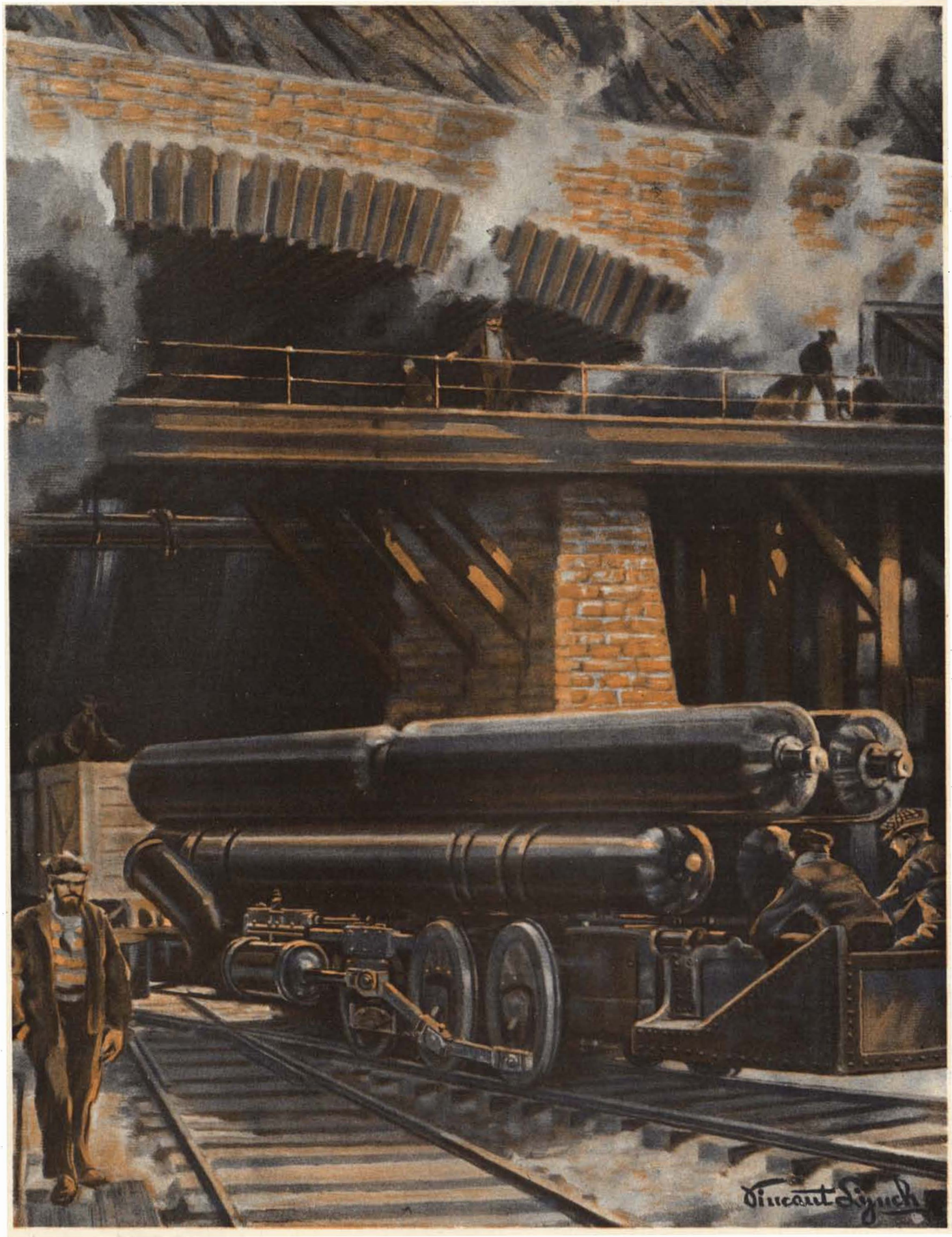
SCIENTIFIC AMERICAN



AMERICAN COMPRESSED AIR LOCOMOTIVE USED IN BORING THE ROVE TUNNEL—[See page 478]

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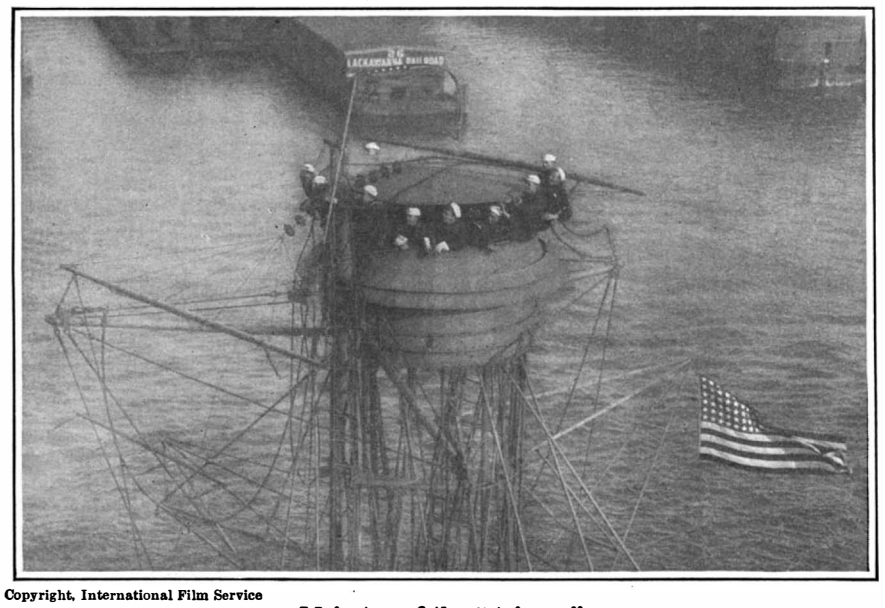
Our Latest Dreadnought, the "Arizona"

WITH the placing in commission of the dreadnought "Arizona" on October 17th last, the Brooklyn Navy Yard has to its credit another record of expeditious construction. The total time occupied in building the ship from the day the order was received at the yard was 37 months, and 32 months elapsed from the date of laying the keel to the day the ship went into commission. It is true that the "New York," built at the same yard and under the supervision of the same member of the construction corps, Naval Constructor Bailey, was turned out in 36 months; but taking into consideration the fact that the "Arizona" is of over 4,000 tons greater displacement, it is evident she represents a greater amount of constructive work per unit of time. The sister ship "Pennsylvania," occupied between 38 and 40 months in building and the "Oklahoma" and "Nevada" from 46 to 48 months.



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Main top of the "Arizona"

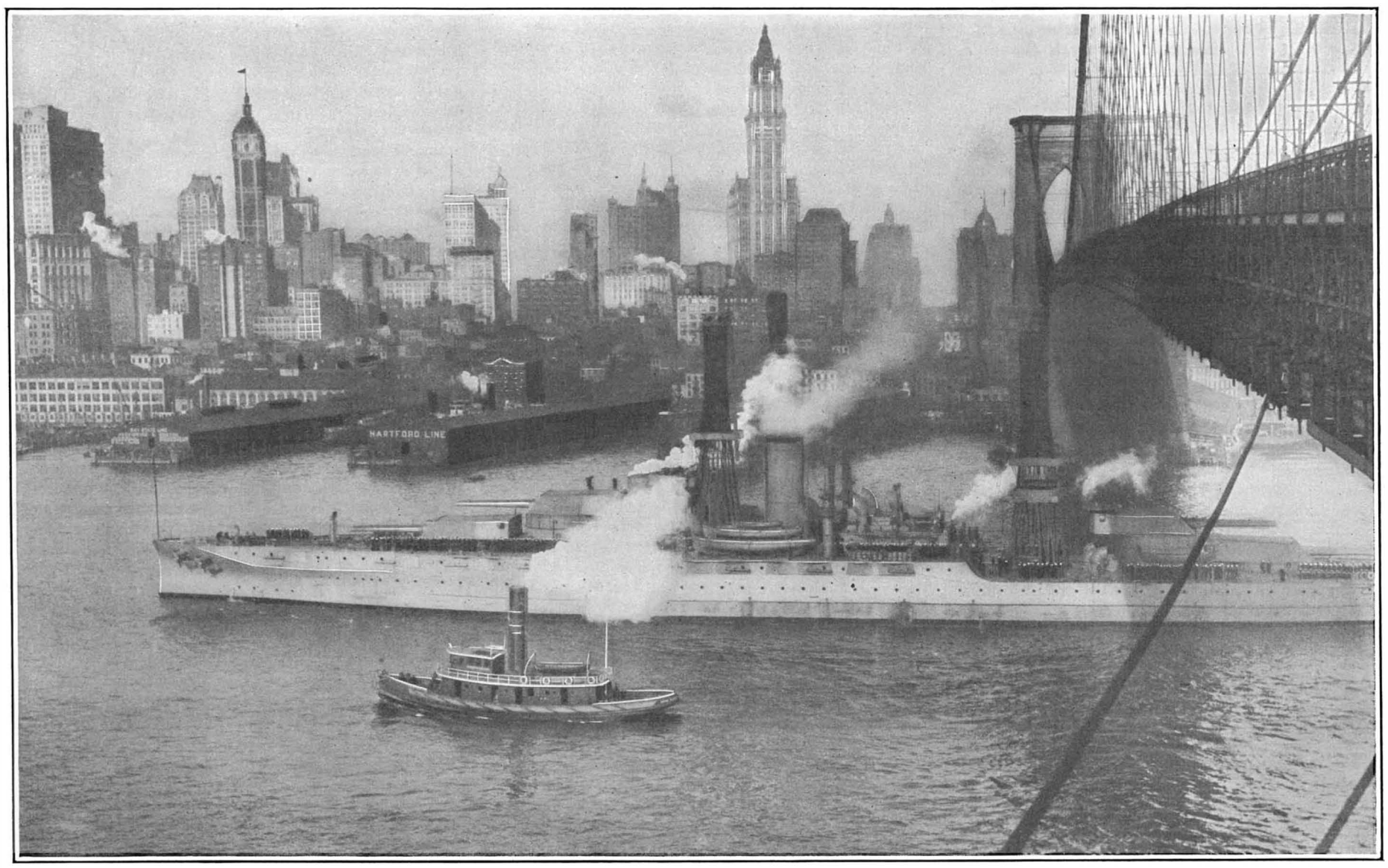
The "Arizona" has a normal displacement of 31,400 tons; she uses fuel oil only, of which she carries normally 2,200 tons, her maximum possible storage being 3,270 tons. The ship is driven by Parsons turbines operating on four shafts, and a novel feature in the motive power is the installation of small high-speed turbines geared down to the propellor shafts, which will be used for cruising at moderate speed. The operation of these turbines will be observed with much interest, since the data secured will serve to give a basis of comparison with the method of electric drive which has already been adopted for some ships of the Navy.

The notable features in this ship in a broadside view such as that presented in our illustration, is her great length (625 feet over all) and the single, large-diameter smokestack immediately abaft the foremast. Another noticeable feature, not observable in our illustration, is the way in which the bow is flared out boldly above the water line, this flare being carried to such an extent that the deck line at the stemhead is practically a semi-circle. The use of a single smoke stack is explained by the fact that, because of the absence of coal bunkers it has been possible to concentrate the whole of the boiler plant in a set of compartments extending entirely across the ship, with the uptakes leading to a smoke stack located centrally above them. The use of a single stack has also the advantage that it is possible to place very thick inclined armor about the base of the stack, this armor extending from the gun-deck to the forecastle-deck.

The armor plan of the "Arizona" follows generally that of the "Oklahoma" and "Nevada," which, at the time they were brought out, marked a great advance in weight of armor carried over any existing ships of the dreadnought class. The main belt 17.6 feet in depth, has a maximum thickness of 13½ inches. Nine feet of this is above the water line and 8 feet 6 inches below, the thickness of the belt below the water line diminishing to 8 inches at its bottom edge. The barbettes carry 13 inches of armor, and the turrets have port plates of the unusual thickness of 18 inches, the sides of the turrets being armored with 10 to 9 inches of armor. Equally generous is the protection on the conning tower, which is 16 inches, the same thickness being used on the conning tower base all the way down to its junction with the protective deck.

The main battery consists of twelve 14-inch 45-caliber guns, mounted in four three-gun turrets, one of each pair of turrets being so placed that its guns can fire

(*Concluded on page* 485)



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Displacement, 31,400 tons. *Speed,* 21 knots. *Armor:* belt, 13½-in., turrets, 18-in. *Guns,* Twelve 14-in., twenty-two 5-in. *Torpedo tubes,* 4. *Oil fuel,* normal 2,200 tons, max., 3,270 tons.

"Arizona" passing down the East River on her first trip from the Navy Yard, Brooklyn, where she was built

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

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

Is Our Naval Programme Imperilled?

WHEN the present administration, urged by the pressure of public opinion, authorized the great naval programme of the past Summer, it was pointed out by the advocates of preparedness that the passage of the bill was, after all, but a preliminary step in the great work of building and putting into commission the powerful fleet called for by the bill. It is one thing to vote $310,000,000, more or less, for the creation of a modern fleet; it is quite another thing to get out the designs for these ships, construct them, vote the annual appropriations as they come due, provide the necessary personnel, put the ships in commission, give them a shaking down cruise, and assemble them in the first line of our naval defense.

The administration has made a notable start by authorizing a programme which is far larger than any that has ever been put through, not only in our own Navy, but in that of any great naval power. The arduous task of carrying this programme successfully through within the time limits imposed, will call for the exercise on the part of the Navy Department of infinite tact, patience, perseverance and zeal, as the years go by.

To any one who is familiar with the past history of the upbuilding of our Navy, it will be evident that the programme can be put through successfully and on time, only if there is the most perfect harmony between the Navy Department and the shipbuilding and armor-plate making interests of the country. It is equally evident that, if this condition is to be secured, there must be a radical change in the attitude of distrust of organized capital which has marred the usefulness of the Secretary of the Navy and has delayed the work of warship construction during the past few years.

The remarkable state of preparedness of the British Navy at the opening of the war, and the rapidity with which new ships have been added to that Navy during the progress of the war, are mainly due to the harmonious cooperation of the Government and the private shipyards; and there can be no doubt that the disappointing results attending the opening of the bids for our own new construction are in no little degree due to the absence of such cooperation and encouragement on the part of our own Government as represented by the present Secretary of the Navy. If the new programme is to be completed on time, the thing can be done only by thorough cooperation with the private yards; and this can be secured only by an attitude of confidence, fairness, and appreciation on the part of the Naval Secretary.

Although we have indulged in some very frank criticism of Mr. Daniels during the four years of his Secretaryship, we are free to admit that the Secretary of 1916 is a different Secretary from that of 1912. Mr. Daniels has shown during the past two years a growing appreciation of the needs of the Navy and an unmistakable desire to avail himself of such criticism of his administration as was characterized by intelligence and fairness of spirit. We do not know whether Mr. Daniels will succeed himself or not, as Secretary of the Navy, but if he should, there is opened up before him, in connection with this great task of upbuilding our Navy and pushing the new programme to completion, an opportunity such as no predecessor in his office has ever possessed.

It goes without saying that during the present great crisis in our Naval history, the shipbuilder, the armor-plate maker, and the manufacturer of ordnance, should give the preference to Naval work. Congress has done its part; and, provided the administration is disposed to cultivate an attitude of sympathetic cooperation, it is now up to the private manufacturers to join with the Government shipbuilding yards in transmuting the great Navy Bill of the past Summer from a dream on paper to a great fleet afloat upon the high seas.

Impressions of a Great Canadian Training Camp

BY the courtesy of the Commandant, Major General E. W. Wilson, and under the personal guidance of his Aide, Lieut. Col. A. H. W. Powell, the Editor of the SCIENTIFIC AMERICAN, was recently given an opportunity to inspect the great training camp at Valcartier near Quebec, in which Canada's first contingent of 32,000 men underwent its preliminary training before leaving for the European theater of war. The site of the camp is a large plateau 17,000 acres in extent, level as a billiard table, situated well up among the hills, and therefore admirably adapted, from the viewpoint both of military maneuvers and of hygiene, to the needs of a great military encampment. The main artery of traffic through the camp is a broad, macadamized highway which extends for a distance of three miles. On each side of this road the troops are arranged by battalions; the tents of each battalion forming three sides of a square, and the enclosed space constituting in each case the parade ground for the battalion.

After we had driven through the sea of white tents, the automobile brought us to one end of what looked for all the world like one of those sloping wooden dams across a river with which we are familiar here in the United States. Facing it at a distance of 100 yards was a line of recruits, chiefly stalwart men from the plains of Western Canada, who were being trained in the art of rushing an enemy's trenches. On they came at the word of command, and sweeping up the inclined face of the "dam," dropped out of sight beyond its crest. The fact that every man disappeared with the butt of his rifle high in air, suggested what was taking place on the further side. We drove on and stopped just to the rear of the structure, and in time to see the second line of men appear over the crest and drop down into the trench. Here, at yard-intervals, was a line of a hundred or more straw-stuffed dummies, into which the attacking troops drove deeply with their bayonets as they dropped to earth. Then followed another rush of some fifty yards until the attackers reached a long line of dummies swung from poles overhead, each dummy about the thickness of a man's body being made up of a large bundle of sticks or oziers. Every man of the charging troops selected his mark and drove home his bayonet with a swift horizontal thrust. The charge finished with a novel bayonet movement which has been developed during the present operations in Flanders and has proved to be wonderfully efficient.

A drive of a mile or so over the splendid turf with which the whole of the Valcartier plain is covered, brought us to the wonderfully complete system of instruction trenches, of which there must be altogether some two miles at this camp. These trenches are a perfect replica of those which the British have built on the Western front, no detail having been omitted. They were built under the direction of officers who have seen active service in the trenches and have been invalided home to Canada. So valuable is the experience of these officers that many of them have been retained permanently at Valcartier and other Canadian camps for instruction of the recruits in trench building and warfare under modern conditions. Every type of construction is here seen, and before they leave for Europe the Canadian contingents are made thoroughly conversant with the various methods of trench building, as determined by the character of the ground and the materials encountered on the various parts of the front.

Particularly interesting were the concealed machine-gun positions and the dugouts, twenty to thirty feet underground, approached by thoroughly timbered stairways. On entering the first machine-gun chamber which was entirely enclosed by earthen walls and roof, we asked where was the port or casemate through which the gun was fired. By way of answer, Col. Powell gave a word of command, and directly in front of us there opened up an embrasure a few inches in width and several feet in length, revealing the plain over which an attacking enemy would have to come.

A little later we were outside and facing the grass-covered parapet of the trenches from which we had just come. "Somewhere opposite you," said Col. Powell, "is the machine-gun position which you have lately examined; can you locate it?" A careful search of the grassgrown slope failed to reveal the slightest indication; and then, at the word of command, a long and narrow strip of the turf lifted, revealing the easily-recognized muzzle and water jacket of a Maxim machine-gun.

