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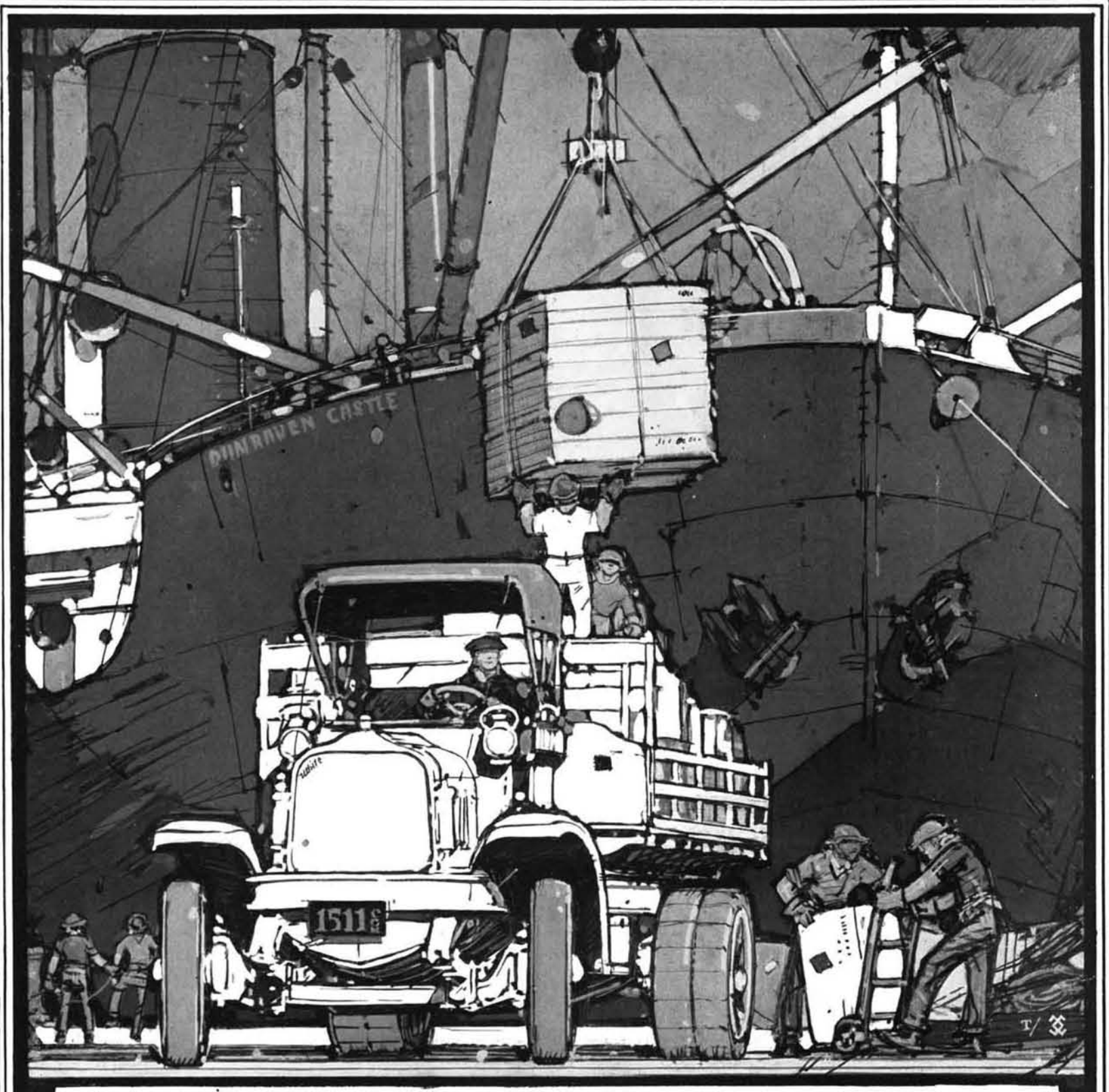
"It will be a signal service to our country to arouse it to a knowledge of the great possibilities that are open to it in the markets of the world."

Woodrow Wilson

March 4, 1916

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

Price 15 Cents



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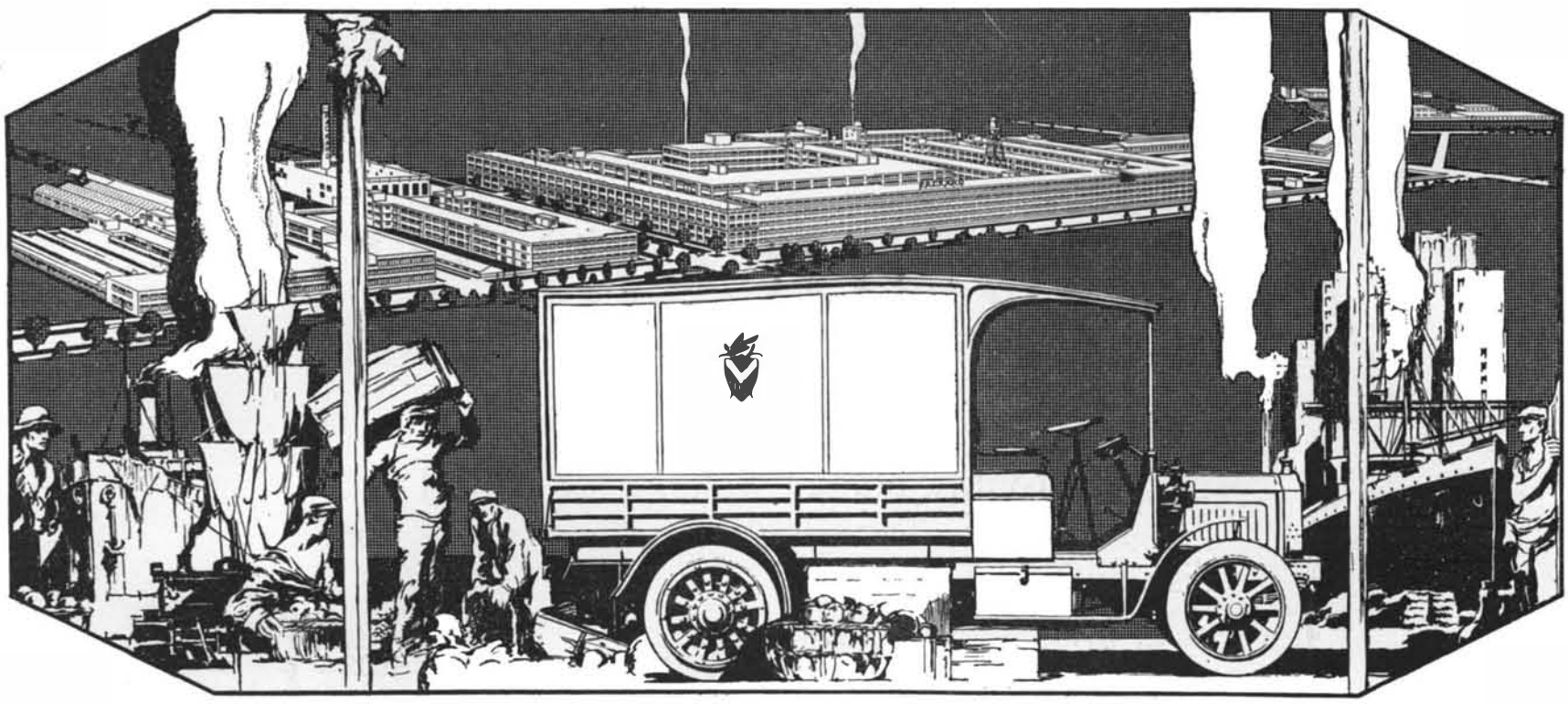

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SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV.] NUMBER 10 NEW YORK, MARCH 4, 1916 [15 CENTS A COPY $3.00 A YEAR

Ruins of a house on the Isle of Marken

A fishing smack driven over the sea wall against a house

Holland in the Grip of Its Old Enemy

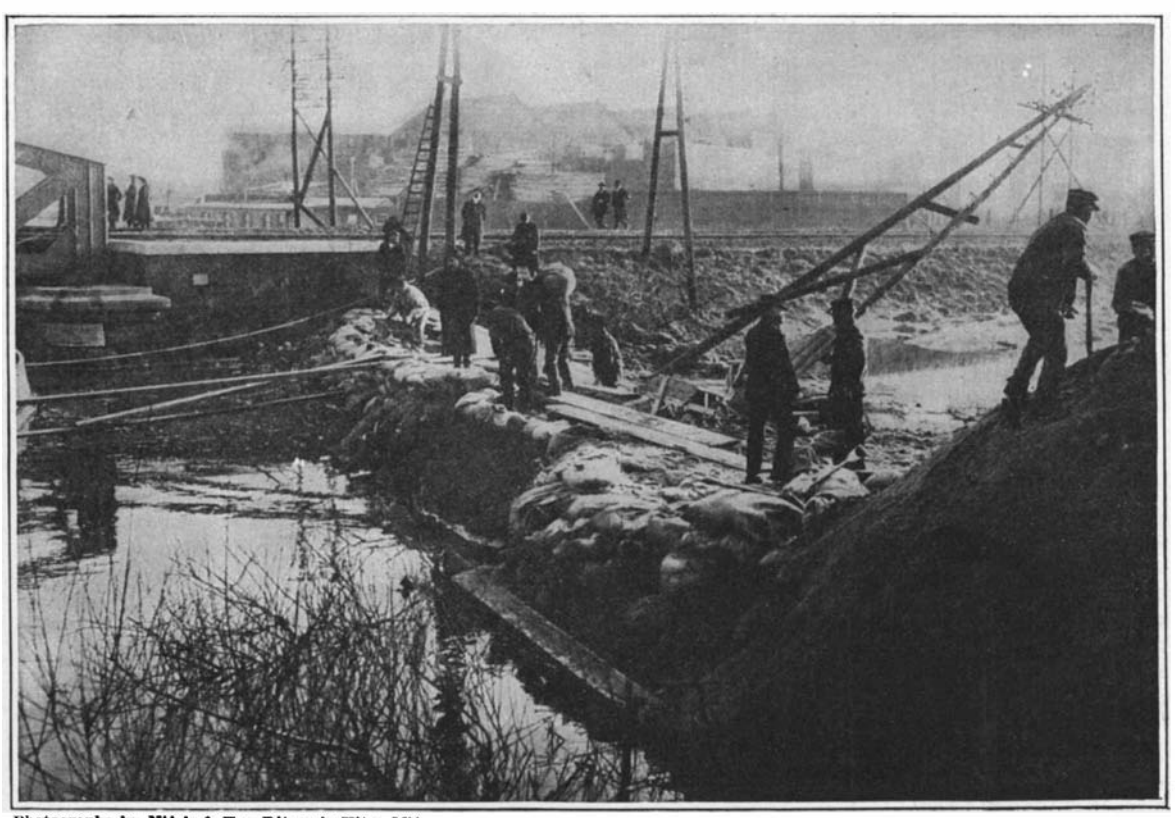
By W. J. L. Kiehl

THE period of stormy weather in the Netherlands which set in around Christmas and continued with short intermissions of fair conditions until January 20th, was marked by a terrific gale on the night of the 13th and 14th. On that night of terror, Holland was invaded by the waters in many places—near Rotterdam in N. North Brabant; near Amersfoort and Nykerk, and along the Eem River; near Muiden and Naarden, two fortresses and towers belonging to the defenses of Amsterdam, and in the Anna-Paulowna polder. But the calamity that befell the southern portion of the Province of North Holland is the worst of all—far worse than can be remembered to have ever happened since the fearful St. Elizabeth flood in 1421, when 10,000 people were drowned, and it must be entirely placed to the credit of better organization of help. better roads, better telegraphic and telephonic communication and railway service, that on this occasion the victims are numbered only by tens instead of by tens of thousands.

