centimeters would theoretically be capable of registering the light of a 28th magnitude star, which is, of course, far fainter than any visible in the largest telescopes. For such an observation, however, an exposure of several days would be required, and this would be difficult to accomplish. On the other hand, with an exposure of only one second such a cell is much more sensitive than the eye. The author believes that we can virtually increase the diameters of our greatest object-glasses tenfold by substituting a selenium cell for the human eye at the eyepiece of the instrument. Thus it should be possible to detect stars about five magnitudes fainter than any now observable.

Spectrographic Observations of Barnard's "Runaway" Star.—The 11th magnitude star in Ophiuchus discovered by Barnard to have the unprecedented proper motion of about 10 seconds a year, has been studied spectroscopically by Adams at Mount Wilson and by Slipher at the Lowell Observatory. The spectrum is characteristic of stars with high velocities and is known as the "dwarf" type of M type stars. Slipher gets for its motion in the line of sight about 40 kilometers a second, while Adams finds this motion to be about 91 kilometers a second. The parallax derived from the spectrum is 0.2 second. According to Adams's observations the actual motion of the star in space is about 161 miles a second. The star has been found on Harvard College Observatory photographic plates as far back as 1888. It is unfortunate that this remarkable star still lacks a name. It is not in any known catalogue or star list.

The Missing Asteroid Aethra.—An object photographed with the 40-inch refractor of the Lowell Observatory in 1913 was suspected to be the long lost minor planet Aethra, discovered by Watson in 1873. Watson observed it on six nights and it was observed on 17 consecutive nights at the Marseilles Observatory, but it has never been seen since July 5, 1873. Widely different orbits have been published. On the assumption that the object observed at the Lowell Observatory was Aethra, Mr. Dinsmore Alter has computed an orbit that appears to explain why this planet has been so elusive. According to this orbit the mean daily motion of Aethra differs less than 4 seconds from being just one-fourth that of the earth. The consequence is that oppositions at which the planet is near perihelion must occur at the same time of year during a long period of time. Moreover, perihelion is in the part of the orbit where the planet is far south of the ecliptic. At perihelion, when the planet is relatively bright, it is so far south that it can hardly be seen from observatories in the northern hemisphere. The eccentricity of the orbit is so great that the planet is relatively very faint at aphelion, when it is in northern skies.

Aeronautical Notes

Andes Crossed by a Balloon.—Two Argentines, Señor Bradley and Lieut. Zuloaga, recently succeeded in crossing the Andes, starting out in a balloon from Santiago, Chile, and landing some four hours later near Mendoza, on the Argentine side. The report states that the aeronauts experienced contrary winds and ascended to a great height. This is the first crossing of the Andes by aeronauts.

The Improving Russian Flying Services.—From the reports of correspondents on the Russian front we learn that there is a constant improvement in the aerial arm of the Russian army. It is said that during the recent fighting in Galicia, in particular, the Russian airmen distinguished themselves. No longer is the Russian air fleet limited to scouting operations, but, following the example of the Western front it is fast becoming an instrument of attack for use in the thickest of the fray.

Germany's Aerial Champions.—An announcement by the German War Office states that the ten most successful German aviators with their records of hostile machines brought down are: Capt. Boelke, 19; Lieut. Immelmann (dead), 15; Lieut. Wintgens, 11; Lieut. Hoehndorf, 10; Lieut. Parchau (dead), 8; Lieut. Mulzer, 8; Lieut. Baron von Althaus, 8; Lieut. Leffers, 5; Lieut. Walz, 4; Lieut. Gerlich, 4. These figures were correct up to the latter part of July last; and Boelke, it will be recalled, has since been killed after having brought down close to 30 enemy planes.

Last Message from L-19.—The Gothenburg *Handelstidende* states that recently fishermen at Marstrand picked up a bottle containing a despatch from Commander Lowes of the wrecked Zeppelin L-19 to his superior officer, in which he says: "With fifteen men on the platform and no gondola, L-19 is going very slowly. I am unable to save the airship. In foggy weather we, on our return from England, passed Holland, and were bombarded by Dutch sentinels. At the same moment three motors failed. 1 P.M." In the bottle were also fifteen letters from the crew to their relatives.

New Twin-Motored Battleplane.—Designed by A. S. Heinrich, there has recently been completed a large battleplane which has a good load capacity and high speed to commend it. The new machine is equipped with two six-cylinder 92-horse-power engines, driving separate tractor screws. With full load the craft can attain a speed of 85 miles per hour and climb 3,000 meters (over 9,000 feet) in 18 minutes. An unobstructed range of 180 deg. is obtainable for the machine gun mounted in the nose of the battleplane. Both top and lower wings are of the same span, namely, 48 feet.

The Electrical Ears of Venice.—According to a newspaper correspondent who recently visited Venice, the Austrian airmen have made over 30 raids on that famous city. The observation station there is provided with sensitive electrical microphones, which are said to detect the noise of the motors on the Austrian planes the moment they leave Trieste, some 60 miles away. Electric sirens are immediately sounded to warn everyone of the approach of hostile aircraft, which cover the distance between the cities in something like 40 minutes. Thus ample time is afforded for completing the anti-aircraft artillery preparations before the first Austrian airman hoves in sight.

An Aeroplane Bomb Fatality.—While attempting to launch a bomb from their aeroplane at the Indian Head Proving Grounds on November 8th last, Lieut. Luther Welsh, U. S. N., and Lieut. Clarence K. Bronson, U. S. N., were killed by the premature explosion of the missile. It is understood that the men were engaged in experimenting with bombs for use against vessels, according to the inspector of ordnance at Indian Head, who added: "The bomb detonated immediately beneath the aeroplane. It was being launched by Lieut. Welsh and apparently struck some part of the machine. It was seen to detonate and the aeroplane broke in two and fell into the Potomac River. Hardly any trace of the aeroplane or passengers has been found yet."

"Blimps"—Combination Dirigible-Aeroplane.—Capt. Thomas S. Baldwin, writing recently in the *Aerial Age Weekly*, states that a new type of dirigible is being developed in Europe, which will probably be built in this country in the near future. This consists of what is practically an aeroplane fuselage with its motor and propeller supported by the gas bag about 130 to 150 feet long and about 30 feet in diameter at the widest point, containing places for four passengers, fuel for six hours and making a speed of 60 miles an hour, with ability to climb to an altitude of 3,000 feet. These small dirigibles can be built for about $12,000. These "Blimps," one of which was illustrated in a recent issue of the SCIENTIFIC AMERICAN, are used in England for military work, and are part of the new aerial program for 1917, which, it is said, promises the building of 50 airships of both rigid and non-rigid types.

Strange Modes of Food Preservation

One Half the World Never Knows What the Other Half Eats

By L. Lodian

THE banana and plantain, merely sun-dried, are most important preserved food staples of the tropics and sub-tropics. They are occasionally seen on northern markets, as New York, Paris and Petrograd, in box-layers, sold as "fig-bananas." They are more nutritious than figs, but lack the fine flavor and honeyed sweetness of the four-inch Izmir, the best type of the Asiatic fig. Much wrinkled through desiccation, the plump banana of every-day life is scarce recognizable in this preserved form; hence its illustration here to familiarize the reader with its appearance. Drying has changed the color scheme to a dingy speckled brown and reduced the size to that of a small sausage.

Banana marmalade is also produced nowadays in great quantities. Tons of it have been shipped for the use of the armies at the front. It is a firm product, of dull brownish red color, the natural result of preserving, just as white apple slicings turn a rusty brown on drying. The flavor of the compost, oddly enough, suggests a combination of currant, raspberry and strawberry preserves, although no extraneous flavoring whatever has been incorporated in its manufacture.

This is certainly the banana age, as the wag said on slipping for the sixth time on a stray peeling; but to-day even these are, on a large scale, worked up into chicken feed, or used in paper-making, or dried and used as fuel (the ash being then of value as fertilizer). Banana flour and choice banana biscuits have been obtainable the past quarter-century, likewise a banana coffee; but the latter is inferior to the compressed fig coffee made for over a century in Europe, and which is employed in many localities for a food, in addition to its normal use as a beverage.

Bean-Casein Cheese

This is ripened bean-curd, and is only made in the far oriental countries, where lactic casein cheese is not used. Bean-casein and milk-casein are identical in composition. The cheese is always snappy and piquant, as soft as Camembert or Limburger, as delectably flavorful as Roquefort, yet so cured as to be totally minus the strong odor of some of the soft animal matter cheeses. Its use is perforce economical, as the veriest trifle imparts to macaroni and other dishes the distinctly cheesy flavor so greatly sought after.

The Unknown in Rice-dom

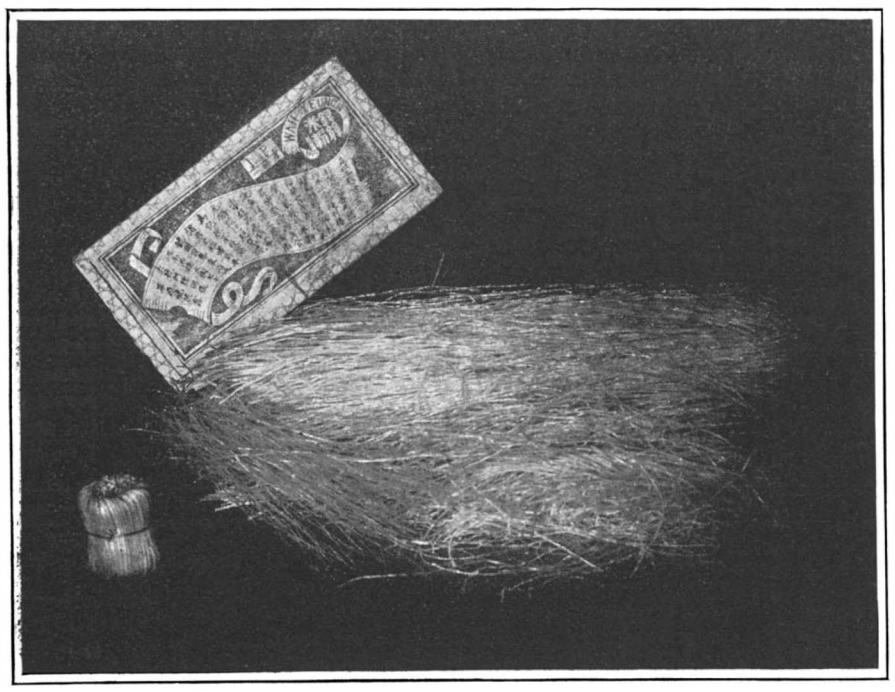
The rice-macaroni illustrated is the most beautiful food product known to the writer. In the sunlight these silvery skeins glisten with dazzling charm. The same product is also put up in compressed blocks; and it appears in miniature imitation of the rice sheaves to be seen through the fields at the height of harvest time.

Other little known rice products always obtainable if one knows where to go are rice-sugar, rice-brandy, rice-oil, rice-bran, rice-soap (queer thin disks, a refuse product from the oil presses), rice condiments, and even waterproof clothing of rice straw.

The bean macaroni of the far easterners is also a curious product, somewhat resembling big withered celery stalks; and their zephyr-weight foodstuffs from tree pith and dried sea foam are edible freaks much akin to their bird nest and shark fin delicacies, a treat for the epicure but of scanty food value.

A Cup of Tea

There are some score or more different forms of compressed teas available, from button-sized tablets in vest pocket containers to bars of delectable fragrance, and from granite-like slabs of two to five kilograms (still in use as money in the interior of China) to the more lightly compressed disks and oblongs in split rattan baskets. The method of preparation of these last is curious; the leaves, in a state of wilt, are compacted by the bare feet of Chinese girls. These teas are esteemed by the Orientals for their earthy flavors. We illustrate a tea cake much used by Russian army men.

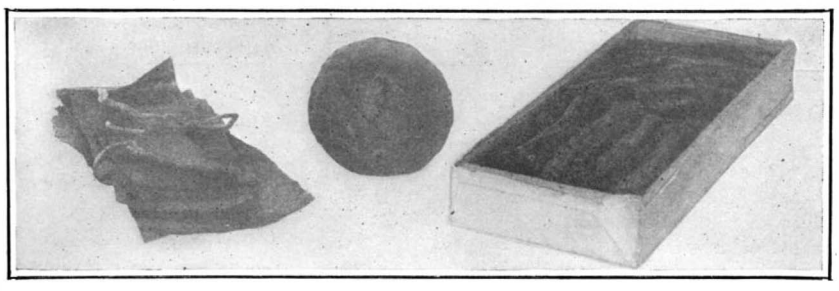


The singularly beautiful rice macaroni comes in small sheafs as well as in big boxes

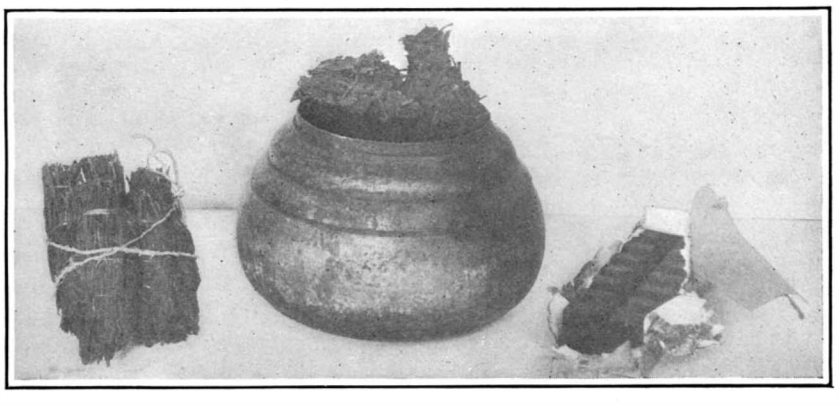
Then there is the compressed tea which comes in irregular chunks, packed in gourds; also called seed tea, because compressed with the little peppercorn seeds intact. These impart to the amber colored infusion a certain flavor much appreciated by the Manchu connoisseurs. The seeds are distinctly seen here and there in the mass; in fact, that is the very reason why no heavier pressure than that of the human foot is used. Mechanical pressure, as employed in the making of the dense bar teas, which can hardly be distinguished from chocolate, would crush the fine seeds to powder and destroy the distinctive flavor.

Foot power in the manufacture of foodstuffs is more universally employed than one would imagine. Within a very brief walk of New York's busy City Hall Plaza may be found dank basement bakeries where the kneading is accomplished in this manner; and I have a capital view showing the extraction of grape-juice by a band of merry laborers dancing a jig, immersed to their knees in a vat full of the heavy purplish mush.

The tea in tiny fagot form, also illustrated, is called virgin tea, and is much used at oriental connubial gatherings. At top and bottom of the little bundles is a binding thread of slim silk. For infusing, only the top thread is cut; so that, on addition of boiling water, the bunch opens like a nosegay. Each bundle, by reason of this gradual opening and yielding up of the virtue of the tea, is good for half a dozen cups, the last of equal strength with the first; then, when finally used up, the bunches are laid away in vinegar for a couple of weeks, and next appear at the table as the justly famed tea leaf salad of the Orientals.



Dried apricot sheets, flat and rolled into balls, and a box of banana figs



Some of the forms in which tea is to be had

Sun Dried Fruits

In the Turkish caliphates, apricots are reduced to pulp in trays, quickly sun dried to a firm cake-like sheet, and these, well overlapping, are run through a roller press, a continuous sheet one meter wide resulting, which may be hundreds of meters long. This is the familiar apricot sheeting of the Turkish bazaars. It is little thicker than heavy brown paper; it can be kept for years, and used for all the purposes to which we put our dried apricots. Cut up into eight-pound lengths, it has all the appearance of a side of thin russet leather.

We illustrate some cuttings from these sheets; also the same, in ball form. The Arab urchins of the desert are wont to play ball with these, and when they are weary of the game, they dispose of the ball and assuage their hunger at one blow. Even after being kept for very long periods, these balls, when cut open, adhere slightly to the knife, and display a savory fruit fragrance which attests the perfection of this curious manner of preservation.

Sea Food Preservation

For diversity, New York is easily the premier sea-food emporium of the globe. Depicted are a bunch of the sun-dried clams—hard to recognize, indeed. Then there are desiccated cuttle fish of all sizes. The devil-fish is to be had, preserved in his own "ink"—of forbidding appearance, but quite delectable. There are sun-dried Turkish caviar, so compact and clean to handle that the roes may be carried in the pocket; fossil-like mackerel steaks from Japan; adamantine shark meat from Sicily—such are a few of the sea food abnormalities in daily use in the markets of Manhattan.

A string of sun-dried clams

Proposed Russian Railroad between Batum and Trebizond

THE British Consul at Batum reports, under date of September 11th, that the Russian government has decided to build a railroad from Batum to Trebizond, and that the work of carrying out this scheme has recently been taken in hand. The new railway, which is to be of the ordinary Russian broad-gage type, is, as far as possible, to skirt the foot of the mountains and follow the coast. It is said that at some points of the proposed track the mountain cliffs are perpendicular to the seashore. Although in several instances the inclines will be fairly steep, the ruling gradients are to be easy. In spite of the difficulties that they have to encounter in building the line, the State engineers are confident that they will be able to bring the work to a satisfactory termination in six months, which is the limit of time given for completing the line and beginning the operation of trains.