Then we motored over to the rifle butts, some two or three miles distant. Everything is on a grand scale at Valcartier, including the rifle butts, which stretch in a continuous line for about two miles, there being no less than sixteen hundred separate targets in the line. Their great number is explained by the fact that, in the first rush, over thirty thousand men had to be trained at Valcartier with all possible expedition; and in order to prevent delay in giving the men a thorough course in sniping, this generous provision of targets was made. The first impression was of the very limited range at which the various firing squads were practicing—200 to 250 yards. "There is no long-distance shooting in trench warfare," said Col. Powell, "and we are training these men for conditions as they will find them at the front." Disappearing targets painted in such a way as to merge with the landscape back of them are used, and the men are made expert in firing at pointblank range at a target which brings its center just above the line of vision and at once disappears.

In view of our own activity in the matter of business men's camps, such as that which General Wood has made such a success at Plattsburg, this great camp at Valcartier should possess deep interest for those patriotic Americans who are offering themselves each year for training. A visit to Valcartier, particularly on the part of those who are training themselves for commissions, would be highly educative; and if the courtesies extended to the Editor of this journal are any criterion, we believe that they would find a cordial welcome awaiting them.

Indian Languages of America

THE Bureau of American Ethnology of the Smithsonian Institution, which conducts studies and investigations among the Indians, is constantly bombarded with requests for "The Indian word" for this and that. It may be worth while to explain to the public, therefore, that there is no one American Indian language. On the contrary there are about 1,000 languages in the two Americas, and practically 500 distinct Indian languages north of Mexico. It becomes, then, impossible to give "the" Indian word for any English equivalent, and consequently it is usually chosen from the language of the tribe which inhabits, or once inhabited, the particular section of the country from which the request comes.

Fortunately for the student of Indian linguistics, nearly all the tribal and family languages may be classified into groups, so that it is not necessary for the philologist to learn each language; he studies the basic principles of the speech of a linguistic group, and, following certain rules and exceptions, is able to comprehend much of the speech of its several branches. He knows, according to Grimm's law evolved years ago by our old friend, the compiler of the fairy tales, that certain consonants correspond in all related languages. Thus the scientist recognizes the same word despite its disguises. But it is not with a view of disguising or making his speech distinctive that an Indian of one tribe pronounces a word differently from one of another tribe, but because he cannot pronounce certain sounds. The Arapaho, Cheyenne and Caddo tribes have the sound of n but lack l and r; on the other hand, the Kiowa, Apache, Zuni and Cherokee have l and n, but lack r. The Sioux call themselves by a name meaning "allies," pronounced "Dakota" by those of the eastern or Santee division; "Nakota" by the middle or Yankton division, and "Lakota" by the western or Teton division.

But besides these variations, and many others, there are the eccentricities in speech of the individual, of the family proper, and of the camp-group, all of which intrude transient forms, just as in the English speech of North America we find variations between the speech of a Northerner, a Westerner, and a Southerner. The philologist has to beware all this, and to sift and sort the languages to eliminate all such local and colloquial accents, for it must be remembered that the speech of the red man is not a written language, with a grammar and a dictionary, except those which his white friends have evolved for him. It is of interest and value to know and record these various aboriginal languages before they become extinct, and that is one part of the work of the Bureau of American Ethnology.

Women Students in German Universities

THE women students enrolled at the different German universities for the summer semester of 1916 numbered 5,460, or nearly twice the number enrolled in 1911. Female students in 1916 constituted 10.5 per cent of the total student body, compared with 4.8 per cent five years ago.

During the past five years feminine interest in mathematics, natural science, and medicine has greatly increased; more than one-fourth of the women students now are enrolled for the last-named course, compared with about 20 per cent five years ago, or in actual numbers, 1,394, compared with 582. The students of mathematics and natural science number 1,011, compared with 504 five years ago. In philology and history the number has risen since 1911 from 1,563 to 2,654; in political history and agriculture, from 67 to 213; law, from 39 to 93; Protestant theology, from 5 to 14; pharmacy, from 8 to 22; and dentistry, from 27 to 58.

Since the outbreak of the war, the enrollment of female students has made particular strides in the Prussian and Bavarian universities of Berlin, Frankfort-on-Main, Marburg, Halle and Munich.

Naval and Military

Cost of the U. S. Navy.—The total expenditures for the U. S. Navy from 1794 to 1915, inclusive, reaches the great sum of $3,214,339,051. This includes ships, establishments, pay, materials, and all expenses in connection with the Navy Department. The total cost of all ships now upon the Navy List, excluding the new work authorized in 1915 and the great bill of 1916 is $459,686,551.

Details of the Latest Zeppelin.— The Zeppelin L-33, recently brought down near London, proved to be one of the largest and latest in the German service. It carries four gondolas in which are mounted six Mercedes engines, each of 240 h.p. There are five propellers, and it is estimated that the airship carried 2,000 gallons of petrol in her various tanks. She is fitted with no less than sixty bomb-droppers. The ship is 680 feet long, and her total estimated weight, with her crew of twenty-two officers and men, is fifty tons. She carried seven guns, including five Maxim machine guns.

Patrolling the British Channel.— The security of the ferry service across the British Channel is one of the astonishing feats of the war. Admiral Sir Reginald Bacon, who commands this patrol, says in his report "during the last six months more than 21,000 merchant ships have passed through my patrol ships." Out of this number, only 21 have been sunk, or seriously damaged by the enemy. Our flotilla has also helped to protect the flank of the troop transport service for our Army in France. Safety has been so perfectly insured that the loss of no single life has been reported during the whole of this period.

Enormous Output of British Shipyards.— Speaking of the wonderful activity in British shipyards, the "Engineer" of London, states that the number of new vessels built during the war almost passes belief. If owners of shipyards had been asked three years ago what their maximum possible output would be, their estimate would have been 100% below the mark. "Twenty months ago," says the "Engineer," "the designs of two great ships were merely under discussion. Today, they are practically completed. Docks are being finished years before their time; factories are being erected; cranes built; berths lengthened or built entirely new; and all things that ships need to maintain them are being pushed forward with astonishing rapidity."

Railroad Wrecking in the Russian Retreat.—The gage of the Russian railroads is about one foot wider than that of the German railroads. Hence the Russians during their retreat after the battle of Tannenberg believed that the Germans would be unable to use their narrower-gage locomotives and cars on the Russian lines. The Germans, however, moved one of the rails a foot inside its former position. At the same time they ruined the track for Russian use, by sawing off the ties just outside the shifted rails. The Russians came back and on their next retreat exploded a cartridge at each rail-joint, smashing the joint and bending in the abutting rail ends so that cars could not pass. This involved for the Germans the huge task of bringing up new steel and re-laying the entire track. The job was completed.

Our First-line of Dreadnoughts.— With the exception of the battleship "Connecticut," our first-line in the Atlantic fleet is composed entirely of all big-gun ships, and in a few week's time, when the newly-commissioned "Arizona" joins the fleet, the "Connecticut" will go into the reserve and we shall have a first-line composed of dreadnoughts. If the "North Dakota," which has been undergoing a thorough reconstruction of motor power is got ready by that time, we shall have 12 ships mounting nothing smaller than 12-inch and 14-inch guns in their main batteries, namely: "Delaware" and "North Dakota," "Utah" and "Florida," "Arkansas" and "Wyoming," "New York" and "Texas," "Oklahoma" and "Nevada," and "Pennsylvania" and "Arizona." The total broadside will be made up of sixty-four 12-inch and sixty-four 14-inch guns.

Bringing Down a Zeppelin.—From an American who was recently engaged in airship construction near London and was in that city during several Zeppelin raids, we gather the following particulars of the method by which one of the Zeppelins was destroyed. The attacking aeroplane carried suspended at a suitable distance below it a light grappling iron, for engaging and tearing the envelope of the Zeppelin. On the grappling-iron was mounted an electrical ignition device connected by cable with a switch placed near the aeroplane pilot. In the case when this device was successfully used, London had ample notice of the approach of the enemy and the aviators had time to rise to sufficient height for a swooping attack on the dirigible. The exploding device was drawn successfully across the envelope, ripping it open so that the liberated gas could be ignited by the spark.

Science

Women Students in German Universities numbered 5,460 during the summer semester of 1916, of whom 1,394 were studying medicine, while 1,011 were taking courses in natural science and mathematics.

Lake Malheur, in southeastern Oregon, is one of the largest wildfowl reservations in the country and a natural refuge and breeding ground for thousands of waterfowl. Bird-lovers throughout the United States feel concerned over a project on foot in Oregon to drain this lake and make use of the land.

A National Census of Research.—One of the committees appointed by the new National Research Council is entrusted with the task of preparing a national census of equipment for research, of the men engaged in it, and of the lines of investigation pursued in co-operating government bureaus, educational institutions, research foundations and industrial research laboratories. Dr. Stratton, director of the Bureau of Standards, is chairman of the committee.

Standardizing Insect Control in the Greenhouse.— The U. S. Bureau of Entomology is engaged in important experimental work which will eventually result in the complete standardization of methods of insect control in greenhouses. Greenhouse fumigation with hydrocyanic acid gas has already been standardized, particularly in relation to the dosage which can be safely used for various kinds of plants and the strength of gas necessary for the control of different greenhouse insect pests.

The Freezing Point of Mercury has recently been very carefully redetermined at the U. S. Bureau of Standards, platinum resistance thermometers being used in measuring temperatures. The value obtained was — 38.87 deg. C. (— 37.97 F.), which agrees substantially with that obtained many years ago in the determination made under the auspices of the British Government. Chappuis, in 1900, obtained a value of — 38.80 C. The value given by Hutchins is — 39.44 C. The precise determination of this constant is of interest on account of its applications in thermometry and elsewhere.

New York Meeting of the A. A. A. S.—The seventieth meeting of the American Association for the Advancement of Science will be held in New York City from December 26 to 30, 1916, under the presidency of Prof. Van Hise, president of the University of Wisconsin. About forty national societies affiliated with the association will meet in conjunction with it, and the forthcoming meeting is to inaugurate the practice of holding large "convocation week" meetings once in four years, successively in New York, Chicago and Washington. Since the association last met in New York, ten years ago, its membership has grown from 5,000 to 11,000, and the coming meeting will undoubtedly be the largest and most important gathering of scientific men ever held in this country.

English Sparrows in the United States.— The Government "bird census" of 1914 indicated an average of six pairs of robins and five pairs of English sparrows on each farm tract of the standard size (108 acres) used in the enumeration. The accuracy of these figures was widely questioned by people who felt sure that the English sparrow was by far the commonest bird in the northeastern United States. However, the recently published results of the 1915 census also indicate the greater abundance of robins, in the proportion of eight pairs to six. A recent estimate by Mr. F. L. Burns based on his sectional census made in 1914 at Berwyn, Pa., places the total population of English sparrows in the United States east of the Mississippi River at 165,000,000 individuals.

Completion of the U. S. Topographic Map.—After many years of excellent work by the U. S. Geological Survey, the Topographic Atlas of the United States covers only 40 per cent of the country, and many of the sheets are already so old that their value is decidedly limited. At the present rate of progress, in spite of liberal appropriations from Congress and the cooperation of many states, it is estimated that it would take about a hundred years to complete the mapping of the country, to say nothing of keeping the map up to date. This situation is extremely deplorable from many points of view—that of national defense, among others—and great interest therefore attaches to the movement recently set on foot by Prof. W. M. Davis, of Harvard University, to take whatever measures may be necessary to secure an acceleration of the work. A strong committee has been formed to push this project, with Prof. Davis as chairman, and members representing organizations and institutions interested in the completion of the map from many diverse points of view. Prof. A. E. Burton, of the Massachusetts Institute of Technology, is secretary. All interested persons are invited to write to him, specifying as definitely as possible the practical advantages that would accrue to the writers from the more rapid progress of our national map.

Radio Communication

The Difference in Longitude Between Paris and Washington has lately been determined with the aid of wireless telegraphy. The work had been in progress since October, 1913. The distance between the stations is 6,175 kilometers; and the result, expressed in terms of time, is 5 hours 17 minutes 35.67 seconds. This finding is probably accurate to 0.01 second.

Remarkable Long Distance Transmission by Amateurs appears to be common in the state of Wisconsin. Recently, E. H. Hartnell, an amateur of Salem, was able to work 75 miles either day or night with a three-inch spark coil consuming 24 watts. Previous to this time the amateurs of California were looked upon as having a monopoly on long distance transmission and reception with ordinary apparatus.

Change in Title of Naval Radio Service.— Hereafter the Naval Radio Service will be known as the Naval Communication Service. Charges on all traffic exchanged between other systems (radio, telegraph, and cable) and radio stations (ship and shore) operated by the Navy will be accounted for by the Naval Communication Service. In addition to his other duties, the Director of Naval Communication will perform the duties formerly assigned to the Superintendent of Naval Radio Service.

Completion of San Diego Station marks the welding of the third link in a chain of five wireless stations for the United States Navy, extending from Washington, D. C., to Cavite, P. I., via the Canal Zone, Panama. The new station has three towers each 600 feet high, and it is to operate in conjunction with the two stations already in service at Washington and Panama, and with the proposed station at Pearl Harbor, Honolulu. The latter, when realized, will connect the Philippines with the United States.

Wireless and the Somme Casualties.— From the reports of war correspondents it appears that wireless telegraphy is being employed to good stead in the offensive actions of the British and French armies on the Somme. The artillery and the aeroplane observers are linked by wireless, and it is said that the airmen are in continual communication with the former. Thus it is possible to establish an accurate barrier fire which is constantly shifted forward as the lines of charging Allied troops move over the ground. The efficacy of the co-operation between aerial observers and artillery has a marked effect on the casualties of the attackers.

Low-Power Ship Stations.—The extension of wireless telegraphy to small vessels, particularly cargo ships, as well as the need for a moderate power installation for emergency purposes on large vessels, has brought into existence a compact transmitter of ¼ kilowatt capacity. All the apparatus constituting this transmitter, including the motor-generator, is mounted in a wooden cabinet measuring 27 inches high, 26 inches wide, and 17 inches deep when closed. The cabinet is divided into two compartments, the larger one being used for the motor-generator and the disk discharger, while the smaller is devoted to the other apparatus.

Women Wireless Operators of England.— At the beginning of the year the Marconi organization in England determined to test the suitability or otherwise of women as wireless operators, and established a school at one of their stations, where instruction of a practical and theoretical nature has been given to women. The school has been well attended, states *The Electrician*, but applications for admission were latterly refused, as a decision had been arrived at to close the establishment for the present. So far as it has gone the experiment is regarded as encouraging, and some of the pupils have been already drafted to stations, where they are taking night duty in turn with men. Sending by female operators has, however, a tendency to be too light. This defect varies in individual cases, and with some of the women learners it is thought that they will become efficient wireless operators with practice.

Concerts Through the Air.— War bulletins and important world happenings, now and then interspersed in a nightly musical program from the air, emanate from the radio experimental laboratory of Dr. Lee DeForest at Highbridge, N. Y. Among the musical numbers on the nightly program are operatic selections, popular dance music, sentimental songs, Hawaiian medleys, and stirring band and orchestra phonograph offerings. In point of clearness it is said that the xylophone and the accordion are among the best instruments for wireless transmission, although the brass band and the human voice, especially if soprano, oft-times are equally clear to all the listening amateur stations. To transmit the human voice by wireless telephone the speaker or operator talks into an ordinary microphone. In the case of the musical selection, on the other hand, the microphone is placed inside the cabinet of a phonograph, where it can get the full volume of sound.

Wings for Our Eagle

What is Being Done by Way of Bringing the United States Army's Air Service Up to the Mark

THE lesson of the European war with regard to military aviation has at last reached home and has been heeded by the United States Government. We are soon to have an air service that will be truly worthy of the name; for recent appropriations passed by Congress make possible the purchasing of several hundred aeroplanes of all types and the training of Army men and National Guardsmen in aviation on an extensive scale. In sum, we have taken the prime step in the direction of bringing our aerial defences to a state of preparedness comparable to that of other world powers.

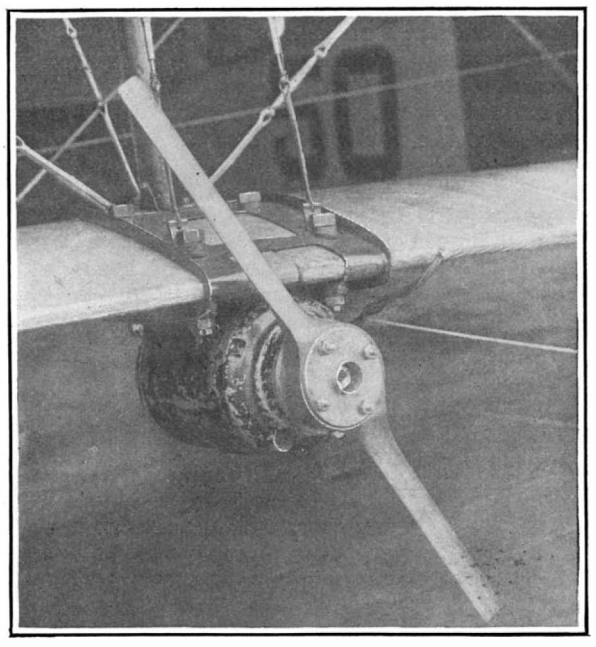
So much has been written and said concerning the precarious condition of our aerial forces in the recent past that it would be superfluous to review even briefly the status of this branch of our defences prior to the passage of the present appropriation in Congress. Suffice it to say here that with a half dozen other countries possessing thousands of machines and having between 2,000 to 9,000 aviators each, the United States—the home of the Wrights, Langley, and other pioneers of aerial navigation—has had less than 50 aviators in the Army and Navy combined.

The appropriation passed by Congress is the consummation of a Nation-wide campaign of education on aerial defence, conducted mainly by the Aero Club of America with the coöperation of the affiliated aero clubs and other organizations and individuals, and the support of hundreds of newspapers. The National Aeroplane Fund, which enabled public-spirited citizens to aid in the development of aerial defence, also played no little part in causing Congress to appropriate a reasonable sum for the rehabilitation of our heretofore unimportant air fleet. In fact, Congress frankly admitted that in granting the substantial appropriation it was only complying with the demands of the American public for adequate aerial defences; and the public, in turn, had been moved to the point of seeing the deplorable and helpless condition of our air service by the campaign of education.

True it is that the obtaining of the necessary funds is the all-important factor in the rehabilitation of our air fleet—but it is only the starting point. There remain the ordering of hundreds of machines best suited to the needs of our Army, and the training of aviators for military service. For these purposes Congress has appropriated close to $14,000,000, with an additional $3,500,000 for Naval aviation.