After the fierce northwester had driven the waters into the Zuyder Zee until they stretched almost level with the tops of the dykes, the Zuyder Zee broke through at two different points between Vovendam and Monnikendam and southward of the Isle of Marken near Uitdam. The island of Marken itself was entirely submerged, only the "flood-mounds" rising slightly above the waters. The whole fishing fleet and 50 houses were destroyed. The damage is estimated at half-a-million florins for Marken alone. Sixteen persons and perhaps more were drowned, or killed by the falling houses. All the houses in Marken are of timber; some have brick foundations and most all so built that the ground floor is employed for storing goods or as stables for cattle, the top floor being used for dwelling purposes. This construction has been taught to the inhabitants to meet the annually recurring floods. But against this dreadful inundation all precautions proved vain. Some of the fishing boats were dashed against groups of houses, and boats and homes were smashed like so much match-wood. In this inundation some 12,000 hectares are submerged. But more land is threatened and everywhere thousands of the mobilized troops are working with feverish haste with thousands of civilians, farmers, laborers and others to strengthen the menaced points in the dykes. In this way, the polders, Purmer, Wormer and Beemster up to the present time, January 29th, have been saved from the inroads of the waters. What has happened in the night of the 19th of January, I do not yet know, but it was with great apprehension that I heard the shrieking of the storm wind. This time, however, from the southwest. All Saturday, Sunday, Monday and Tuesday other menaced districts were being gradually evacuated. All cattle were driven out or carried away in shallow punts towed by small tug boats. At the Tolhuis, an ancient toll-bar and hostelry, 20,000 cows were counted as they were brought in. There, 4,000 of these animals were milked (they were in sad need of it), fed and sheltered through measures taken by the municipality. Later on, they were sent to various "dry" towns and villages or farms where they were "billeted" on the farmers. The municipality of Amsterdam buys all the milk at nine cents a liter and it is then distributed to all the dairies in the neighborhood. In this way milk supply of Amsterdam and surrounding districts has been assured. But thousands of cattle, horses, pigs and fowl perished. In one polder it was only possible to save 20 cows out of the 500 it contained. Many farmers have lost all they possessed. The churches and church yards in the

(*Concluded on page* 264)

A break in the dyke at Eemnes near Amsterdam



Photographs by Nijgh & Van Ditmar's Uitg. Mij.

Temporary repairs on the first dyke that gave way

SCIENTIFIC AMERICAN

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

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

Preparedness in the Chemical Industries

AN admirable display of confidence in the ability of American technical workers to provide resources of munitions and other materials of defense in any emergency that may arise in existing relations between the United States and European powers was made by W. L. Saunders, vice-chairman of the Naval Consulting Board, at a joint meeting of chemical societies which was held recently in New York City.

The index of a country's industrial standing as formerly recognized was its consumption of sulfuric acid, the nation that produced and consumed the most of this chemical substance in her arts and industries being accounted the most prosperous, and judged by this standard Great Britain was for a long time reckoned the leading nation of the world. A new and more accurate standard is now employed—a nation's coal consumption per capita; and, judged by this standard, the United States, with a per capita consumption of five tons, stands at the head, outclassing both Great Britain and Germany, who are second in the scale, with an equal consumption of four tons per capita. France stands third, being credited with a consumption of only 1.6 tons, while Russia, with its abounding population and great extent of territory, is away down on the scale of industrial progress, having only one quarter ton per capita to her credit. These figures are convincing of the fact that the United States has a preponderating advantage over other countries in the strength of its industries, the most important consideration in the question of preparedness for war or peace.

The thing that is lacking in this country is intelligent preparation for an emergency by means of correlation between the various industries and a closer relation with the Government, so that they may know what will be required of them in times of war. If Germany at the outbreak of the European war was able to so mobilize and direct her industries as to overcome the blockade of the British fleet and manufacture from natural resources the basic materials needed for explosives, what may not be expected of the United States under similar conditions? The strength of our country from an industrial standpoint is eloquently attested by its per capita coal consumption, which, as mentioned, exceeds that of any other nation, and all that is needed apparently to raise the efficiency of industrial plants here is to correlate them and bring them in touch with the needs of the Government. Even under existing conditions the production of atmospheric nitrogen in this country and Canada has reached a state where, in the event of an emergency the United States could rely as confidently as Germany does on the air for its own supply of nitric acid that would be needed in the production of explosives.

What is true of explosives holds good as regards nearly all other electro-chemical war supplies. As a consequence of the shutting off of supplies from Europe by war conditions, a number of important chemical industries have been started in the United States, which, if given adequate encouragement by the Government and the people, will eventually place this country in a position of unassailable economic independence of the rest of the world. The case of magnesium may be instanced. Magnesium is an element of vital necessity in the manufacture of munitions, as well as of the machinery employed in military operations. Before the great war all of the magnesium used in the arts and industries in this country was imported from Germany and other countries. Now a full-fledged industry is in existence, producing metallic magnesium of a purity that surpasses that of the article formerly purchased from European manufacturers, and the domestic and some foreign demand for American manufactured magnesium is already much in excess of what can be produced at the present time. Magnesium is used in aluminum castings, finding extensive employment in the construction of motor car and aeroplane accessories, though it is most in demand at present for the manufacture of illuminating bombs to make daylight over enemy operations at night-time, and for trailers attached to shrapnel shells, which serve at night to show the effectiveness of the fire.

National preparedness was promoted when the Government took steps to establish the Naval Consulting Board, and, given the right kind of encouragement on the part of Congress, the board should accomplish substantial results in the direction of industrial mobilization, for, as cogently stated by the vice-chairman of the board, Mr. Saunders, it is far more important, at least in the present stage of the country's defense plans, to have the men in the works organized to know just what to do than to have them in the trenches or in military barracks.

Use of Congressmen's Names for Advertising

IT has been a common practice among certain classes of patent attorneys, conducting their business in Washington, to make use of the names of prominent members of Congress in forwarding the interests of their business. The obtaining of letters of endorsement from members of Congress is a very simple and easy procedure, and anybody possessing a little political influence may obtain such letters of recommendation, and such letters are given almost invariably without any knowledge of the true merits of the case.

There is one well known attorney in Washington who advertises extensively, and publishes a book of endorsements, in which a number of letters from members of Congress are reproduced in fac simile. The book in question is embellished with a frontispiece of a portrait of the well known features of the Speaker of the House. There is nothing to indicate in the letter of endorsement that this gentleman is an inventor or that he has made use professionally of the services of the firm of attorneys whom he recommends. The letters which follow in the same thick pamphlet are equally indefinite on this particular point, and many of them are written in an evasive tone. Nevertheless, upon the incredulous and innocent inventor the publication of such a list of endorsements provides a very imposing certificate of merit.

The use of these methods has carried with it such abuses that an effort is being made to discredit such a system of advertising, and to that end a bill has been introduced in the present Congress to put a stop to this practice. This was one of the first bills introduced into the Senate when it convened in December. We had occasion to refer to it in our issue of January 8th, 1916. The following extract is published verbatim from a report by the Commissioner of Patents to Congress, which appears in the Official Gazette of February 15th, 1916. The trenchant criticism of the Commissioner upon the practice of such attorneys needs no comment.

"Last year, toward the end of the session, a bill was passed by the Senate and failed to pass the House of Representatives, which declared it to be unlawful for any person, firm or corporation practicing before the Patent Office to use the name of any member of either House of Congress or of any officer of the Government to advertise said business. I recommend that a law be enacted in the terms of this bill (S. 7427, 63d Congress, 3d Session). The attorneys who make use of letters from Members of Congress for purposes of advertising are not as a class entitled to be commended to their constituents. A recent investigation showed one concern in Washington which had pending for different applicants 94 applications for nut-locks. This is doubtless an exceptional instance; but it is nevertheless true that these advertisers take applications which conflict without considering the fact that they are representing conflicting interests. They make searches which careful examination will show to be inadequate and inaccurate, and they induce people whose circumstances they do not know to file applications, both in this country and abroad, which no attorney should permit a client to file. In this way they collect hundreds of thousands of dollars every year from people scattered all over the United States and, on the whole, people of the poorer class. The Office never recommends these concerns. I trust the bill referred to may pass."

The Scientific American as a Work of Reference

THE Scientific Library of the United States Patent Office is a vast store house of works of reference. Books and publications in every language form the collection, and the long reading tables are always crowded with visitors who are searching for information which will enable them to act intelligently upon applications for patent. These visitors comprise patent attorneys, inventors, statisticians and patent office examiners and employees. During the office hours the Scientific Library presents a busy scene, a spectacle of activity which to the layman seems hardly commensurate with the somewhat dry and scientific nature of most of the volumes. Here may be found British, French, German, Russian, Austrian, Italian, Swedish, Danish, Belgian, Norwegian, Spanish, Japanese and British Colonial patents, both specifications and drawings running back to an exceeding early date. Indeed the English patent volumes run back to the eighteenth century. These patents are constantly in demand for searching and the item for rebinding books for the Scientific Library is a considerable percentage of the Patent Office budget. This is due, of course, to excessive handling of the volumes.

It has been noted by those who have opportunity for observation that one of the most popular works of reference in the library is the SCIENTIFIC AMERICAN. Bound volumes of this publication occupy one of the alcoves, the series beginning with the issue of September 26th, 1846, and continuing up to date. The SUPPLEMENT is bound separately and occupies a place of its own. No day passes on which both the SCIENTIFIC AMERICAN and SUPPLEMENT are not found on the reading tables. Publication of a description of a device is considered by law an anticipation of invention, and consequently a bar to a patent. For this reason the SCIENTIFIC AMERICAN is also largely consulted by the examiners in the Patent Office. Scarcely one of the forty-two examining divisions but has its collection of clippings from this magazine, which are being constantly consulted in connection with applications for patent.

It is interesting to note that the issue of the SCIENTIFIC AMERICAN of September 26th, 1846, referred to above as the earliest issue on file in the Patent Office, contains an article entitled "Information to Persons Having Business to Transact at the Patent Office." So it is seen that from the very beginning this paper was relied upon by inventors as a guide to procedure in the matter of obtaining patents.

Two Curious Diseases Recently Noticed by Doctors

ONE of the two curious diseases that have recently come to the attention of the doctors is commonly known as "sleep palsy," but, because it is so often found in those who have been too festive on Saturday night, the hospital name is "Saturday night paralysis." It comes from pressure on that nerve (the musculospiral) which actuates the extensors of the elbow, wrist and fingers. The hard drinker, for whom, on Saturday night, money and leisure inopportunely meet, will often fall forward on the table with his head resting on his arm, and so remain until the effects of drink are over, waking up to find his forearm and hand inert and nerveless, a condition persisting for days or weeks, even months, and similar to that seen in lead palsy.

The other disease is known as "Monday morning paralysis." Fortunately, it is, as yet, confined to horses and does not come from over-drinking but from food too nutritious or too much food while resting in the stable on Sunday.

The technical name is *Astasia* (gr. a-stasis) and it is regarded seriously by horse breeders and ranchers for recovery is rare. In fact, the animal dies in two or three weeks or even as many days.

It seems to be a form of uremic poisoning. The whole system is clogged; the kidneys are inactive; there is breaking down of the blood vessels in the rump. The poor beast presents a pitiful spectacle: he sweats profusely and seems to have absolutely no control of his hind legs.

A Texan rancher recently lost a number of valuable draught horses this way. He tried taking them out for half mile walks, then resting, then walking again; but they all grew weaker and weaker and died.

Notice Concerning the Encyclopedia Americana

SEVERAL years ago we published notices in the SCIENTIFIC AMERICAN stating that the Encyclopedia Americana, published by the "Americana Company" or by the so-called "Scientific American Compiling Department" was not connected in any way with Munn & Company or the SCIENTIFIC AMERICAN. The title "Scientific American Compiling Department" is used without our consent and against our wishes. The company publishing this encyclopedia passed into the hands of a receiver some months ago. A number of sets of the encyclopedia, however, are being offered to the public, through canvassers and in other ways, and we publish this notice with the object of warning intending purchasers that in spite of any representations that may be offered by canvassers and others in connection with the sale of the Encyclopedia Americana, we are not in any way connected with this enterprise. We wish to caution the public against investing in the encyclopedia through any misapprehension of the true facts of the case.

Economic Preparedness

Our Natural Resources and How They Are Being Developed

By Franklin K. Lane, Secretary of the Interior

PREPAREDNESS is generally understood as the state of being ready to fight if necessary.

But the finest army and the biggest navy in the world cannot constitute real preparedness without the complete mobilization of the industrial resources, which must be behind them. Fortunately, such mobilization means profit and development for the country, in the absence of any war or threat of war.

Industry and natural resources are strained in time of war from two great causes: it is more difficult to get supplies from abroad, and the demand for what is at hand is supernormal. With an increased demand and a possible source of supply cut off, confusion follows unless a nation is industrially prepared as to its natural resources to such an extent that an abnormal demand does not throw machinery into disorder.

The natural resources of the United States are the most remarkable in the whole world. We have made some mistakes in their development, and private interests have dominated public interests in some cases. But we have seen our mistakes, corrected many of them, and are now correcting others. That this policy will continue, and that nothing will interfere with the development, conservation and proper use of our enormous natural wealth, should be the first aim of all who have real preparedness, either for war or peace, at heart.