Reading the Secrets of the Earth

Subterranean Pressures Recorded by a New Type of Electric Cell

By Annis Salsbury

EITHER disastrous failure or excessive cost has marked the building of a wide variety of masonry structures, designed to withstand earth pressure from steep embankment or earth fill. Every city has its example of wall pushed out at an angle because of earth pressure or of foundation disrupted by weight of soil fill. On the other hand, the building of many walls has been marked by lamentable extravagance in the excessive amount of masonry put into the wall.

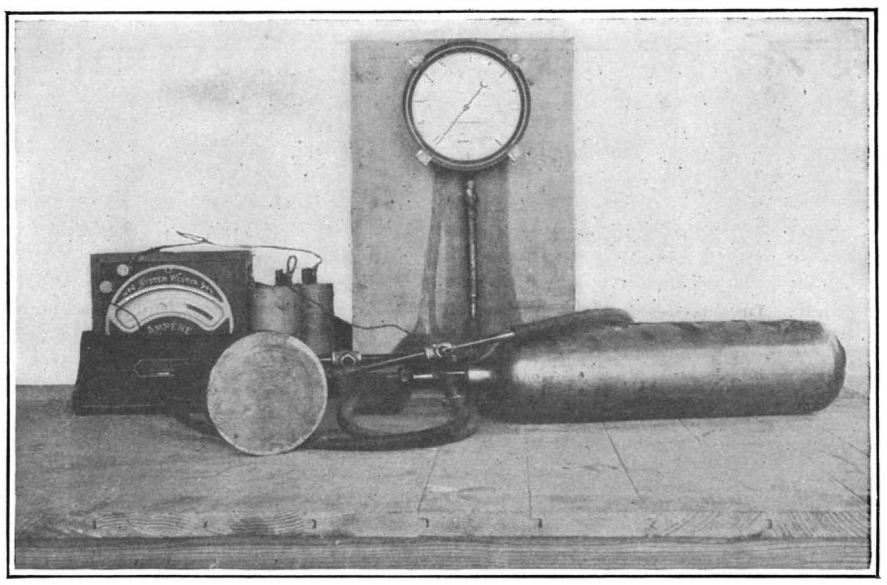
The invention of an apparatus for measuring earth pressure in the Office of Public Roads in Washington, D. C., marks great advance in this particular line of engineering science. It will enable the engineer to determine definitely the earth pressure with which he has to cope at any point along the line of construction, and knowing the pressure it is a matter of mathematical calculation to build masonry designed to withstand that pressure with a reasonable margin of safety, but with excessive cost eliminated.

The invention is simple. A small cell having a thin brass, annular diaphragm is buried at the desired position with pipe and electrical connections to a compressed air supply and electrical equipment at the surface where the pressure reading is to be made. Enough air is admitted to equilibrate the soil pressure, indicated by breaking electrical contact. At the moment an ammeter registers zero, the reading on the pressure gage represents the earth pressure at the spot investigated.

This pressure cell, with iron pipe projecting to the surface, is buried in the fill where pressure is to be determined. A number of cells may be buried at intervals in any position, making it possible to measure earth pressure in any direction. One set of indicating and controlling instruments, consisting of ammeter, electric batteries, pressure gage, and bottle containing compressed air, all mounted in a convenient carrying case, may be connected up with one cell at a time, and used for reading any number of pressure cells. No matter how remote the station, the pressure cell may reach it with practically no disturbance of the pressure which it measures. Government experimenters are now using it in testing the earth pressure against the concrete foundation of the Lincoln Memorial Monument, and also in the retaining wall built along the Sixteenth Street cut, which must support extremely heavy fills.

The pressure cell may be applied to a number of useful purposes besides that of measuring pressure against retaining walls and earth fills. It may be used to determine the pressure against the sides of a grain elevator, that of ensilage in silos and the pressure of concrete in forms. Another useful application will be the measurement of the resistance of various subsoils to weight of concrete pavement, and superincumbent load of traffic.

This resistance, it is found, varies with the character of earth, and some soils require the building of thicker concrete bases in road construction than other more resistant materials. The pressures for a range of soils will be determined by engineers of the department and will be available for general use. With increasingly heavy traffic due to the popularity of motor driven vehicles and trucks, the road engineer will find it valuable to have exact data on underlying earth pressures, and the laws of their distribution.



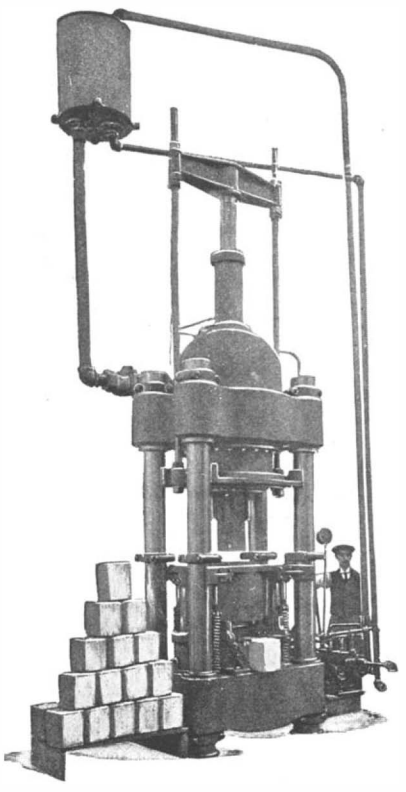
Electric cell which reacts to pressure changes, with recording apparatus

Artificial Rock Salt from Hydraulic Presses

By Frank B. McMillin

MANUFACTURERS and producers of both evaporated and rock salt have long appreciated the prevention of waste and the convenience in handling and shipping that would result from the development of efficient and profitable methods of producing commercial salt blocks of uniform size, weight and density.

Both evaporated and rock salt are secured from the same source, evaporated salt being originally rock salt. Rock salt is taken out the same manner as coal, a shaft being sunk and the salt removed in lump form. Similarly it passes over screens for obtaining different grades for various purposes. Evaporated salt is obtained by drilling a hole into the rock salt bed and casing the hole in the same manner as producers of petroleum and natural gas case their oil and gas wells. Tubes are sunk into the casing and the latter sealed at the top. Water is then pumped through the casing down into the salt bed for dissolving the salt, the resulting brine being forced out and evaporated.



Hydraulic press for making rock salt artificially

The natural block of rock salt, as it comes from the mine, is used for stock feeding purposes because it is slow to evaporate and does not easily break up. The crude blocks are thrown into the field and left for the stock to lick at their will. However, with all of the apparent advantages of rock salt, there is considerable waste in mining and handling the natural block. When removing the natural rock salt in large lumps and breaking it up in many smaller pieces and screening it, much loose salt results which in its natural state is unsuitable for commercial purposes. There being no way to dispose of this, it has been left to accumulate in piles outside of the mine. This waste salt becomes a menace to surrounding territory, because the rains wash the brine out and carry it away to destroy the producing value of the farm land and impair the natural value of the fresh water streams.

So serious had this situation become in rock salt centers that it attracted the attention of the federal government as well as individuals in the affected territory. Thought was turned to methods of disposing of the waste salt; and by extensive experiments it was found that loose salt could, under heavy pressure, be easily made into solid blocks of uniform size, density and weight which would have no tendency to disintegrate from the effects of the weather in the open field. The only action of water on such a block is to wear it away very slowly by dissolution from the outside. When the block becomes wet and is again dried, it appears actually to be much harder than before the moisture came in contact with it.

When it was found that a good solid block of uniform size and weight could be easily made from loose salt, evaporated salt manufacturers at once saw an opportunity to dispose of their waste and off-grade salt as well as a part of their standard product for a purpose and formerly monopolized by rock salt manufacturers. That the artificial salt blocks are much more satisfactory from every point of view than the natural blocks is evidenced by the fact that rock salt manufacturers are making artificial blocks in preference to the natural ones. Blocks made by the hydraulic press are equally satisfactory whether they are made from evaporated salt or rock salt.

In the development of the production of artificial salt blocks the hydraulic press and pump manufacturer has stood foremost. Much experimental and development work was necessary to arrive at a design of hydraulic press which would produce a salt block of uniform size, weight and density. Such a press is now designed and built, and has given complete satisfaction in operation. The accompanying photograph is a reproduction of this machine, which is built in two sizes, one having a pressure capacity of 1,000 tons and the other 750 tons. The salt is compressed in a mold into a compact block of uniform density approximately 8¼ inches square by 12 inches high. The salt block is removed from the mold by hydraulic pressure, and is then ready for immediate shipment or storage.

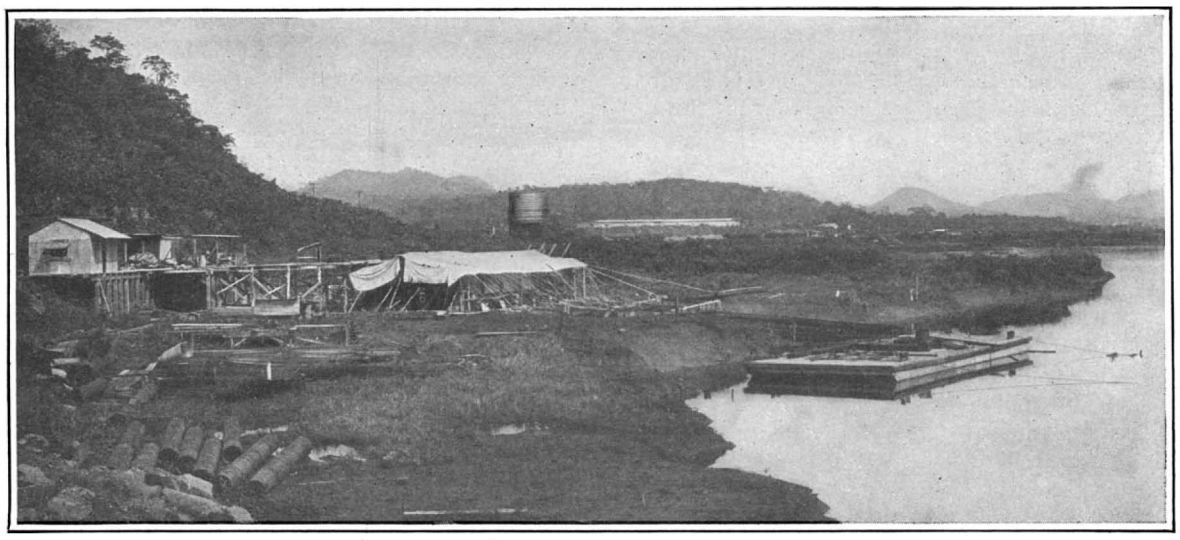
Among the advantages of the artificial salt blocks thus produced are mentioned the absence of the sharp shale fragment which cut the mouths of stock feeding on the natural blocks. Also, it is so much denser than the natural block that it lasts longer and stands up better in the open field. The uniformity of size and shape is of great aid in packing. Finally, the artificial salt block affords an ideal vehicle for sulfur or other medicaments.

Ships of Stone

APPARENTLY an international controversy has arisen over the question as to which country put into operation the first stone or concrete ship. While the United States does not claim priority in concrete-ship construction, it did, through its Isthmian Canal Commission, construct in 1910 three concrete barges for use at Panama. These were 64 feet long by 24 feet wide, having a depth of 5 feet, 8 inches.

At the time the statement was made that while the construction of barges from concrete was not a new idea, it was not known to have hitherto been attempted in American engineering. Concrete barges had been successfully used in Italy as well as a type of concrete vessel similar to the New York ferryboats. The plans of the Pacific Division barges contain numerous modifications from the Italian type, some to meet local conditions and some because of the continual improvement in concrete construction methods.

It may be worth noting that two concrete scows 112 feet in length and 28 feet in beam were built at Fairfield, Md., in 1912 and 1913. These vessels are still in commission.



The first concrete vessel built by the United States Government, in the waters of the Panama Canal. At the left under the tarpaulin another is under construction

Strategic Moves of the War, November 9th, 1916

By Our Military Expert

THE principal military events of importance during the past eight or ten days have been the reoccupation of the "Fort de Vaux" by the French, the new offensive on the Italian front and the sharp though indecisive fighting in Rumania.

The political situation has been somewhat enlivened by the interview credited to Von Hindenburg and the issuance, by the Central Powers, of a decree of independence for Poland. It is not believed that the military situation will be materially affected by either.

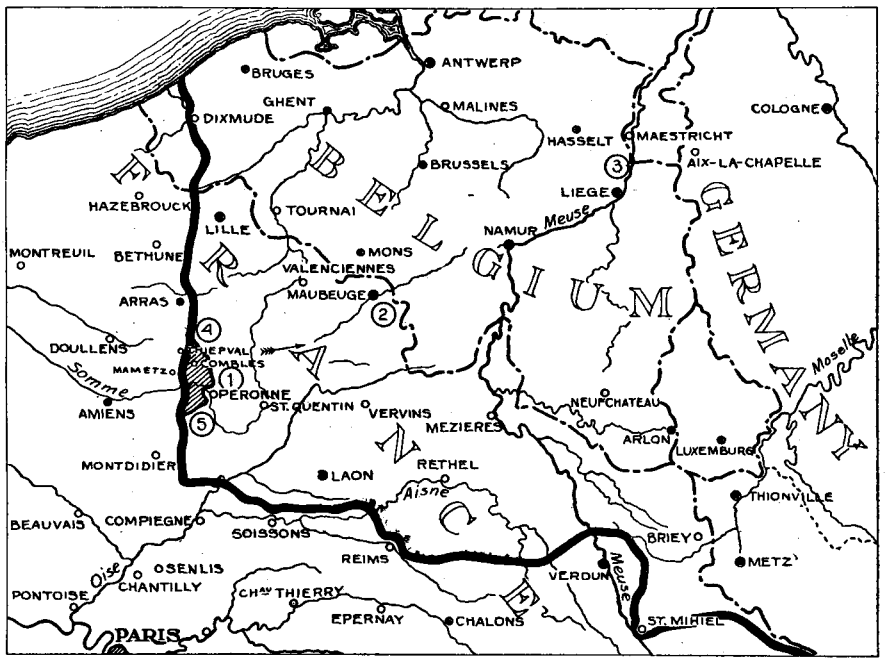
On the Verdun Front

Severe fighting continues around the positions recently retaken by the French northeast of Verdun. The advantage, which at date of writing is slight, appears to be on the side of the French.

While the territory retaken from the Germans represents, in area, but a small portion of that which fell into their hands as a result of the great Verdun drive, its possession is of great importance to the defenders of this famous fortress. This importance has a moral as well as a physical side. On the physical side we see that the French Army under General Nivelle has been able, at a comparatively small cost, to recapture about ten square miles of territory containing a number of important points—Douaumont, Vaux and Damloup—of the greatest advantage to the defenders of Verdun, while in the hands of the attackers they were a constant menace to the security of the French lines of defense. In the early part of this year the German Crown Prince decided to capture Verdun, and with that end in view started a campaign that soon developed into a conflict of unexpected magnitude, and one in which the ferocity of the attack, the tenacity of the defense, the expenditure of war material, and the number of casualties has never been equalled. It has been estimated that the campaign of Verdun cost the Germans 500,000 men in killed, wounded and captured. After eight months of constant fighting, the German Army holds the greater part of the territory captured during the struggle, but the essential points, the prize that the German Crown Prince's Army was fighting for, have been retaken by the French at a relatively small cost.

Berlin tells us on the second of November, when Fort Vaux fell, that the positions that were worth 500,000 men as late as last July, had so depreciated in military value as to be, then, not worth the number of men that might be lost in defending them, and therefore they were "evacuated without being molested by the French." General Nivelle reports the French losses to have been 4,000 killed, wounded and missing; he also reports taking over 5,000 German prisoners.

Taking into consideration the fact that the French troops have been able to keep up a progressive offensive on the Somme front at the same time, the moral advantage won in this Verdun campaign seems to be very much on the side of the French armies.



The Western fighting line from Verdun to the sea

The shaded portion of the line east of Amiens shows Franco-British gains on the Somme. The arrow indicates the general direction of advance.
(1) Section of the Allied "push" into the German line.
(2) Maubeuge, on the Mons-Maubeuge-Avesnes line, a railway center and distributing point, about 50 miles from Allies' advanced line.
(3) The south-eastern corner of the frontier of Holland, about 75 miles from Maubeuge.
(4) Approximate location of Beaumont-Hambel. London reports that on Nov. 8 a German attack on this part of the British line was repulsed with severe losses inflicted on the attackers.
(5) Chaulnes. Paris reports, and Berlin admits, French gains in that section. Scale of map, 1" = 33 miles.