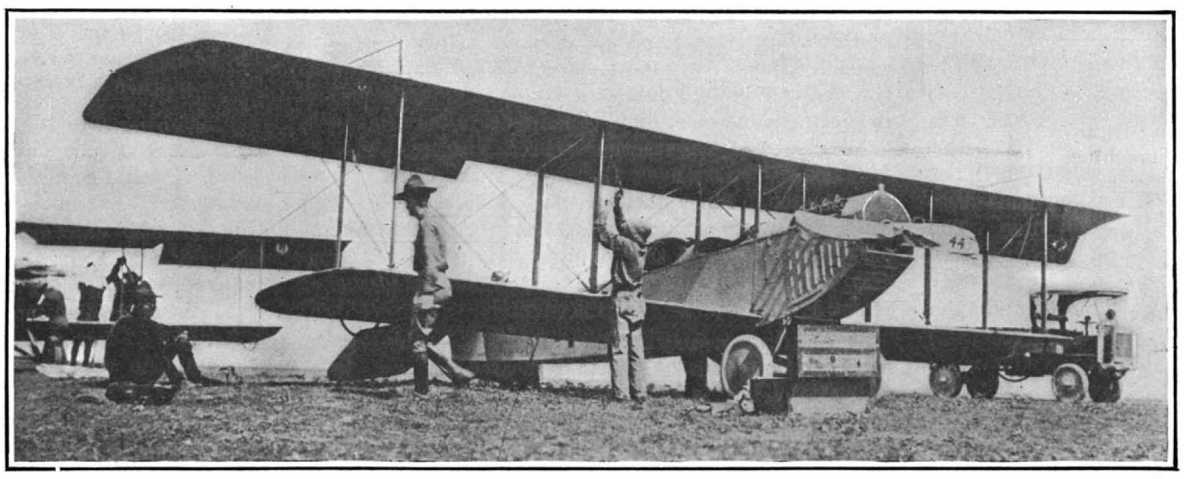
Even with the funds immediately available the ordering of the new aeroplanes is a matter of some months at least. The board of Signal Corps engineers, known as the Technical Aero Advisory and Inspection Board, have already busied themselves with the study of our Army's aerial requirements, following the teachings of the latest military aviation science as propounded by the present European war. As a result of their findings, they have been preparing lists and specifications of the machines and the equipment which will be required, and these are being submitted to aeronautical manufacturers as fast as they are ready. Thus far it appears that the materiél forces of the new fleet, which will be under the command of Lieut. Col. George O. Squier, will in all probability be composed of about 175 aeroplanes for the Army, which number is to include high-speed pursuit machines, scouting machines, and bomb-dropping machines; 100 hydro-aeroplanes for coast patrol duty, and 100 school machines to be used in training aviators.

But after all is said and done, the assembling of the necessary machines is by far the simplest task in the rehabilitation of our aerial forces. Once the specifications have been drawn up and the bids received from the competing manufacturers and passed upon, there remain but the awarding of orders and the inspection of the machines delivered. Thanks to the confidence of several Allied governments in American-made aeroplanes, our aircraft constructors during the past two years have developed their plants in a big way, and to-day finds several of them in a position to execute the United States' orders in record time, with a number of smaller constructors in a position to supply good machines also, if only due allowance is made in dating the deliveries to provide for their modest facilities.



Wireless telegraphy on Army aircraft

This generator, driven by a two-blade propeller, was used by Captain Cluver in his recent wireless telegraph experiments with military aeroplane No. 50 at San Diego, Cal. The generator is fastened to the butt of a strut on the lower wing section, and because of its unique wind drive it continues to generate current after the aeroplane engine is shut off during a volplane.



Assembling one of the Army aeroplanes now in use along the Mexican border. This type of machine is particularly intended for scouting purposes

The obtaining of trained airmen, however, is by comparison an extremely difficult and, perforce, intricate undertaking. For here we are dealing with the human element and not with man-made articles.

Although public opinion in America has demanded the immediate training of 1,000 aviators, the Army authorities, in order to make a start in the training of the new personnel, will probably set the limit somewhat below 500 for the immediate future. Because of the magnitude of the undertaking the plans of the Army authorities at this writing are mostly in the nature of tentative projects which are liable to numerous changes in the course of putting them through a practical test.

Aside from the officers and enlisted men in the Regular Army, the aviation personnel of our new air fleet is to consist of civilians employed by the aviation section of the Signal Corps, and National Guard organizations mustered into the service of the United States; and it is particularly in the training of the civilians that the problem is most interesting. As far as flying is concerned, the Army authorities state that all the personnel must be trained from uninstructed material. This also applies, to a great extent, to mechanicians and chauffeurs.

In the training of aviators it is planned that the schools will be of two general catagories: first, the United States Army aviation schools—such as the one now at San Diego, Calif.—whose number, for the time being at least is intended to be three, that is to say, one for the Pacific coast, one for the Central States, and one for the East; second, the civilian schools, maintained by manufacturers or others, which may be utilized for preliminary training purposes. The country will thus be divided into three school districts, and the commanding officer of each Army aviation school will have jurisdiction over all the schools in his district. It is intended to send aviation personnel for all formations, except those of the Regular Army and possibly the National Guard, to civilian schools to obtain their preliminary instruction, after which they may finish their course at the Army aviation schools and obtain their military aviators' rating.

The personnel for the Aviation Section of the Signal Corps, U. S. A., will be obtained as now prescribed by law and Army regulations. The personnel for the Aerial Reserve Corps and National Guard aviators, on the other hand, is a subject of peculiar momentary interest and one of heated controversy between the Army officials and the Aero Club of America. The latter organization contends that the Army is not making proper provision for training the militiamen who have applied for training as aviators, while the Army replies with the statement that provision has been made so that any State which seriously desires an Aero Company can get one. The Army officials believe that success with the National Guard Aero Companies depends upon the providing of trained units able to take the field as units in aviation as well as in cavalry, infantry, or artillery; and since the object of rehabilitating our air fleet is ostensibly for the purpose of having an ample number of aeroplanes and trained military aviators for immediate service in time of war, it is held that the duty of the Federal Government is to train those fliers as Federal Reserve Officers. Under the language of the bill, the Aviation Section of the Signal Corps has power to train an unlimited number of Reserve Military Aviators with the rank of first lieutenant, and as fast as applications are received for training in this grade the applicants will be examined.

According to recent advices the training of reserve aviators will fall into two classes: the Reserve Military Aviators, who will be trained at civilian flying schools; and the National Guardsmen. At the termination of the thorough training of the reserve aviators they will, if

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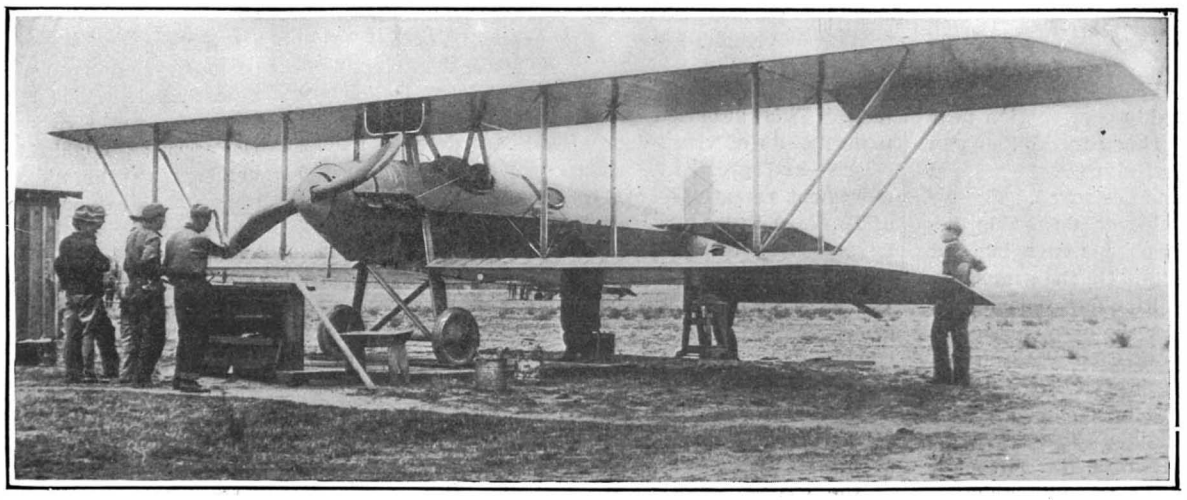
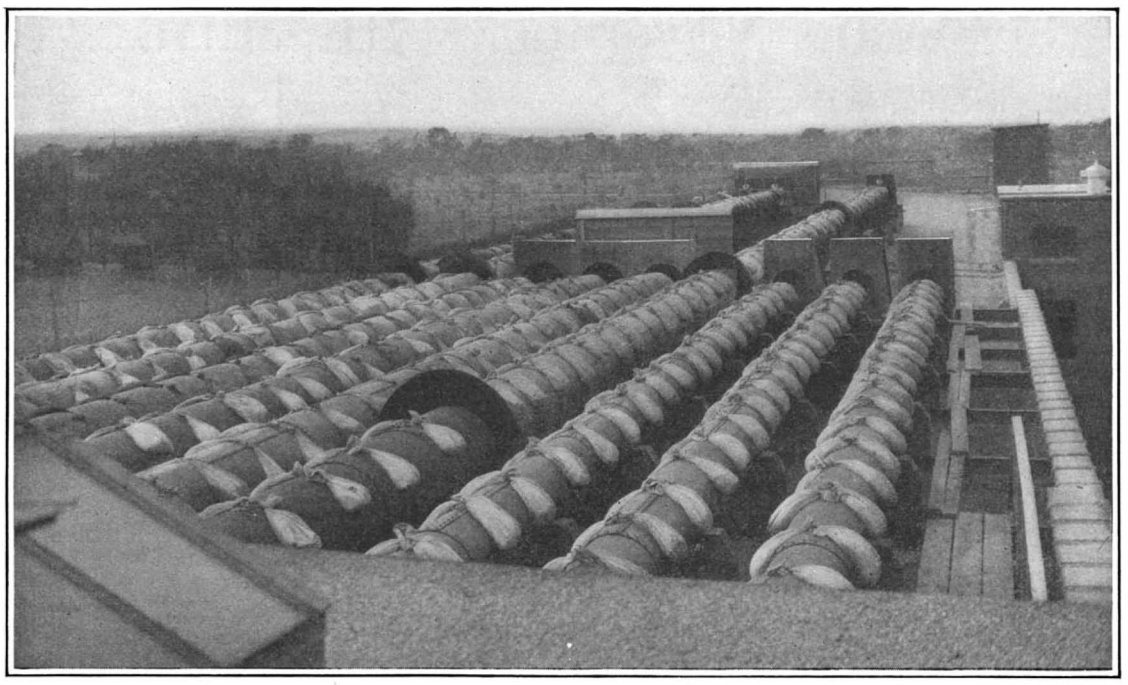
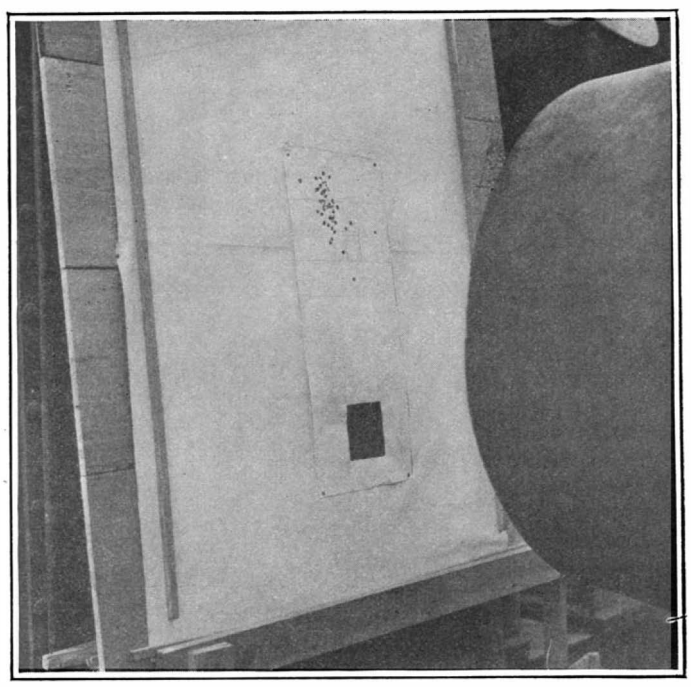


First steel battleplane purchased for the use of the Army Signal Corps Aviation School at San Diego, Cal. This machine, carrying a pilot and observer, has made a speed of 82.5 miles per hour



Steel tubular gun ranges on top of factory roof. Ranges are 100 and 300 feet



A target showing result of short-range accuracy test

The Inspection and Tests of Lewis Machine Guns

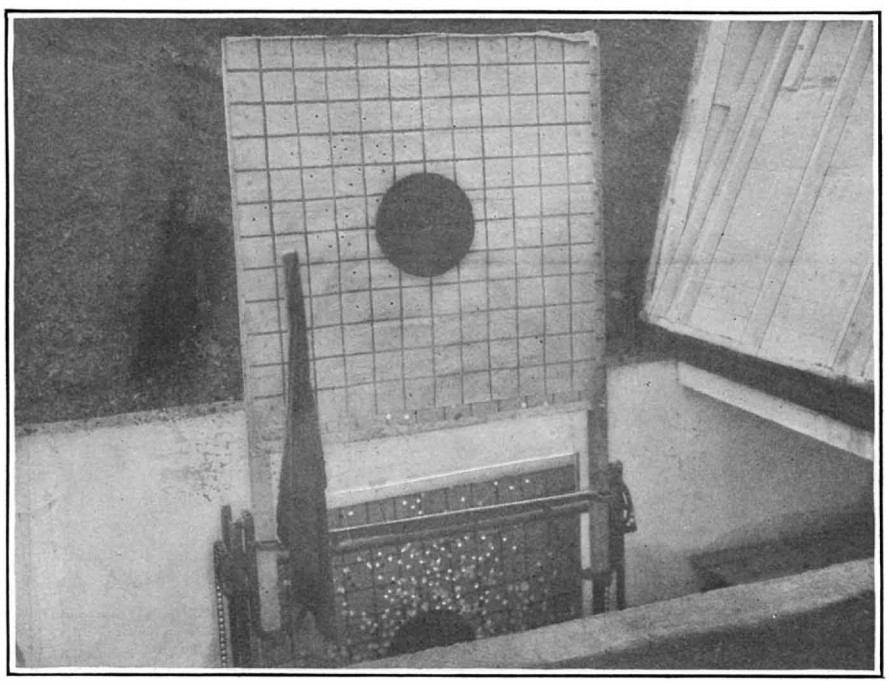
Parts Must Be Interchangeable and Made to an Accuracy of Three Thousandths of an Inch

ONE of the most important departments in the factories of the munition makers in this country is that devoted to the proper inspection of the output. This will be understood when we state that in the larger factories, as many as 100 inspectors are employed by the Allied Governments to pass upon and approve each detail of the product. Foreign army officers who are experts in ordnance and munitions have been detailed by their respective governments to the duty of directing this inspection, and they are carefully supervising the product during its manufacture, assembling and tests.

The present article shows how this inspection is carried on in a large factory in which several hundred Lewis machine guns are being turned out every week for the Allied armies.

One of the strictest requirements is that of interchangeability; for it can be readily understood that if one or more parts from a certain gun can be used in the assembling of another gun, and that if, from the vast store of separate parts, it is possible to select a complete set necessary to make up a complete machine gun and assemble the parts with the certain conviction that they will go together with perfect fit and perfect functioning—the question of rapid repairs and replacement at the front will be greatly facilitated.

The Lewis Machine Gun, upon its completion, is first given careful inspection and actual service tests by the manufacturer. It is then turned over to the Allied inspection force for further tests. The guns are taken to a room such as the one shown in our illustration, where they are completely disassembled. As the gun is taken to pieces, every part is carefully weighed and measured, and if any part shows a variation exceeding .003 of an inch in measurement, or a correspondingly small variation in weight, it is rejected. The parts are all placed in one box, and in the re-assembling care is taken to select the parts for each gun from different boxes, thereby insuring perfect interchangeability.



The guns must hit this bull's-eye at 600 yards

An interesting picture is the one showing the firing ranges which, in this case, are located on the roof of the munition factory building. The ranges consist of sheet-steel tubes, three of which are 100 yards in length and the others 100 feet. They are used to determine the ability of the gun to maintain accurate fire under rapid-fire conditions. Army officers of the Allied governments are in constant attendance at these ranges, noting every action of the gun under test; and, by the way, the ranges are working 24 hours a day under three shifts of these army inspectors.

It should be explained that these are what is known as "rigid" tests, that is to say, they are tests of the accuracy of the gun and not of the gunner. Hence, the gun to be tested is clamped at four places in its length to a heavy cast-iron table which is capable of being elevated and traversed. The table is firmly mounted on a heavy concrete base and hence, when once the gun has been aimed, it is certain that any dispersion of the shots as shown on the target will be due to the gun or the cartridge, and such dispersion will be an absolute record of the accuracy of the gun.

In the photograph showing the result of Lewis machine-gun fire at 100 yards in rigid tests, it will be noted that at the bottom of the target is a black rectangular space, directly below and of about equal size to the actual target above it, which is ruled off into four quarter sections. The object of this black spot is to assist the gunner in locating the target proper which is a known distance above it.