Some months since I sought to learn what we had with which to meet the world which was teaching us that war was no longer only between armed forces, but an enduring contest between all the life forces of the contesting parties, their financial strength, their industrial organization and adaptability, their crop yields, and their mineral resources, and that it ultimately comes to a test of the very genius of the peoples involved. To mobilize even a great army is now no more than an idle evidence of a single form of strength if behind this army the nation is not organized. An army is no longer merely so many rifles and men, cartridges and horses; but chemists and inventors, mines and farms, automobiles and roads, airships and gasoline, barbed wire and turning lathes, railroads and weather prophets; indeed, the complete machinery of an industrial nation's life.

With the exception of one or two minor minerals, the United States produces every mineral needed in industry. We produce 66 per cent of the world's output of petroleum, 60 per cent of its copper, 40 per cent of its coal and iron, and 32 per cent of its lead and zinc. Tin in small quantities is produced in Alaska and platinum in Oregon, Nevada and California, manganese in Virginia, Georgia, Arkansas and California; but of these latter minerals, as of nickel and some others of less importance, our supply is altogether inadequate for our consumption. We can build a battleship, or an automobile (excepting the tires), a railroad or a factory, entirely from the products of American mines and forests. To replenish the soil we have phosphorus in abundance, potash is known to exist in the deposits of Searles Lake, California, which, however, is not yet commercially available, and in alunite, where it is combined with aluminum and deposits of which are found in several states; and nitrogen can be extracted from the air by cheap hydro-electric power as is now done in Germany, Norway and elsewhere. So that we can feed the earth and keep it sustained. Our soil and climate are so varied that we can produce all the grains, fruits, vegetables and fibers known to the temperate zone, and some found in the semi-tropics. And to crown all these, we have water power that can be made to generate perhaps as much as 60,000,000 horse-power.

Our resources are not alone physical. Our ingenuity and ability to design the machine to meet the need have been proven a thousand times, never more convincingly than in a compilation of the most necessary inventions and discoveries which the world uses.

During the past fifty years the people of the United States have uttered two thirds of the revolutionary, epoch-making inventions of the world, from the telephone and the incandescent lamp to Wright's aeroplane and high speed steel. Each day we issue an average of two hundred letters patent to American inventors, and the number of inventions is increasing with the years.

How great a resource this characteristic might be in time of need has been amply demonstrated during the present war in Europe, which has denied us imports formerly considered essential. Benzol and toluol, foundation of aniline dyes and explosives, have been produced from crude petroleum by a new process discovered by Walter F. Rittman, of the Bureau of Mines. That an increase in the amount of gasoline which is yielded by crude petroleum is also possible by the Rittman process is by no means the least of its advantages.

THE WHITE HOUSE
WASHINGTON

February 11, 1916

Sir:

It will be a signal service to our country to arouse it to a knowledge of the great possibilities that are open to it in the markets of the world. The door of opportunity swings wide before us. Through it we may, if we will, enter into rich fields of endeavor and success. In order to do this we must show an effectiveness in industrial practice which measures up to our best standards. We must avail ourselves of all that science can tell us in aid of industry and must use all that education can contribute to train the artisan in the principles and practice of his work. Our industries must be self-reliant and courageous because based upon certain knowledge of their task and because supported by the efforts of citizens in the mills. If scientific research and the educated worker go hand in hand with broad vision in finance and with that keen self-criticism which is the manufacturer's first duty to himself, the fields will be few indeed in which American commerce may not hold, if it chooses, a primary place.

Yours very truly,

Woodrow Wilson

The Editor,
The Scientific American,
New York City.

A letter from the President of the United States

Barium salts, needed for a variety of purposes, were formerly imported in large quantities, although the raw material, barytes, occurs in extensive deposits in this country. We now manufacture these salts in California, Colorado, Illinois, Pennsylvania, New York, Tennessee and West Virginia, the new industry not only meeting the domestic demand, but also furnishing large quantities of barium compounds for export, and we are substituting domestic barytes for the foreign material for all purposes. The substitution of sodium cyanide for potassium cyanide in the treatment of gold ores to the extent of more than half a million pounds in Colorado alone illustrates how the potash shortage is being met throughout the mining states. Tungsten, an absolutely essential constituent in high-speed tool steel, is being mined at more points than ever before to meet the special demand in the steel-working industry; a tin smelter has been erected to reduce Bolivian ores; cobalt, which is a recent and valuable acquisition to the family of steel-alloying metals, is now being produced in quantity sufficient to lower the market price; American antimony is quoted in the metal market for the first time, and from Alaska alone more antimony has been shipped this year than was ever before produced from American mines in any one year; cadmium, formerly imported, is now an article of export; and in other minor metals full independence of foreign supplies is being worked out. Practically all the crude platinum from Colombia and part of the New Zealand output is coming to the United States for refining.

There is probably no one thing we can do more vital to real preparedness than a comprehensive conservation and development of our petroleum resources. In spite of the alarmists, statistics show no immediate prospect of a coal shortage; the total coal produced in a year in the United States is a minute quantity compared to the supply in sight.

But of petroleum we have no such comforting statistics. How much of it there is in the United States no one knows. The Geological Survey has made a maximum estimate of twenty-three billion barrels, which sounds like an inexhaustible supply. But at the rate that it is now being consumed in this country alone (265,000,000 barrels a year) this does not mean an indefinite supply, and from the rapid exhaustion of some fields it is manifest that there can be no real approximation of the oil in our lands. Whatever the supply, it should not be allowed in its crude state to compete with coal as fuel. Petroleum is a priceless resource, for it can never be replaced. Trees can be grown again on the soil from which they have been taken. But how can petroleum be produced? It has taken the ages for nature to distill it in her subterranean laboratory. We do not even know her process. We may find a substitute for it, but have not yet. It is practically the one lubricant of the world to-day. Not a railroad wheel turns without its way being smoothed by it. We can make light and heat by hydro-electric power, but the great turbines move on bearings that are smothered in petroleum. From it we get the quick exploding gas which is to the motor and the airship what air is to the human body. To industry, agriculture, commerce and the pleasures of life, petroleum is now essential.

Among our natural resources which should be developed as speedily as possible to their full capacity as a measure of preparedness for a successful peace or the prosecution of any war into which the future may draw us, are our wonderful water powers. Among the strange things done by Benjamin Franklin was to give an added and peculiar value to the ledges of granite which confine our western streams and turn them into dam sites, useful for purposes of power generation. How many of these are on public land not yet disposed of no one knows, but we have several hundred under withdrawal which should be freed from withdrawal and turned into use just as quickly as possible; for, as the muscle of man or horse can raise a few barrels of water from the well to supply stock or irrigate the garden patch, so can the power of the stream, turned into electricity, be used to raise millions of barrels of water to irrigate alfalfa farms or orchards. And this is now one of the most common uses of electric power in the West, and, in fact, some of the eastern states, where irrigation is found of value. Then, too, there is that mystifying miracle of drawing nitrogen from the air for chemical use, which can be done only with great power, but is being done in Germany, Norway, Sweden, France, Switzerland, and elsewhere, by which an inexhaustible substitute for the almost exhausted nitrates of Chile has been found. This is already a great industry in Europe, and will of necessity become greater in the United States than elsewhere, because

(*Concluded on page* 258)

A wartime Garde de Champêtre

Women Workers of France

New Duties that Women Are Assuming to Release Men Needed at the Front

By Martin Wells

THERE is more than a sentimental side to the story of how the women of France—and for that matter the women of every nation engaged in the gigantic conflict—have enlisted their services in the numerous industrial and civic activities heretofore engaged in by men only. There is involved the all-important question of labor readjustment after the war. And this becomes more serious when it is recalled that women have proved so competent in their new work that already there are rumors to the effect that women will retain certain of their new tasks in post-bellum days.—EDITOR.

Woman ticket puncher of Paris

THE response of European womanhood to the necessities of the states engaged in the great war has been so general that abroad it is now taken as a matter of course, exciting little comment in the more vivid interests which, having upset the Continental balance, now center upon the battle fronts. Yet, in the travail of conflict has been brought forth an emancipation from the customs of centuries, a visible expression of the national soul through those whose lot it has previously been but to stand and wait; and the women of the warring empires have writ for themselves a page into history which no erosion of time can dim.

From Paris in particular, we are told how the wives, mothers, sweethearts and sisters of Frenchmen have rallied to the workshops and humble civic posts, in order that men, otherwise needed in the industrial fabric, might be released to shoulder a rifle or crouch grimly behind the shield of a "Seventy-five" under the Tricolor of the Republic.

The ravenous maw of battle clamors for incessant feeding. Shells, shrapnel, rifles and equipment, clothing, tools, hospital supplies and provender—and always more shells—must be forthcoming or the safety of the line will be jeopardized. So, into the factories devoted to this class of product these women have gone, donning coarse aprons or overalls and bending a splendid vitality and intelligence to mastering their proud duties.

An examination of the accompanying illustrations will more definitely epitomize the spirit of these women than cold, printed words can. The pictures are so obviously unposed, the attitudes so natural, that they convey an impression of reluctance to be interrupted for so trivial and incidental a thing as being photographed.

The illustrations depicting women laboring in the shell factory suggest the scope of their activities. From the rough casts of shells being turned down to fit the guns to the final placement of fuses, through the various stages of completion, the work is being performed by women

A French woman conductor at work for the street car railways of Paris

A typical scene at a rural railway station in France: A woman station keeper at work

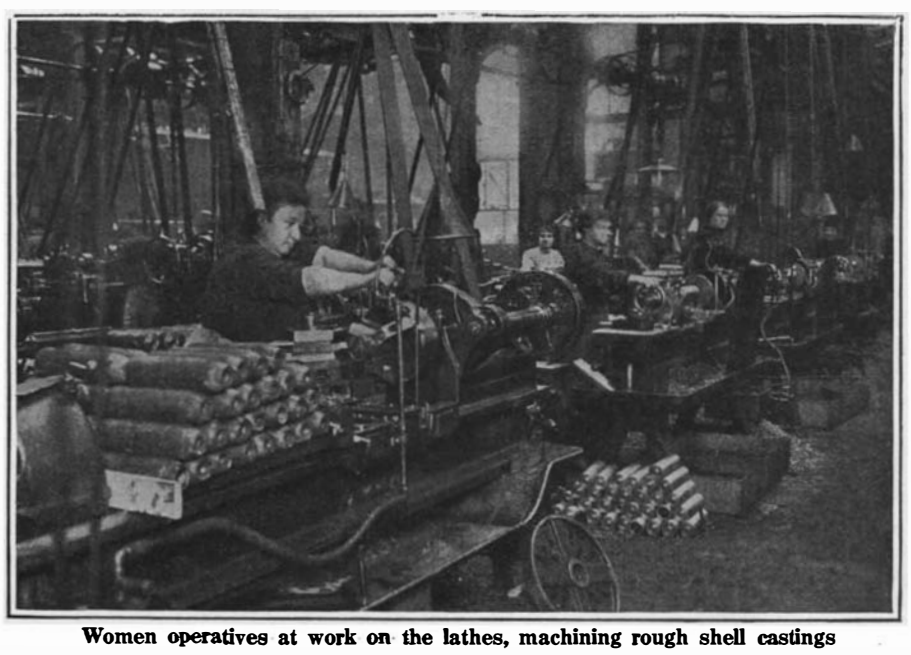
whose brawny hands seem to grasp lever and tool with efficient confidence and ability. It is remarkable that in these pictured munition workers no smile is to be seen; they are evidently in earnest with no time for trifling.

Among women engaged in the discharge of lesser civic duties are to be found some who perform certain duties of the Garde de Champêtre, such as the old peasant who rolls her drum and voices her announcements as the local town-crier did before her. At rural railway stations women have taken over many of the posts of former station agents. Some have even mastered the mysteries of the telegraph and are becoming expert manipulators.