On the Somme Front

There is no rest in the fighting on this particular front. Both sides report slight advantages, captures of prisoners, etc. It is difficult to indicate on the map exactly where the fighting line is located, but by carefully noting the gains claimed and the losses admitted, we can see that the Allies are still pushing their wedge into German-held territory. London reports the British end of the line as improving its position east of the Buttes de Warlencourt. Paris reports slight successes in the neighborhood of Ablaincourt. The advance appears to be slow but constant; it cannot be called "a drive" within the generally accepted meaning of the word, and we do not know that it was ever intended to be such. Our daily papers seem to have fallen into the habit of describing tactical and strategic movements by names that are apt to give an erroneous idea of the nature and purport of the movement under consideration. The term "drive" and the verbs "to smash" and "to hurl" have been used recklessly to describe almost all military movements, from a simple attack to an invasion. According to certain reports, armies are constantly being "hurled" at or out of a given position, generally without commensurate results.

I note in one morning paper, the report that Mackensen is being "*hurled back*" in the Dobrudja. I cannot conjure a mental picture of the tenacious and skilful Mackensen being "hurled" in any direction except that in which he has decided to proceed. Mackensen should be compelled to evacuate the Dobrudja. I expect to read before very long that this movement has begun and that Mackensen is fighting doggedly for every mile of the way.

Of course the unexpected may happen and the pushing process on the Somme may find a weak point or succeed in wearing out the defenders and the push may suddenly become a drive in the full meaning of the word. This is possible but not probable.

The Allies' objective in this section has not been announced, but a study of the map indicates that this objective is probably located beyond the line of Cambrai-Maubeuge, along the valley of the Sambre to that of the Meuse. This is one of the most important sections of the German lines of communications. It contains several trunk lines of railroads, with branches radiating to the north, west, and southwest, over which flows a constant stream of men and supplies from the central depots in Germany to the fighting line extending from near Craonne north of the Aisne to Nieuport on the North Sea. A successful and fairly rapid Allied advance along the line indicated would so seriously endanger these communications and avenues of supplies as to compel Germany to withdraw her troops from all the territory north of that line. This withdrawal, in order to be successful would have to begin at about the time the Allies reached the line of Mons-Maubeuge-Avesnes. This is quite evident when one realizes that the distance between Maubeuge and the nearest frontier of Holland is only about 75 miles in a straight line and that most all the railroads that would have to be used for the transportation of troops and material are running in a southerly or southeasterly direction, which is also the direction that the German "containing troops," delaying the Allies' advance, from the northwest, would have to take to re-enter Germany. The City of Namur is about midway on the direct line from Maubeuge to the nearest frontier of Holland, the distance from Namur to the coast of Belgium, to the North, is over 100 miles; to Dixmude, over 95 miles and to Lille about 82 miles. There may be more sound strategy involved in the Somme operations than appears at first glance.

The question may be asked, "would Germany hesitate to violate the neutrality of Holland in securing a safer line of retreat; this in view of what happened to Belgium?" My answer would be, "yes," Germany would hesitate to do this for the following reasons: A victorious, conquering Nation, supremely confident of her power to dictate the final terms of peace may not hesitate to trample under foot the weaker nations that may stand between her and her goal; but the same nation, the tide having turned against her, and being no longer confident of ultimate victory, will have more respect for the rights of neutrals and will refrain from even appearing to disregard these rights. She may be glad to have the good will of her little neighbors when the accounts are being settled.

Russian Front—Galicia, etc.

Fierce fighting is reported to have taken place at several points along the line of trenches but no decisive gains seem to have been made by either side. The cold weather is bound to restrict operations more and more along this entire front as time goes on.

What was intended to be a political bombshell of the largest calibre was recently thrown into the allied camps by the Central Powers in the form of a decree of independence for Poland. It is yet too soon after the explosion to make even an approximately correct estimate of the damage done. There are many angles to the proposition. The effect on the general situation at this time must be mostly psychological. It should be noted that the text of the proclamation, as published in our papers, applies only to the Polish territory "conquered by our brave Armies from Russian domination."

The Italian Front—East of Goritz

The opportunities for new strategic moves are comparatively small on this front. The Carso Plateau is rather narrow and not very long. It is bounded on the east by a mountain range that will offer difficulties greater than any yet encountered by the Italian Army, on that particular front, should they attempt to advance in a northeasterly direction. As a matter of fact there is, I believe, a great deal more smoke than fire in this quarter. The ultimate objective of the Italians seems to be Trieste and the Istrian peninsula. After more than a year's fighting they are still a long way from their goal.

In my opinion, the Italian Army will make no attempt to gain territory east of the Julian Alps. It will confine its operations to the provinces of Goritz and Istria, and this, I think, will give the Italians all the work that they seem to be able to handle.

Nothing short of a complete collapse of the Teutonic defense on this as well as on other fronts will start the Italian army on the road to either Vienna or Budapest.

On the Balkan Front

There appears to be a lull in the military operations in the Dobrudja. Mackensen's offensive seems to have come to a stop. I do not expect it to be resumed in the near future. As long as the Danube continues to flow, Mackensen's lines of communication in the Dobrudja are practically safe from attacks by the Rumanians on his western or left flank. The same obstacle protects Rumania proper from Mackensen's army. The natural field of operations for the present at least, must be confined to the Dobrudja territory. This naturally limits Mackensen's operations to a further advance in a northerly direction, or to the occupation of the territory he is now holding in order to keep the Russo-Rumanian forces out of it and prevent them from using it as a base for future offensive operations against Bulgaria. This is about all the Teutonic strategy can hope to accomplish in this quarter. In the case of the Russo-Rumanian armies, strategy offers greater possibilities and we may look for a reversal of roles in the Dobrudja. I suggested last week that it was within the probabilities that a reorganization of the Russo-Rumanian forces would take place. A recent press despatch from Bucharest announced the arrival in that city of Lieutenant General Vladimir Sakharoff, commander of the Russian forces in Galicia, for the purpose of taking command of the Russo-Rumanian army in the Dobrudja.

There is also an unconfirmed rumor to the effect that the Grand Duke Nicholas has been, or is to be re-

(*Concluded on page* 466)

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.]

A Defense of the Steamer

To the Editor of the SCIENTIFIC AMERICAN:

May I infringe upon your space to reply to the letter of "A Rider in a Steam Car" appearing in your issue of Oct. 28? I am owner of a steam car, and often find people ready to ridicule this type of conveyance on general principles, and in complete ignorance of that of which they speak. The notion held by such persons that the steam car is to be identified by its trail of smoke and poisonous vapor is as out of date as the One Horse Shay spoken of by this particular member of the genus.

Of course, if one wishes to compare the old time steamer with the latest gas car, the benefits of the parallel can run only one way; but that is beside the point, although probably indicating where the state of mind of which I complain has its origin. The latest steamer, however, has exactly fifteen moving parts in its engine; it makes 15 miles to the gallon of kerosene, 1400 miles on 15 gallons of water, 8000 miles on a single gallon of valve oil. As for vile smell, there isn't any, and that is all there is to say about this point.

As for being a complicated steam engine requiring a technical training to operate, I would say, that whether one has a steam car or a gas car, one has to learn how to operate it. You can't step off the street into a car and run it, as though it were a wheelbarrow or a wringer. And the steam car is easier to master and simpler to control. As evidence of this I need only point out that you will usually find the driver of a steam car doing his own minor repairs, while the average gas car man has to rely upon the expert at the garage to diagnose and remedy the most trifling ills. I have a steamer which I have been driving since it was new in 1908, at a total cost for repairs of $1.55, outside of four tires and a few small parts, value perhaps $5.00, which I have made myself. Although I have pulled many a gas car out of bad holes, I have never broken down on the road myself or been towed in.

I will admit that it takes time—say fifteen minutes, on the old models—to get steam up; but that is a trifle compared to cranking your gas car for half an hour in the rain when the starter refuses to work. And the latest steamers start from the seat in a minute and a half from the cold.

How anyone can fail to see that in its inherent principles the steam car is simpler than the gas car escapes my comprehension. For one thing, it does not demand that its fuel be in a stated condition; and it has no complicated carbureter to go wrong and upset that condition. And in every other essential feature the principles underlying the steam engine are simpler and more direct than those of the gas engine. Let "A Rider in a Steam Car" come out of his rut and cast off his prejudice; let him enlighten himself on the true status of the steam car—to-day, not ten years ago; and he will then surely have to revise his opinions.

ELYRIA, OHIO. CLINTON WADSWORTH.

The Navy's Need of Dry Docks

To the Editor of the SCIENTIFIC AMERICAN:

Your recent description of our latest super-dreadnoughts, the Pennsylvania, Arizona and their sisters, suggests the query whether our pride in their size and power ought not to be somewhat tempered by the thought that we have so far failed to provide any suitable docking facilities for them on our Atlantic seaboard.

I understand that the only drydocks which can take them are those at New York and Norfolk and the inadequacy of the approaches to those docks is well set forth in the following quotations from a recent essay by Commander Earle, U. S. N.:

"In January, 1915, the super-dreadnoughts of the Arkansas class, on account of low tides, were compelled to remain at the New York yard two days after the date set forth for their departure before there was sufficient water in the channels to permit them egress to the sea. Again in December, 1915, one of these same vessels waited six days off Tompkinsville before there was sufficient water in the channels to permit her to proceed to the navy yard. Yet, this yard is presumably the most accessible one on the Atlantic coast, and the vessels are ones of a normal displacement of only 26,000 tons."

"The channel abreast the Norfolk dock is but 525 feet in width, so that docking a large battleship is hazardous business and a fine seamanlike bit of work. The Pennsylvania has been docked and undocked at this yard by placing her diagonally across the channel and at an angle to the length of the dock. The slightest mishap would result in serious damage to the vessel."

It would seem important to give publicity to these matters, so that our people, to whose initiative alone any improvement in our Navy will be due, shall be informed as to its needs and see to it that their Congressmen are instructed to provide for them.

Hoping that we are in accord in this view of the matter, I am,

Very respectfully,

EDMUND M. PARKER.

"Pouring" Concrete

To the Editor of the SCIENTIFIC AMERICAN:

On page 368 of the SCIENTIFIC AMERICAN for October 21, we find a very fine article entitled "The Up-to-Date Method of Pouring Concrete."

Some time ago we took the word "pouring" from our concrete dictionary and are using our best efforts with the hope that it may be eliminated by other writers on concrete subjects.

Considerable experimentation has determined quite conclusively that the amount of water used in concrete effects to a very considerable extent the strength obtained. Beyond a certain reasonable limit, the addition of water becomes quite detrimental to the strength. This immediately points out the reason why we have discontinued the word "pouring." To pour a material naturally implies that it be in a somewhat liquid state. The kind of concrete which can be poured will not give the best results. The word "placing" or "depositing" in our opinion is a very satisfactory word and does not have the disadvantages of the word "pouring."

If you agree with us on this subject, any editorial comment which you might make will be very greatly appreciated. If you are not convinced of the statements set forth in this letter relative to the lowering of strength due to excessive water, we shall be glad to quote references.

CHICAGO. W. M. KINNEY.

A Submarine Query

To the Editor of the SCIENTIFIC AMERICAN:

Having been a reader of the SCIENTIFIC AMERICAN for 30 odd years and noting that in the past 10 or more years you have been shouting "big navy," "big ships," I was interested to see that in your editorial under the title of "A Warning," page 384, issue of October 28th, you state that the German submarines could come over here and destroy the entire United States Navy. To quote your words, you say:

"And if such a raid were made, say by a dozen submarines, the loss of our whole first fighting line of 21 dreadnoughts in the brief space of 15 or 20 minutes would be a perfectly reasonable possibility."

The question immediately arises, of what use is it to build a fleet of dreadnoughts that can be sunk in 15 or 20 minutes?

And the next question is, that if the German submarines could do this, why do they not sink the entire British fleet?

I think that all of your readers would be interested to have you answer this question without any "sidestepping."

PALMER H. LANGDON.

[The answer to the above is that if proper precautions (patrol boats, nets, etc.) are taken, a fleet of dreadnoughts will never be sunk; as witness the British and German fleets.—ED.]

The Number of Primes and Infinite Assemblages

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue of your paper the question was raised as to whether there is a finite number of prime integers, and you stated that you "would not say that there is an infinite number of prime numbers, since there is only an infinite number of numbers altogether, and some of these are multiple numbers."

Now if the number of primes is finite there must be a last prime, say P. Then form the number N = factorial P = 1.2.3.4.5..... (P-1).P. Adding 1 to both sides of this equation we get the number N + 1, which is prime, since whatever number you try to factor it with, there is always a remainder of 1. Hence there is no greatest prime, and the number of primes must be infinite.

Cambridge, Mass. DAVID GREGG.

[Our correspondent is correct in his statement. While his proof requires a bit of amplification to make it absolutely rigorous, the facts are as he states. The argument which he quotes from our "Notes and Queries" column is altogether fallacious, for it ignores the fundamental fact distinguishing an infinite assemblage from a finite one; namely, that a part of the former may be "equal" to the whole, in the sense that its elements may be put in one-to-one correspondence with those of the whole. Thus, there are just as many positive integers divisible by 97 as there are positive integers altogether, since for every positive integer x there exists a positive integer 97x. Name x and you determine 97x. The fact that the ordinary intuitional arguments which we make for finites break down in many cases when we attempt to apply them to infinites has long been recognized by mathematicians.

EDITOR.]

Measuring the Heat Value of Fuels to the Thousandth Part of a Degree

THERE was a time—and that, not so long ago—when the purchaser of fuel was well satisfied with his purchase after making sure that the amount ordered, whether it was measured in pounds, tons, or gallons, was delivered to him in full. But in these days of scientific management the large purchaser of fuel is no longer contented with the knowledge that he has received the full measure in bulk; for, he argues, the object of purchasing fuel is to obtain a certain amount of heat and power rather than so many units by weight or liquid measure. Pounds, tons, or gallons are meaningless terms to the modern fuel purchaser, except when translated into heat and power units.

In measuring the heating value of fuels an instrument known as the calorimeter is employed. Its principle of operation consists in imparting the quantity of heat to be measured to a known mass of water or some other suitable substance which is placed in a vessel or calorimeter of known thermal capacity, and observing the rise in temperature of the water or other substance.

Our front cover illustration for this issue represents the modern way of measuring the heat value of fuel by means of a Berthelot-Mahler combustion calorimeter. The fuel to be tested is placed in a steel reservoir or bomb, which is then hermetically sealed. The latter consists of a heavy steel casing with a screw top, and lined inside with a non-corrosive surface such as platinum. Passing over the fuel is a fine wire of platinum or iron, through which an electric current is passed at the desired moment. The bomb, by means of a valve in its cover, is charged with compressed oxygen from a tank, following which it is placed in the calorimeter chamber.

A thermometer graduated in hundredths of a degree permits readings to be taken of the water in the calorimeter chamber at frequent intervals, until the temperature is practically constant. The electric circuit is then closed, causing the incandescent wire within the bomb to fire the fuel. The heat from the combustion is imparted through the steel walls of the bomb to the water in the calorimeter chamber, and from the rise in temperature of the known weight of water the quantity of heat can be deduced. Such precautions as the careful heat insulation of the calorimeter chamber and the constant stirring of the water or other liquid are incorporated in the test, in order to insure the greatest accuracy. The thermometer is read by means of a high-powered telescope, so that the thermometer reading can be estimated to the one thousandth part of a degree. This is precisely what the man at the right of the picture is doing, while his assistant at the left is turning the stirring device.