Another photograph shows the regular army disappearing target with its bull's-eye in the center, which is used in munition factories for testing Lewis machine guns. If the guns do not hit the bull's-eye, placing the majority of the shots therein at 600 yards, they are rejected by the Allies' inspectors

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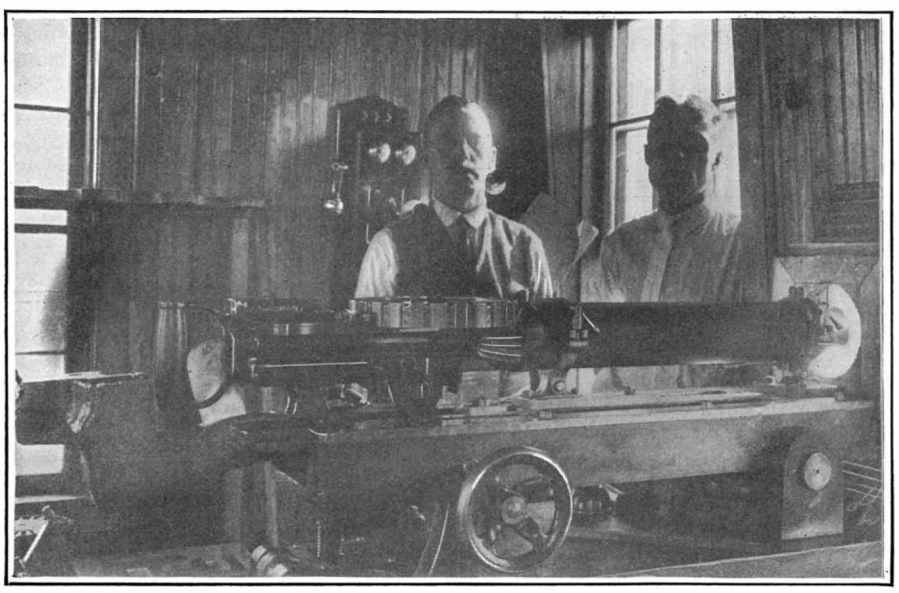
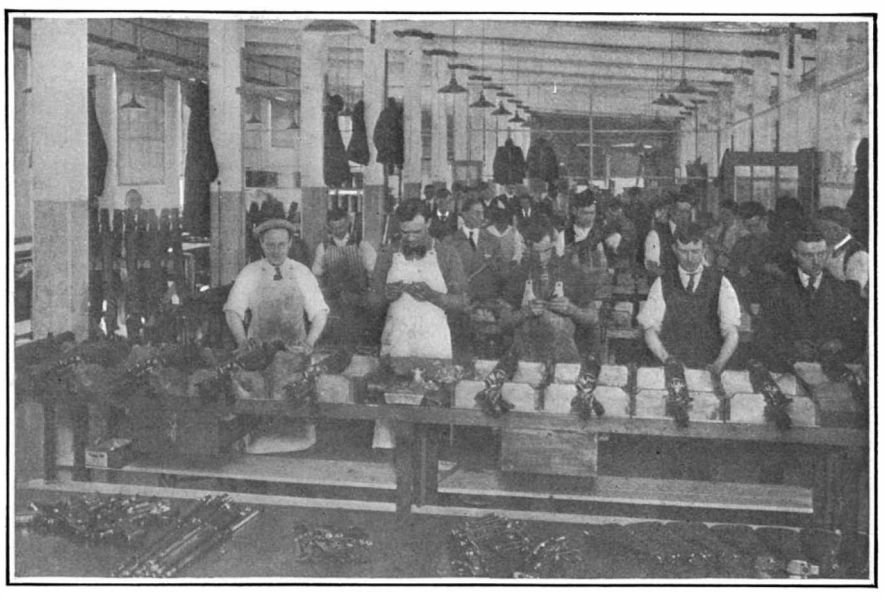


Firing test for accuracy. Gun is held in a metal clamp anchored to concrete base



Here the guns are taken apart and re-assembled, the parts being taken from different guns.

Testing Lewis machine guns

Strategic Moves of the War, November 17th, 1916

By Our Military Expert

THE general situation has changed but little during the preceding week. At date of writing nothing has happened to indicate any radical change in the strategy recently outlined in these columns.

The Rumanian fronts continue to supply the greater part of the daily news bulletins.

The Russo-Rumanian Armies in the northern end of the Dobrudja are slowly but surely pushing Mackensen back upon his lines of communication. The continuation of this movement should be the aim of the Russo-Rumanian Commander. Sound strategy makes it necessary that this be carried forward as rapidly as possible and with every man and gun that can be spared from the Transylvania front.

I expect the progress made in this field of operation to be slow and laborious until Mackensen is pushed back to a line eight or ten miles south of Cernavoda. Once this is accomplished, the Rumanians should be able to repair the bridge over the Danube and thus greatly improve their lines of communication and supplies. Further developments on this front will then depend upon conditions that will be outlined later on in this article.

It will be remembered that at the time of Mackensen's capture of Cernavoda, we were told that the Rumanians, on evacuating the town, had destroyed one arch of the bridge to prevent its being used by the invading forces. Since that time nothing had been heard referring in any way to this particular bridge and it was fair to suppose that the invaders had made no attempts at repairing it or had been prevented from so doing by the Rumanian forces on the other side of the river, assisted by the fleet of small war crafts which the Rumanians and Russians are known to maintain on the Danube. It was therefore very surprising to read in the news bulletins from Petrograd, under date of November 10th, that the Russo-Rumanian Cavalry and Infantry detachments had occupied the station of Dunareav (not shown on any available map), two miles west of Cernavoda and were fighting for the possession of Cernavoda bridge. This description, if correct, would indicate that the Teutons had succeeded in repairing the bridge and had actually taken a stand west of it on Rumanian territory which at this particular point consists of marshes and swamps from ten to twelve miles in width extending along the left banks of the Danube south and southeast of Hirsova for a distance of nearly one hundred miles. It should be noted that the Teutons have never claimed to have repaired or crossed the Danube over this bridge or to have advanced on the other side, nor had the Rumanians reported or admitted the loss of the bridge or the enemy's advance into their swampy territory at this point.

Subsequent dispatches make no mention of this incident and no reports of farther advance or retreat in this particular section have been received. In view of the peculiar circumstances connected with this report, I am inclined to believe that the fighting reported did not take place on the left bank of the River. The dispatch must have been badly mixed in the transmission. There may be a point, called Dunareav two miles west of Cernavoda, but I have not been able to find it on any map. The Rumanian end of the Cernavoda bridge over the Danube abuts in a swamp which necessitates a continuation of the bridge for a distance of over ten miles. Dunareav may be a station or stopping point on this bridge or causeway. It may be the point from which the Russo-Rumanians, according to a Berlin report of November 13th, shelled Cernavoda without success. The fighting for the possession of the bridge will be done, I am quite certain, on the Cernavoda side of the river, where, Berlin tells us, hostile detachments were feeling their way along the Danube against Mackensen's left wing, resting on that river a few miles north of Cernavoda.

We read frequent reports of Russian success in crossing the Danube and compelling Mackensen to beat a "hasty retreat." On the other hand we are told that the Teutons are taking towns and prisoners on the Transylvania front. The former report reaches us via Petrograd and London; the latter via Berlin. The Petrograd-Bucharest dispatch admits yielding ground, under strong pressure, in the valley of the Alt. Teutonic pressure in the Juil valley is also reported to be very strong. From these I deduce that in spite of strong Rumanian resistance, the Austro-German troops are progressing slowly in the Juil valley south of Vulcan pass, along the Alt river and in the Predeal section north of Campulung. There seems to be very little going on to the east and north of Kronstadt. It is now evident that the Austro-Germans' original objective was a line running from Kronstadt to the southeast, striking the shores of the Black Sea somewhere north of Constanza.

The Central Powers may have had hopes of a junction of Falkenhayn's and Mackensen's forces somewhere in the vicinity of Bucharest; but this is now out of the question. I doubt very much if such maneuver, desirable as it may have seemed to the Central Powers, ever had a chance of being successfully accomplished. The stiffening of the Russo-Rumanian Army on all fronts compelled a modification of this program. I believe the Teutons still hope to be able to establish approximately the same line somewhat south of the one originally selected, and if this surmise is correct, we may expect to see Mackensen make a determined stand very far south of the Cernavoda-Constanza line. This is subject to two conditions; that Mackensen be suitably reinforced and that such reinforcements can be sent to him without weakening the offensive power of Falkenhayn's armies in Transylvania. The object of this strategy is twofold; first, it would, if successful, shorten by several hundred miles, the line of frontiers to be defended by the forces of the Central Powers and second, it would practically destroy Rumania. This would be considered, by the Teutonic Allies, a fit punishment for this nation and would have considerable moral effect on the other small nations who find it exceedingly difficult, at this time, to remain neutral.

It will be noted that Falkenhayn's lines of advance into Rumania are progressing along the natural highways to the Danube. The main roads, rivers and valleys as well as the railways appear to be running in a southerly or southeasterly direction, the rivers emptying into the Danube. They form natural avenues for an invading force from the North. The advance will grow easier and the defence correspondingly more difficult as the invasion progresses.

From the Russo-Rumanian view point, good strategy involves pushing Mackensen out of the Dobrudja at least as far as a line twelve or fifteen miles below the Cernavoda-Constanza and, at least, holding him there. It may be possible to push him over the frontier into Bulgaria. This depends entirely on the condition of his Army. If he has not been reinforced since his second invasion of the Dobrudja, the chances are against him. At the same time, and with even greater determination, Falkenhayn should be compelled to halt in all the sections in which he is now advancing. If this cannot be done within the next two or three weeks, I don't see how the occupation of the entire western half of Wallachia by the Austro-German forces can be prevented. This may include the loss of Bucharest, the Capital of the Nation. Even if the Russo-Rumanian Army finds that it is able to drive Mackensen into Bulgaria, the invasion of that country should be deferred until Falkenhayn has been driven to the other side of the Carpathians.

The British front, north of the Somme and near the river Ancre, has been the scene of severe fighting. The British forces appear to have gained some territory including three important small towns, Beaumont, Beaucourt and Divion, in the direction of Bapaume, from which their most advanced lines are about five miles distant. The severity of the fighting, the number of casualties, killed, wounded and missing, as well as the large number of prisoners (5,680) taken by the British Commander, seem at first glance to be out of proportion to the amount of territory taken; but the natural obstacles as well as the fortifications which the Germans had been preparing and perfecting for nearly two years made this one of the strongest parts of the German line and compelled the British troops to extend themselves to the limit of their power in order to overcome the resistance of the defenders. Berlin admits heavy losses, due to the tenacious defense of the German troops. It will be noticed that the present German line forms an obtuse angle to the southwest, the apex of which is several miles in rear of a straight line drawn from Serre in the north to Le Sars in the south; the latter point is on the most advanced section of the line in the direction of Bapaume. London news bulletins report the British army as still advancing in the direction of Grandcourt, taking prisoners as they proceed.

Grandcourt is reported to be very strongly fortified and may prove to be more of an obstacle than either Beaumont, Beaucourt or Divion.

The British, however, have the advantage of being able to attack on two and probably three sides at the same time. The town is well within easy range of heavy field artillery. During the progress of the British attack on Beaumont, the French section of the Somme front was severely bombarded by the German artillery. In the region of Sailly, northeast of Combles and to the southeast, near Bouchavesnes and Les Beoufs, the firing was specially severe. The French bulletins also report heavy bombardment and use of liquid fire in the region of Pressoire and Ablaincourt, northeast of Chaulnes. These attacks, evidently intended to hold the French troops to their section of the line and prevent them from assisting in the British attack, appear to have been successful to that extent only, as the French reports indicate that they were able to repulse all attacks and no gain of territory was made by the German troops except in some advanced defensive work of little importance.

The Verdun front has been unusually quiet. Only intermittent cannonading, specially active in the region of Fort Vaux and Douaumont, has been reported.

From the Champagne and Argonne districts the bulletins have little to report; the repulse by the French of a German detachment (strength not mentioned) in the former district and a mine explosion in the latter, seem to be all.

From the Russian front, we receive little more than claims and counter claims. Petrograd reports a slight success in Galicia near the village of Lipnicadolna on the Narayuvka in the Haleiz Sector southeast of Lemberg. Berlin denies the correctness of these reports and claims successful attacks against the Russian positions in the same section. I conclude that the operations reported are of very small import, involving but very small areas of the same section and that both sides may be, to a limited extent, correct in their reports. Winter

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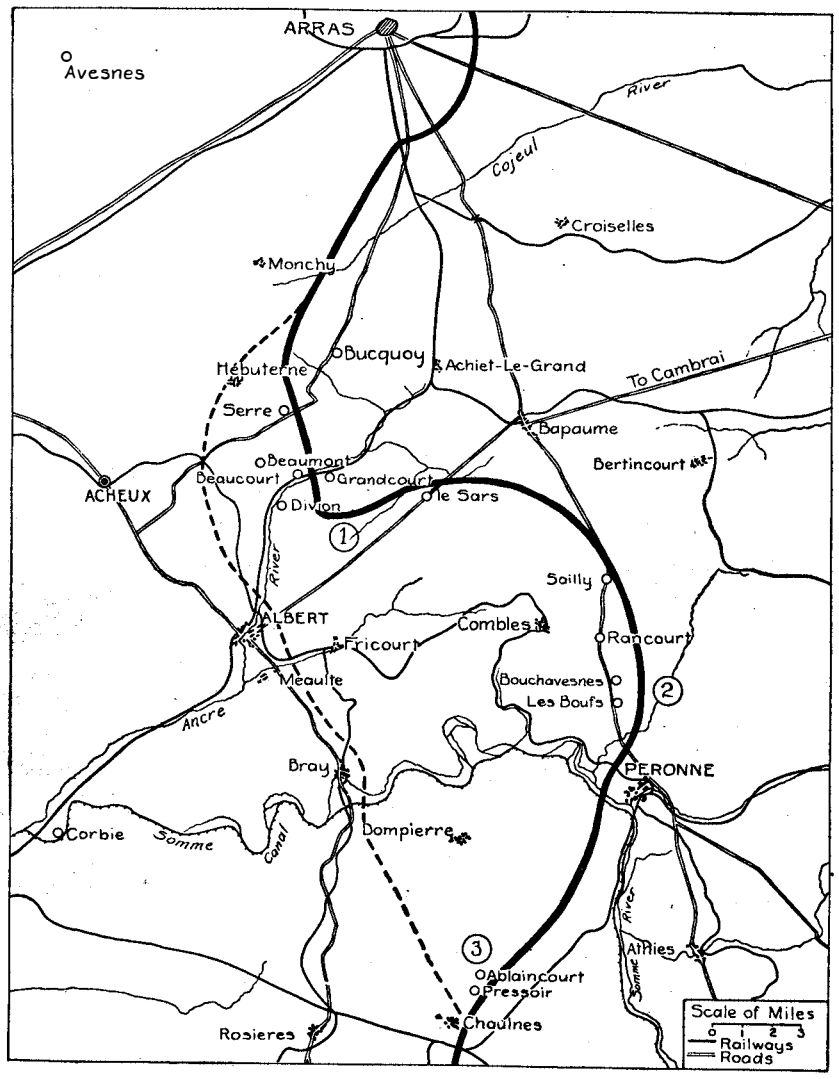


Map of the Somme and Ancre regions

The heavy black line indicates (approximately) the present location of Franco-British advanced line. The broken line indicates the same line before the "Somme Drive" began.

1. The section of the line where the recent British advance and consequent gains were made.

2 and 3. The sections of the line held by French troops against which the violent counter attacks of the Germans were directed.

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.]

Figures on the Steam Car

To the Editor of the SCIENTIFIC AMERICAN:

The undersigned has read with much interest Mr. Charles Prior's letter on the steam car in your issue of September 9, 1916, and also a letter on the same subject in the issue of October 28, in which Mr. Prior is accused of eating in the kitchen. If Mr. Prior is willing to receive callers in the kitchen the present writer will be glad to join him there, opening the conversation with the remark that a very good case can be made for the steamer—not only on the grounds that the steamer uses cheaper fuel, can be throttled to as low a speed as you please without loss of tractive effort, is smooth in action, and has no gear shift, though these are all points of advantage that would be proclaimed from the house tops by "gas car" drivers if they had them on their cars—but on the grounds that the steamer is a more consistent and steadier performer, its engine much more powerful and responsive to the driver's will, and the car incomparably more active on the road.

On the road the steamer has all the best of it. On a straight speed trial it has to be an extraordinary gas car that the steamer will not run away from. In pick up, the steamer gets away at least twice as fast as any comparable gas car. A comparison between a steamer and a representative gas car will illustrate this point; the gas car selected for this comparison is a very good one and is not singled out for criticism; it has an eight cylinder 3.125″ by 5.125″ L-head engine geared 4.5 to 1 with 36″ wheels. This car can develop on high gear a tractive effort of 425 pounds; but this figure represents an absolute limit, and is not attainable unless the speed is about 15 miles per hour and all conditions favorable. At 2 miles per hour the tractive effort is practically nothing; at 5 miles it is about 300 pounds, rising to 425 pounds at 15 miles; beyond that speed it decreases. These draw-bar pulls are obtainable only on steady runs at constant speed; they cannot be obtained during rapid acceleration, as the conditions of carburetion and ignition timing are then unfavorable. It is doubtful whether this car can develop an average draw-bar pull as high as 350 pounds (giving an acceleration of 2.75 miles per hour per sec.), when rapidly accelerating through that part of the speed range lying between 2 and 30 miles per hour.

A steamer with a two cylinder double acting 4″ by 5″ engine geared 1.5 to 1 with 34″ wheels, when operating on 600 pounds steam pressure and full stroke cut off, can develop a draw-bar pull of 1,975 pounds. This is much more than enough to slip the wheels. Besides, at this cut off, steam will be used faster than the boiler can make it unless the speed is low. With the cut off at half-stroke the tractive effort on full throttle is still much more than enough to slip the wheels. On some cars the valve gear will not permit a cut off earlier than half-stroke, the control below that being by throttle. On such cars the throttle is never opened wide, and because of this there is some uncertainty in the position of the steam line on the card, and thus it is not easy to determine what card area and tractive effort are continuously available. To get a basis for comparison a cut off at one-sixth stroke (which can be had on some cars) will be assumed, with full throttle. At one-sixth stroke cut off with 600 pounds steam pressure and 200 degrees superheat the mean effective pressure is sufficient to produce a tractive effort of 900 pounds. Although this cut off does not give a result especially favorable to the steamer, compare it with the gas car's average value of 350 pounds or best value of 425 pounds; even on the basis of the latter value the ratio is over 2 to 1 in favor of the steamer. But the steamer is not limited to this value. A later cut off than one-sixth can be taken; or on cars with cut off at half-stroke the throttle can be opened. In either case the limiting tractive effort of 1300 pounds can be obtained, and sustained if the speed is not too high. On this basis at 5 miles per hour the comparison is between 1300 pounds for the steamer and 300 pounds for the gas car or 4.3 to 1 in favor of the steamer. The steamer is far more powerful and lively, and can get away from the gas car fully as fast as the gas car can get away from a post. Gas cars have speed enough, of course, but the instantaneous leap of the steamer in response to the throttle is unmatchable by any gas car.

In hill climbing the ability of the steamer is limited only by the ability to get traction. The steam car driver does not need to rush hills, but can approach and climb at any speed he may think advisable; the choice of speed is wholly his and is not subject to the dictation of his engine. He does not need to keep his mind and muscle set for the prospective shift of gears. He knows in advance, before the hill comes into view, that the car will climb it without asking any consideration from him. He also has that comfortable feeling that comes of knowing that he can beat the other fellow, *any* other fellow in a gas car, with ridiculous ease.

The performance of a gas car on a hill that is a little too much for the high gear is pure comedy. Borrowing from the kindergarten tale of the plucky, puffing little switch engine, "Life" put it this way:

IthinkIcanIthinkIcan!
I-think-I-can-I-think-I-can!
I--think--I--can--I--think--I--can!
I—think—I—can—I—think—I—can!
I—guess—I—can't—I—guess—I—can't!
Iguess———Ican't———Iguess———Ican't!
I KNOW I———————————CAN'T!