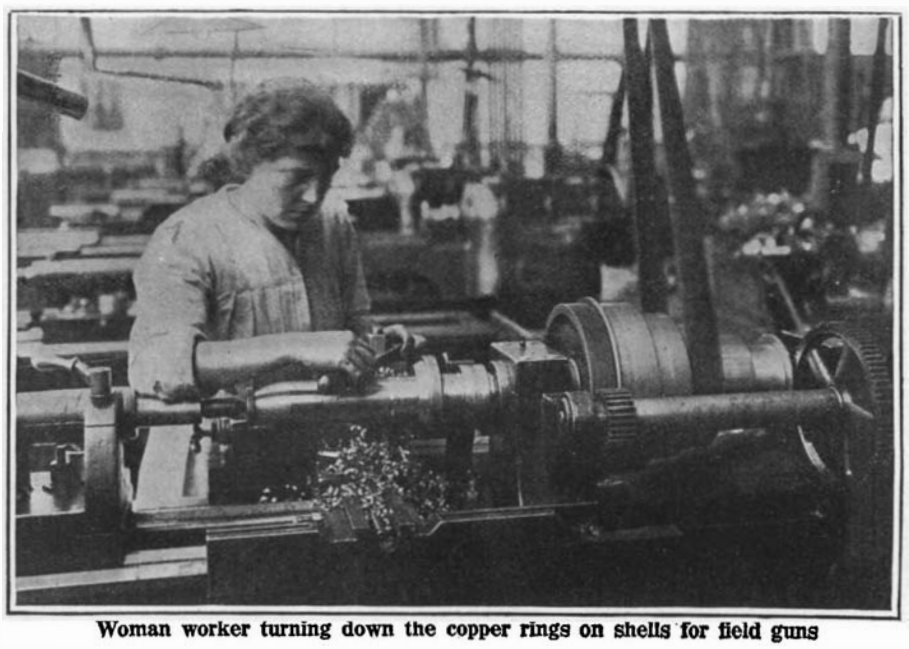
In the Paris subways, ticket controllers —women—stand at the entrances, ably executing their functions and amply equal to any emergencies which may arise through contact with the public. A certain deference is, of course, accorded by chivalrous France to their sex. So effectively have they served that, after veterans incapacitated for other occupations have been provided for, a disposition is evidenced to retain women in these duties even after the establishment of future peace.

Trams, omnibuses and public vehicles in French cities have largely been given over to the control of women officials. Such positions as require a certain amount of physical strength beyond mere endurance are not difficult to fill, for the peasantry and so-called lower classes of women are sturdy and have been accustomed to hard labor since childhood.

Dating back to the beginning of hostilities, the old custom of women to work in the fields has been amplified until by far the greater part of the agricultural work is now being performed by them. The plow-point sinks as deeply into the soil beneath the guidance of their able hands as it did when their men grasped the handles, and the mowers clatter as effectively as ever. Strong, vigorous women, among them the mothers of lusty sons who are with the colors,



Women operatives at work on the lathes, machining rough shell castings



Woman worker turning down the copper rings on shells for field guns

may be seen in the fields pitching bundles of grain high onto traveling ricks, or engaged in any of the various duties of farm and field, even to the swinging of ringing axes and the cording of wood.

Women have almost entirely replaced men in the manifold clerking positions in offices, while the municipal laboratories employ the services of many young women whose education has made possible adequate discharge of their exacting duties.

They clean the streets, bake the bread, curry horses—such few as have not been requisitioned for the service—work in mines, engage in almost every class of manufacture and, as always, devote themselves with tenderness and ability to the care of the sick and wounded. There is practically no post that a man may fill, save those on the line of battle, which these Frenchwomen do not occupy efficiently.

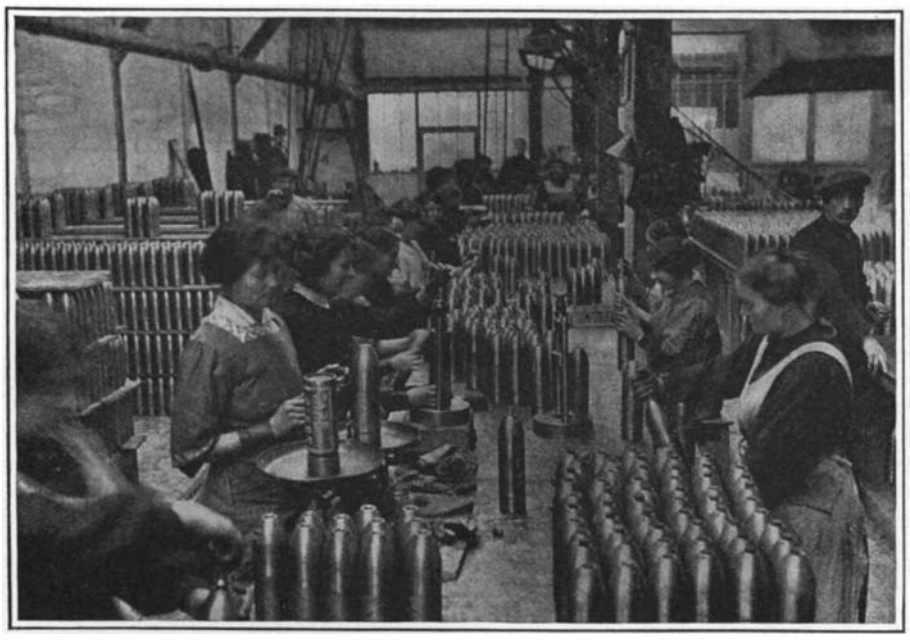
This volunteering of women suggests strongly an actual unity of public sentiment as to the prosecution of the war and the general resolve to see that the conflict is carried to a satisfactory conclusion, in order that future warfare may be rendered improbable.

In France a story, seemingly well authenticated, has been current for a year. It is said that when England was about to join the Allies, Germany offered to restore the Lost Provinces to France if she would give guarantee to remain out of the struggle. The recovery of Alsace and Lorraine has been dear to the heart of France; the offer was tempting. The tale goes that those in authority hesitated, appreciating how much blood and treasure might be saved, yet realizing that it was the right of the French people, particularly the women, to have a voice in the decision; and it was unofficially submitted to them.

"No," they replied, according to the story; "while we want Alsace and Lorraine, we are not fighting for them alone. We are fighting for our children and our children's children that war may be abolished for evermore. If we must lose our husbands, fathers, sweethearts and brothers, so be it—but let us fight it out at any cost, even that of national destruction."

The story may or may not be true actually, but such a spirit is evident; so there is, after all, little wonder that Frenchwomen have rallied to the state as they have.

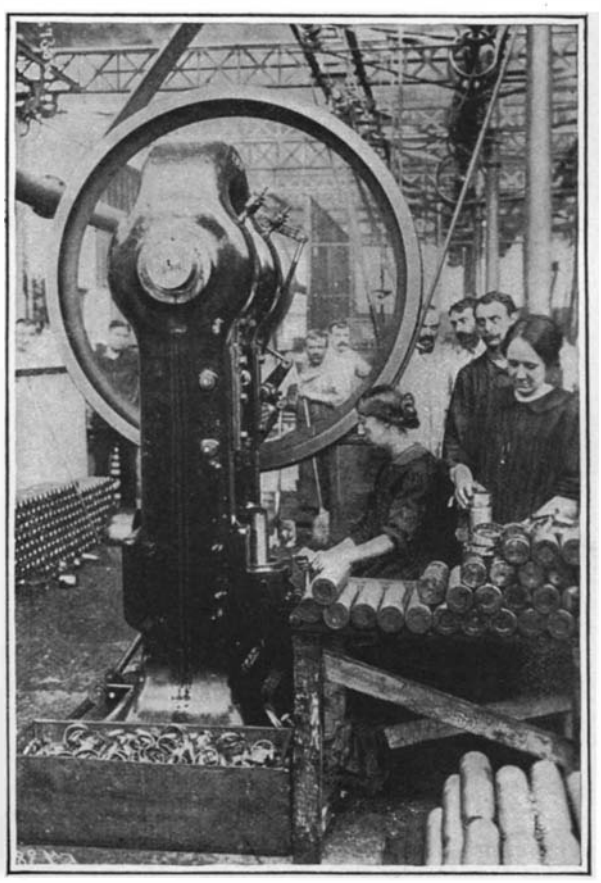
Verifying the calibre of each shell, using a sensitive but quick-acting gage for the purpose



An important feature of shell inspection: Weighing the shells by means of a standard

The Current Supplement

AN important article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2096, for March 4, 1916, is *The Longest Railway Tunnel in America*, which describes, with a number of excellent illustrations, a great engineering work being prosecuted in British Columbia. An interesting feature of the undertaking is that the mountains are being penetrated by an entirely new method that results in very rapid work. *The Importance of Geographical Research* calls attention to the crudeness of many past observations, and makes a plea for more scientific and accurate methods. *War Illuminations* describes and illustrates a number of methods employed for illuminating the enemies' lines at night. *Torpedo Tubes* gives a popular description of the mechanism by which torpedoes are launched either from the deck of a vessel or from beneath the surface, as by a submarine. Illustrations accompany the description. Many suggestions have been made in relation to commercial preparedness, in view of the competition that is anticipated after the war. *Industrial Militarism* is a valuable addition to this literature, for the writer shows how military preparedness may be made of extreme commercial importance in the individual development that results from systematic training. The interesting article on *Evolution in Shipbuilding* is concluded. *Signalling Among the Ancients* is an unusually readable historical account of methods of transmitting information, mainly of a military character, that have been employed in years gone by. *Wood Older Than the Hills* describes and illustrates some interesting specimens of wood discovered in glacial deposits. *Some Remarkable Armadillos* tells of these curious armor-bearing mammals of South America, some of which are little known. There are several excellent illustrations. *The Screw Propeller* reviews some fundamental facts in relation to this important adjunct to marine transportation, and treats of its method of action. Among other interesting articles in this issue are *The Limitations and Possibilities of Radio Telephony; Some Recent Experiments on Pasteurized and Boiled Milk*, and *Our Modern Engineering Education.*



Huge punch press forcing copper rings in place on the shells

Sir Clements Markham

IN Sir Clements Robert Markham, who died in London January 30th, British geographers lost a leader whose influence has made itself felt for more than half a century. The importance of this influence will be evident from the fact that Sir Clements, apart from being a most prolific writer on geographical subjects, was by all odds the most commanding personal factor in the affairs of the Royal Geographical Society, which is, in turn, the most influential geographical organization in the world. For twenty-five years, from 1863 to 1888, Markham was honorary secretary of this society (the "honorary" being, of course, merely the British way of denoting the fact that he was unsalaried, but not, for that reason, the less hard-worked), and on relinquishing this post he received the Founder's Medal of the society in recognition of his services. For the unprecedented period of twelve years, 1893-1905, he was president of the society, and from 1905 to 1912 he was one of its vice-presidents.

Born in 1830, he served in the Royal Navy from 1844 to 1852, during which period he first acquired his interest, destined to be lifelong, in polar exploration, through taking part in the Franklin Search Expedition of 1850-51. In 1852-54 he made the first of his visits to Peru. A second visit, in 1860-61, was made under the authority of the Secretary of State for India, with a view to collecting specimens of the cinchona plant, then grown only in South America, and introducing the cultivation of this plant in India. His mission was successfully carried out, and resulted in an enormous increase in the use of quinine in fever-stricken regions where it had previously been a rarity. In 1867-68 he served as geographer to the Abyssinian expedition under Lord Napier.

Among his numerous and varied geographical activities, Markham's efforts in behalf of arctic and antarctic exploration were perhaps most widely known. The arctic expedition of Sir George Nares, fitted out in 1874, was chiefly due to his indomitable energy. The same may be said of the National Antarctic Expedition of 1901-04. It is not too much to say that this epoch-making expedition would never have left England but for Markham's indefatigable efforts to raise the necessary funds, from private sources, from the government and from scientific societies. Neither, except for Markham, would the expedition have been commanded by Captain Scott.

Sir Clements was inclined to be obstinate in his opinions, and managed to tread on the toes of a good many people, including those cisatlantic geographers who have most jealously defended the reputation of the American antarctic explorer Charles Wilkes. Markham's contemptuous dismissal of Wilkes's claims in the former's article, "Polar Regions," contributed to the ninth edition of the Encyclopædia Britannica, represents the extreme attitude on the British side of an international controversy which did not altogether terminate until the recent Mawson expedition confirmed the general results of Wilkes's explorations, while revealing their many incidental inaccuracies. The irrepressible Sir Clements was also credited with some skeptical remarks on the subject of Mr. Roosevelt's South American discoveries.

Tamping down of the charge in the field-gun shells

Industrial Preparedness for Peace

IV. Staff Organization

By Miner Chipman

FIVE HUNDRED MILLION DOLLARS are annually expended by the people of the United States for medicines. At least 80 per cent of this Five Hundred Million Dollars is spent without the advice of a physician. The Panama Canal has cost to date approximately $375,000,000. If 80 per cent of the medicines for which these Five Hundred Million Dollars were spent could be dumped into the three hundred and seventy-five million dollar canal, we would materially increase the efficiency of the people of the United States, and the canal as a highway of commerce. Think of it! An amount equal to the Anglo-French loan, blown in for medicines, 80 per cent of which were taken without the advice of a competent physician.

Why this waste?