Europe's Largest Dam the Work of Americans

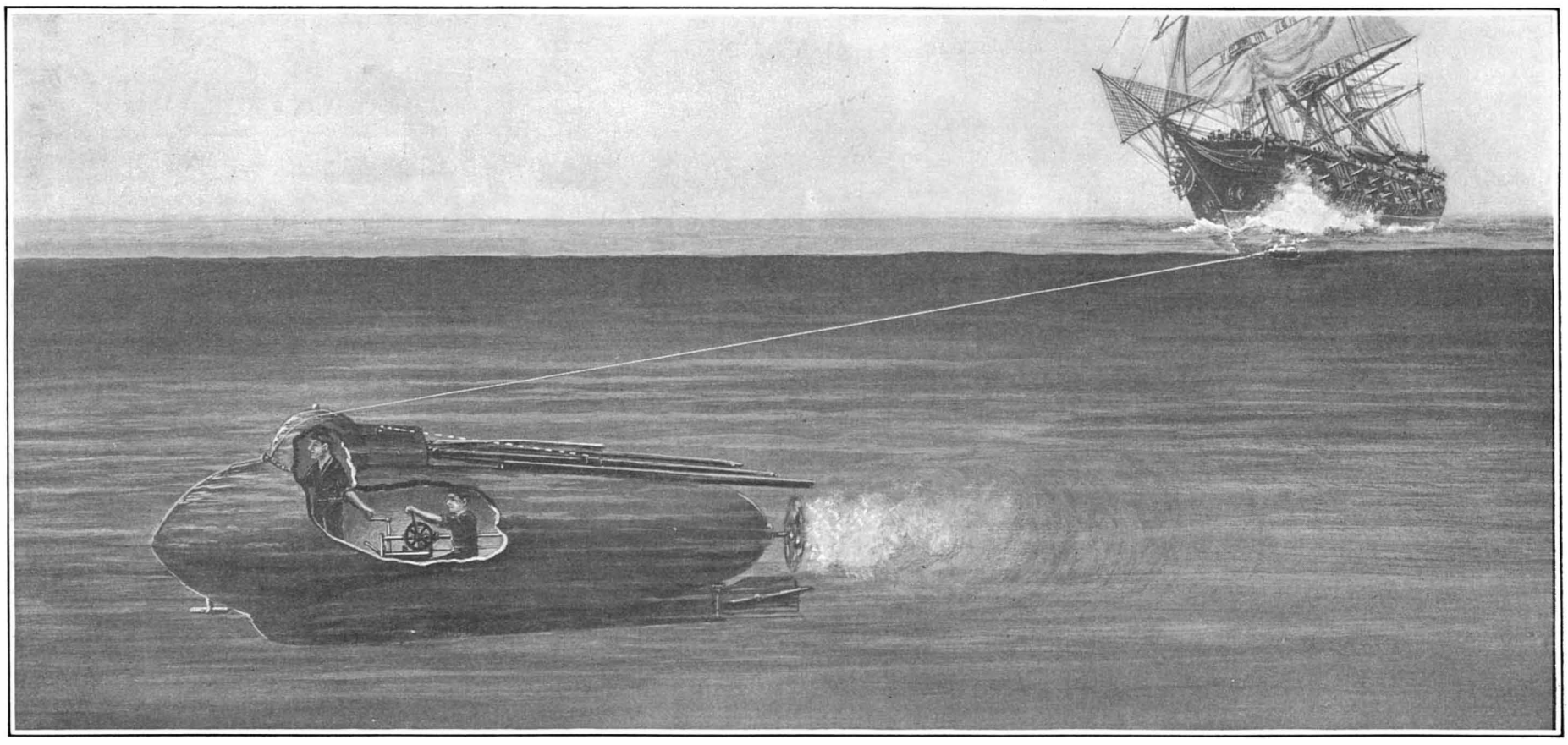
THE largest dam in Europe, just completed in the Barcelona consular district of Spain, is the result of the work of American engineers and experts. It is built across the chasm through which the Noguera Pallaresa River flowed, and is situated near the old fortified town of Talarn. Abutting on almost perpendicular cliffs, the dam is constructed of concrete and measures 330 feet in height and 700 feet in length. The thickness is 230 feet at the base, gradually decreasing to 14 feet at the top.

The valley above the dam was bought from the various landholders at a cost of nearly $1,000,000, and now filled with water forms an artificial lake 15½ miles long and 3¾ miles wide. The floodgates are so carefully balanced that they open automatically under the pressure of a rise of one inch of water. The natural formation of the rock near the dam has been utilized to provide a spillway with a capacity of 70,000 cubic feet of water a second.

The dam has a twofold object in the production of electric power and use in irrigation. The water that now passes through the power house yields an electric current of 20,000 horse-power. Later it will be increased to 40,000 horse-power. The water is carried by a system of canals into an arid district, where it irrigates a surface of nearly 100 square miles.

The cement used in the construction of the dam was made on the spot from limestone and marl found within a short distance and transported by a temporary railroad. The cement-making machinery, stone crushers, mixers, etc., were brought from the United States, as well as considerable quantities of the other machinery and parts employed in building.

An obstacle that had to be overcome in this construction work was the lack of communication. This necessitated the running of a telephone line from Barcelona to the dam and the building of a road more than 11 miles long, part of which was cut through a canyon at heavy expense. Over this road two traction engines hauled the building material on platform cars of American manufacture.



Method of torpedoing a hostile ship employed by the "Nautilus," Fulton's first submarine

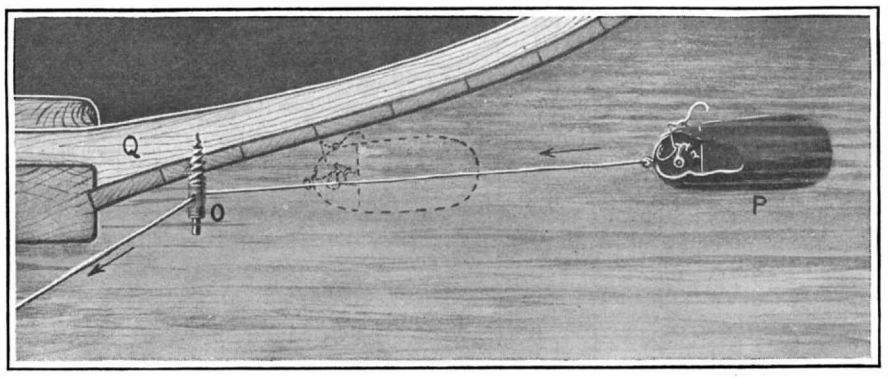
When Fulton Suggested Submarine Warfare

Is the History of More Than a Century Ago Being Repeated In Part Today?

SIX score years ago the British navy was threatened with submarine warfare not unlike that waged against it since the opening of the present European conflict; and the submarine then available was as formidable a weapon against the wooden fighting ships of the period as the most modern under-sea-boat is against our present-day steel battleships. Just how effective the submarine would have been against the British fleet—then as now the mistress of the seas—will never be known; but the probabilities are that it would have had a decided effect upon the map of Europe and perhaps of other continents for centuries thereafter. It was largely the decision of the French government that the submarine was an unethical weapon that largely prevented its use then, and nothing else.

The treaty which France signed in 1797 left her free from war with the coalition of European powers except England, whose fleets still faced France and blockaded French ports. At this time came Robert Fulton, an American artist residing in Paris, to offer his plans for a means of attacking the blockading British ships.

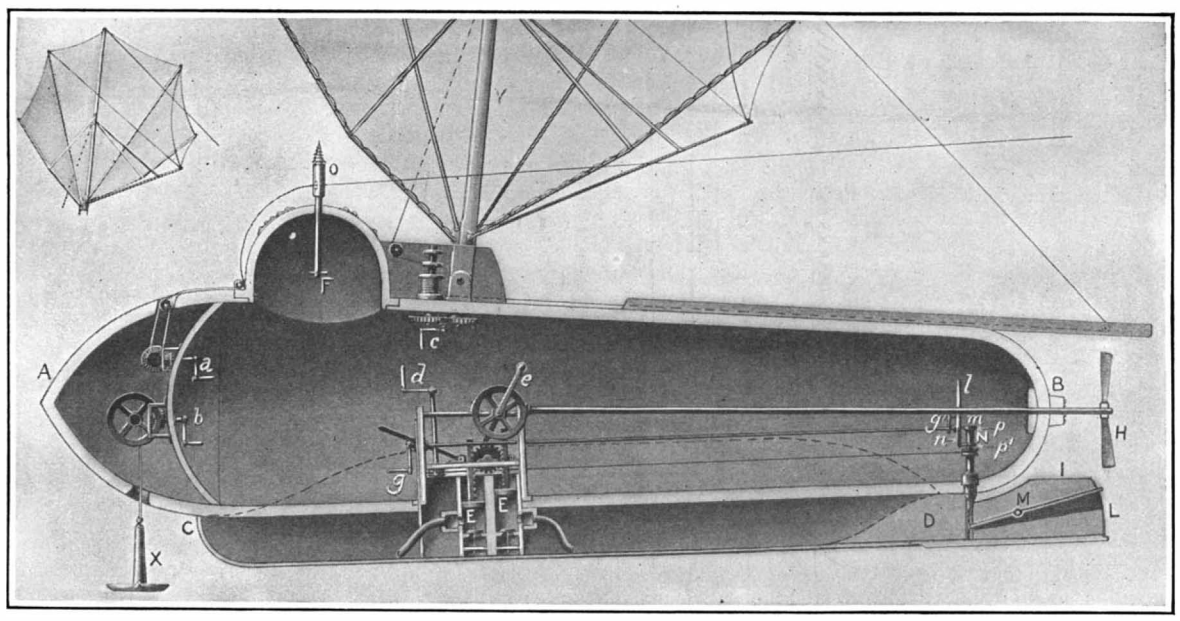
Fulton had just invented his submarine, the "Nautilus," which was as different from the previous crude efforts at submarine navigation as can be a weapon methodically worked out and carefully designed. It was in 1797 that he addressed a letter to the officials in which he offered the proposed "Nautilus." He stipulated that the French government was to agree to pay to his company the sum of 4,000 francs per cannon for every English warship above 40 cannon which was destroyed, and 2,000 francs for every English warship under 40 cannon. The amount was to be paid within six months after the destruction of the vessel. All war vessels and commercial vessels captured by the "Nautilus" were to become the property of the company. The French government was to give the company exclusive monopoly for the submarine invention, except if the former wished to build its own submarines, in which event it was to pay the company 100,000 francs for each "Nautilus" constructed for the service of the Republic. The French government was not to employ the invention against the United States, unless the latter first employed it against France. If peace were to be concluded with England before three months from the date of the letter (December 13th, 1797), the government was to pay to the company the expenses incurred for the experiments. If England purposed to execute the members of the crew of the "Nautilus" captured in the course of the warfare, France was to make reprisals on English prisoners.



Fulton's towed torpedo, just prior to striking an enemy ship

The torpedo or mine *P*, is towed by a rope passing through an eye in the barbed spike *O*. The latter is embedded in the wooden bottom, *Q*, of the warship.

The Minister of Marine accepted Fulton's offer, but believed that the sum asked for the destruction of English ships was too high and accordingly cut it in half. The offer to pay the company in the event of peace before three months was refused, except if the peace was attributable to the fear inspired in the enemy by the use of the submarine. Authorization was given to construct as great a number of submarines as were judged necessary for an effective campaign, and it was stipulated that the construction of the craft was to be carried on at a point far removed from all war ports. But the Minister of Navy did not believe that it would be possible to give commissions to the men engaged in this method of destroying enemy warships, and that even if commissions were given they could not be considered as guarantees for the men. As for threatening the English government, the Minister of Marine pointed out that this procedure would be ineffectual, since England held three times as many prisoners as France. Then there was the matter of neutral opinion: all countries at the time were adverse to the use of mines and mine warfare. However, various conditions were drawn up in the form of a contract between the government of France and the submarine inventor.



Sectional view through the "Nautilus," built in 1800

The parts of this forerunner of the modern submarine are as follows: *A B*, the shell or hull; *C D*, the iron keel; *E E*, pumps for regulating the submergence of the craft, by taking on or throwing out a small amount of water from the ballast tank; *G*, bulkhead cutting off the forward compartment, *G A C*, from the remainder of the interior, and mounting the cranks *a* and *b* which control the anchor, *X*, and the floating mine, through individual windlasses; *F*, handle attached to the barbed spike, *O*, which is thrust into the wooden hull of an enemy warship; *H*, screw propeller operated by hand power applied at *E*; *L*, ordinary rudder manipulated by handle *d*; *I*, submerging rudder, pivoted at *M* and controlled from lever *g*; *c*, mechanism for raising and lowering the mast and sail *Y*.

The Forerunner of the Present-Day U-Boat

The "Nautilus" was to be made in the form of an imperfect ellipsoid, with an exterior length of 6.48 meters (about 22 feet) and a largest diameter of 1.94 meters (about 6½ feet). Fastened to the bottom of the submarine body was a water ballast tank, which ordinarily contained a quantity of ballast just sufficient to make the difference between the weight of the craft and the weight of the water displaced a matter

of some five to ten pounds. The water ballast was taken into the tank and pumped out later by means of a simple double-cylinder pump, which was operated by handpower through suitable gearing. Since the buoyancy of the "Nautilus" was but five to ten pounds, it was necessary only to introduce a small quantity of water into the ballast tank to cause the craft to settle beneath the waves; and reciprocally, only a small amount of water had to be expelled to bring the craft back to the surface.

Up forward was the conning tower section pierced with thick glass windows. Here stood the submarine skipper. Directly in front of the conning tower section, or about 3 feet from the prow, there was a bulkhead of iron which served to form a compartment in front, containing the apparatus for handling the mushroom anchor, and the windlass for the torpedo. These two mechanisms could be handled from the interior of the craft by means of cranks. The stem of the anchor came up into the forward compartment, so that the anchor was out of the way when the "Nautilus" was in motion.

The propulsion of this pioneer submarine was obtained by means of a screw propeller. Borrowing his idea from Bushnell, Fulton also employed man-power for turning the propeller. Applying this power through gearing he obtained a top speed of 240 revolutions per minute, and 120 ordinarily. The blades of the propeller were about 2 feet high, making the diameter somewhat over 4 feet.

The rudder, placed in the rear as on any ordinary vessel, was about 3 feet long and not quite a foot in height. It was manipulated by means of a crank within convenient reach of the skipper in the conning tower. A second rudder, designed to aid the craft in submerging, or, more exactly, to maintain it at any desired depth by limiting the upward and downward movements, consisted of two inclined planes turning on a pivot passing through the vertical rudder. The manipulation of the horizontal rudder or plunging rudder was effected by the employment of a gear wheel and a crank within convenient reach of the skipper.

The offensive weapon of the "Nautilus" was in the form of a torpedo composed of a barrel of copper containing a heavy charge of gun powder. The forward end of the torpedo carried a delicate primer designed to fire the charge at the least shock. The barrel was towed by means of a rope passing through the eye of a rod fastened in the hull of the enemy vessel, and attaching at the other end to the windlass in the submarine.

The "Nautilus," in order to blow up a ship, called for rather skilled seamanship. It had to be maneuvered about until the conning tower came directly beneath the wooden hull of its intended victim. Several blows delivered with the barbed spike by means of the handle protruding through into the conning tower, served to embed the spike firmly in place, following which the rod was disconnected from the barbed spike. The submarine then got under way, meanwhile paying out rope by turning the windlass at the front of the boat. When all the rope had been paid out, the motion of the craft was transmitted to the torpedo through the rope passing through the hole in the barbed spike, with the result that the torpedo was brought against the side of the enemy vessel with disastrous consequences to the latter.

A Question of Air and Illumination

The interior capacity of the "Nautilus" had been calculated at 10.37 cubic meters (about 460 cubic feet). Granting that the crew and the apparatus occupied one third of the available space, the designer figured that the air would suffice for three men for a period of one and one half hours under water. But recalling the fact that these men would require a candle or a lamp to illuminate the interior of the craft, which would materially increase the rate of vitiating the available air supply, the committee of experts reported that the six hours claimed by Fulton as the maximum duration of the air supply was certainly the maximum.

On October 17th, 1798, Fulton made a new proposition to the French government, following the report of the committee that had investigated his plans. The terms were similar to the terms of the first proposal, except in these particulars: first, the capture or destruction of the first British warship, proving as it would the importance of his invention, was to pay immediately to Fulton's order the sum of 500,000 francs (about $100,000) in French money, with which sum the inventor proposed building ten "Nautiluses" to be used in carrying out his campaign in a big way; second, that the government agree to pay him or his heirs the sum of 100 francs in specie for every pound of projectile of cannon carried by British warships destroyed by the submarines or incapacitated during the war. To make the second demand more precise: for a cannon of five-pound projectiles, for instance, Fulton was to be paid the sum of 500 francs; for a cannon of 10-pound projectiles, 1,000 francs, etc. The money was to be paid immediately following the receipt of reliable news.

The government did not take kindly to Fulton's second proposal, so the discouraged inventor went to Holland, believing that he might have better success in the latter country. But his success there was no greater than it had been in France, and upon hearing of Napoleon Bonaparte's nomination as First Consul of the French Republic, he decided to return to France. Arriving in Paris, he again took up his activities.

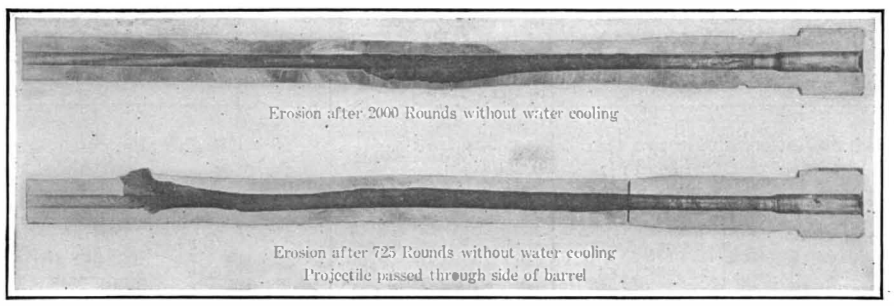
Fulton counted heavily on the moral effect that the destruction of the first English warship would have on the English people. He even contemplated the sinister and enormous moral effect on London's populace when the city found itself suddenly shut off from the outside world by a fleet of "Nautiluses." He even reasoned that France had nothing to fear from England by way of the latter also adopting submarines, since it would not be possible for two "Nautilus" fleets to combat each other; and France, having a good start on her adversary, could cause the starvation of England long before the launching of the first English undersea-boat. To the suggestion that the submarine might become a favorite craft of pirates, Fulton rejoined that they would be unable to sell their prizes, and hence their activities would be of little value to them. And while admitting that the submarine pirate might materialize, he suggested that the entire world would arise against this class of buccaneers and hasten their extermination.