The poet had in mind a one-cylinder car, but the twelve-cylinder is essentially the same in kind and sings the same song. All members of the internal combustion family are alike in having no reserve of energy beyond a mere trifle of kinetic energy in the fly-wheel; they all eke out the same kind of improvident, precarious, hand-to-mouth existence without a penny in bank.

The weakness of the gas car on hills (and in pick-up) is the result of its bad speed-power characteristic; in this respect the twelve-cylinder car is really not much better off than the one-cylinder, multiplicity of cylinders having but little to do with the matter. The speed-power curve for the eight-cylinder engine already referred to shows this clearly. This engine is as good as any of its type, and can develop a maximum of 70 horse-power. The owner probably realizes that all this power is not ordinarily needed but he tells himself (and this thought is usually fathered to some extent by the salesman of the car) that it is a fine thing to have a lot of surplus power when he wants it on grades or for heavy going. Right enough, if the power were only there, but the point is that it isn't there, *when he wants it.*

Suppose for example that the owner wants to take a hill at 10 miles per hour—how much power can he use? At that speed the curve referred to tells us that the engine on his car is an 8-horse-power engine and no more. It isn't a matter of calling it that; the engine *is* actually that; 8 horse-power is exactly what it develops. At 5 miles per hour the engine is entitled to a rating of but 1 horse-power and balky at that; at 20 miles per hour, 25 horse-power. Unless the speed is 60 miles per hour there is no 70-horse-power engine on the car. Fully two-thirds of that maximum power is non-available at the usual touring speeds.

In the gas car the process of combustion is involved with the motion of the engine, so that the rate at which fuel can be burned is rigidly dependent upon the engine speed; for this reason the power decreases with decreasing speed, and the former decreases at the more rapid rate, so that the power becomes small, uncertain, and reaches the edge of complete disappearance just when maximum effort is most needed for negotiating grades or heavy going at moderate speed. The worst of it is that the power and torque disappear together.

In the steam car the conditions are radically different. The transfer of heat to the working substance takes place in the non-moving boiler by a continuous process and the available rate of transfer is completely independent of the engine speed. Just as much steam can be made at the lowest speed as at the highest speed. If the boiler can make steam at a rate corresponding to a 70-horse-power output (this is conservative) at maximum car speed, than that 70-horse-power rate of steam production is available at all speeds down to standstill. Of course at 10 miles per hour the engine cannot develop 70 horse-power, but it can develop more than three times as much power as the given eight-cylinder engine can develop at that speed, and have steam to spare. At 20 miles per hour the steamer can develop between two and three times as much power as the gas car, and at 30 miles per hour the available power of the steamer is about double that of the gas car. This is the real argument for steam: *you get several times as much power at the speeds you use.* Moreover this advantage is secured without entailing any loss of high speed ability, and with an engine speed only about one-third of that customarily used on gas cars.

In making these estimates it is assumed that steam is used only as fast as the boiler can make it so that the pressure is not pulled down; but steam can be used faster than that for a short time if necessary by drawing upon the reserve of energy in the boiler, about 750,000 foot-pounds being available, the pressure being pulled down on the grade and picked up again after the grade has been topped.

It is for these good reasons that no gas car whatever has the slightest chance with a steamer on hill work.

At this place the following extract from a paper by Browne and Lockwood (Trans. S. A. E., Volume 10, Part 1, Page 87), may be of interest: "It is the pull or push of the tire on the road that is effective in the propulsion of a car. Witness the utter absurdity of a steam car equipped with a 20-horse-power engine out-pacing and outclimbing gas cars the engines of which will develop upward of 80 horse-power on the block. The steam car does this by greater and more uniform torque delivered to its rear wheels . . ." On Page 90: "The remark relative to steam car rating was taken from the basis of the . . . rating. I have driven in a . . . steamer which is owned by a friend of mine who enjoys an occasional brush on the road. He has a motor rated at 20 horse-power at 500 lbs. of steam, I think. He carries 600 boiler pressure. I assure you that no 80 horse-power touring car built in this country has any license with him on the road." Now this is all true, but there is nothing absurd about it; it is exactly what should be expected from the far better speed-power characteristic of the steam car. If great power is the supreme motor luxury, then that luxury is only to be had through the use of steam.

Bona fide flexibility means the ability to put upon the drivers, in instantaneous positive response to the driver's will, at any time and at any speed, any tractive effort that may be required by the road condition. That kind of flexibility can be had only with steam.

In consistency of performance the steamer is far better than its rival. There is no known way to make a steam engine miss fire, but the number of ways by which a gas engine will miss fire is beyond any counting. The performance of the steamer is entirely regular, the same every day and every mile; it is beyond comparison with the whimsical and temperamental performance of the gas car.

Chicago, Ill. J. D. NIES.

When Niagara Was Dammed by Ice

To the Editor of the SCIENTIFIC AMERICAN:

In your September 30th number, under answer to inquiry 14159, you state that you were not able to confirm or deny that water once ceased to flow over Niagara Falls. If I may be allowed to state the facts I have the following to give as authoritative information:

Niagara Falls was still on the morning of March 31st, 1848, and many people for some distance from the Falls actually thought they had become deaf during the night, when they awoke and heard no thundering of the water. The winter had been a severe one and the ice on Lake Erie had been exceptionally thick. Warm weather and the subsequent breaking up of the ice came suddenly. During the last week of March a stiff northeast wind drove the broken ice floes up on the bank and piled the ice into miniature icebergs. On March 30th, a gale came from the opposite quarter and hurled the ice back with such force that it formed an enormous ice-dam at the head of Niagara River. This held back the stream until the water above the falls was completely drained off; thus the falls were silenced for nearly 24 hours, after which time the ice gave way beneath the pressure of the water behind it and on April 1st the water was again going over the falls as usual.

I trust that this information may be of use to you that you may answer No. 14159 to his satisfaction. I keep a clipping book of all such things to use in my school work and it happened that I had read this to a class a few weeks ago and so recalled and hunted it up.

Ashland, Mass. WALTER K. PUTNEY.

The Loss of the U. S. S. "Memphis"

To the Editor of the SCIENTIFIC AMERICAN:

I note in your last issue an account of recent West Indies hurricanes, and a reference to the hurricane that destroyed the U. S. S. "Memphis" on August 29th.

The only report of a hurricane on August 28th, 29th and 30th was one of small intensity supposed to be off Porto Rico, that finally passed South of Cuba, and dissipated in Mexico. There are no reports of any destruction by this hurricane.

On August 29th, at San Domingo, the wind was light and off shore and remianed so, the barometer was steady and remained so. The seas began small and rapidly reached destructive violence, but at no other West Indies ports was this the case.

The "Memphis" anchored in 44 feet of water, and drawing 27 feet, struck bottom between waves with violence enough to dislocate her boilers, which means a wave height of at least 25 feet, 50 feet from hollow to crest. Such waves are almost unprecedented, and must be originated by unusual means, if a storm, one of long duration and extreme severity.

The crew of the "Memphis" were chilled by very cold water from the first waves, but soon normal temperature was restored.

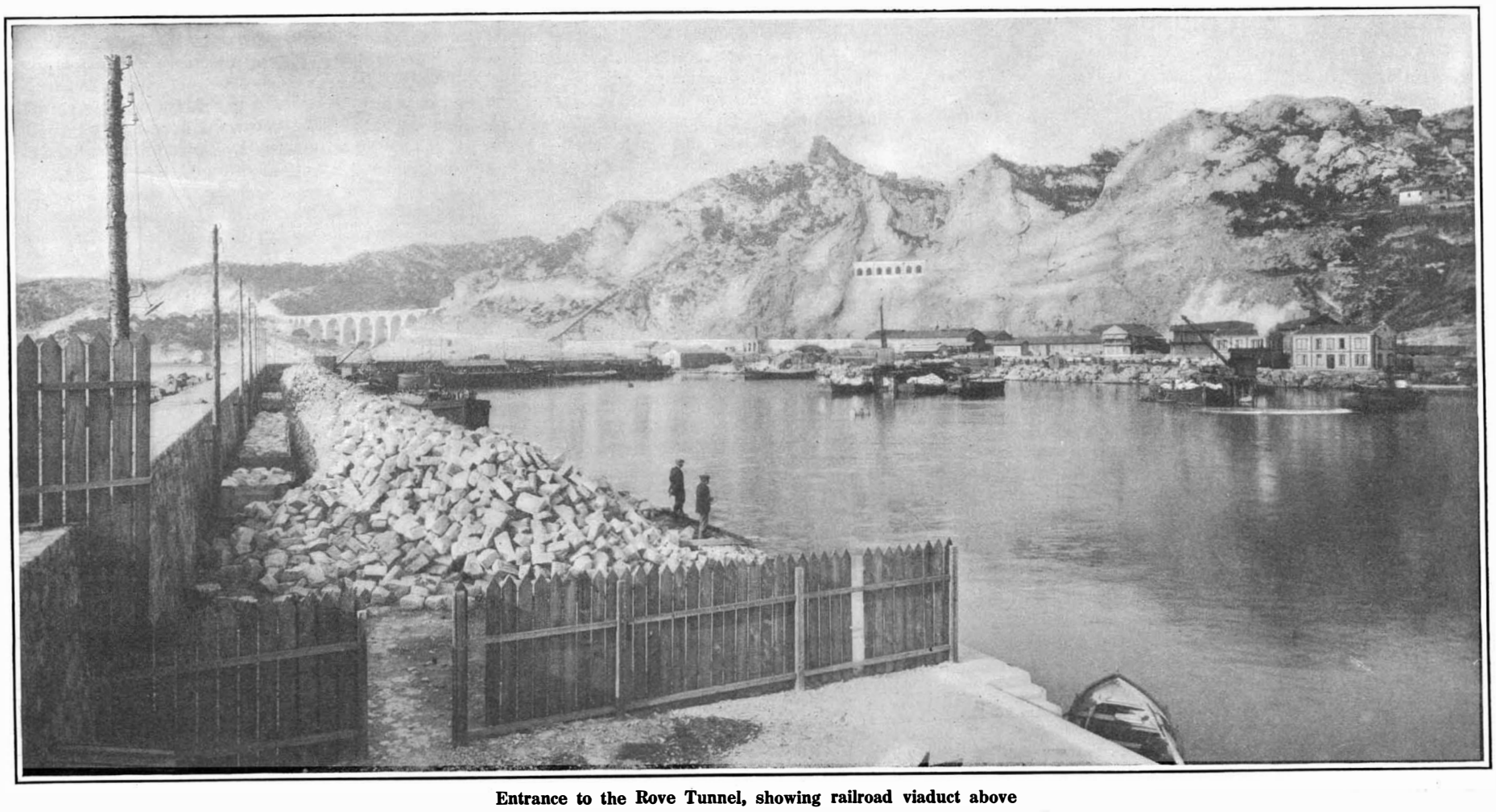
Evidently the waves were caused by undersea tremors that happened to coincide with the wave period.

Until the Court of Inquiry has published its findings, I prefer not signing this, but the facts are as stated, and are of common knowledge.

I write because the publication of the loss of the "Memphis" by a storm does not do justice to her Commanding Officer.

A Reader of the SCIENTIFIC AMERICAN.

Norfolk, Va.



Entrance to the Rove Tunnel, showing railroad viaduct above

A Giant Among Tunnels

Where the Marseilles Canal Goes Through the Mountain

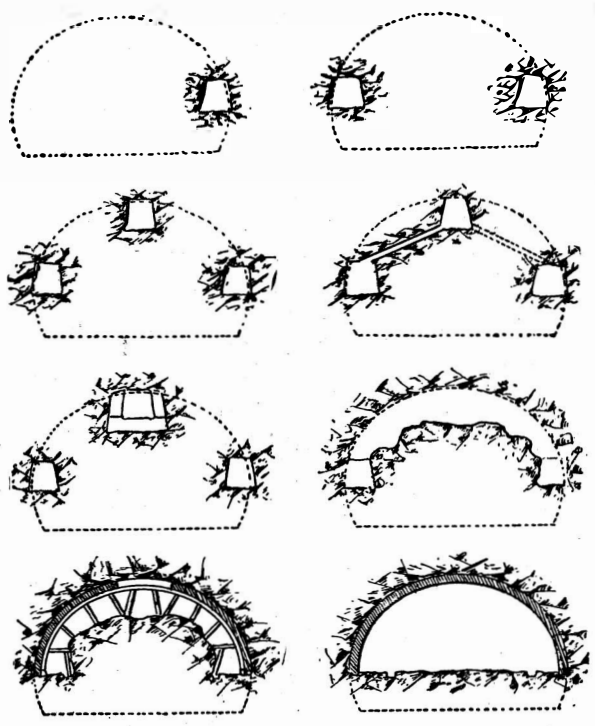
WITH resources strained to the breaking point by the war, it would seem that none of the European powers could possibly devote any attention to the normal engineering works of peace. But in France, at least, one notable undertaking, instead of being given over to a more favorable time, has been pushed at close to normal speed, and has now reached the stage where ceremonies are in order to signalize important phases of the work. We refer, of course, to the Marseilles-Rhone Canal.

Just why there should be any commercial or geographic necessity for connecting Marseilles by canal with a stream which empties into the Mediterranean less than 30 miles away requires explanation. Ever since the opening of the Orient to western trade—and, since the cutting of the Suez Canal, to a far greater extent than ever before—Marseilles has seen the big freighters go sailing past her doors on the long journey around Gibraltar and through the Channel, in order to land goods at Hamburg and Rotterdam for shipment up the Elbe and the Rhine to inland destinations actually nearer, in miles, to Marseilles than to the North Sea ports. This tremendous detour, cutting off Marseilles from its fair share of the rich trade with the interior, is occasioned by the fact that while the Rhone, which on the map apears to offer Marseilles a fine waterway into central Europe, is officially classified as navigable, it is in reality of little account commercially. Its mouths are so badly choked by immense alluvial deposits that they are quite impracticable, even for river vessels of the lightest draft. The construction of the canal has been undertaken as a more satisfactory means than perpetual dredging for opening up a permanent line of water communication between Marseilles and the interior in order to put the metropolis of the French Mediterranean in what she conceives to be her rightful place in relation to the traffic flowing through the bottle-neck of Suez.

The canal falls naturally into three sections, with an aggregate length of close to 50 miles. For the first 3 miles out of Marseilles it is hardly a canal at all, properly speaking, being located off-shore, separated from the open sea only by a heavy dike, and constituting a sort of extension to the westward of Marseilles's system of artificial ports. It then turns sharply, and in a tunnel of some 4½ miles passes under the mountain ridge which skirts the shore of the Riviera. Emerging into the open behind this barrier, it proceeds by the most convenient overland route to the Rhone at Arles.

The first and last of these sections present no extraordinary problems. The digging of a canal across 40 miles of level country cut by streams and lakes is an old story. Nor is there anything about the construction of a 3 mile breakwater a few yards out from the shore to make an engineer think twice before undertaking the work. But of the Rove Tunnel, by means of which the canal will penetrate from the sea to the interior, so little cannot be said. It at least is an engineering feat of a magnitude that would claim the attention of the world were that attention not engrossed in watching the simpler but more compelling processes of destruction.

We cannot fairly compare the Rove Tunnel with undertakings such as the New York Subways, in which the cut and cover type of construction is employed; for while these often present difficulties of the first order, from the engineer's standpoint they are not tunnels at all, merely ditches. But even excluding such ditches from our consideration, we find that the claims of the Rove Tunnel to distinction are not by virtue of any inordinate length. To be sure, 7,946 yards makes a very respectable tunnel; but we recall at least 13 other true tunnels, in various parts of the globe, that exceed this, of which as many as four are more than double the length of the Rove bore. It is rather its unprecedented sectional dimensions that give the Rove first place among the world's tunnels. If we compare its 72 feet of width and 47 feet of height with the dimensions of the 30 x 23 tunnel of the Lackawanna Railroad under Bergen Hill, just west of the Hudson River, recalling that the latter is an unusually commodious double-track bore, we will get some idea of where the Rove Tunnel stands. Even the New York Subway, with its four tracks in a single chamber 54 feet 8½ inches wide and 16 feet 7 inches high, would not begin to fill the Rove excavation.



Successive phases of the Rove bore

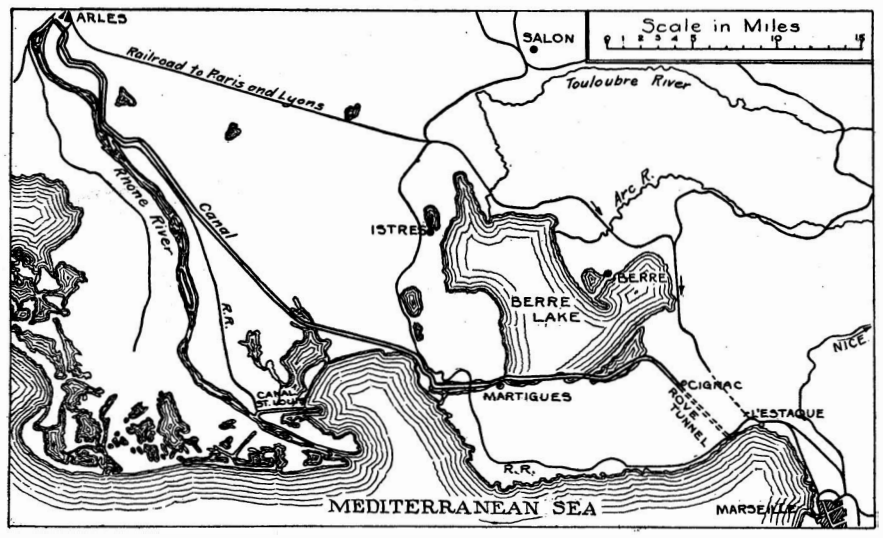
It is one of the three galleries of the third sketch that has been completely driven. The tunnel is not finished as the workers proceed, but each stage shown is pushed independently of the succeeding stages.

Still more illuminating is a consideration of the cross-sectional area and the total volume of material removed. The exact area of a section of the graceful arch of the Rove Tunnel is given as 359 square yards. With a length of 7,946 yards we find that the total "volume" of this tunnel is about 2,800,000 cubic yards. We are almost at a loss as to where to turn for a tunnel whose aggregate size will even approach this. Perhaps the new aqueduct tunnel under New York city in connection with the Catskill Water Supply project—the longest of all true tunnels—will come nearest to it. Ranging in diameter from 15 to 11 feet, this bore may fairly be assumed to have an average width of 13 feet. On this basis, we find that its construction called for the removal of barely 400,000 cubic yards of material for the tunnel itself, exclusive of shafts, reservoirs, etc. And in one respect there is no comparison at all to be made between these two achievements. The aqueduct tunnel, while driven in places at an unprecedented depth, was, from the constructional point of view, hardly a single tunnel, but rather a series of twenty odd tunnels connecting successive shafts. The Rove Tunnel is from every standpoint a single tunnel, since it was driven from the extreme ends to meet in the middle, with no auxiliary shafts whatever.