The answer is found away down deep in the problem of National Efficiency. We lack confidence in Staff. We prefer to be our own staff, make a guess—a stab, and let it go at that. It is stated that the average wage-earner loses about nine days every year because of sickness. There are approximately 39,000,000 wage-earners in the country. At only two dollars per day, the annual wage lost through sickness is approximately $722,000,000. Add to this figure the five hundred million expended for medicines, and we have the staggering sum of $1,222,000,000, of which at least 60 per cent is preventable waste. Yet we see many pages of the Congressional Record devoted to a discussion as to whether or not we shall build one, two, or three battleships. I shall not go into a discussion of such National wastes as chewing-gum, bon-bons, toy-dogs, cheap jewelry, etc. This waste of six or seven hundred million dollars for medicine, and lost time in industry, is illustrative of a typical American inefficiency.

If there is one drawback to a democratic form of government, it is the tendency to regard majorities as more indicative of perfection than individual staff advice. In the long educative process of creating an efficient democracy, the problem of bringing about a recognition of the significance of *Staff Organization*.

The Staff is a kind of aristocracy, and even an enlightened democracy will be slow to recognize the aristocracy of Staff trained intelligence. As science takes the place of guess work, the Staff Organization becomes more and more an autocratic aristocracy. Yet science, as a contributor to social organization, is the most *democratic* thing in the world. As a schoolboy, I was often told of my chances to become President of the United States. I have been ready to sell my chance for a nickel for the past twenty years. The average American boy had rather belong to the aristocracy of engineers, chemists, or physicians, than hold any political office to be offered in the land. Charles P. Steinmetz is the *Grand Duke* of electrical engineering. In any branch of engineering, a man would rather hold a John Fritz medal than any commission to be offered by the Federal Government.

The one factor of our present social organization the Socialists have failed to account for is the *Staff*. We have had the division of labor, and the specialization of industrial occupations, and, at the same time, we have had the specialization of intellectual occupations and the consequent development of *Staff*. Although Staff represents the ultimate ideal of a perfected democracy—viz.: complete knowledge and recognition of the Laws of the Universe, socialism tends to discredit Staff and substitute the undivided and unspecialized intelligence of majorities. The Socialist would rule the world by arithmetic, and, therefore, when he finds a condition where one plus one equals one, he is confounded.

The measurement of Staff is not arithmetical. Two engineers do not know twice as much as one engineer. Two physicians will not cure you in half the time required for one. The two physicians may possibly kill you in half the time, but that is not a part of our discussion. Staff plus Staff equals Staff, and the total is greater than one of the units only to the degree in which one or the other of the factors is greater. Two engineers of identical training and experience, if thrown together upon a problem, do not produce the work of an engineer having twice the engineering ability of either one.

Five Hundred Million Dollars are spent annually for medicines, because we, the people, do not have adequate confidence in Staff. Most of us look upon the doctor as we do upon the fire department or the police force—to be called in when things look real bad. This vast sum of money is only a drop in the bucket to the sum total of money wasted because we do not recognize and take advantage of competent staff advice.

This wastage is not confined to the naive citizen. Not at all. It is found in the little grocery store, the department store, the small factory, and the largest industrial institution. It even extends itself, perhaps naturally so, into the activities of the machinery of the Federal Government. If F. W. Woolworth located his Five and Ten Cent stores with the same degree of intelligence exhibited in the location and construction of post offices throughout the country, but there is no "if" about it—he doesn't. His stores are located upon the basis of "staff studies," and there are no log-rolling or pork barrel calculations in it.

The large electric manufacturing companies maintain large and expensive staff organizations. The Rockefeller Foundation for Medical Research is essentially a staff organization. Physicians, surgeons, engineers, chemists, and architects—all are staff.

The foundation of staff is technical education. Germany's industrial and military organizations are built upon Line and Staff organization ideals. We marvel at the stories relating the wonderful detail of control to be found in the German General Staff. It sounds new and strange to us because we are unfamiliar with strict obedience to staff principles. Just the other day I read a report where one of the German armies invading Serbia discovered an old copper mine. The commanding officer wired Berlin of his discovery, and asked to have timbers, mining tools and equipment, and men, sent to the spot. He received an answer immediately to the affect that the materials, equipment, and men were already at the frontier. The General Staff knew in advance that this mine would be found, and what would be needed to operate it. Information that can be obtained in *advance* is procured, the Staff does not wait until something happens.

The Staff plans, the Line executes. This scheme of organization is the underlying principle of scientific management. We wish to build a house. We employ an architect who prepares the plans and specifications to the smallest detail. We then employ a builder who, in our opinion, is best fitted to carry out the plans of the architect. The former is Staff, and the latter is Line.

The processes of paper manufacture require Line and Staff organization for maximum efficiency. Paper making is largely a chemical process. The chemical laboratory should be the center of the planning department of the mill. The Chief of Staff should have under him a corps of staff specialists, as follows:

(1) Chemists:
  (a) Raw materials.
  (b) Materials in process.
(2) Machines:
  (a) Capacity.
  (b) Efficiency.
(3) Sequences:
  (a) Routing.
  (b) Despatching.
(4) Time:
  (a) Standard time.
  (b) Efficiency.

All paper mills, without exception, maintain a chemical laboratory. At times the staff service of the laboratory is very inefficient. I have found chemists who did not appreciate the significance of Staff, but desires to be in a line position, issue orders, and assume authority. The chemist is usually in very bad odor under these conditions. In other cases I have found chemists who were truly staff, but the line management refused to recognize the staff. In this case the reports of the chemical laboratory were nicely filed away, and line action was not controlled or influenced by the recommendations of the staff. In one large paper mill I found both of of these causes in operation. Much depends upon the personal equation. It required the Prussian type of military genius to develop and enforce Line operation in accordance with Staff planning. Von Moltke had the genius and the power to carry out his ideas of line and staff in military organization. Discipline of the highest order is essential to an efficient organization of this type. Maximum production efficiency can be attained only under such an organization. The functional foreman of scientific management, as developed by the late Dr. Frederick W. Taylor was Staff and Line at the same time. The functional foreman had back of him, however, the purely staff operations of the planning room.

Our program for Industrial Preparedness for Peace must recognize those principles of industrial and commercial organization which contribute toward maximum efficiency. Education, technical and vocational, must be given most hearty support. The so-called Smith-Hughes Bill, providing Federal aid for vocational education in the states is a step in the right direction. This bill has been indorsed by the National Society for the Promotion of Industrial Education and the American Federation of Labor. Vocational education paves the way for an intelligent line organization. In a democracy we cannot hope to enforce a recognition of staff by Prussian methods of discipline, although we might wish to do so. Proper recognition of staff upon the part of the line workers, can only come through an adequate system of industrial education. In the opinion of the writer, industrial education is the first step in real scientific management.

The Government at Staff

The Government at Washington maintain many large and efficient Staff organizations for the benefit of business. I am, at times, surprised to discover how many business men are unfamiliar with the activities of many of these staff departments of the Government. I shall not attempt to describe all of the staff departments now in operation, but desire only to point out a number of them whose service can be of imminent value to the business man.

Bureau of Foreign and Domestic Commerce

This Bureau issues a Daily Commerce Report. In my opinion this publication should be on the desk of every business man, large or small, in the United States. In condensed form you have prepared the story of business conditions throughout the world. Each day there appears a list of Foreign Trade Opportunities. Every businessman who is alive to the opportunities for trade expansion should glance through this report every day in the year. The Daily Commerce Report will be sent to your address, post-paid, upon receipt of $2.50 by the Superintendent of Documents, Washington, D. C.

Bureau of Labor Statistics

The Bureau of Labor Statistics issues a series of Bulletins dealing with labor conditions throughout the world, labor laws, court decisions, cost of living, etc. A number of very valuable bulletins have been issued dealing with vocational and industrial education. The bulletins as issued by this bureau form a very valuable library upon labor problems.

The Bureau of the Census, the Child Welfare Bureau, the Commissioner of Education, and other departments issue bulletins and other publications upon subjects of great value to the progressive businessman. We should utilize this staff service of our Government at Washington.

From the Editor's Mail Bag

C. Wilbur Miller, President, Davidson Chemical Company, of Baltimore, Md.:

"I have had upon my mind for quite awhile the problems we must meet with regard to what you term 'Industrial Preparedness for Peace.' There is quite a difference of opinion as to what conditions will be in Europe after the war with regard to labor. It seems to me that for some time to come there will be a great lack of immigration into this country and the labor situation will be our most serious problem. Our company is planning in every way possible to improve that step of our progress, looking toward every possible improvement in a mechanical way to prevent lost energy from manual labor."

John Barneson, President, General Petroleum Company, San Francisco, Cal.:

"I should say that first of all, legislative attacks against business and capital must cease and the attitude of the Government toward economic business combinations should undergo a material change, and conform more, say, to the German methods prior to the war.

"I do not see how it is possible for our businessmen to compete successfully with foreign business supported by the governments of those countries in the face of repeated attacks of every nature by our own Government. I should also say that labor must recognize the necessity for moderation in demands and coöperation with the employer, rather than attitude of distrust and antagonism with continued demands for higher rates of pay and lower hours of work, in lines that most natur-

(*Concluded on page* 265)

Commercial America and the War

Present and Future Effects of the European War on Our Industries and Foreign Trade

By Hon. Edward Ewing Pratt, Chief of the Bureau of Foreign and Domestic Commerce, Washington, D. C.

MUCH has been said, and properly so, about preparedness. By the term "preparedness" we usually refer to preparedness for war. We have in mind preparedness to resist an invader, or to protect our rights by force of arms.

No matter how great our hope for peace, we may, some day, become involved in war, and we should be prepared. But we are certain that, following the great European conflagration, there will come a period of peace, and we must be prepared for peace.

Our Present Prosperity and Its Contemporaneous Effects

The coming of a period of peace in Europe will bring with it consequences almost as grave as those that followed the outbreak of the war. But in the meanwhile we have learned our great lesson,—that the United States was not, is not, and cannot be an isolated nation. The United States is bound to other countries of the civilized world by ties closer than those of blood relationship. The vital importance of those commercial ties was revealed to us only by the greatest war of all time. We did not realize our dependence upon Europe until we found our credit facilities snatched away from us; the ships which had carried our commerce commandeered; the markets for many of our staple crops suddenly closed; and new markets with which we were unfamiliar suddenly thrust upon us. We are not isolated; our interests are vitally bound up with the interests of other countries. We can no longer, facing the facts as they exist and facing the facts which have been driven home to us in the last few months, declare ourselves a nation apart and living unto ourselves alone.

As long as the war in Europe continues with unabated vigor, the United States will continue in an abnormal and, in fact, unhealthy economic position. We must not be led into the fallacy of supposing that the phenomena of business life which we see about us to-day are normal, or will permanently endure. The keen business man must carefully segregate those features in our commercial and industrial activities which are normal and will endure from those features which are war-caused and transient.

This much, however, we can accept as true, that the longer the war lasts the deeper will be the impression on our economic life and the more permanent will be the effects. Already there have come into existence, by means of the abnormal world conditions, many factors which two short years ago would have been scoffed at as impossible. The United States has assumed a position of commanding importance in the world of international finance. We have contracted our output of cotton and have increased our output of wheat. Many products which a few months ago we imported from Europe are now being manufactured by American concerns. Many manufacturers have found to their surprise that they can manufacture articles heretofore imported, and can manufacture them cheaper than they were manufactured in Europe. These facts point to a complete change in the economic position of our country and lead us to the belief that conditions will be essentially different with us after the European war.

While considering our own position, we must not forget that conditions in Europe will also be essentially different after the conclusion of the war. We pity those great nations of Europe, engaged as they are in a determined effort to destroy one another. We regret the waste of capital and labor which can never be replaced. We admire their sacrifices and their sturdy, foresighted plans for rebuilding their economic organizations.

How European Powers Are Preparing for the Resumption of Normal Commerce

While this gigantic struggle is going on in Europe we bask in a hectic and unstable prosperity. While cataclysmic economic changes are in process, we talk and congratulate ourselves that we are at peace and that things seem to be going well with us. We are all too calmly watching a struggle which has almost as vast and important consequences for us as for the contestants. But the European nations, even while engaged in a war that would seem to absorb every energy in the immediate struggle for existence. have time to look ahead and to plan for the future. Even now they are taking action to prevent or to carry out, as the case may be, an economic invasion. They foresee, as we must foresee, a giant struggle for commercial supremacy.

The Central Powers are even now planning a close alliance for commercial defense and for commercial offense. The Allied nations, especially those in Western Europe, are planning preferential tariff arrangements which will prevent their enemies from commercially invading their territory, and will give each the preference in the other's markets. Much has been said, and perhaps accurately, about the possibility of special and preferential tariff arrangements between Great Britain and her colonies. It is even possible, although not so probable, that Russia will permit her present allies to enter her markets on more favorable terms than others.