The "Nautilus" and Her Intrepid Crew

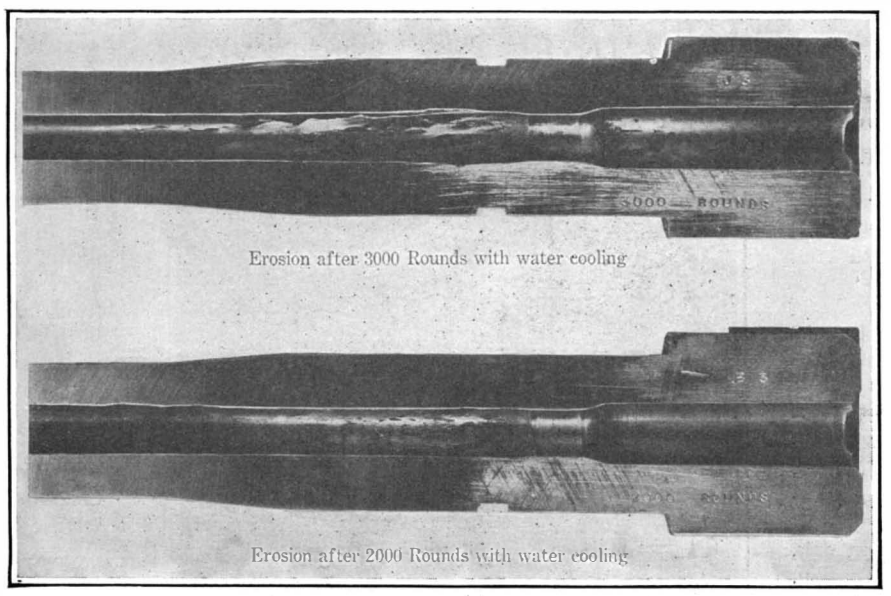
Authorization to build the first "Nautilus" was granted, and it was constructed in the shops of Perrier, mechanical constructor, at Rouen. By the beginning of July, 1800, the craft was nearly finished, and it was then that Fulton judged it necessary to bring about a modification of the design. According to Quesnel, then Commissioner of the Navy at Havre, the inventor added a sort of boat which formed a bridge or deck about 6 feet wide and 20 feet long, so that when the "Nautilus" was on the surface its appearance would be similar to that of an ordinary boat. Its immediate purpose was to permit the crew to come out of the hull and stand on the bridge, and it had no detrimental effect on the plunging qualities of the craft.

On July 24th, the "Nautilus" was launched. Five hours later it underwent the initial test, which was in the form of a submergence in 25 feet of water in the middle of the Seine River, near the city of Bapaume. With a crew of two other men besides Fulton, the "Nautilus" made two submergences, the first one of 8 minutes' duration and the second of 17 minutes. The entire test lasted three hours, during which the boat changed its position several times, due to the strong current of the river, which proved so troublesome that Fulton resolved to go to the harbor of Le Havre for further

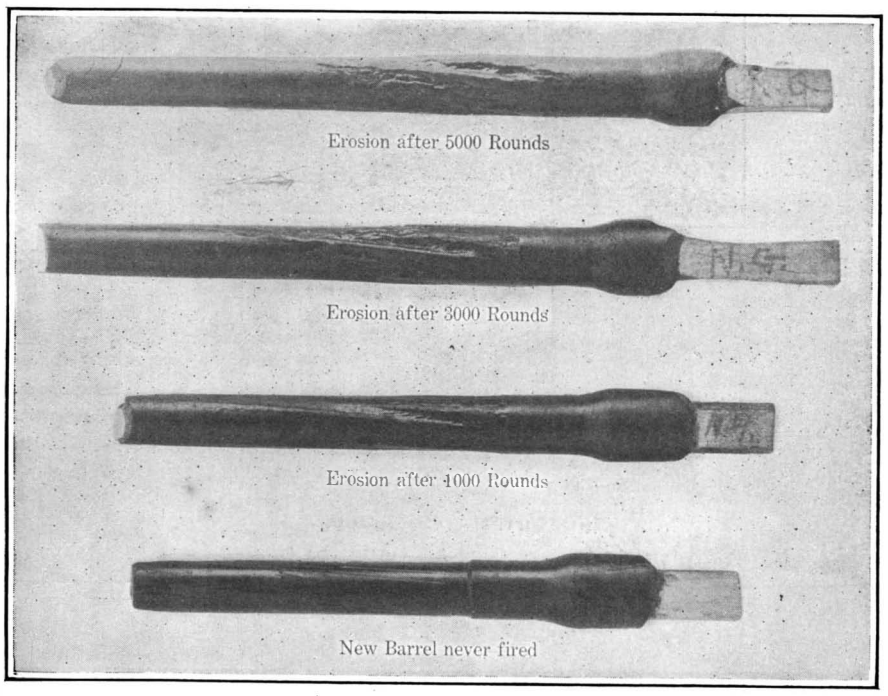
(*Continued on page* 464)



These photographs show that great care should be taken to keep the water jacket of machine guns filled



The benefit of water cooling in keeping down erosion is seen by comparison



Wax impressions of the barrel of a machine gun made during progressive firing up to 5,000 rounds

EROSION OF MACHINE-GUN BARRELS

The Erosion of Machine-Gun Barrels

BY the courtesy of the Chief of Ordnance, U. S. A., we are enabled to present a series of photographs showing the gradual destruction of machine-gun barrels, due to the action of nitroglycerin powder when the gun is being rapidly fired. After the tests were made, the barrels were sawn in two along the longitudinal axis. The accompanying photographs show the destructive results of failing to keep the water-jacket around the barrel of a Maxim machine-gun filled with water.

One of the sections shows a great enlargement some distance down the barrel after the gun had been fired 2,000 rounds without water. The next section shows what happened to a gun after it had been fired 725 rounds without water. In this case, the enlargement progressed to such an extent that the projectile tore its way through the side of the barrel.

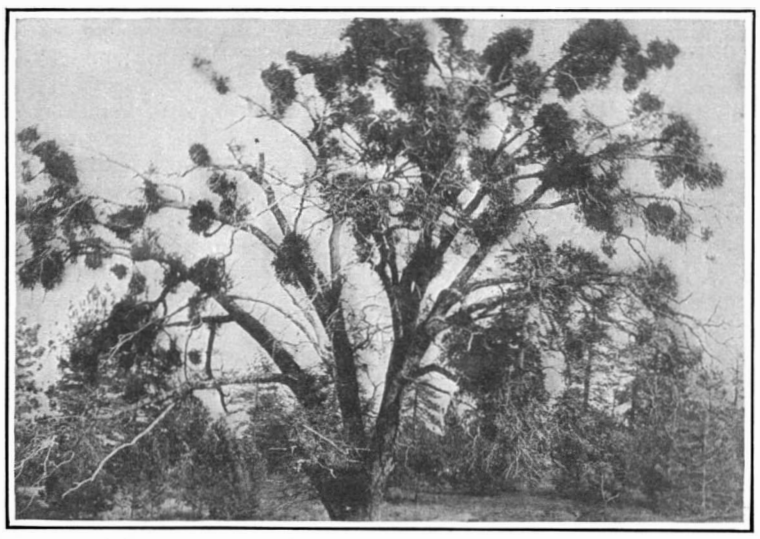
The next two photographs prove what a modifying influence a full jacket of water has in keeping down erosion. The first of these two photographs shows the condition of the barrel after 3,000 rounds in which nitroglycerin powder was used; the second photograph shows the erosion after 2,000 rounds under the same conditions.

The next three photographs represent wax casts of the bore and chamber of a machine-gun barrel. This particular gun was fired continuously up to 5,000 rounds. A wax impression was taken of the interior of the gun barrel before a shot was fired, and it will be noticed that the rifling appears clean and sharply cut—the slight irregularity at the upper edge of the cast being due to a defect in the wax.

Our next photograph shows the condition of the barrel after 1,000 rounds; the next after 3,000 rounds and the last is an impression taken after 5,000 rounds. It will be observed that the erosion commences with small pits at the seat of the bullet, which develop, after a large number of rounds, into continuous pits or regular channels. These gutters extend from the seat of the bullet, immediately in front of the cartridge case, for several inches down the bore.

A Bulb Planter

IT has recently been shown that, in the planting of bulbs, a great deal depends upon the depth at which they are placed. Bulbs that are put in at too great a depth in the soil are poor in development, and those which are not planted deeply enough appear too soon above the surface and suffer great injury on this account. An ingenious little device for the planting of bulbs insures that each kind is put in at the right depth. In a stake with a handle there are certain holes at intervals. Into these are placed projecting pieces of wood as shown in the photograph. When being used the stake is pushed down to the depth indicated by the outstanding slip of wood according to the kind of bulb being planted.



Festoons of mistletoe are fast killing this tree

Oregon pine covered with mistletoe

Mistletoe, an Insidious Pest, to be Exterminated

THE traditional mistletoe, which has been so sacred to the hearts of the young and old as a Christmas decoration the world over from a period anterior to the revelation of Christianity, has come to be termed by friends of trees in this country as not merely a parasitic or ordinary pest, but an insidious and destructive pest which should be exterminated. According to the government forest pathologists, who have concluded a series of investigations in various parts of the United States, mistletoe has caused losses of millions of dollars to our hardwood trees of the forests, shade and orchard trees.

Mistletoe is a leafy, green shrub commonly found growing upon various species of broad-leafed trees throughout the Southern States, and extending in more or less modified forms across Texas, southern New Mexico and Arizona, to Southern California, and thence northward in the coast region to Oregon and Washington. Eastward its northern limit is in New Jersey, southern Pennsylvania, southern Ohio, Indiana, Illinois, Missouri, and eastern Oklahoma.

It shows a strong attachment for the common oak, but it lives off most other trees, among them the pecan, hickory, post oak, bur oak, Texan oak, water oak, willow oak, blackjack, live oak, cedar elm, white elm or American elm, hackberry or sugarberry, osage orange, paper mulberry, sassafras, sweet gum, apple, pear, cherry, thorn, acacia, mesquite, water locust, honey locust, prickly ash, China berry, black gum, persimmon and water ash. It has also been known in the far West to grow upon the yellow pine, Douglas fir, lodgepole pine and cedar.

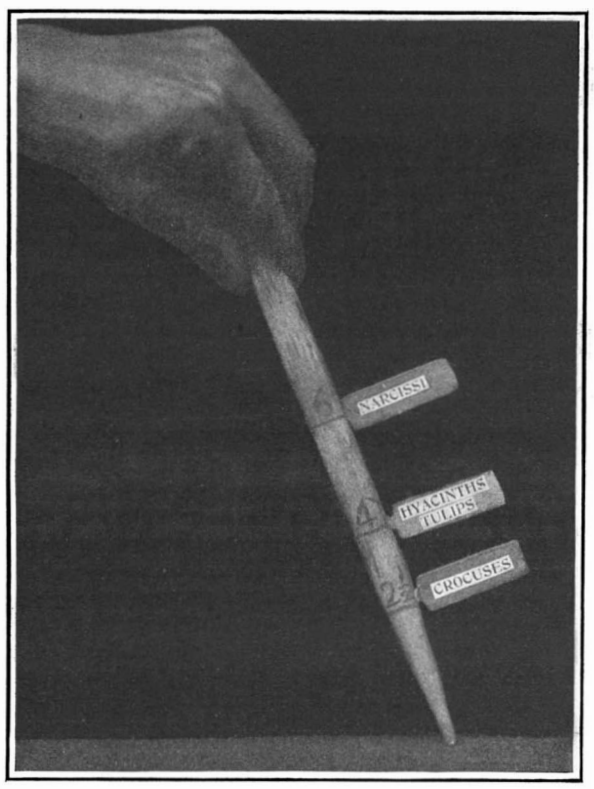
Naturally the mistletoe is a parasite. It fastens itself upon its host—the tree—penetrates its tissues, and draws nourishment from it, deforming and sapping its vitality. Yet the mistletoe is a green, leafy plant. Birds feed upon its berries and scatter them from tree to tree. The seed, inclosed in a sticky, pulpy covering, readily adheres to any part of the tree upon which it falls, whether branch or trunk, and when germinating, a spike-like "sinker root" bores through the bark until it reaches the sap. Then the plant's growth spreads and increases, the tree proportionately starves and finally dies.

The presence of green leaves indicate that the mistletoe has the power, which independent green plants everywhere possess, of constructing organic foodstuffs, such as starch, out of inorganic compounds—carbon dioxid and water—utilizing sunlight as the source of energy in the process. It is, therefore, only partly a parasite so far as dependence upon a host for food is concerned. It secures from its host only what the normal shrubbery plant derives from the soil, namely, water and certain necessary mineral constituents.

Planting Trees by Machine

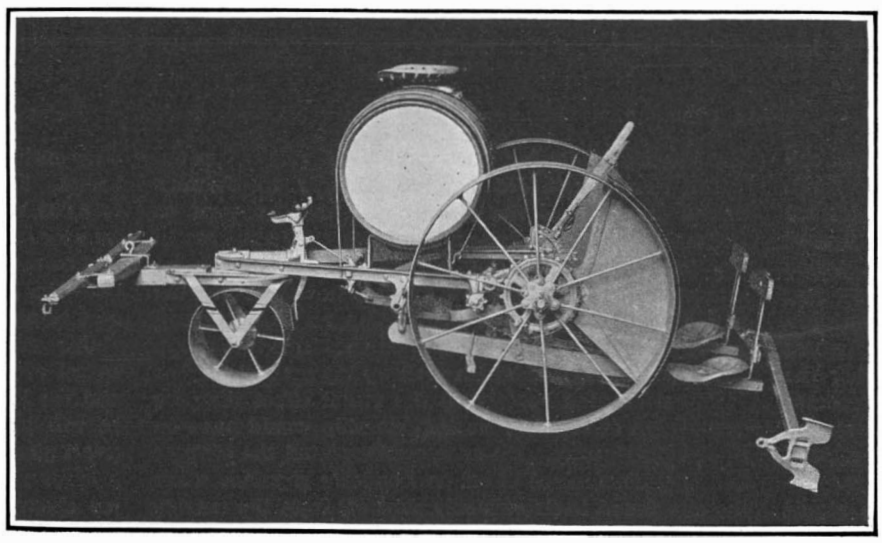
A MACHINE which plants from 10,000 to 15,000 forest tree seedlings a day has for some time been in use in Wyoming County, N. Y., according to officials of the Forest Service, who are acting as advisers in the work. Previously the planting has been done by hand at the rate of 1,200 to 1,500 trees each day per man.

The machine was designed to set out cabbage and tomato plants, but works equally well with trees. It is about the size of an ordinary mowing machine and is operated by three men and two horses. One man drives the team while the other two handle the seedlings. The machine makes a furrow in which the trees are set at any desired distance, and an automatic device indicates where they should be dropped. Two metal-tired wheels push and roll the dirt firmly down around the roots. This is a very desirable feature, it is said, because the trees are apt to die if it is not well done. Two attachments make it possible to place water and fertilizer at the roots of each seedling, and another marks the line on which the next row of trees is to be planted.



The measuring bulb-planter

No cost figures are available yet, but officials say that the cost will be much less than when the planting is done by hand. It is stated that the machine can be used on any land which has been cleared and is not too rough to plow and harrow.



Machine for setting out forest tree seedlings and other small plants

The Current Supplement

AN extremely interesting article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2133, for November 18th, 1916, is *The Salt Wells of Tzuliu-tsing* which describes an ancient industry of China, of which but little is generally known; and it is illustrated by a large number of unusual photographs which show every process in the production of salt, from the drilling of the well to the shipping of the finished cake. *The Distribution of Gaseous Matter* discusses the traditions and mysteries of cosmic space. *The Testing of Automobile Motors* describes in a brief and comprehensive manner methods of investigating all thermal and mechanical efficiencies. *The New York Barge Canal* discusses this important undertaking in relation to other waterways and outlying territory. *A Vortex Hypothesis of World Formation* deals with a recent cosmogenic theory that not only explains the origin of the solar system, together with the eccentricities presented by its members, but accounts for the general character of land and sea distribution on the face of the earth. Another paper of importance is *Some Modern Conceptions of Spontaneous Generation*, which considers the nature of the bridge that spans the gap from the inorganic to the living. *The Analysis of Living Matter Through Its Relation to Poisons* deals with pharmacological conditions of the present day.

New Oil Fields in Chile

RECENT discoveries of oil in the Territory of Magellan have created much interest, for heretofore Chilean oil has been found only in the northern and central sections of that country. The National Association of Manufacturers (Sociedad de Fomento Fabril) in a recent bulletin states that geological experts from various parts of the world have made tests of the oil in Magellan, and pronounce it equal in quality to that found in Argentina, and the extent of the deposits appears to rival that of the famous Comodoro Rivadavia fields.

Commenting on the prospective working on an extensive scale of the oil lands in Chile, the Manufacturers' Association presents the need of legislation to regulate the well-drilling, with a view to preventing the inundation of the oil deposits by subterranean streams. The Association also advocates legislation to restrict the owning and operating of oil fields to native Chileans or to foreigners settled in the county with Chilean families. The greater part of the oil lands in Magellan belong to the Government, and the Association recommends that the Government retain a royalty of 10 per cent on all the oil produced from the lands it sells to private producers. Such a royalty is frequently stipulated by individual owners, and it is urged that the right to a percentage should be legalized and extended to all proprietors of oil fields.