The unprecedented dimensions of the Rove bore created technical difficulties peculiar to it, details which are of the smallest importance in the construction of an ordinary tunnel playing here a decisive role in the prompt execution of the work or even in its successful accomplishment. To take but a single instance, the lining of the great vault absorbs such enormous quantities of dressed stone that a sufficient supply was to be had neither from the mountain itself nor anywhere in the immediate vicinity. It was necessary to open a special quarry 22 miles away, at a point on the coast, but yet sufficiently sheltered to make loading of the special barges built for the purpose possible at all times, without interruption. Only in this way could the daily supply be assured of from 75 to 90 cubic yards of stone to cover the surface of 180 to 240 square yards laid

bare by the average daily advance of between 4½ and 6 yards.

For the work of drilling, the more usual machines mounted on wheeled carriages were discarded in favor of hand hammers operated by compressed air. While of course the capacity of a single one of the latter cannot compare with that of one of the heavier instruments, a far greater number of them can be employed at a given point. Besides rendering excellent service, these hammers are so easily moved about that they make it possible to reduce materially the interruption in the work of drilling at the moment of setting off the charge. Compressed air is likewise utilized in the temporary traction system in the bore. The locomotives are an American product, looking altogether like a torpedo on wheels, and developing 250 horse-power from air at a pressure of 22 pounds.



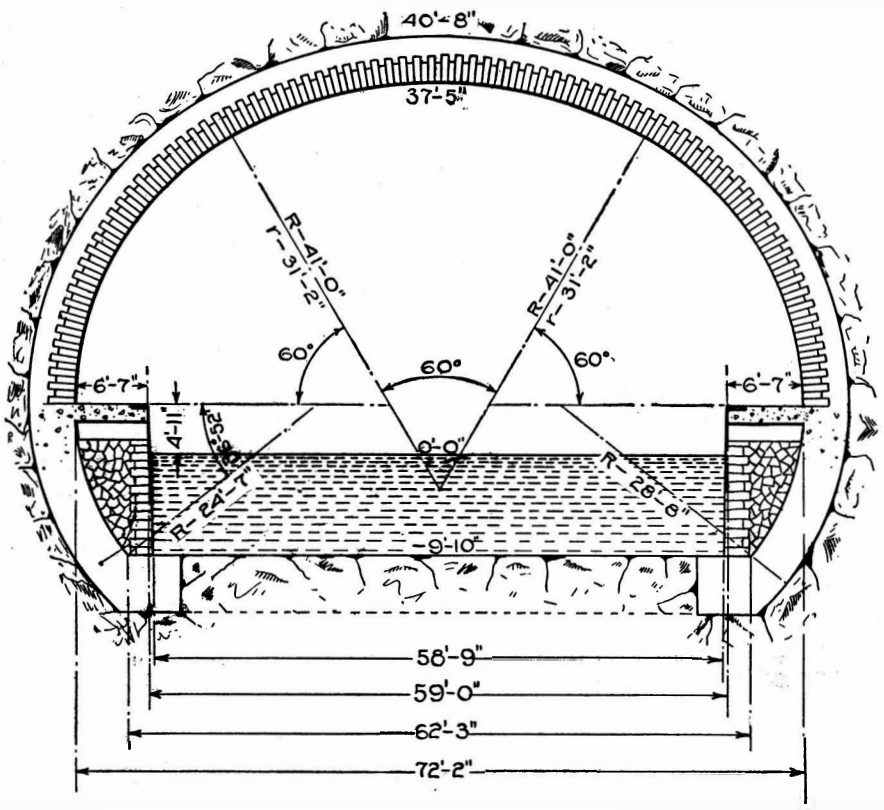
Route of the canal joining Marseilles with the Rhone

The total working force engaged in the piercing of the tunnel and the building of the arch was, before the war, about 2,000. Mobilization reduced this number by half, and the loss has not been entirely made good, in spite of the employment of foreign workers and the recent arrival of German prisoners of war.

Work at the south portal of the tunnel began in April, 1911, while actual tunneling from the north end was delayed until 1914 by the necessity of excavating a large portion of the heavy Gignac cut before access could be had to the head of the tunnel proper. On February 16th of the current year the two galleries met at a point 5,149 yards from the south end, 2,797 from the north.

It will of course be understood that this does not mean that the canal, or even the tunnel, is in a state remotely aproaching completion. So far distant is that stage that no published announcement has yet been made of the means to be adopted to propel the canal-boats through the tunnel. In fact, the tunnel has not even been rounded out in any part of its length. One of the three opening galleries shown in our diagram is completed for its entire length, affording the basis for the statement made above with reference to meeting of the headings. The portion above the tow-path is complete for half the length. The rectangular canal ditch has nowhere been begun. Altogether, it is estimated that 35 or 40 per cent of the work on the tunnel is still to be done.

The total cost of the entire canal is estimated at some $18,000,000 dollars. Of this over $10,000,000 represent the outlay for the tunnel and its approaches.



Typical cross-section of the Rove tunnel. Note the heavy facing

The Current Supplement

AN article of unusual interest in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2134, for November 25th, and one that will be widely appreciated, is *The Organism as a Thermodynamic Mechanism*, which reviews and criticises some of the literature relating to the subject, including a paper that appeared in the SUPPLEMENT last year. *Motor Trucks and the Army* refers to some of the experiences of our military forces on the Mexican border that will prove of value in future operations. It is accompanied by photographs. *Analysis by Machinery* describes and illustrates a clever filtering device that greatly simplifies and expedites the work of a chemical laboratory. *Medicine as Practiced by the Chinese* is a most excellent account of the fantastic theories that have prevailed in that country for ages, and which are now gradually giving way to modern methods. *The United States Light House Service* gives a sketch of the history and growth of an important department of the government, together with brief descriptions of the various methods adopted for the guidance of mariners on our coasts, and it is accompanied by a large number of instructive illustrations. The question of rehabilitating men injured in the war abroad is a most important problem in the countries involved, and several articles relating to it have already appeared in the SUPPLEMENT. In this issue is given an outline of an address by one of the best known authorities in France, giving some description of the methods and apparatus employed by him, together with illustrations of the same. *Growing Drug Plants in the United States* deals with a subject about which much has appeared in various publications. The present article is from a recognized and authoritative source, and should be read by everyone who has considered the matter as a source of revenue. There are also a number of other articles of general interest.

A Safety Plate for the One-Armed Soldier

WE are perhaps all familiar with the tale of the independent fortune amassed by a resident of a metropolis of a certain type of culture, which may well go nameless, from his invention of a knife with a rim about the blade to keep peas from rolling off. The last place where we would look for this sort of thing would appear to be Paris; yet we learn of a device recently brought out there for use by the *mutiles* who have lost an arm, which may well cause a snicker or two among the unregenerate.

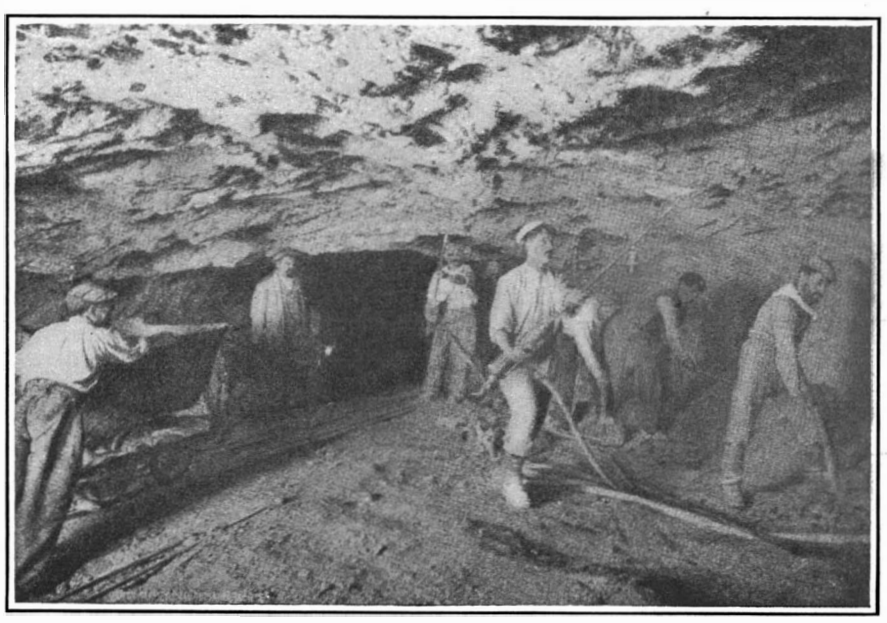
It seems that a one-armed man has considerable difficulty in getting certain articles of food upon his fork or spoon. Even those of us who retain all our members will recall occasions on which we have pursued an elusive morsel several times around a plate before finally subduing it. The invention of which we speak consists of a plate with a high built-up buffer at one side. The user drives the recalcitrant tidbit to bay against this, and there captures it with comparative ease. The buffer, it is pointed out, can be made either in a separate piece of any suitable material and attached to the rim of the plate by clips, or it can be made *en bloc* with the plate, necessarily of the same material.

We are not informed concerning the reception which the victims of the war have given this little brother of the mustache cup.

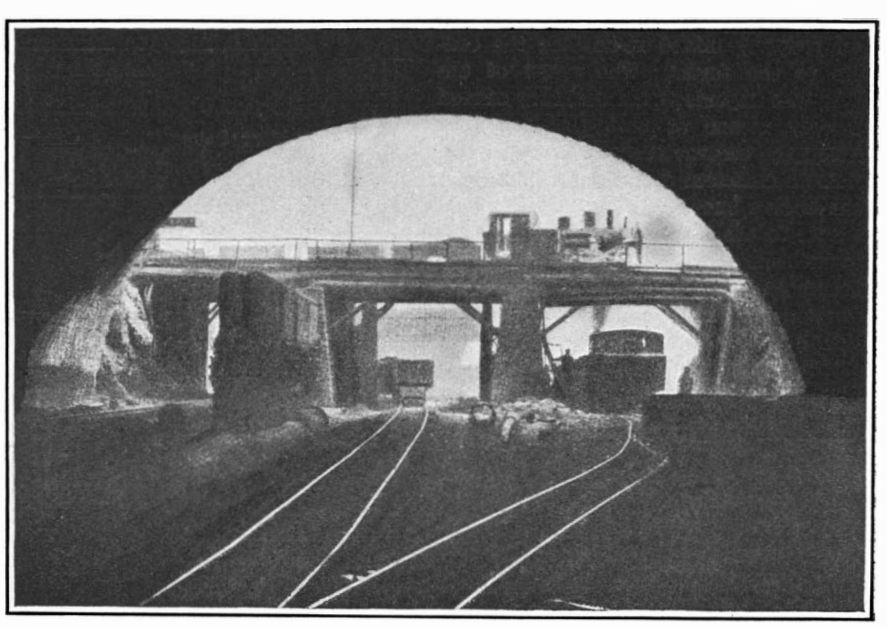
The Defective Teeth of Our Rural School Children

A RECENT investigation made by the United States Public Health Service in connection with studies of rural school children showed that 49.3 per cent had defective teeth, 21.1 per cent had two or more missing teeth, and only 16.9 per cent had had dental attention. Over 14 per cent never used a tooth brush, 58.2 per cent used one occasionally and only 27.4 per cent used one daily.

Defective teeth reduce physical efficiency. Dirty, suppurating, snaggle-toothed mouths are responsible for many cases of heart disease, rheumatism, and other chronic affections. The children are not responsible for the neglected state of their teeth. The ignorant and careless parent is to blame for this condition—a condition which hampers mental and physical growth and puts a permanent handicap on our future citizens. School teachers can and are doing much in inculcating habits of personal cleanliness in the rural school child, but this will fail of the highest accomplishment unless parents coöperate heartily and continuously. This is a duty we owe alike to our children and to succeeding generations.



Using the pneumatic hand-drills



At the north portal of the Rove tunnel

Cleveland's New Bridge—The Rôle of the Motor Truck in Its Construction

LIKE so many water-front cities, Cleveland is built upon the banks of a river; and after a period of rapid growth in all directions, she found the stream dividing her most inconveniently into two halves. Heretofore the west side of the city, with its population of 300,000, has been connected with the downtown districts by means of the old Superior Viaduct over the Cuyahoga River. This was built in 1875 at a cost of a million and a half, but the expansion of the city and the accompanying increase in traffic has found it totally inadequate. Another serious handicap was the fact that it was a draw-bridge. To allow the lake freighters to pass up and down the draw had to be open at stated intervals throughout the day, causing each time a holdup of from 10 to 20 minutes. The narrowness of the roadway was the cause of numerous accidents which tied up traffic and afforded still another strong argument in favor of replacement by a more modern structure.

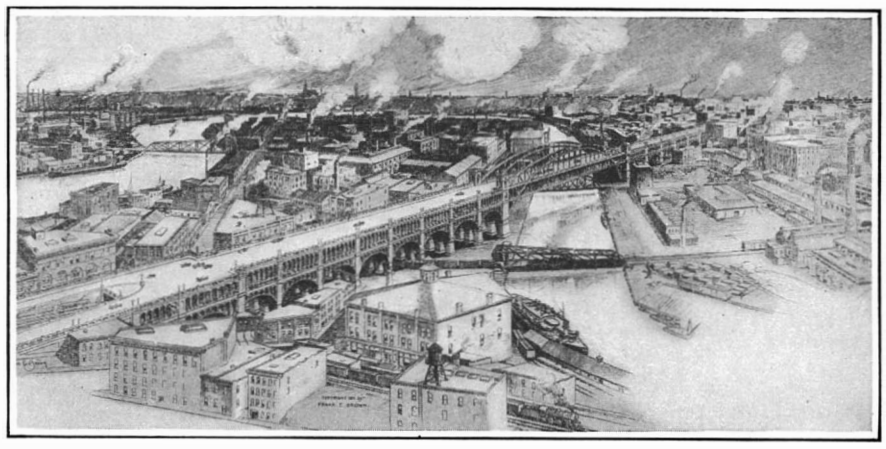
So plans were drawn for the tremendous double-deck, high-level structure which we illustrate, and, with the work now well under way, it is expected that the upper deck will be open to vehicles and pedestrians before the new year, while cars will be in operation on the lower level some time in 1917. There are long approaches on each side, carried on concrete arches, and leading up to the 591-foot steel span which crosses the river 200 feet above the water, marking this bridge as belonging to the new school of American engineering which has eliminated the draw-bridge from our municipal economy along with the grade crossing and the ferry-boat.

The total length of the bridge is 2,880 feet, its width 81 feet 6 inches. To transport the material used in its construction—of structural and reinforcing steel alone, 7,825 tons—would require a train of railroad cars over 75 miles in length. And conditions were such as to make the problem of local transportation a very serious one. All material was brought into Cleveland by water. For delivery to the west end of the bridge haulage was necessary up the 12 per cent grade of the Detroit Avenue hill; and the corresponding activity on the east side of the Cuyahoga is only less steep. But to ensure against heavy loss it was essential that delivery be made with absolute regularity and in sufficient quantities to keep the giant concrete mixers running to capacity.

A solution was found in the exclusive use of motor trucks. The cost of tackling this job without the use of dependable motor trucks would have been prohibitive, engineers say, because it was estimated that in certain phases of the haulage work one truck could make four trips to a team's one, hauling 24 tons of material while a team could haul but 3. The trucks performed a double duty, first hauling the cement, sand, gravel, slag and limestone to the mixers, and after it had been properly mixed re-hauling the concrete to the forms. The speed of the trucks was important, because they offered the only means of transportation that enabled the contractors to secure the materials in sufficient quantities to keep the giant mixers busy. In hauling the mixed concrete to the forms all the units of the job had to be poured continuously. It was absolutely necessary that the handling be done in a dependable vehicle, as a breakdown in the middle of the job would be very serious and entail heavy loss.

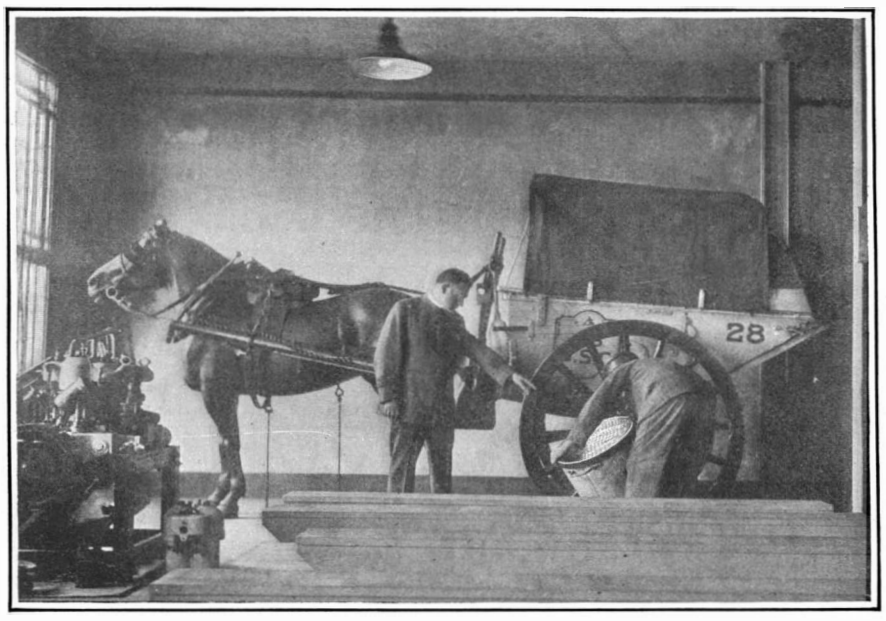
The whole undertaking affords a remarkable demonstration of the value of the motor truck. We all understand that the motor truck has an advantage over its horse-drawn prototype; but a comparative efficiency of eight to one must seem surprisingly high to most readers. The figure is authoritative, however. The county engineer in charge of the work says:

"We have watched the work of the trucks with great interest and they have been very satisfactory. They have hauled enormous quantities of materials in the shortest possible time and are the only mode of transportation that could be depended upon to keep the mixers busy."