The European nations are hard at work, collecting and collating material which will serve as the basis for the negotiation of new commercial treaties. Great Britain is appointing commercial attachés in neutral and Allied countries and trade commissioners in her colonies. She is collecting thousands of samples of manufactured products sold by her rivals in foreign markets. France, even in the midst of her present difficulties, is sending commissions composed of prominent officials and experts to many countries, our own included, for the purpose of establishing closer trade relations. Even the smaller countries of Europe are alert to the opportunities and dangers of the present situation.

Probable Aftermath of the War and What We Must Do Now to Meet It

It is sometimes urged that the hatred engendered by war will soon pass away, that each country will seek the cheapest market, irrespective of nationality, in which to buy. In an unorganized market this would be true. But Europe is not unorganized. Legislation, taxation, and organized public sentiment will be the means of continuing for decades, and even generations, the commercial struggle which will grow out of the armed conflict. The United States, the innocent bystander, cannot expect altogether favorable treatment at the hands of either group.

We may justly reverse the old saying, "In time of peace prepare for war," and for us it should read, "In time of war prepare for peace."

There are two phases of the aftermath of this war which we should carefully distinguish,—the one has to do with immediate effects of the war, and the second has to do with the ultimate and more or less permanent effects of the war.

We have to look forward in the months immediately following the cessation of hostilities in Europe to the complete disarrangement of entire lines of industry, those industries which have been stimulated by the demands of the warring nations for their belligerent activities. It is likely that manufacturers of munitions, and of what might be called direct war supplies, are alive to this situation, but there are two classes of manufacturers who are not in a position to see the matter clearly and who have not made adequate preparation. These are the manufacturers who are making the raw materials that go into munitions, and the manufacturers who are producing goods which are not munitions, but for which the demand has been considerably stimulated by reason of the war. Every manufacturer should consider carefully how far the demand for his products is stimulated by the war conditions, and he should carefully write off against present profits the enlargements of his plant and equipment. We have to look forward immediately following the war to a complete change in the trade routes of the world. We cannot expect to be able to do business through the same commercial and financial centers or by the same methods that we did it before the war or during the war. We must look forward to large readjustments in important markets. We cannot expect to be able to maintain our position of supremacy in certain lines unless we have taken due precautions. Following the cessation of hostilities there is likely to be a considerable reaction, and it is up to us now, during this period of apparent prosperity, to prepare for what is sure to be a period of real but perhaps less apparent prosperity.

The permanent or long-time effects of the war which should interest us are not only those which immediately affect us, but also those in Europe which are of importance to us. The belligerent nations have suffered a tremendous loss of men, and consequently a loss of labor power. Millions of men have lost their lives; other millions are maimed and diseased. The labor supply of Europe is depleted and has lost much of its efficiency. Europe's abundant supply of capital has been withdrawn from production, and is being spent for destruction. Much invested capital, in factories, machinery, mines, railroads and public works of all kinds, has been destroyed. The belligerent nations will be saddled with immense debts. For years to come taxes will be high and the burden upon every kind of business will be great. Their fiscal affairs will be disorganized. There is a bare possibility that the gold standard may be broken down and may be replaced by an arbitrary monetary standard. Europe, then, must look forward to a period of high costs of production and high price levels.

Those effects are likely to exist for years, decades, or even generations. We will also find many results which will extend over a long period and will tend to become permanent. We must, first of all, reckon with the diminished producing power of Europe—our best customer. We can look forward to some gains in markets which are outside of the war zone. We can look forward to the increased independence of our domestic manufactures. We can look forward to a more independent and more important financial position. And, what perhaps is even more important, we can be sure that the American people have acquired an international point of view, a point of view which will prevent in the future the repetition of blunders in our foreign relations which we have so often made in the past.

The Coming War for International Markets

No matter how certain these results of the European war may seem to be, there is one result which is even more certain. The European war will be succeeded by a period of world-wide commercial and industrial competition. It will be a period of competition as between the present belligerents to recoup their losses or to further conquests already accomplished. It will be a period of competition as between the belligerents and as against us. As for ourselves, we must realize that not only our foreign markets which we had before the war and which we have established since the beginning of the war, but our own home market, will be the object of commercial attack. That nations depleted in every resource, reduced in labor supply, exhausted in capital, and overburdened by taxation, will be able to compete successfully with an alert and prepared United States I believe to be impossible. The essential question is, are we alert to the possibilities of the situation and are we commercially prepared? Are we alert to the fact that the other nations of the world, to whom sacrifice has become a daily routine, have their very national existences at stake? Are we prepared to meet the advances of our competitors? Are we mobilized commercially and industrially to hold our position and to go forward?

Preparedness in Domestic Industries and Preparedness in Foreign Trade

Any program of preparedness for peace must comprehend preparedness at home and preparedness abroad. We must be prepared not only to make ourselves economically and industrially independent, but we must be prepared to carry on an aggressive commercial campaign for foreign business which will be carried on in competition with the other nations of the world.

We have prided ourselves on our independence, but the European war has shown us how far our pride has led us astray. We had political independence, but we could not even find a market for, or utilize ourselves, some of our important staple crops. A vast section of our country was in distress. Even to-day we find our industries sadly cramped because we are unable to supply them with some of their essential raw materials. We have natural resources, but they are undeveloped.

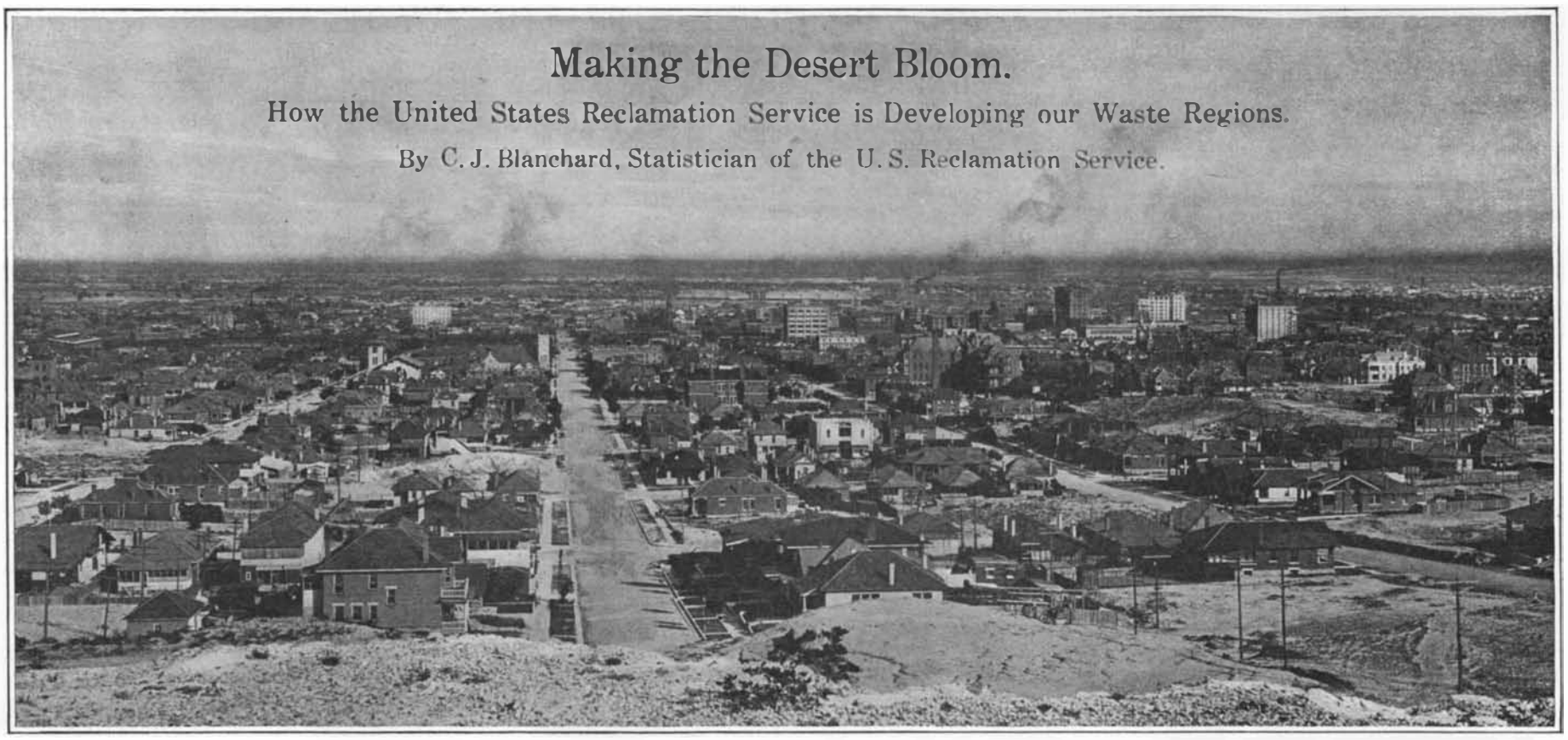
We must prepare to produce dyestuffs. Our textile industries and many others are suffering for the want of dyestuffs. We have the raw materials, but we are not prepared to manufacture the finished product. We must look to the future, and if, as seems probable, our European competitors will be able to crush our growing dyestuff industry by unfair methods of competition, we must be prepared for that emergency by the enactment of laws which will prohibit such methods of competition and will give our manufacturers a fair chance to establish their industry. We are sorely in need of potash, which we have heretofore obtained from Europe. Apparently, we have a considerable supply of the raw material, but we have not manufactured the final product. This we must also do if we are to get the best results from our agricultural lands. There are many industries in which we are making progress toward independence. We have been dependent upon Europe for a vast variety of articles which we must learn to make for ourselves. We must make our own dyes, our

(*Concluded on page* 260)

Making the Desert Bloom.

How the United States Reclamation Service is Developing our Waste Regions.

By C. J. Blanchard, Statistician of the U. S. Reclamation Service.

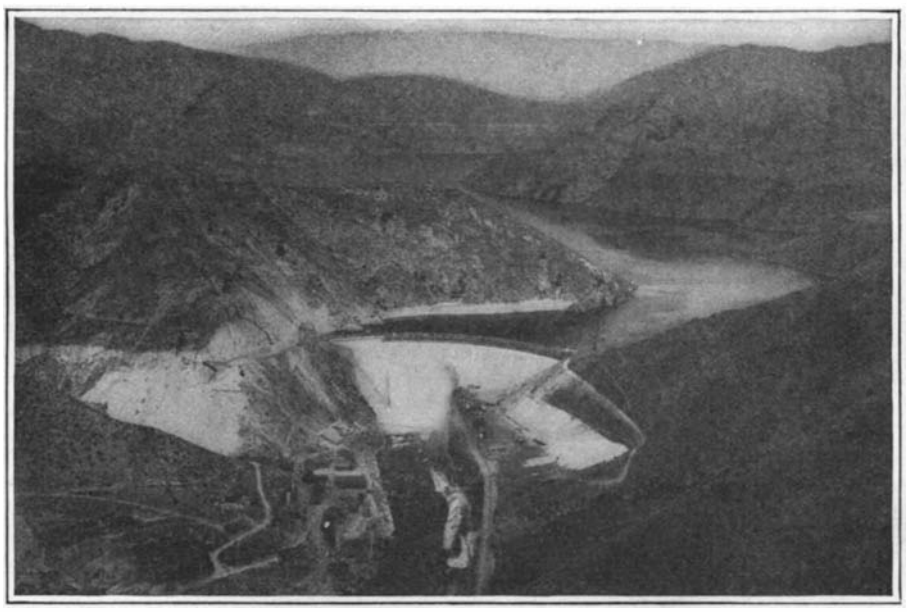


El Paso, Texas, a city that has grown up in the desert

IN the long vista of years stretching before us our Nation must prepare against attacks not only from without but also from within our borders. While preparedness against an outside foe is a duty immediate and important, the menace of a great population poorly housed and underfed calls for like consideration on the part of our lawmakers. Many economists are agreed that when the Dove of Peace builds its nest once more in war-stricken Europe we may look for a return wave of aliens, probably the heaviest known for many years. In addition to this the natural increase in the number of our citizens who attain majority makes more complex the problem of wise distribution in order that congestion in our great cities may be prevented.

It is an economic axiom that the stability of a nation is assured only when the bulk of its citizens reside in their own homes. The ideals and principles for which our forefathers fought cannot be preserved and maintained by a citizenship whose interest in our Nation's integrity does not extend beyond mere wage earning. As Secretary of the Interior Lane aptly put it—"The highest sense of nationality comes from a sense of purpose—a sense of common purpose—for the United States is not yet ours in the proudest sense, and cannot be until we are doing all that can be done to give all its people and to the world the full expression of its highest intelligence applied alike to its resources and to the life of the people." A nation of tenement dwellers possesses neither inclination nor ability to defend itself. The late Henry Grady well said, "A citizen standing in the doorway of his home, contented on his own threshold, his family gathered about his hearthstone, while the evening of a well spent day closes in scenes and sounds that are dearest—he shall save the Republic when drum tap is futile and the barracks are deserted." Making provision now for the millions of aliens who will flock to our shores and for millions of our sons and daughters who will want homes of their own is as necessary as the fortification of our coasts and the enlargement of our Army and Navy.