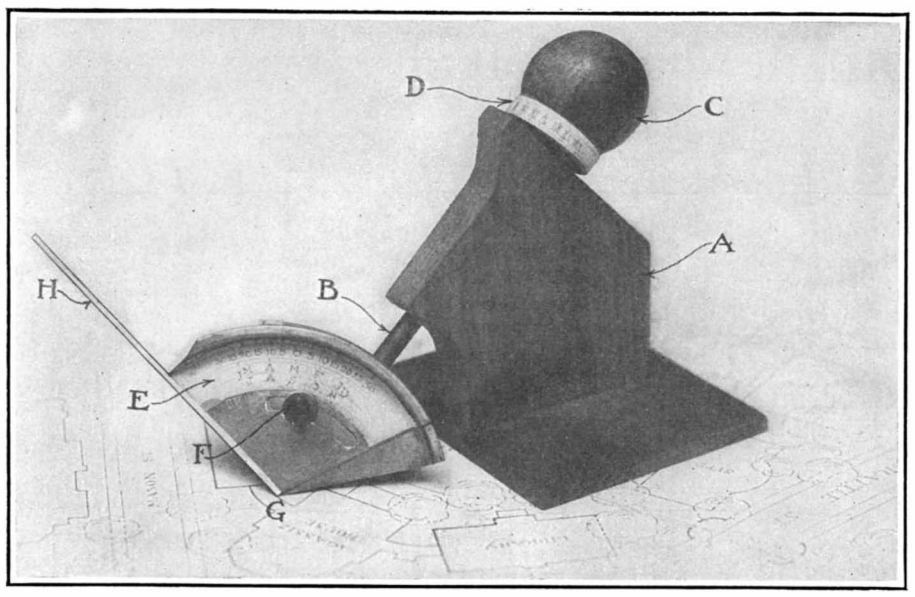
Death of William Bell Wait

ON October 25th last, William Bell Wait, widely known as an educator of the blind, passed away in New York.

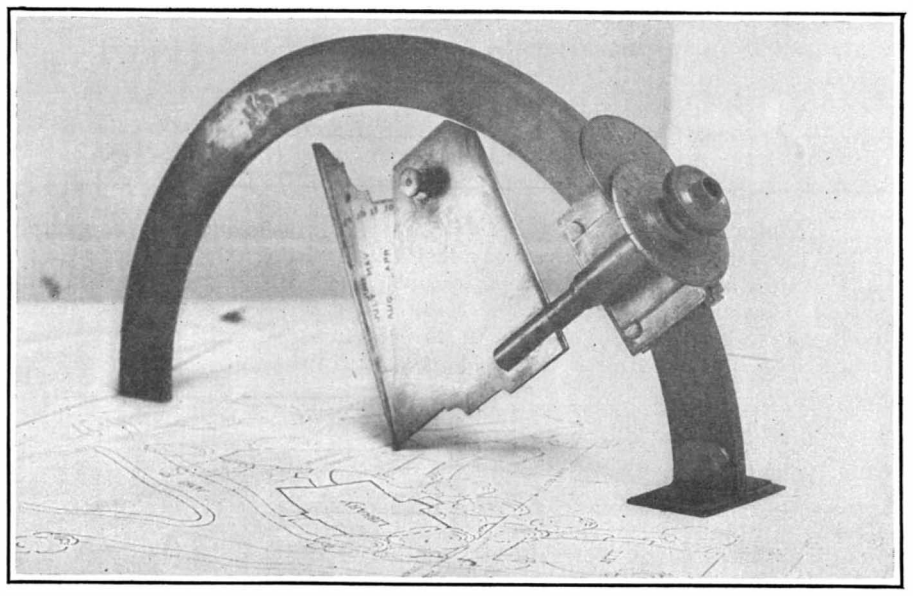
Mr. Wait, who for many years was principal of the New York Institution for the Education of the Blind, bequeathed his inventions to the public. He made his will last February, setting forth that "I hereby give and dedicate to the public the free use of the following inventions made for the purpose of reducing the cost, increasing the durability, and enlarging the amount and scope of literature for the blind in the New York point system; and I hereby authorize and direct my executor to do whatever he may deem necessary to carry out and effect this gift and dedication." The patents of Mr. Wait numbered thirteen, and are described very briefly as follows:

Press for embossing printing of literature, music, and the like, apparatus for embossed punctographic writing, device for automatically adjusting plates, sheet-carrying apparatus, embossing device, device for bridging recesses in cylinders of embossing presses, marginal holding device, embossing machine, bookbinding machine, plate holding device, sheet delivery apparatus, sheet gage and strip-fastening device for embossing plates.

Another valuable gift of Mr. Wait is his very interesting collection of books relating to the blind, which he left to the New York Institute for the Education of the Blind.



The first "Prodigal Sun," for a fixed latitude



A more finished product, adjustable to any latitude

The "Prodigal Sun"

How His Wanderings may be Exhibited in Connection with Building Plans

THERE are many questions which embarrass the architect, but none which he has greater difficulty in disposing of satisfactorily than that of the client who asks at what hours during the different months the sun will enter the various windows shown on his plans, and how far into his rooms it will extend. The same question arises in laying out streets and gardens, tennis courts, baseball grounds and athletic fields in general, and in many other phases of architectural work.

The answers usually given are unsatisfactory either because too casual to be convincing, or too technical to be readily translated into visual terms. If the professional adviser tries merely to indicate with pencil or arm the general elevation and course of the sun, his demonstration is of necessity incomplete and indefinite; if, on the other hand, by means of chart or tables he attempts to follow in detail the rising and setting points and the path across the heavens, as these vary from season to season, it is a most exceptional layman who will possess the power of visualizing in three dimensions the ultimate effect as displayed by the rays striking his windows. And other methods are equally deficient.

A Boston architect, after several efforts, has devised and donated to science an instrument to fill the want indicated by these remarks. Unlike most apparatus of comparable nature, it makes no demands upon the user's mathematical knowledge, or lack thereof. All that is attended to in the construction of the instrument, so that the user merely has to set the month-scale and the hour-scale, and then observe from the pointer the precise direction of the sun's rays at the time in question.

We illustrate the first rough working model which the inventor constructed, valid only for the latitude of Boston, and a later and more finished specimen, adjustable to all latitudes. In the former, the spindle B passes through a hole drilled in the standard A at precisely the latitude angle of the City of Culture. The lower of the two circular sectors of tin, unmarked, is fastened to this spindle so that as the latter is turned the tin rolls about from one edge to the other. The upper piece of tin is arranged to slide independently upon the lower one through an extreme angle of 23½ degrees in either direction from a centered position. The reader will appreciate the reason for this particular range of adjustment by recalling that it represents the latitude of the Tropics of Cancer and Capricorn.

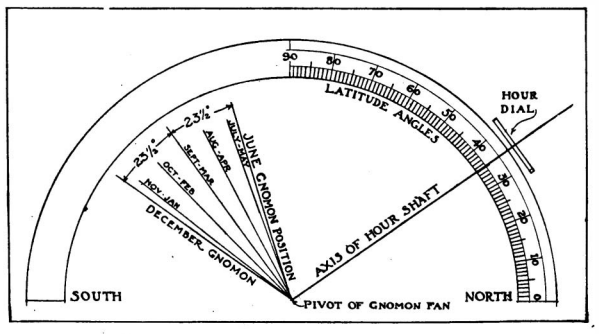


Diagram of gnomon fan and hour shaft

In the preparation of the scale of months on this dial a certain amount of special knowledge is required. The problem is of course identical with that confronting the builder of a sun-dial. We present a diagram showing its final solution, as well as the angular relations between all parts of the instrument.

In using the "Prodigal Sun," as the inventor has facetiously dubbed his invention, the spindle B must be placed so that its projection on the paper falls in the north and south direction of the plan to be tested. The point G of the gnomon—that is what the pointer really is—must fall exactly upon the spot for which the test is to be made. Then, after setting the spindle for the hour and the dial for the date, the pointer GH indicates the quarter in which the sun will be found. Or if desired, the gnomon can be set for the date, and then by rotating the spindle the entire course of the sun for the day can be followed with precision.

Perhaps it may not be out of place to remark that the readings of the hour register determined by the initial and final horizontal positions of the pointer GH correspond to the times of sunrise and sunset. So it turns out that the machine cannot lie; for if we try to get a reading for an hour at which the sun is not yet up or at which he has gone to bed, the pointer will meet the surface upon which the instrument rests and make it impossible to turn the hour scale to the desired point.

The only fundamental difference between the first working model, which we have been discussing, and the more elaborately gotten up instrument, which we also picture, is the adjustable latitude scale. Instead of being constructed for a single latitude, the spindle slides about an upright metal semi-circle; and the first step in using the instrument is then of course to set it for the proper latitude.

The inventor does not intend to patent his "Prodigal Sun," so its manufacture and use are free to anybody sufficiently interested to construct one.

The Doom of the Hand-Picked Mailing List

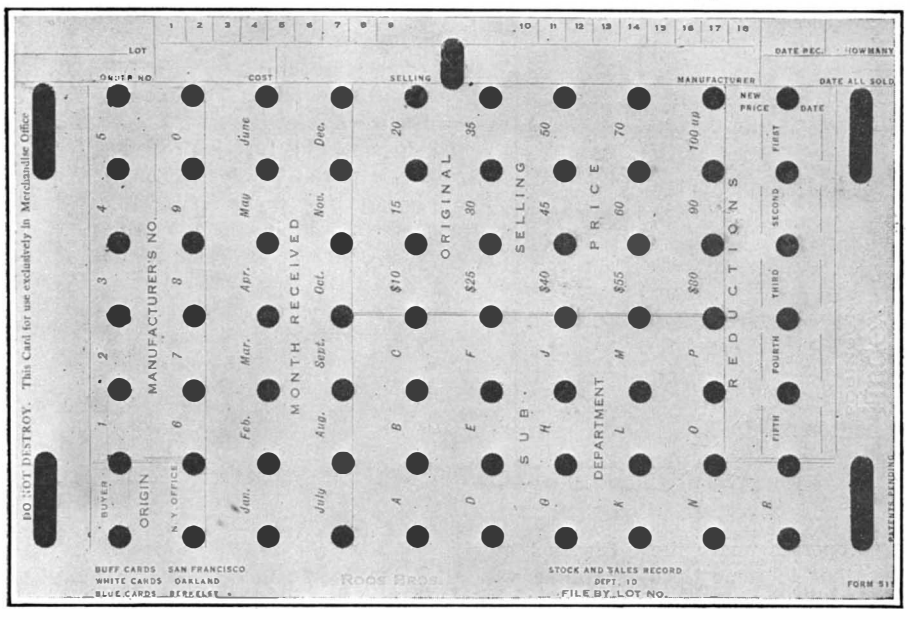
SUPPOSE you were at the head of the sales force of a large jobbing house, and in planning your fall campaign wanted a list of all dealers who had bought a thousand dollars last year and had paid promptly when due. And suppose your accounting department were sufficiently up to date to possess a card ledger. What would you do?

The chances are that you would get a clerk to plough through that card ledger and pick out all the cards on which the postings showed the conditions in question to have been met. Then a week later you would chase another man through the cards on a still-hunt for a class of smaller customers, and he would find several buyers of the first class who had been overlooked, and who had consequently been mortally insulted by the failure of your first flight of agents to call.

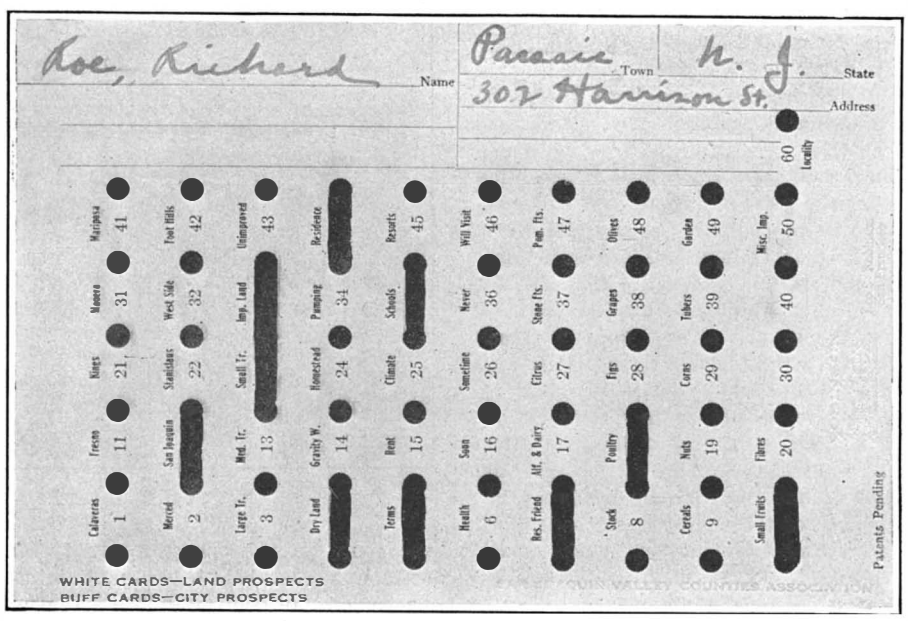
In addition to this inaccuracy, the compiling of hand-picked lists from a card file consumes a lot of time.

(*Continued on page* 463)

The drawer returned to upright position, with the desired cards projecting above the mass



Form for stock record card



Card used for recording real estate inquiries

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

Motor Truck as Locomotive

A VERY interesting and unusual use of a motor truck is illustrated in the accompanying photograph. The four-wheel drive truck shown is in the service of a contracting firm in Sioux City, Iowa. It is used in place of a locomotive to draw a train of heavily loaded dumping body trailers which run on a narrow gage track and which convey various materials of construction. The truck itself is of standard tread and straddles the rails and it is interesting to note that enough traction is secured by applying the power to all four wheels to pull the train easily up to a five per cent grade, although no load whatever is carried in the body of the truck. The crushed rock, gravel and cement hauled by this outfit are being used in building a 16-foot concrete highway, and that a large amount of material is being hauled is indicated by the fact that from 50 to 600 linear feet of pavement are being laid daily. The track is 4 miles in length and ten round trips are made each day. Each trailer carries one and one half cubic yards of gravel or crushed rock, making a total pay-load varying from 24 to 26 tons. The truck pulls this load while running in high gear and travels at 12 to 15 miles per hour. The contractor states that the truck is doing the work of 50 two-horse teams and that an enormous saving in cost of hauling is effected as the average daily expense of operating the truck and trailer train in this service is but $17.00.

Using a motor truck as a locomotive on a narrow gage track

Motor Trucks as Submarine Boat Tenders

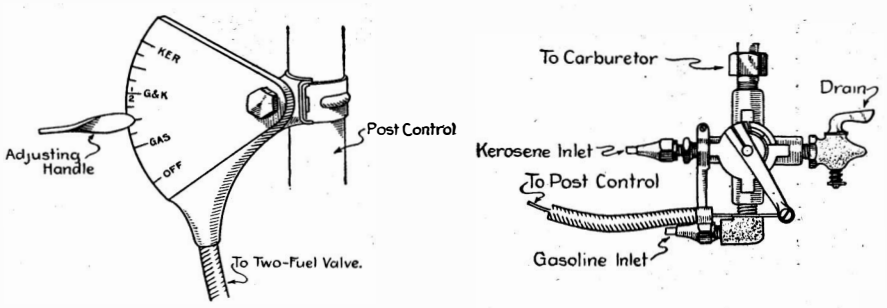
THE various oil companies throughout the United States operate large fleets of tank trucks successfully in the economical delivery of gasoline, kerosene and fuel oils to the consumer. These powerful, large capacity trucks are a familiar sight along our highways, especially in the large commercial centers and their suburbs. That these trucks are proving valuable adjuncts to the United States Navy in supplying lubricating oils; gasoline and other liquid fuels to submarines, hydroplanes and other types of naval vessels along the Atlantic and Pacific coasts is to be expected. The accompanying photograph shows trucks of this nature at the dock in New London, Conn., delivering fuel to the United States Submarine D-1 shortly before the submersible left port to participate in the maneuvers of the Atlantic squadron. The speed of the trucks is important in delivering the vast quantities needed and make it unnecessary for such naval craft to lie at the docks for long periods awaiting the arrival of these highly essential supplies. The tank trucks are of large capacity and the oil companies can deliver large quantities of oil and gasoline in one haul. On arriving at the dock, a section of rubber hose is used to transfer the fuel directly to the storage tanks of the vessel, and as the trucks are at a higher level than the boat the liquid will flow to the storage tanks of the vessel by gravity.