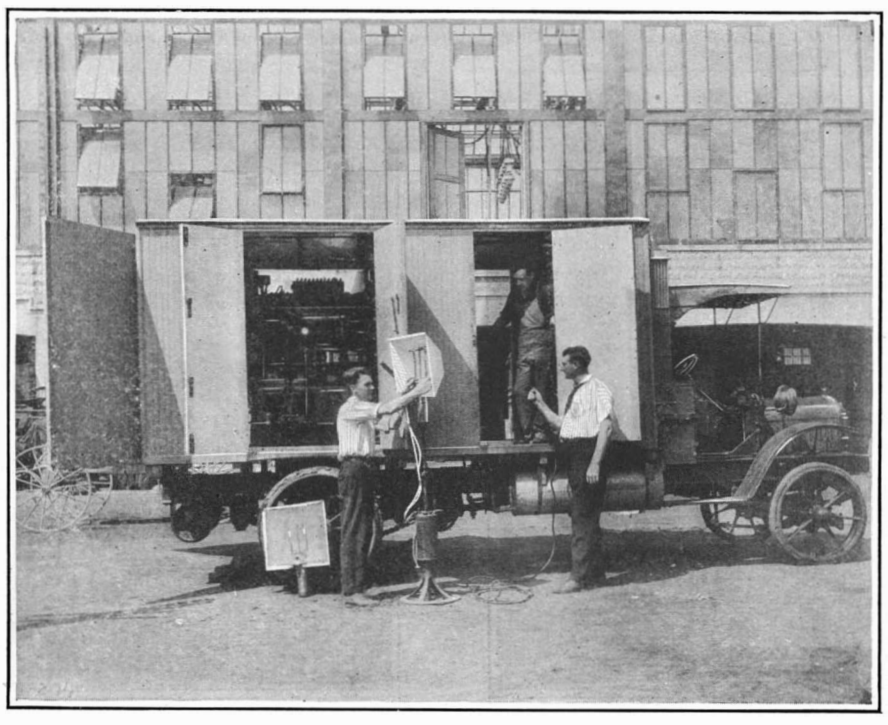


How Cleveland's new bridge will look when finished

Sumatran bridge with cement-bag piers



Life size model of horse and ashcart used in New York's Street Cleaning School



Equipment for taking outdoor moving pictures at night

A Sumatran Bridge with Novel Abutments

ROADS on the island of Sumatra are generally little more than trails, along which only the deeper streams are crossed by bridges. The geologic formation is volcanic, there being no gravel. Recently a hydroelectric plant was installed in the interior and it was necessary to build a road wide enough to accommodate bullock trucks, and bridges of sufficient strength to bear up the heaviest parts of the water wheels.

The bridges built had timber stringers and abutments consisting of piles of bags of cement and sand. The mixture was of dry cement and river sand in the proportion of one to four. This was shoveled into dry burlap bags and these were piled, as shown in the view, in the stream. The first tropical rain that came along was expected to complete the setting of the concrete.

In the far interior some of the natives looked on these bridges as traps set by the white men, and still clung to the familiar fords. The more daring spirits, however, finally mustered up sufficient courage to test the diabolical contrivances, and use of the bridges for foot travel soon became general.

A School for Street Cleaners

IF the drivers of New York's ashcarts do not heave the contents of a loaded barrel over the gunwales of their bob-tailed craft with a minimum of effort and a maximum of result, or if they find that the problem of harnessing the four-legged member of the crew presents unlooked-for difficulties, it will not be the fault of their superior officers. For the right way of executing every detail of their day's work has been carefully thought out by efficiency engineers; and the White Wings, like the policemen and firemen, are compelled to qualify in the special school of their department before taking up their duties on the streets. To aid in the instruction here, life size dummies of horse and cart are used; and the candidate is not passed into actual service until he can satisfy the expert eye of the instructor.

Motion Pictures from a Motor Truck

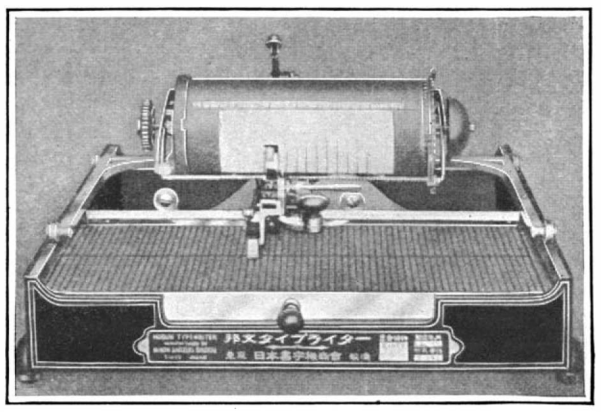
OUTDOOR motion picture photography at night has often been hampered or rendered impossible because of the inconvenience or impossibility of getting current for lighting purposes at the site where the work had to be done. One large New York film-producing concern experienced considerable trouble of this nature, but has at last solved the problem by the design of a portable lighting system. This consists of a large motor and electric generator mounted on a 5-ton truck. This unit can supply sufficient light for the filming of the night scenes of the largest productions and can reach any desired spot because of the motor truck's ability to negotiate even the worst of ground.

The unit consists of an inclosed van-like body divided into two separate compartments. In the front or smaller compartment there is a generator of 218 amperes and 120 volts. This is driven direct by means of a five-cylinder marine gasoline engine mounted in the rear compartment. The current supplied by the generator is carried by wires to as many of the regular indoor studio arcs as are necessary. These and the truck can be moved to any position.

The entire body is lined with galvanized iron for fireproofing and heavy rubber mats are used on the floor for insulation. The motor turns over at a rate of 750 revolutions per minute, which is sufficient to provide a more steady light than that obtained from a steam-driven lighting set in use at the indoor studio of the concern using the outfit. The motor is of the water-cooled type and is provided with two vertical-tube radiators placed at the front of the body, each side of the seat.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



The Chinese typewriter

Chinese Typewriter

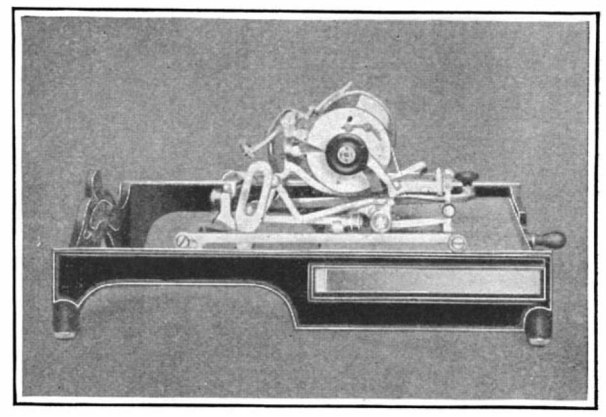
MANY have been the jokes about the Chinese typesetter and his wonderful accomplishment as a pedestrian, but a typewriter capable of handling the Chinese language, while considered a possibility, has, on account of its complexity, always been dismissed with a smile as an impractical machine. However, a Japanese has invented a typewriter that handles the thousands of characters used in writing Chinese and Japanese with a speed that approximates the work of the machines used in writing the European languages.

The machine consists of a platen roller mounted upon a carriage which can be readily moved about in any direction in a horizontal plane above a case which contains the type, each in a separate compartment; this type case can be moved to the right or left to facilitate the selection of the type. The type is practically identical with the type used in printing. Attached to the roller carriage is a bar slotted to receive the type, and a handle which actuates the printing mechanism. The slot in the type-bar, when at rest, just clears the type-case; above the slot is a felt ink roller. Attached to the carriage, but moving below the type-case, is a bar ending in an upward pointing arm which is in register with the type-bar.

To operate the machine the type-bar slot is brought directly over the compartment containing the desired character, and the handle is pressed downward. This first actuates the elevator-bar under the type-case which pushes the type up out of its compartment into the slot in the type-bar and inks it on the felt roller; the type is then locked in the slot and the bar swings up with an overhand motion and strikes the type against the paper on the platen roller. The process is then reversed by the release of the handle and the type is returned to its proper receptacle. Throughout this sequence of events the point on the elevator-bar remains in the receptacle from which the type has been removed, thus locking the carriage and the type-case until the type is returned.

The main case holds about two thousand four hundred characters and there are two auxiliary cases which hold about eight hundred fifty more. The machine readily lends itself to any line of work, as the characters used in any particular profession or business can be used in the type-case in place of the ones in the ordinary font of type not needed. Carbon copies can be made when desired.

While it may seem that this machine is rather slow as compared with our standard typewriters, yet when the fact is taken into consideration that each character usually stands for a word, it is readily seen that a very creditable speed can be developed. As there is a standard system for the classification of Chinese characters, the seeming difficulty of locating the desired character is readily overcome. Only those who are acquainted with the Chinese characters can appreciate what a saving in time and labor can be accomplished with this machine.



Side view of the celestial writing-machine

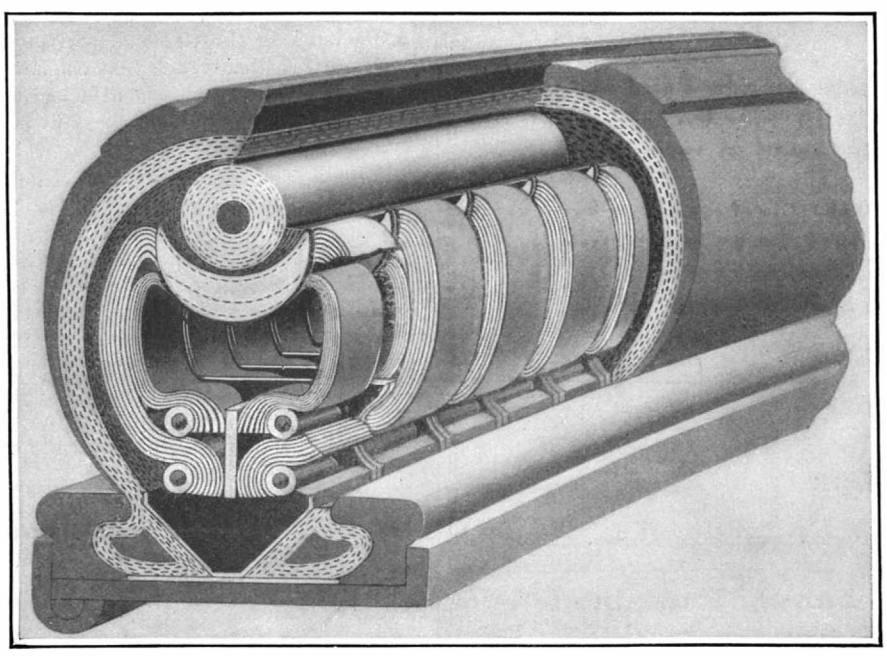
An Improved Life-Boat Hoist

RECENT tests at Portland, Ore., of a new hoisting and lowering apparatus for lifeboats, invented by a Columbia River pilot, will result in its adoption by the Federal Government and the sale of the patent to a strong manufacturing concern.

The invention has several new features, the main one of which is that the launching of a lifeboat can be performed by one person. After the passengers climb into the boat and take their seats, every operation, from the raising of the boat off its chocks to its final delivery into the water, requires but a single man. Other advantages are its light weight, simplicity and the speed with which a boat can be lowered. At a recent test a complete launching was performed in forty-eight seconds.

The davits consist of a pair of arms which swing inboard or outboard in an arc of 90 degrees. The lifting cable from the boat runs in over sheaves to a drum, and the swing of the arms and the raising of the cable are controlled by a crank at either davit. A shaft connects the two davits so that raising or lowering goes on simultaneously at both ends. A man at either end can control both davits; and the passengers cannot be spilled out by one end of the boat hanging fire while the other continues to descend.

In launching the boat, one of the davits is upright over the chocks. By turning the crank the cable is wound on the drum, raising the boat a few inches. The operator then slides the crank into another set of cogs operating a worm-gear which swings the davits outboard. As soon as the boat is clear of the vessel the cable is allowed to unreel on the drum, and the boat drops instantly into the water. The lowering away of the boat can be done by the man at the davit, or can be controlled by a person in the lifeboat by means of a small rope running to a brake on the davit.

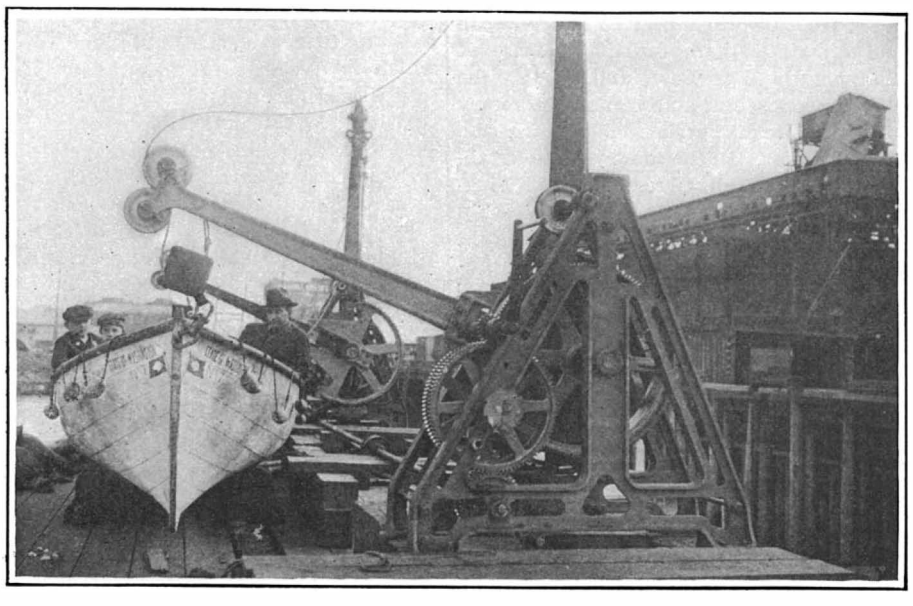


Using steel springs in place of the inner tube

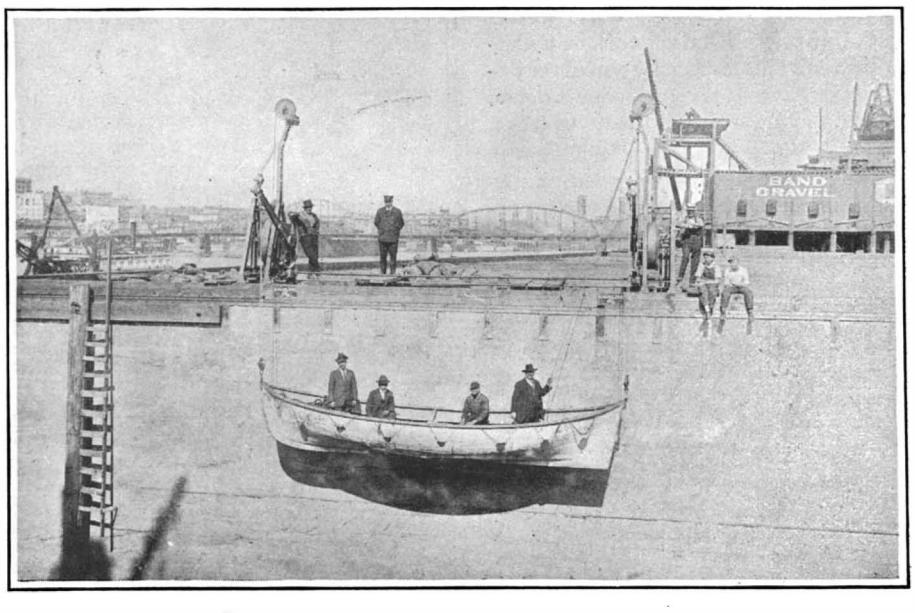
A New Spring Cushion Tire

ALTHOUGH vast improvement has been made in pneumatic tires the tire question still remains a vital problem in the upkeep cost of automobiles, and to meet it innumerable plans for spring wheels and spring tires have been proposed. One of the latest of the latter inventions is shown in the accompanying drawing, and it appears to have a number of meritorious features. As will be seen, the ordinary form of tire casing is retained, but the inner tube is discarded, together with the principle of pneumatic inflation, and to give the cushioning effect the casing is filled with a series of spring units of peculiar construction. Each unit consists of two sets of thin, flat steel springs that conform to the shape of the sides of the casing, but at the top are given a downward curve, to afford space for an additional cushion of rubber and fabric. These springs are not rigidly attached at their ends, but are curved to hook loosely around studs, on which are placed free bushings that permit the springs to work without binding. The studs are fixed in end plates, which form a

(*Concluded on page* 482)



New life-boat installation



Lowering away from a safe place in the life-boat

A New Spring Cushion Tire

(*Concluded from page* 481)

portion of the bottom frame of the device; and located between these plates is a vertical, longitudinal plate that retains the ends of the springs in place. The central curved portion of each set of springs is so shaped that a space is left between the two sets, the object being to carry the ordinary load on the main set, while the second set comes into action when the tire is subjected to an extra shock, thus producing a reinforcing effect.

The main spring is composed of ten thin steel leaves, while the inner secondary spring has five leaves. Between each two leaves is a thin strip of brass, which takes up all wear of the leaves, and besides producing a lubricating effect the rubbing on the brass keeps the steel leaves polished and prevents the formation of rust. At the upper curve a light brass clip retains the leaves of both series of springs in position.

Between the spring units and the tire cover an auxiliary cushion is interposed, consisting of a built-up circular roll that extends entirely around the tire; and this cushion has side flaps that reach down to the base of the tire.

The frame at the base of the springs fills the space between the heads of the casing, and holds them firmly locked in the rim channels, so that it is impossible for the tire to leave the rim under any conditions.

It will be seen that under ordinary running conditions the tire and springs are compressed vertically, and that when there is side pressure the loosely attached ends of the springs permit them to yield laterally, while still offering a firm support.

It would seem that the claim made for this arrangement that it is proof against puncture, blow outs, rim cuts and creeping are justified; and although the scheme adds to the weight of the tires, a compensating saving results from not having to carry any spare wheel, tires or tubes. To insert a set of these spring units a special tool is necessary, which would be part of a garage equipment, and no further attention is necessary until the casing is entirely worn out.

The Death of Dr. Percival Lowell

SUCCUMBING to an attack of apoplexy, Dr. Percival Lowell passed away on November 12th last at Flagstaff, and the world of science in consequence has lost one of its most famous astronomers.

Percival Lowell was a brother of President Abbott Lawrence Lowell of Harvard University. As an astronomer he won his chief distinction by his study and the publication of works concerning Mars, to which he devoted the better part of his life. It is particularly in conjunction with his theories concerning the canals of Mars that the world in general knows Lowell best.

Born in Boston on March 13th, 1855, Percival Lowell was the son of Augustus and Katherine Bigelow Lowell. In 1876 he received his academic degree from Harvard. Some years later, to be more exact from 1883 to 1893, he went to Japan and remained there for the purpose of studying the Far East, and in 1894 he became counsellor and foreign secretary of the Corean special mission to the United States. In the same year he established the Lowell Observatory at Flagstaff, Ariz., and undertook the editorship of its annals. The astronomical world was, in 1897, attracted to his work in connection with the question of the rotation of the planet Mercury, for Dr. Lowell, by combining a long series of measured diameters of the planet with drawings of its apparent surface, sought by the seeming constancy of the surface appearance to prove the theory of the slow motion of the planet held by Schiaparelli. The year 1900 found Dr. Lowell heading an eclipse expedition to Tripoli. Then followed his researches on the subject of the planet Mars, which continued up till the time of his sudden death.