Nations like Germany, France and England, con-



Bird's-eye view of the Arrowrock dam, Idaho

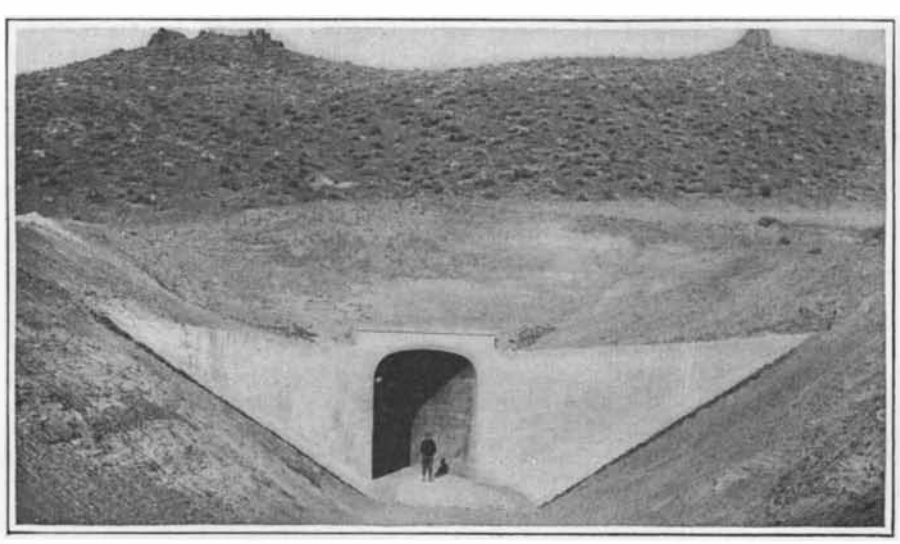
fronted with the same problem, find its solution only in the acquirement of new and distant territory. Thank God! We have yet within our own imperial domain vast areas scarcely touched which can be prepared for our homemakers. The man of Destiny for this herculanean task is the hydraulic engineer. Though colossal in its magnitude, the work nevertheless is so practicable and feasible that no doubt of its ultimate accomplishment clouds the mind.

The United States is a country of vast extent and almost unlimited resources. Our continental area is over 3,000,000 square miles. Of this fully a quarter is undeveloped. In the United States, exclusive of Alaska and our island possessions, there are 80,000,000 acres of swamp lands and 400,000,000 acres of deserts. What shall we do with this princely territory? Leave the one a pestilential, disease breeding spot and the other a vacant and untilled wilderness? Why not live up to our boast of being the biggest and richest nation on earth, and tackle one with the drain and the other with the irrigation ditch?

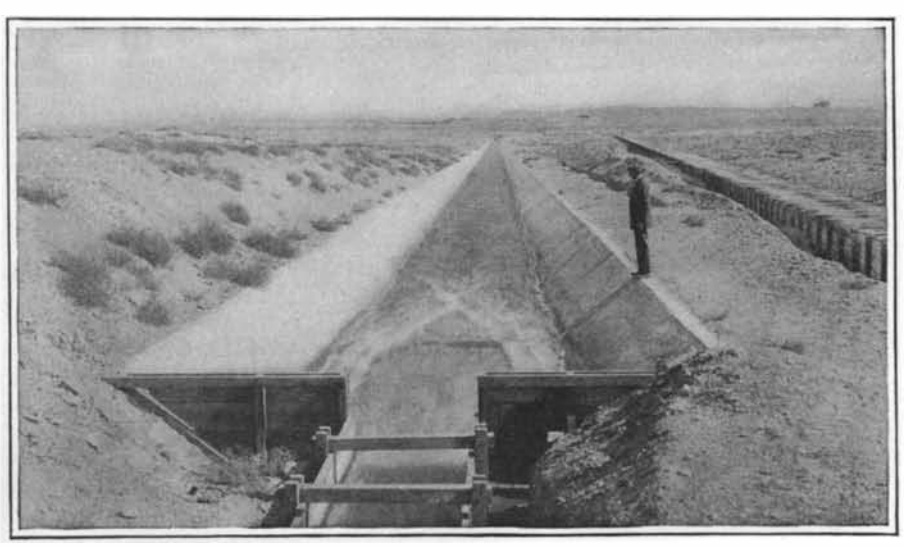
American genius has cut a gash across a continent to connect two great oceans. It has tunneled rivers and cities to facilitate transportation, it has conquered the primeval forests of our North Atlantic States and developed an empire of unparallel richness in the Mississippi Valley. With a sure swiftness and completeness where history nowhere else records since the Egyptian dynasts gathered the tribes of mankind together, our western march has developed the great interior valley and our Pacific slope. Shall we then delay longer the conquest of our vacant areas?

Our swamp and overflow lands embrace an area greater than that of the Philippines. These lands for the most part are adjacent to large centers of population, with excellent transportation facilities by rail and water. Their reclamation will give employment for years to hundreds of thousands of laborers, and later will afford opportunities for the establishment of approximately 2,500,000 families in homes of their own. Two harvests from these lands would suffice to pay the entire cost of reclamation. Hon. Champ Clark, Speaker of the House of Representatives, has introduced a bill which, if enacted into a law, will provide a practical method for undertaking the task.

An enormous expansion of our agricultural and

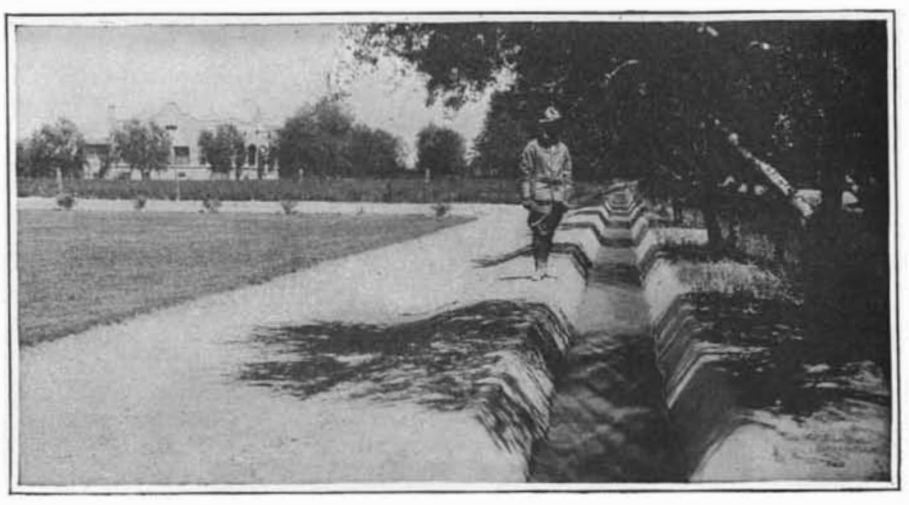


West portal of the tunnel on the Truckee canal



Bringing water to the thirsty desert, Shoshone project, Wyoming

Arizona desert near Phoenix before reclamation



Irrigating ditch brings water into an Arizona ranch

manufacturing industries will surely follow the initiation of this work. From Texas on the southwest to the Atlantic Coast States on the east, northward to New Jersey, and including enormous areas in Minnesota, Illinois, Missouri, Arkansas, Tennessee, California, and Idaho, a new agricultural empire will be opened to settlement equivalent to the addition of a second New England. The value of our agricultural products will be increased $2,000,000,000 annually. Under a plan now successfully in operation in Australia our Government in coöperation with the several states could complete the work and be assured the full return of its investment and 4½ per cent interest. By the issue of amortization bonds extending over a period of 31½ years with 6 per cent interest, 4½ per cent on principal and 1½ on amortized payments, the entire investment would be returned. The bonds would be secured by the land and improvements, and this security would be improved with each year's development work of the farmer. By guaranteeing these bonds the Government would be able to dispose of them at a premium which would more than meet all expenses of issuance and collection. In the settlement of these lands the assistance of the Departments of the Interior and Labor would be available through their settlement and employment bureaus. To obviate possibility of undue speculation the lands before reclamation should be acquired under appraisal and condemnation. By this method the settler will not be compelled to pay commissions to real estate dealers often ranging from 15 to 40 per cent of the selling price.

Bonds would be issued only when required to keep the work under way. To further guarantee the success of the settler each state should establish a fund to be advanced for the purchase of stock and equipment and repaid under similar amortization payments running 31 years.

What Our Desert Offers

The boundaries of arid and semi-arid United States roughly include two fifths of our continental area exclusive of Alaska. Here is a region of unparalleled resources of soil, diversity of topography, and favorable climate. It is the most truly American part of America, the most enterprising, and the most unsettled. It is peopled with a larger percentage of our native born than New England. The remaining public lands are largely located in rainless regions, and their acquirement by homemakers cannot proceed until they have been made cultivable. Reconnaissance surveys and stream gaging made by the Government during the past 20 years have given us fairly accurate knowledge of the conditions, and we are able to predicate reasonably the limits of future development of this extensive area.

The electrical high school at Rupert, Idaho

It is well known that our desert areas are far in excess of the natural water supply. While the former include several hundred millions of acres, the latter will not suffice for the needs of more than 40,000,000 acres. In the preparation of this irrigable area for homemakers the construction of enormous engineering works for storage of floods will be required. Hundreds of thousands of miles of main canals and ditches must be laid across the desert, and elaborate systems of distribution must be planned.

Here is a territory won to us by war, treaty, discovery, and purchase. Flying at one time the flags of four nations, its history is rich in thrilling incident and adventure. Its milestones are the bones of trappers, explorers, and pioneers. Its people are strong and courageous. To battle with the elemental forces of Nature has become a passion. They are captivated by the immensity of the field in which they operate and the majestic scale on which things are done. It is a race of unequaled energy and optimism. While the glamour of romance which enwrapped this region in years agone is dispelled, it is still romance-land, but with a new background. The romance of creation now pervades the once silent desert, and the dominating thought and impulse of the new land is to establish here the well ordered life of New England, with all the highly organized facilities for making existence in the country attractive, comfortable, and sufficient. There are many communities dwelling to-day in the valleys of the Snake and Yellowstone rivers and at the feet of the snow-capped Rockies and Sierras to whom this vision and hope are ever present.

Street scene in the Government town of Rupert, Idaho

What We Are Doing in the Desert

American capital, genius, and pluck already have wrested from aridity 15,000,000 acres, and planted thereon 200,000 families in independent homes. In crops alone these lands are each year returning more than 300,000,000 dollars to the farmers. The taxable wealth of this new empire is estimated to exceed the entire wealth of the Nation in 1860, yet the work is only in its infancy. The remotest parts of our desert are being connected by railroads carrying the commerce of the world. Cities populous and prosperous have risen in the desert and have attained commercial and mercantile greatness. In the swift march of events the National Government until recently had but small part. It was not until 1902 that the insistent demands of the west won recognition at the lands of Congress. At that time the efforts of private enterprises had covered the field which was open to their limited capital and a period

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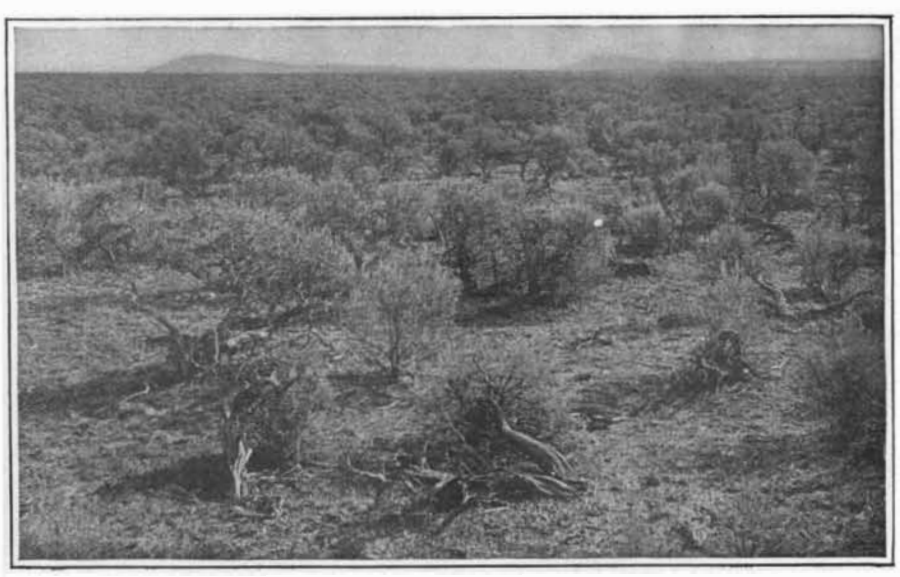
A fruit section in Washington. The Okanogan project



Irrigable lands in Washington before reclamation

The Naval Losses of the Allies

A Fleet of Thirty-Two Major War Vessels Sent to the Bottom of the Sea

THERE are many ways in which the results of war on land are obvious to the follower of its progress. There is a well defined theater of control on the part of each belligerent at the beginning of operations, and a somewhat less defined idea of the number of troops and quantities of munitions available. We are startled by the accounts of the number of men involved, the casualties incurred and the munitions expended. But the main and final impression of the results achieved is measured by the value, commercially, politically and strategically of the enemy territory occupied.