How a non-stalling truck chassis was tested

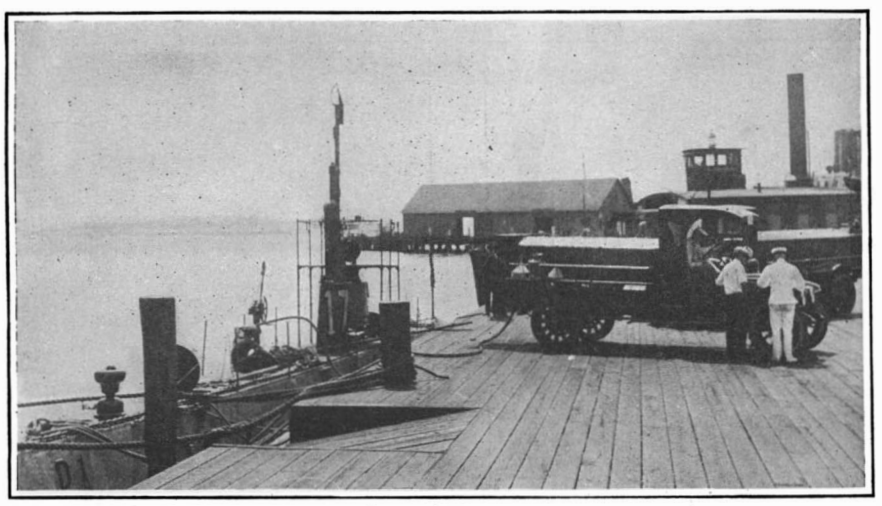
Testing Unstallable Truck

THE severe requirements of army service has resulted in the development of special forms of trucks which would seemingly have just as wide application in every day industrial pursuits as in the more spectacular war service. The four-wheel drive type of truck was developed primarily to meet conditions of operation much more severe than are apt to be encountered in ordinary commercial work. At the same time, there are some uses of motor trucks in civil life that call for just as much stamina as war service does. The photograph shows how a truck equipped with power driven winch and nigger heads was purposely mired to demonstrate its ability to pull itself out of a swamp by means of ropes attached to a suitable anchorage at one end and wound around the windlass heads so that the power of the engine could be utilized at such times as traction by the usual means could not be employed. In making the test the chassis was loaded with more than its normal rated capacity of pig iron weights and that it was able to extricate itself by its own power is clearly shown by the deep ruts going through the mud and also by the way in which the axle has leveled off the soft ground between the wheel tracks.

Severe tests of this kind certainly do much to foster the development of motor trucks, and while no truck operator would ever want to operate under the conditions shown, it is conceivable that in some lines of contracting work that a truck equipped with a power driven winch and windlass heads would be able to work under conditions that would stall the ordinary truck. One use of a truck of this nature that suggests itself is in hauling dirt out of deep excavations where the ramp or runway is very steep or where the soil is of clayey or sandy nature and seriously interferes with proper traction.



Device for mixing high and low grade fuels while the engine is running



Oil tank trucks as submarine tenders

Burning Kerosene-Gasoline Mixtures

AS a matter of economy, many users of motor trucks are experimenting with combination fuels consisting of gasoline, mixed with less volatile oils in various proportions. A two-fuel adapter valve has been developed by an American carbureter manufacturer which makes it possible for the truck owner to use that mixture of low-grade and high-grade fuel that will be best handled by the carbureters and engines of individual cars. Any carbureter will operate satisfactorily on a fuel containing large quantities of kerosene when the engine has been run for a time and is of sufficiently high temperature to properly vaporize the heavier gas mixture. The difficulty has been to introduce the kerosene properly and also to ascertain the best proportions of the mixture. While the quantity of kerosene that can be combined with gasoline in any given carbureter could be arrived at by a more or less tedious cut-and-try process, it is possible to arrive at the maximum amount of kerosene that can be mixed with gasoline very quickly with the adapter valve illustrated. The adapter is valuable as it permits a start to be made on pure gasoline, which is a marked advantage. When endeavoring to start on an already mixed fuel, it is not possible to use as much kerosene in the mixture as the engine will take when it is warmed up to its work. Ordinarily from 20 per cent to 30 per cent of kerosene may be used and in some types of engines having thermo-syphon cooling and short, well jacketed inlet manifold and gas passages as high as 50 per cent of kerosene may be burned successfully though of course, it would be very difficult to start a cold engine on a mixture half gasoline and half kerosene.

The device is very simple and consists of a cross shape hollow casting with a control cock in the center. The gasoline supply is attached to one arm of the cross and the carbureter to the other. The kerosene supply enters the fitting at the top and a drain cock is provided in the lower arm by which the carbureter float chamber may be cleared of either fuel, if desired. The handle of the control cock is connected up with a sector on the steering post by means of a flexible wire. The sector is provided with an adjustable handle and a graduated scale which will provide any proportion of mixture between the extremes of all gasoline or all kerosene. It is evident that by setting the adjusting handle at the graduation marked "Gas" that the engine will start up readily as nothing but gasoline is supplied the carbureter. After the engine is operated long enough to become thoroughly warm the operator can determine the most economical mixture it is possible to use by gradually increasing the proportion of kerosene up to that point where the engine no longer runs satisfactorily. Just before stopping the car the lever may be moved down so that the float bowl of the carbureter will fill with gasoline thus making the engine easy to start when it is again put into action. The extreme downward movement of the lever makes it possible to turn the fuel entirely off. This feature is useful in that it makes it possible to use the engine as a brake when going down hill and as only cold air is taken in, there is no waste of fuel as is the case with the ordinary carbureter. The device is not an experiment, as it has been on the market for some time. The great advantage is that no alterations are needed in the carbureter except a slight change in the adjustment of the float control needle valve so that the height of liquid in the spray nozzle will remain the same. The heavier fuel has a greater degree of flotation and is apt to shut off the fuel quicker because the float set to operate on gasoline will alter the lever slightly when supported by heavier fuel. The main disadvantage of this device is that two fuel tanks are needed, one to carry gasoline, the other, kerosene.

LEGAL NOTICES

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

AGENTS WANTED

AGENTS. 500% Profit. Free Sample Gold and Silver Sign Letters for store fronts and office windows. Any one can put on. Big demand everywhere. Write today for liberal offer to agents. Metallic Letter Co., 438 N. Clark Street, Chicago, U. S. A.

FOR SALE

IMPROVED ENVELOP SEALER. More efficient and can be manufactured at a price to undersell any other machine on the market. Descriptions and drawings on request. Patent applied for by John O. Griffith, 1813 9th Street, Washington, D. C.

HELP WANTED

OPPORTUNITY WITH A New Jersey drop forge tool plant for man of experience in this or a kindred line. Work will be drafting for formers, cutters, etc., and general oversight of the work and product. Good future and chance for advancement with this growing business. Address, "Future," Box 773, New York City.

INVENTIONS DEVELOPED

INVENTIONS DEVELOPED—The specialists who develop auto accessories, gasoline, vapor and steam engines, electrical appliances, automatic cigarette making machines, repeating rifles, weighing, vending and other intricate devices are at your service. They will handle your development, drawings and experimental work. Make any metal novelty. Advice backed by 30 years experience. Send drawings or sample. The Wm. Gent Machine Co., Box 172A, Cleveland, Ohio.

POSITION WANTED

YOUNG MAN, MARRIED, accustomed to deal with foreigners, seeks position in some foreign country as demonstrator of American machines for machine shops. Address Position, Box 773, New York City.

MUNITIONS SPECIALIST

YOUNG ENGLISHMAN, 36, with 10 years broad experience in the manufacture of metal fuzes, fine tools, gauges, repetition work, etc., for the British Government, is open to an engagement in America. Has a successful record as an organizer and in the control of labor. Now connected with a munitions plant in British India. Good reasons for desiring a change. A1 credentials. Address "Munitions," Box 773, New York City.

WELDING

A WONDERFUL DISCOVERY. New welding compound for aluminum, aero metal, etc. SO-LUMINUM saves parts heretofore scrapped. Perfect substitute for acetylene welding—one-half time and cost. No flux required—use gasoline torch. Sample bar, $1.00; per lb. $3.00. Dept. "A." Address So-Luminum Mfg. Co., 1790 Broadway, New York. Telephone 8420 Columbus.

The Doom of the Hand-Picked Mailing List

(*Continued from page* 461)

This appears to be of no great moment in the case cited, except in so far as the clerk's time is money. But imagine a valued customer, in any line of trade, kept cooling his heels for a couple of hours while the index was examined, card by card, for a property meeting all of his rather complex requirements. His state of mind would probably be such as to indicate clearly to the seller the wisdom of the invention of a San Francisco man which has made obsolete the time-killing and patience-trying business of thumbing over the card index for information.

The theory of this device is simple enough. Each question which the cards are designed to answer about the names appearing on them is assigned a definite position; and in that position on each card appears a little round hole. As long as the hole stays there, the card answers the question by "No"; as the course of business reveals the fact that the answer should be "Yes," the card is modified to make it so—the hole is removed.

The reader will laughingly ask how to remove a hole. By his ingenious reply the inventor has at the same time solved the urgent problem of how to make the card speak up and tell its story. The way to remove a hole, he argues, is to swallow it up in a bigger one; and then of course the way to find whether it has been removed is to put something in it that would fit the original opening and see whether it still fits.

Let us look at a concrete instance to see how the thing works. We illustrate the card used by a large California land company in the classification of its inquiries. As in every case the holes are in uniformly spaced rows and columns. Beside each appears, in words or when necessary by key number, an indication of the information which it gives. In addition each hole carries a number corresponding to its position. It is found convenient to group in the same row or column holes which give information in the same field; it is then frequently possible to use general headings which abbreviate the headings of the individual holes.

It is plain that with all the cards in a drawer punched in the same way, the entire collection may be locked in place by the insertion of a rod into one of the series of superposed holes thus provided. But if on any card one of the holes be enlarged, an effort to lock the cards by the use of this hole will leave that particular card free to move. This leads us to the *modus operandi* of the new file.

Initially all the holes are intact, all the questions answered "No." As a posting is made or information developed which makes the correct answer "Yes," a long, narrow hand-punch is applied to the hole, joining it with the one immediately below it. Thus the card illustrated states that Mr. Roe has inquired for a small tract of improved land in San Joaquin County suitable for residence and dry farming. He will be especially interested in terms and school facilities, and has a friend in the neighborhood. He wants land suitable for poultry and small fruits.

The first time a small tract of improved land in San Joaquin County is placed in the hands of this concern the drawer containing these records of inquiries is placed upon a table. In the drawer front are holes corresponding to those in the cards. In the positions 12, 23, 33, metal rods are thrust right through the drawer from front to back, after which the drawer is turned upside down. Every card which has not had all three holes 12, 23, 33, extended by the slot punch will be locked in place by the three rods; every card which has these three slots, on the other hand, will at once slide down and project below the others. By rods through one or two of the bottom row of holes, which is there for just this purpose, the projecting cards are prevented from sliding back when the drawer is righted. The rods which

served to separate these cards from the body of the file are then withdrawn, and the selected cards may be removed one by one and examined.

It will be seen that any single item can be selected by using a single rod, or that any combination of items, however complicated, may be secured by using a quantity of rods. It is a simple matter, for instance, to pick out all inquiries who want to rent a large unimproved tract convenient to a school; all stock purchased within a given period for given departments from given manufacturers and retailing within a given price range; or to discover whether an employee exists who has a high record of sales and personal efficiency, who speaks Spanish and Portuguese, who is Catholic and single, who has a high school education and is familiar with the details of certain departments of the business. How long, under the old systems, would it take the president of the Steel Corporation, for instance, to find such an employee to send to South America? The punch holes would locate him or deny his existence in two minutes.

This appears to be the file without restriction. In the one drawer the records are responsive to alphabetical, chronological, geographical, numerical, or topical selection without disarrangement, delay or confusion. The holes may occupy the entire card or they may be placed at the bottom of a larger ledger card, with space above for postings. And if you ask the file a foolish question it refuses to answer—that is, it "throws a blank." Thus if you try to locate all names living in Boston and in New York, the Boston rod locks all the New Yorkers, the New York rod locks all Bostonians, and both these lock all other cards. A similar result will follow any impossible classification which may be attempted.

When Fulton Suggested Submarine Warfare

(*Concluded from page* 459)

tests. So on July 31st, at 6 o'clock, the "Nautilus," towed by two sloops, descended the Seine to the harbor of Le Havre.

Fulton lost no time in resuming his tests after arriving at the great French harbor, in the presence of important authorities. In one of the tests he descended with two passengers and remained in the harbor water for a period of two hours, two minutes, without experiencing the slightest discomfort. For illuminating the interior of the submarine he used a candle, so that the crew would not be in total darkness. After making some changes in the propeller, and bringing his submergence experiments to a close, Fulton engaged in speed tests. On the surface, with two men driving the propeller, the craft made 60 toises (about 128 yards) in seven minutes. The same two men a short while later succeeded in driving the craft over an equal distance in four minutes. Strangely enough, it is reported that with the craft entirely submerged the speed was about the same as on the surface.

The inventor discovered in the course of his tests that when navigating below the surface, the horizontal rudder had little effect. By providing the front of the "Nautilus" with a propeller identical to that used at the rear, however, he obtained a marked improvement in the stability of the plunging control.

Shortly after Fulton succeeded in navigating his craft over a distance of 128 yards while submerged 5 feet below the surface, he observed that the compass functioned quite as well when placed inside the submarine as on the deck.

After satisfying himself with regard to the navigating qualities of his boat, Fulton next turned his attention to the towed mine. For some reason or another there existed at the time a strong doubt regarding the efficacy of a submarine mine, so Fulton set about making his mine as powerful as possible to make his demonstration convincing.

On August 28th, the American inventor destroyed a barrel by means of a torpedo

fitted with his exploding mechanism, the detonation being accompanied by a column of water from 60 to 80 feet in height. This convinced the incredulous of the destructive power of a mine.

Leaving Le Havre on September 13th, the "Nautilus" set out in search of enemy ships that might be most readily destroyed. The craft made as high as 4½ miles per hour, and plunged and rose to the surface at the call of the control apparatus. On the 28th of the month the weather became threatening, followed by severe winds the succeeding day. During 35 days Fulton and his boat stayed at Growan, because of inclement weather.

During a calm Fulton attempted an attack which, had it succeeded, would in all probability have had a considerable influence on the affairs of Europe. Two English ships cruising along the coast near the island of Marcon offered a tempting target for his efforts, so profiting by a temporary respite in the weather he tried on two occasions to approach the vessels. But each time the British ships were forewarned and sailed away. During one of the attempts the "Nautilus" rested under water, entirely submerged, for a period of six hours, during which the air supply was secured through a little tube whose upper end on the surface of the water could not be seen at a distance of 200 toises (426 yards).

The Unsolved Mystery of the "Nautile"

Meanwhile Fulton again interested the government authorities, and this time succeeded in being introduced to Bonaparte. After many discouragements at the hands of the government Fulton was finally successful in securing from Bonaparte a commission to build another submarine, the "Nautile," for a test at Brest. The archives do not disclose where this craft was constructed, but it is probable that Brest was its birthplace.

At any rate, on July 3rd, 1801, Fulton embarked with three men on board his boat in the port of Brest. He descended to 5, 10, 15, and even 25 feet below the surface, but did not descend farther because of the fear that his craft, being still of crude design, would not withstand the pressure of the water below the 25-foot limit. In one of the tests he rested under the surface of the water for one hour, during which the men were in total obscurity. Subsequently he used candles to illuminate the interior, but realizing that the air consumed by these materially reduced the period of submergence, he caused an opening to be cut in the upper part of the boat, in which was placed a disk of thick glass. This afforded sufficient light for him to read the time.

On the 26th of the month the boat, provided with a mast and a sail, left the port of Brest on a contemplated raid. The breeze was feeble, and the speed was only 2 miles an hour. However, the slow speed did not prevent the rudders from functioning. After a while the mast and the sail were pulled down, and the craft descended several feet below the surface, the navigation being then effected by two men driving the propeller. A third man was stationed at the control levers, while Fulton occupied himself with a barometer which served as his guide in regulating the depth of submergence. All this was in the form of a maneuver—no attack appears to have been attempted.

Later, Fulton had constructed a surface boat 36 feet long, driven by side wheels which were turned by 24 men. This boat towed a floating mine, and was to serve as a form of torpedo boat. Its tests were most convincing, especially when an old schooner was blown up, and it certainly had the effect of removing the attention of the French government from the submarine.

To this day it is a mystery why the "Nautile," apparently a successful submarine, was not employed against the English ships. In fact, the foregoing information, which has been gathered from correspondence and documents in the French archives, if anything causes Fulton's work in France to be more mysterious than ever.

Strategic Moves of the War, Nov. 9th, 1916

(*Concluded from page* 456)

called from Asia Minor, to take command of all operations in Rumania. Should this be done, it may also be found expedient to bring a part of his army with him. The Russians are in control of the Black Sea and could accomplish this transfer in a comparatively short time and with little difficulty.

With the advent of winter, operations on the eastern front (Galicia and to the north) will be practically at a standstill. This will release quite a large number of troops from both sides, which will then become available for use elsewhere. However, past experience indicates that during the extremely cold weather prevailing in this section of the line, the Russian troops can operate to better advantage than their opponents, and on that account it may not be possible for the Central Powers to reënforce their other fronts, at the expense of this one, to the same extent that the Allies may be able to do, consequently I look for a Russo-Rumanian offensive in the Dobrudja to be well under way in the course of a few weeks. The latest news reports from that section seem to indicate that this movement has commenced.