Dr. Percival Lowell first attained universal notice when he announced as his firm belief that the peculiar linear markings of Mars were canals or channels constructed mechanically, and hence the planet must be inhabited by a race of superior beings. But he received scant support from his fellow astronomers, and was openly ridiculed for disagreeing with certain established theories concerning conditions on the planet Mars. Dr. Lowell contended that the conservation of the water formed by the melting of ice at the poles of the planet was necessary to support life on its surface, and that there was oxygen in its atmosphere and water vapor as well.

Heretical as his theories may have been to the recognized theories of astronomers, the fact remains that Dr. Lowell accomplished much of value in this field; and furthermore, his teachings about the wonderful canals and irrigation systems of Mars did much to attract large numbers of people to the subject of astronomy, who would never have been attracted by the achievements of the more practical astronomers. In other words, Percival Lowell did much to make astronomy popular. That he was a conscientious investigator cannot be denied, although he is held in the scientific world as having been too largely governed in his researches by a vivid imagination. Many of the canals which he mentioned in his reports of his research work could not be seen by other observers, which fact accounted largely for the general discrediting of his theories.

The Varnished Frog

SCIENCE has proved that the varnished frog croaks its last croak in air warmed above 96 deg. Fahr.; the unvarnished frog will, however, survive this ordeal. There is a reason: the frog must use the pores of its skin to radiate the extra heat, which cannot be done through a coat of varnish. Moreover, disease germs make short work of varnished frogs.

There are humans that, although unvarnished, yet take on successive coatings of other material quite as deleterious to health—as the citizen who, in overweening pride, boasted he bathed regularly, every Fourth of July, "whether he needed it or not." The meaning is no doubt clear; further specification were but painful supererogation.

Also, improper, too long unchanged, and too much clothing disturbs the skin functions, sometimes seriously. The skin is an organ of respiration; really a part of one's breathing apparatus. And it secretes, as when its oil glands lubricate it and keep it from becoming dry. And it excretes—perspiration. He who bathes a'morning gets his blood elements enriched, thus avoiding blood stagnation—an evil thing; has his lung power and area increased; his appetite and nutrition enhanced, and the food elements better stowed away in those parts of his body where they rightly belong; is assured a sense of mental as well as physical well-being; and, wherever such improvement is desirable, has his morals jacked up considerably. The skin is indeed the peripheral, that is, the surface heart. A child from two to ten years old has a skin surface up to ten square feet; underneath which is a stream of blood and lymph that should be constantly and rapidly circulating. Within two minutes this blood—up to ten pounds of it in a child—enters and leaves this surface heart, comes from and back to the central heart. If such circulation takes longer, or if there are pools and pockets, by the way, the organs and tissues will get clogged up with impure blood, and will become hospitable to disease germs. The whole bodily machinery will get clinkered, and sooner or later there will be illness.

The man of forty and after, who has several square yards of peripheral heart, and a veritable sea of blood flowing through it; who exercises little and prefers to run instead to the undistributed middle—that is, to develop a hefty and inelegant waist line; such a one is especially counseled to apply his fluid restoratives more outside and less inside his system.

Strategic Moves of the War, Nov. 17, 1916

(*Concluded from page 476*)

weather will prevent operations on a large scale from this time until next spring, although as before stated, this will apply to the Russian troops in a lesser degree than to the Teutons.

In the region north of Saloniki, the Serbian army assisted by some French Infantry is reported to have captured a hill near Tepavtsi some few miles south of Monastir in the Cerna river sector. Berlin admits having had to withdraw a part of the Teuton-Bulgar line "in order to avoid pressure on the flanks of the line." The absence of details and lack of geographical definiteness connected with these reports of Serbian engagements and successes around Monastir, are calculated to create considerable doubt as to their accuracy and strategic importance. Personally I am inclined to adhere to the opinion previously expressed in these columns to the effect that the Allies in Saloniki are simply killing time until the political situation in Greece has cleared sufficiently to warrant them in moving away from their base.

The latest reports from the Italian front, are to the effect that the Italian troops have been compelled to withdraw from their most advanced position in the Carso region.

NEW BOOKS, ETC.

CHEMISTRY IN THE SERVICE OF MAN. By Alexander Findlay, M.A., D.Sc., F.I.C. New York: Longmans, Green and Co., 1916. 8vo.; 269 pp.; illustrated. Price, $1.60 net.

Mankind owes a tremendous debt to chemistry, and the chapters of this work impress the fact upon the reader with cumulative force. Most of them may be appreciated and understood by those making no claim to chemical knowledge, for they are based upon a series of lectures delivered before laymen. Every statement therein made as to England's failure to make herself industrially independent of foreign chemistry applies with equal truth to our own position. "The rule of thumb is dead, and the rule of science has taken its place." We are slow to realize this fact, and there can be no surer way to quicken our realization than by showing us, as does Prof. Findlay, what the science of chemistry has already done for us, and what services and marvels it offers to the diligent student and the ultimate consumer when the coördination of science and industry shall have been perfected. His volume is a survey of the more important principles and theories with their applications, under such heads as the chemistry of illuminants, cellulose products, the colloidal state, molecular structure, and synthetic chemistry.

INORGANIC CHEMISTRY FOR COLLEGES. By Lyman C. Newell, Ph.D. New York: D. C. Heath & Company, 1916. 12mo.; 606 pp.; illustrated. Price, $2 net.

LABORATORY MANUAL OF INORGANIC CHEMISTRY FOR COLLEGES. By Lyman C. Newell, Ph.D. New York: D. C. Heath & Company, 1916. 12mo.; 246 pp.; illustrated. Price, 60 cents net.

Prof. Newell's Inorganic Chemistry is well known to instructors, and in this, its revised form, it should materially strengthen its position as a college text-book. The revision more particularly affects those portions of the work which deal with the theory of chemistry; an extension of treatment is noted in the subjects of catalysis, osmotic pressure, colloidal solutions, mass action, radioactivity, and molecular weights, and in various other divisions of the science; and where principles and characteristics are involved with industry or art, these applications are still more fully dealt with. In all this, however, the tried and proved pedogogical features of the first edition are retained. The Laboratory Manual supplements the Inorganic Chemistry, and offers a wide choice of experiments performable with simple and inexpensive apparatus; the Manual may also be used with any standard text-book.

A TEXT-BOOK OF HUMAN PHYSIOLOGY. Including a Section on Physiologic Apparatus. By Albert P. Brubaker, A. M., M.D. Philadelphia: P. Blakiston's Son & Co., 1916. 8vo.; 788 pp.; illustrated. Price, $3 net.

Most medical students and practitioners are familiar with this standard work in its earlier editions. By judicious selection and studied presentation it succeeded in collating the basically important facts of human physiology in such a manner that the reader might not only understand the tissues and organs in normal action, but might also better appreciate the abnormal functioning met with in medical practice. In its fifth edition, the work has greatly gained in appeal and usefulness by revisions and additions that put it abreast

with the latest knowledge; this fact is especially well demonstrated in such subjects as the metabolism of the food principles, the electric currents of the heart and their graphic registration, internal secretion, the localization of functions in the cerebral cortex, and the automatic nerve system. Besides an adequate knowledge of the subjects upon which he writes, Prof. Brubaker brings to his task the rarer faculty of expressing vital facts in a concise yet inclusive manner; it is this which gives his work a distinction and a value that are too frequently lacking in instructive texts. Three hundred and sixty well-chosen illustrations visualize to the student those constructions and operations that might otherwise be exceedingly difficult to understand, while the appendix on physiologic apparatus will be appreciated as rounding out a most complete and satisfactory volume.

First American Commercial Motor-Driven Ship

Loaded with a cargo of refined oils, the motor vessel, "Bramell Point," the first American commercial motor driven ship ever built in this country, sailed from New York, November 13th, for Lisbon, Portugal, on her maiden trip. The "Bramel Point" is owned by the Vacuum Oil Company, Rochester, N. Y.

The "Bramell Point" was launched at Baltimore, July 1st. She has a capacity of 5,000 tons, is 293 feet long, 47 feet beam, and has a depth of 28 feet. Her three Bolinder oil engines develop 1,650 horse-power. She was built by the Baltimore Dry Dock and Ship Building Company. The "Bramell Point" flies the American flag, is manned by a crew of 28 American seamen, and is in command of Capt. Andrew Munkewitz.

Our Latest Dreadnought, the "Arizonia"

(*Concluded from page* 471)

over the roof of the adjoining turret. This arrangement makes it possible to deliver an end-on fire, at bow and stern, of six 14-inch guns and a broadside fire on each beam of twelve 14-inch guns. The three-gun turret has proved to be a success, the interference of the three shells with each other during their flight, due to the bow air waves, having been obviated by firing the center gun a small fraction of a second later than the two outer guns. The whole battery has been so arranged that all of the guns can be aimed and fired by a single officer, the errors inseparable from the use of a gun-pointer at each gun being thereby eliminated. At the same time, should it prove desirable during an engagement to return to individual gun-pointing this can be done without any delay. A noticeable improvement in the "Arizona" and "Pennsylvania" over earlier ships is seen in the emplacement of the torpedo-defense battery of twenty-two 5-inch guns; 16 of these are mounted on the main deck, from amidships forward, and four more upon the forecastle deck above. The remaining four guns are carried aft on the gun deck, two on each broadside. The high command thus secured is such that these batteries can be fought in any weather in which an engagement is liable to take place. A novel feature of the armament, which reflects the growing importance of aerial warfare, is the provision of four anti-aircraft guns.

Following the "Pennsylvania" and "Arizona" and generally similar to them, there are three battleships now under construction, the "New Mexico," "Idaho" and "Mississippi," whose completion will give us a division of five of these exceptionally powerful and heavily armored ships. The four battleships of this year's programme, construction of which is to be started just as soon as satisfactory contracts can be made, will be of slightly larger size, but they will mount eight 16-inch guns in place of the twelve 14-inch guns mounted on the ships of the "Pennsylvania" and "California" classes.

The Inspection and Tests of Lewis Machine Guns

(*Concluded from page* 475)

and sent back to the shop for further examination and perfecting.

It should be mentioned that the experience had during the war has led the ordnance expert to divide machine guns

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broadly into the heavy and light classes, the heavy to be used in more or less permanent emplacements and the lighter guns for front line work in the advanced trenches from which they can be moved forward or back on the shoulders of the men, according as the troops are advancing or retreating. The typical heavy, or semi-permanent-position type of machine gun is of course the celebrated Maxim water-cooled type, which weighs between 50 and 60 pounds. The principal representatives of the light, portable machine gun are the Lewis, the Colt and the Benet-Mercier, of which if we may judge from reports from the Allied fronts, the Lewis is the most efficient and popular. Both the heavy and the light types are needed in modern warfare; but for every gun of the heavy type there should be at least three or four of the lighter weapon. We understand that it has been decided to order a large number of the Maxim type for the United States Army. This is good so far as it goes, but the order should be followed by one for at least three times as many machine guns of the Lewis type or whatever type may be selected for use in the front trenches, in the air service and in any field of activity where light weight and mobility are a prime consideration.

Wings for Our Eagle

(*Concluded from page* 474)

successful in passing the tests, receive commissions as officers in the Officers' Reserve Corps. Only the preliminary training of the reserve aviators is to be given at the civilian schools, for more advanced and actual military flying is to be undertaken at one of the Army aviation schools. It is understood that Army schools will be formed as rapidly as necessary to take care of the applicants.

Any civilian desiring to join the Officers' Reserve Corps as a Reserve Military Aviator should send in his application to the War Department in Washington. The applicant will then be examined by a medical officer and also, if possible, by an officer of the Aviation Section of the Army, who will pass upon the applicant's qualifications for the strenuous duties of a military aviator. If the applicant is accepted, he will be ordered to one of the civilian flying schools where he will be put through preliminary training under the supervision of an inspecting officer. This training will enable the candidate to pass the preliminary flying test that the Army aviation authorities have drawn up, which, we are told, is but a trifle more difficult than the test of the Federation Aeronautique Internationale.

The Government, through its arrangement with the civilian flying schools, will pay for the training of the Reserve Military Aviators. Although $500 has been mentioned in the press as the sum which would be paid to the civilian schools for the training of each successful aviator, it is now understood that no fixed sum has been agreed upon, the present intention being to keep careful records of the expenses incurred in the training of each man and to base the amount paid for the course upon these records. At any rate the civilian schools are to be paid for the training of each man after he has succeeded in passing the Army's preliminary test.

The candidate, having passed the preliminary tests, may either be ordered to an Army station or to continue his work at the civilian school under military instruction until he is ready to take his Reserve Military Aviator's tests, which are described as requiring a considerable degree of skill as a pilot, although not so difficult as the Junior Military Aviator's tests which the Army pilots must pass. Upon successfully passing the Reserve Military Aviator's tests, the candidate is commissioned a first lieutenant in the Officers' Reserve Corps, in which capacity he is required to report fifteen days every year for instruction and practice at one of the Army flying fields, during which time he will receive the same pay and allowances as an officer holding the same rank in the Regular Army.

The aviation authorities of the Army expect to train 297 Reserve Military Aviator First Lieutenants, and about 2,000 mechanics, truck drivers, and other personnel, who are to be trained as individuals. In case of war or threatened war this personnel may be mustered and incorporated in one of the Regular Army flying units, or made into separate units of their own, as circumstances dictate. In this manner the Army hopes to have a large number of aviators and mechanics who can be depended on for immediate service in war time.

So much for the Reserve Military Aviators. The Militia problem, according to the Army men, is quite a different one. For the Militia's measure of success in aviation depends solely on the building up of trained units able to take the field as units at any time. The present plan of the Army officials with regard to Militia aviation is as follows:

Any State wishing to form an Aero Company should, through its Adjutant-General, select the man best suited to command it and his second in command, and submit these men to the physical tests for Reserve Military Aviators laid down by the Chief of Division of Militia Affairs. They will then be sent at the Government's expense to the Signal Corps Aviation School at San Diego, Cal., where they will receive the same course of instruction as is now given to officers of the Regular Army. Upon the completion of their training these candidates are to take their Junior Military Aviator's certificates, returning then to their State where it will be their duty to enlist their men and secure one serviceable aeroplane. When they have six officers and thirty-nine men—two of the officers holding Junior Military Aviator's certificates—they will receive probationary recognition from the Army, which will be continued for about a year. During the period of probationary recognition the Federal Government will supply the necessary gasoline and oil for the practice flights, but the State Aero Company will continue to use the machine furnished by the State. The Company will be expected to train the four officers who have not had the San Diego schooling, as well as the mechanics; and at the end of the probationary period, or sooner if the Company desires, a second inspection will be made. At that time, if the Company possesses the required number of aviators and the necessary enlisted personnel, it will receive complete Federal recognition and the allotted complement of aeroplanes, motor trucks, and other equipment will be furnished by the Federal Government.

The $76,000 which Congress has appropriated for the training of Militia officers will be used in training the men who go to San Diego. Aside from this sum the Division of Militia Affairs has about $400,000 out of its general appropriation for all arms—infantry, cavalry, artillery, etc.—which can be used for equipping Aero Companies. While it is believed that this sum is ample, should it be found insufficient the officials plan to request additional funds from Congress during the session beginning in December.

It is a big task that confronts the men who have the rehabilitation of our air fleet in hand, yet it is no more difficult than that which confronted Great Britain some years ago—and then the British did not have an aircraft industry of their own; they had to build up one. Surely, with the aircraft constructors ready to turn out any machines our Army may require and with the necessary candidates available in almost infinite numbers for aviation training, a good working plan should result in aerial defences which, in a short time, will be a distinct credit to Americans.

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The Outlook for 1917

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Perhaps the general purpose of The Outlook cannot be better defined than in these recent words of Theodore Roosevelt:

"For six years I was steadily at the editorial council board. In all that time I never once heard it even suggested that the conduct of The Outlook should be shaped in any way save as sincere conviction and conscientious regard for the public good demanded it should be shaped Always the discussion was along practical lines. The editors, as practical men, discussed what the course of the magazine should be, but they discussed it always from the standpoint of practical men devoted to the service of lofty ideals."

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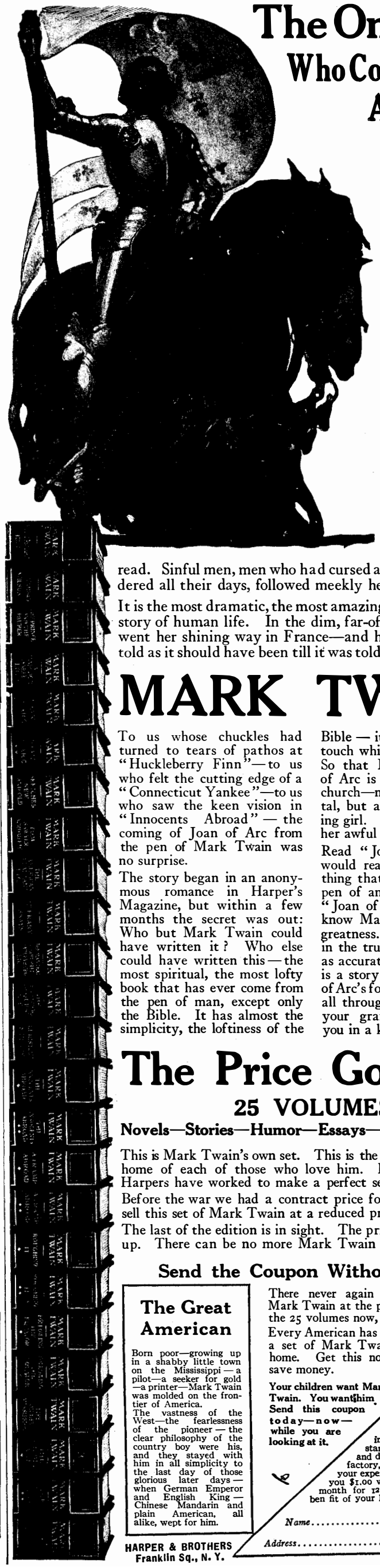

The Only Girl Who Commanded A Nation's Armies

A simple little girl of sixteen played one day in a little lost village. The next year, in supreme command of all the troops of France, she led them in triumph to victory. No woman—no man in all the world's story has done so wonderful a thing.

Great dukes bowed before this girl who could not read. Sinful men, men who had cursed and drank and murdered all their days, followed meekly her every order.

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