Should the Rumanians be able to drive the Teutons out of their present stand south of the eastern Carpathian Range, it would be good strategy for the former to hold all the mountain passes and confine themselves to the problem of keeping the Teutons out. Every man and gun that can then be spared from that line should be made available for operations in the Dobrudja and south of the Danube.

It has been pointed out by a number of writers that this is what should have been done in the first place and that the invasion of Transylvania was a terrible blunder. There is no doubt that this invasion was unfortunate but before we condemn it as a military or strategic blunder it might be well to consider some of the conditions that might have had a compelling influence on the action taken.

The Rumanians, like the French, Spaniards, Italians and Portuguese are of Romance origin. They are proverbially impulsive and sentimental. Their first move in a new situation is more likely to be prompted by sentiment than dictated by cold blooded calculation. It has been said that the Rumanians came into this war "both in hope and fear"—"the hope of a greater Rumania and the fear of a strangled homeland." After reading the history of this little kingdom one must believe this to be true. Rumania has 7,000,000 Rumanians within her border. In Bessarabia, about 1,750,000 out of a population of 2,600,000 are said to be Rumanians. In Transylvania 1,500,000 out of a population of 2,500,000 are said to be Rumanians. In Bukovina nearly one half of a population of 1,000,000 are Rumanians. Is it strange then, that having decided to enter the war with the hope of bringing within the homeland boundaries the territory occupied by these members of her family, Rumania, prompted by her sympathies rather than by the judgment of her military advisers should have committed the sentimental blunder of invading Transylvania to show her expatriated sons the flag of the mother country?

The French made a similar mistake for very much the same reasons when they invaded Alsace-Lorraine at the beginning of this war; but those who heard the French people say, "Our soldiers are in Alsace!" realized that this move, whatever might be said against it by strategists, met with popular favor everywhere in France.

On the Greek front, north of Saloniki, the situation remains practically unchanged. From the view point of the Allies, good strategy has demanded for some time past and still demands a strong offensive in this section in order to relieve the Teutonic pressure on Rumania, but there does not seem to be any indication of it at present.

SCIENTIFIC AMERICAN

December 2nd Issue

ELECTRICAL WEEK

DEC. 2 ——— DEC. 9

THE early plans for America's Electrical Week, December 2nd to 9th, 1916, were announced in midsummer by the Society for Electrical Development which is the parent organization behind this nation-wide boost of the electrical industry. This Society, composed of the men who are directing the electrical destinies of America, realize the necessity for co-operation from magazines of wide-reading and recognized authority.

The SCIENTIFIC AMERICAN, always in line with technical, scientific and industrial progress, and endorsed by the Society as "A recognized medium for reaching the Nation's Leaders," has gladly co-operated in the launching of Electrical Week by preparing a Special Number devoted to matters electrical.

The SCIENTIFIC AMERICAN can well assume this role of leadership in view of its concentration among technical men and the use made of it in industrial plants, general offices and factories where executives and mechanics are united in the opinion that SCIENTIFIC AMERICAN is giving them unparalleled help in the solution of many of their daily problems.

Master minds in the field of Electricity have contributed important articles for this issue, as this partial table of contents indicates:

Thos. A. Edison — Chas. P. Steinmetz
Hugh L. Cooper — George Gibbs

Have We Reached the Limit of Electric Transmission?

Dr. Chas. P. Steinmetz, one of the most brilliant electrical inventors the world has seen, will answer this question.

Electric Heat in the Industries.

New uses of Electricity in factories for safe heating, etc., will be interestingly discussed.

Electricity and the Smoke Nuisance.

To get rid of the smoke nuisance some railroads are electrifying their terminals—advantages and disadvantages.

Fifty-Six Million Horse-Power Going to Waste.

Utility of electrical power still in its infancy—written by one of the foremost hydro-electric engineers.

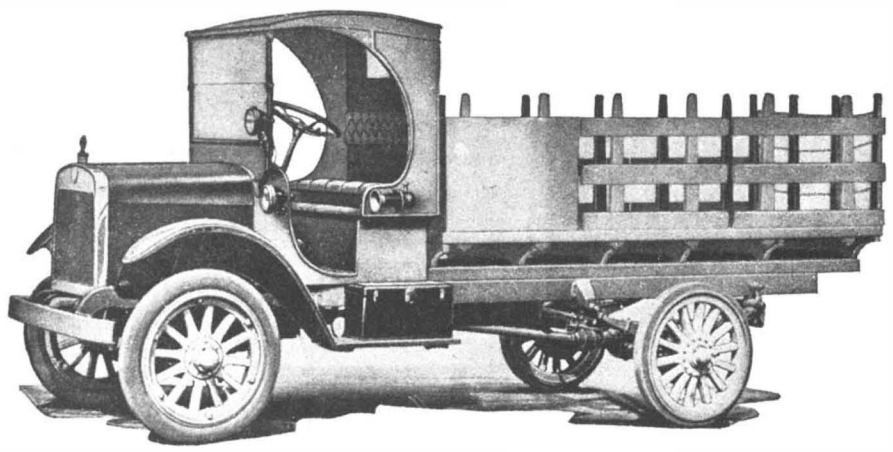
This strong editorial appeal to all broad-minded men who have interested themselves in electrical advance is to be made the first week in December, right at the time when America's Electrical Week is bringing to the direct attention of the public, by means of nation-wide exhibitions and demonstrations, the great possibilities of this bridled Giant. This Special issue of SCIENTIFIC AMERICAN thus combines an extraordinary value with a most opportune time for the individual advertising of the electrical manufacturer.

MUNN & CO., Inc.

WOOLWORTH BUILDING

NEW YORK CITY

Advertising Forms Close November 20th, 1916



1¼ Ton Model 10 **DENMO** **PRICE $1385**

BUILT of the world's best truck units, the value of DENMO TRUCKS to your business can be computed with mathematical certainty. Bigger loads, carried further and in less time—dependable day after day service with maintenance and operating costs that are satisfyingly small—as a matter of course, follow the purchase of a fleet or a single DENMO TRUCK.

The DENMO is a truck from the ground up. It cannot be confused with converted pleasure cars equipped with commercial bodies that are now on the market. It has power in abundance yet the gasoline consumption is remarkably low. An average of 14 or more miles to the gallon is not at all unusual.

The most strenuous tests ever given any truck have but served to prove DENMO reliability. 8,000 miles of merciless driving over the worst roads of Ohio and Pennsylvania failed to expose a weak spot in the construction of the DENMO experimental models. And through all of this grueling test excessive overloads were carried.

Electric starting and lighting is an exclusive DENMO feature. Long demanded by both owners and drivers, the invention of the DENMO spring cradled battery suspension eliminates all the difficulties that have hitherto prevented its use.

The price of the DENMO model 10 includes complete chassis equipment. Everything that could contribute to efficient and economical operation is furnished. Better drivers mean lower operating costs for you and the best drivers are eager to drive DENMO TRUCKS.

Hundreds of progressive dealers have secured the agency for the DENMO and are giving DENMO SERVICE. There is probably one right near you. If you will write us direct, our corps of trained haulage engineers will gladly analyze your delivery problem without obligation. Write us today.

Brief Specifications

Wisconsin Motor—DENMO design—forced feed, non-splash lubrication. Splitdorf-Apple two-unit starting and lighting equipment.

Spring Cradled Battery Suspension—a DENMO invention.

Pierce Governor—DENMO Transmission Drive.

Stewart-Warner Speedometer—transmission drive. Correct Distribution of Pay Load—only 85% on rear wheels.

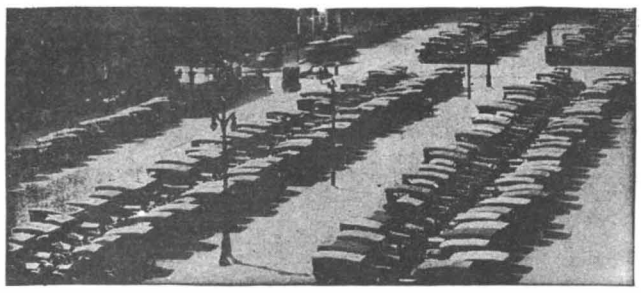
Cushioned radiator carrier—a DENMO invention.

Torbensen Drive Axle—backed by Gold Bond Guarantee.

Complete Chassis Equipment

The Denneen Motor Co.

Cleveland, Ohio



The Unseen Source of Power

Unseen, but vitally important, is the source of power in automobile or motor truck. All else in the construction has its due importance, but for the owner it's the motor that makes the car.

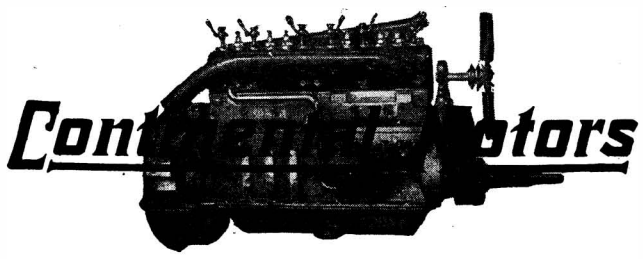
In over 250 models of pleasure cars and trucks, the Continental Motor is under the hood. Powerful but quiet, responsive yet sturdy, with speed only short of a racer's, with economy beyond one's expectation, this motor brings the look of gratified content to the owner's face. Both by such silent tokens and by their oft-spoken praise, hundreds of thousands of car owners indicate their pride in their Continental Motors.

Thus has the Continental Motor earned its widespread reputation as America's standard motor. The uniform satisfaction of owners—this truly is its unseen source of power.

CONTINENTAL MOTORS COMPANY

OFFICES: Detroit, Michigan
FACTORIES: Detroit-Muskegon

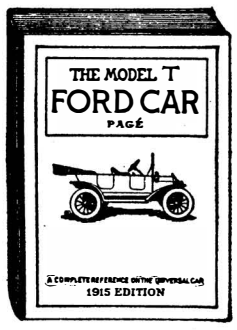
Largest exclusive motor manufacturers in the world.



JUST PUBLISHED

A New, Complete Book for every Ford Owner, Dealer, Salesman and Repairman.

The Model T Ford Car



Its Construction, Operation and Repair

By VICTOR W. PAGÉ, M.E.
Author of "The Modern Gasoline Automobile," etc.

300 (5x7) Pages. Over 100 Specially Made Engravings and 2 Large Folding Plates

Price $1.00 Postpaid

This is the MOST COMPLETE and PRACTICAL instruction book ever published on the FORD CAR. All parts of the Ford Model T Car are described and illustrated in a comprehensive manner—nothing is left for the reader to guess at. The construction is fully treated and OPERATING PRINCIPLES MADE CLEAR TO EVERYONE. Complete instructions for driving and repairing are given. Every detail is treated in a non-technical yet thorough manner.

This book is written specially for FORD DRIVERS AND OWNERS, by a recognized automobile engineering authority and an expert on the FORD, who has driven and repaired Ford Cars for a number of years. He writes for the average man in a practical way from actual knowledge. ALL REPAIR PROCESSES ARE ILLUSTRATED AND FULLY EXPLAINED.

WRITTEN SO ALL CAN UNDERSTAND—NO THEORY, NO GUESSWORK
AUTHORITATIVE—UNBIASED—INSTRUCTIVE—COMPLETE

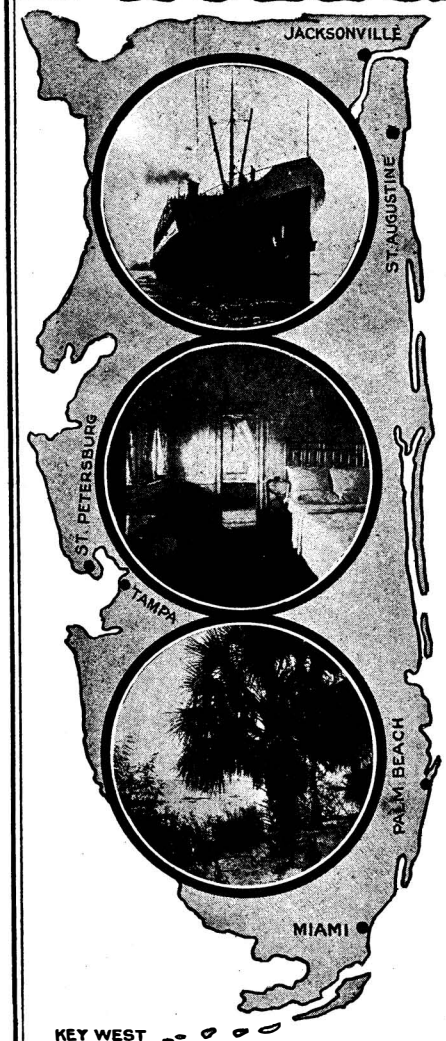
Contains Special Chapters on

1. **The Ford Car.** Its parts and their functions. The Ford Three Point Suspension System—Frame Assembly Details—Spring Construction—The Ford Body—The Ford Power Plant, Etc. 2. **The Engine and Auxiliary Groups.** How the engine works, the fuel supply system, the carburetor, making the ignition spark, cooling and lubrication.—Induction Coil System Action Explained—Why a Magneto Is Used on a Ford—Wiring Dry Cell Batteries—Master Vibrator Systems—The Ford Muffler, Etc. 3. **Details of Chassis.** Change speed gear, power transmission, differential gear action, steering gear, front axle, frame and springs, brakes, etc. 4. **How to Drive, and Care of the Ford.** The control system explained, starting the motor, driving the car, locating roadside troubles, tire repairs, oiling the chassis, winter care of car.—Lighting System—Electric Lighting for Ford Cars—A Typical Engine Stop Analyzed—Conditions that Cause Failure of the Ignition System—Common Defects in Fuel Systems—Adjusting Transmission—Adjusting Loose Front Wheels—What to Do When Rear Brakes Do Not Hold, Etc. 5. **Overhauling and Repairing Mechanism.** Systematic location of troubles and remedies—Faults in Power Plant and Symptoms—Value of System in Overhauling—How to Take Down Motor—Carbon Deposits and Their Removal—How to Repair Cracked Water Jacket—Reseating and Truing Valves—Method of Valve Grinding—Inspection of Piston Rings—Piston Ring Manipulation—Fitting Piston Rings—Wrist Pin Wear—Inspection and Refitting of Engine Bearings—Knocking Indicates Loose Bearings—Adjusting Main Bearings—Scraping Bearing to Fit—Rebabbitting Connecting Rod—Testing Bearing Parallelism—Camshafts and Timing Gears—How to Time Valves in Ford Engines—Repairing Ford Magneto—Packings and Gaskets for Ford Engines—Precautions in Reassembling Parts—How to Take Down Transmission—Relining Brake Bands—Rear Axle Troubles and Remedies—Care of Springs—Steering Gear Repairs—Miscellaneous Chassis Parts, Etc., Etc.

The illustrated chapter on repairing and overhauling alone is worth many times the price of this book.

MUNN & CO., Inc.
233 Broadway **Woolworth Building** **New York, N. Y.**

Florida First



No matter what other places you have planned to visit this winter see Florida *first.*

Make your plans *early,* thus insuring choice of accommodations. It will pay you to write *now* and see for yourself how comfortably and inexpensively you can go on low round trip fares from New York to

Jacksonville, St. Augustine, Miami, Palm Beach, Tampa, Key West, St. Petersburg
AND ALL OTHER
Florida Resorts, Charleston and the Carolinas

Clyde-Mallory steamers offer the ideal route—delicious cuisine, spacious social halls, latest magazines, broad decks, comfortable staterooms, some with connecting private bath.

REMEMBER, meals and sleeping accommodations aboard ship are included in the fare without additional cost.

Fall and Winter bookings now open

Write for information and beautiful descriptive literature

CLYDE-MALLORY LINES
Pier 36, North River, New York

AGWI LINES — CLYDE · WARD · MALLORY · POTOMAC

DISTRICT PASSENGER OFFICES
BOSTON—192 Washington St.
PHILADELPHIA 701 Chestnut Street
NEW YORK 290 Broadway

Tact and Tenacity

according to Daniel Guggenheim, are the prime requisites of business success.

Tact and Tenacity

secured for B. C. FORBES the intimate story of the Mining King's remarkable career, the story of a Swiss immigrant who now controls half the world's copper,—the eighteenth chapter of

"The Men Who Are Making America"

Tact and Tenacity

resulted in F. J. Splitstone's exclusive interview with SIR SAM HUGHES, the first personal "talk about Canada's part in the war" ever granted by this great figure among the Allies' War Lords,

B. C. FORBES

"Canada's Kitchener"

Both these articles appear in this week's Leslie's.

Leslie's
Illustrated Weekly Newspaper
Established in 1855
225 Fifth Avenue, New York City

Sci Amer.

LESLIE'S
225 Fifth Avenue
New York City

Enclosed find $5.00. Please send me Leslie's for one year, beginning with (the issue of July 27th) or (the current issue).

Name.....

Address.....