In order to get impressions of the results of the naval warfare of the present struggle, it is necessary to approach it from corresponding points of view.

We have read with varying emotions of the sinking of this or that warship in some remote or unknown theater of naval operations, but with small understanding of the result attained, other than the destruction of the particular naval unit in question.

On the other hand, while the number of men disabled and the ammunition expended strike us similarly in each individual case reported, the occasional lists of the total casualties bring strikingly before us the enormity of the totals.

It has been our purpose to summarize graphically the destruction at sea in order that the extent of it can be properly realized. However, before proceeding, a brief review of the naval situation will clarify in some measure the results attained in addition to the destruction effected.

The sea, in so far as naval warfare is concerned, may be considered as that portion of navigable waters outside the range of land fortifications. Warships are built to control the use of the sea as thus defined.

At the outbreak of the war the preponderance of the allied fleet was sufficient to give it virtual control of the seas. The Central Powers, recognizing the situtution, concentrated their vessels so far as possible in home waters. Those unable to seek this shelter, on account of the hazards involved without adequate returns, cruised in remote waters less efficiently policed. Here it was possible to prey on the enemy's commerce while awaiting confiict on more nearly equal terms.

From the first, then, the control of the sea has been conceded to the Allies, except for the guerilla warfare of these isolated vessels; and the first stage of the naval warfare consisted in clearing up the ocean of the daring marauders who temporarily disputed the allied control in remote seas.

The completion of this task was accomplished, not without loss to the Allies. The principal units lost to the British in this phase were the "Good Hope," a cruiser of 14,100 tons; the "Monmouth," a cruiser of 9,800 tons, in Admiral Craddock's ill-fated squadron on the west coast of Chile; and the "Pegasus," a light cruiser of 2,135 tons, sunk by the "Koenigsberg" at Zanzibar. These naval losses may be considered light for the results obtained.

As the Teutons have not felt inclined to major operations, the succeeding allied operations, with one exception, have been with the object of restraining raids and submarine activity. The exception consists of the Dardanelles campaign, where second line or predreadnought battleships were employed out of their normal sphere to reduce fortifications which subsequent events proved were more capable of resistance than anticipated. A modern vessel, the "Queen Elizabeth," was frequently mentioned in the bombardments that occurred; but it is probable that owing to the range of her 15-in. guns it was not necessary and presumably never intended that she should come within range of the forts, or that she should be exposed to the floating mines and possible torpedo attack in the straits.

Of the vessels engaged within the danger zone, the Allies lost heavily. The battleships "Irresistible," "Ocean," "Goliath," "Triumph," "Majestic," "Bouvet" and "Leon Gambetta" were the major units lost; but the losses also included a number of submarines and transports.

From the experience gained in this adventure it is extremely unlikely that important ships will be jeopardized in similar campaigns.

The Allies' problem henceforth became one of repressing any German naval activity. This took two forms: one, the raid in force; the other, the war of attrition by the sowing of mines and torpedoing by submarines.

The second raid in force, with a squadron of powerful high speed battle cruisers and cruisers, encountered Admiral Beatty's battle cruiser squadron. This resulted in the loss of the "Bluecher" and serious injuries to other German vessels.

Important injuries occurred to the British vessels, notably the battle cruiser "Lion," in this engagement; but the damage inflicted upon the enemy raiders was sufficient to prevent a recurrence of raids by sea up to the present writing. In this instance important results were accomplished without loss of vessels to the Allies.

The destruction incident to mines, navigation, and the dangerous explosives carried forms an important part of the total, and is a part of the unfortunate losses which must be counted upon in the vigorous prosecution of any war. The proportion of this damage to the whole is much greater in the present war than it would be in one where the control of the sea was disputed. In this category has come the principal naval loss of the Allies, so far in the war, through the sinking of the dreadnought "Audacious" off the Irish coast. The "King Edward," "Bulwark," "Natal," and "Benedetto Brin" were also lost in this way. The remaining method of harassing the Allies, and the one that continues, is through the use of the submarine.

Naval opinion received an impressive shock when the news of the torpedoing of the cruisers "Hogue," "Aboukir," and "Cressy" was flashed round the world. This event undoubtedly modified the allied scheme of sea patrol. Numerous other war vessels have since fallen prey to the submarine, notably the "Formidable," "Majestic," "Amalfi," and "Giuseppe Garibaldi," though the principal field in which they are feared is in commercial traffic.

Altogether, the number of allied war vessels destroyed from one cause or another looms large; but the conditions existing on the sea have not been changed thereby. In fact, their grip on the situation is tighter and more secure as time passes. The Allies have the immense shipbuilding capacity of the British Isles to thank for their improved situation.

As long as the war shall last this industry will continue in feverish activity to produce warships in numbers and types deemed necessary to cope with their antagonists.

In next week's issue of the SCIENTIFIC AMERICAN we shall publish an article and full page illustration of the Teutonic naval losses.

Patent Office Reorganization

THE Patent Office reorganization under the new law just approved by the President was based upon the principles of adjusting the work of that important branch of the Government to the new conditions. The old organization had been expanded to meet the growth of the business until it failed to be as effective as it should be. Its foundations were inadequate. The system worked out by Commissioner Thomas Ewing, which by mischance failed of enactment in the last hours of the last Congress, but which has been given prompt passage now, establishes a broader foundation and takes into account the very greatly increased responsibilities that rest upon the office, with some increases of compensation and with provisions against stoppages in the working of the system of hearing appeals.

An important change is that which gives the Commissioner discretion in the matter of appointing women as assistant examiners. Heretofore the law permitted two woman assistant examiners, but this limitation is removed, and as Commissioner Ewing holds that women make excellent workers in this field, it is possible that in the reorganization of the system through new appointments women may appear in the personnel.

It has been often urged that in the reorganization of the patent system provision should be made for a special Court of Appeals to replace the present Court of Appeals, which now has jurisdiction. Many cases are carried up from the Interior Department to the judiciary on appeals involving questions of law, and sometimes a determination of facts. These law and fact questions call for special consideration, and it is not an infrequent experience of patent lawyers to have judges acknowledge their entire unfamiliarity with such questions. In Washington this is not likely to be the case, because here occur most of the patent appeals, and the Court of Appeals has become to a large extent technically qualified in this particular class of cases, but on the circuit these patent cases are often heard by courts without any experience whatever. A court of patent appeals similar to the Court of Customs Appeals would greatly relieve the present appellate court system and would facilitate the disposition of these cases, which involve enormous pecuniary interests. It might be a circuit court, moving from city to city to facilitate hearings and the convenience of litigants. Many of these appeal patent cases involve conflicting claims between individuals and corporations, and sometimes great industrial interests are involved. So important are the issues that the United States would be justified in creating a new tribunal for this special work.

The Conservation of Platinum

THE Director of Materials in the new British Ministry of Munitions has addressed a circular to dealers in platinum, requiring them to make a return of the whole of their stocks of this metal and forbidding any trading without a permit. *Nature*, commenting on this step, expresses regret that it was not taken sooner, as "it is most unfortunate that this rare, and for many purposes indispensable, metal has been allowed to be used for jewelry and purely ornamental purposes. Either silver or gold," says this journal, "is much better adapted to the production of attractive ornaments and is more beautiful than the grayish-white of platinum, while, of course, neither has the high melting-point, electrical resistance and chemical refractory qualities which make platinum so valuable a metal both in science and in the arts." In consequence of the war the annual output dropped from 300,000 to 250,000 troy ounces. About 95 per cent of the world's supply comes from Russia.

Efficient Vision

AMONG the many circumstances in modern civilization tending to impair human vision is improper illumination, either natural or artificial. Too intense light is as bad, perhaps worse than, poor lighting. Eyes are not merely optical adjuncts; they are integral parts of the body, really expanded portions of the brain. They mutually affect the functioning of most other organs; inefficient eyes cause many chronic headaches, much depression and bodily fatigue, most indigestions, many (some believe, practically all) of the abberations of genius and of the alleged *demi-fous*, the half-witted.

Any organ exercised well within its limits tends to increase in power and facility; if persistently overworked it becomes progressively unable for any work at all. One habitually using his eyes in strong light decomposes his "visual purple" faster than it can be regenerated. Even normal eyes are ruined by overuse, especially in lowered general health; and as most eyes are abnormal, or at least not perfect as visual machinery, many people have to cope not only with bad environment and lowered health, but also with inherent optical defects. Doctor Ellice M. Alger, whose knowledge of the eye is peculiarly full and exact, considers that because of the many newly invented methods of commercial lighting, by gas and by electricity, the composition of light as well as its intensity have come to require serious consideration. In the days, and nights, of oil and candle light, the question was simply one of quantity, the quality being generally soft and benignant; but modern lighting, whether gas or electric, is often so intense as to be injurious; these latter means of illumination contain many more of the violet and ultra violet rays of the spectrum than our fathers were accustomed to. Such rays are useful in the treatment of disease by light and in radiography; but they are certainly amiss for illuminating the printed page or the object on which the artisan must work. Lights that can tan and sunburn the skin, and perhaps induce baldness, are no doubt responsible for much of the present-day visual weakness. The effect of such illumination on the deeper optical structures is certainly pernicious. It is very likely much cataract comes from this cause; certain it is that stokers, glassblowers and other workers in intense light and heat, are enormously prone to this grievous eye disease.

Illumination made up of red and yellow rays of the spectrum is the best for visual purposes. The problem of securing a light which shall allow a maximum of efficiency, comfort and convenience is one more within the province of the illuminating engineer than of the physician to solve. The solution was not only a humane procedure, but one which should be also very profitable to inventor, to employer, to employee, and to all who read—that is, to everybody.

Another State Geographical Society

THE valuable work accomplished by local geographical societies is well known, and we are therefore glad to record that a state geographical society has been organized in New Mexico. Its chief functions, as announced in the *University of New Mexico Weekly*, will be to recommend nomenclature for various historical places and landmarks, to gather information concerning such places, and especially to preserve old Spanish and Indian names. Dr. D. R. Boyd, president of the university, has been elected president of the society.

WAR VESSELS LOST BY ENGLAND, FRANCE, RUSSIA, ITALY AND JAPAN DURING THE PRESENT WAR UP TO FEB. 25th, 1916

1 *Audacious* 2 *Triumph* 3 *Bulwark* 4 *Irresistible* 5 *Ocean* 6 *Argyll* 7 *Good Hope* 8 *Formidable* 9 *Majestic* 10 *Monmouth* 11 *Cressy* 12 *Aboukir* 13 *Hogue* 14 *Goliath*
15 *Hawke* 16 *Benedetto Brin* 17 *Amalfi* 18 *Bouvet* 19 *Garibaldi* 20 *Pallada* 21 *Takachiho* 22 *Jemtchug* 23 *Hermes* 24 *Amphion* 25 *Niger* 26 *Pathfinder* 27 *Pegasus* 28 *Speedy*
29 *Casabianca* 30 *Leon Gambetta* 31 *Arethusa* 32 *Amiral Charner*

Strategic Moves of the War, February 24th, 1916

By Our Military Expert

THE capture of Erzerum by the Russian forces in the Caucasus has been foreseen, indicated by the slow but consistent advance of the Grand Duke, for some time. The fall of this fortress is, of course, but a necessary incident in the accomplishment of the larger objective which seems to demonstrate the first concrete result of coöperative strategy between the Powers of the Entente.

A general survey of the war map of Europe shows that the Teutonic power is practically hemmed in. Emergence by Germany from the Baltic on the north is stopped by the sea power of England; the English, Belgians and French block the west; Holland and Switzerland are hornets' nests that nobody cares to poke; Italy binds the landward south, flanked by the Adriatic and the Mediterranean, even though the Kaiser's legions overrun Albania; Greece, for all purposes of gaining touch with the outside world, is locked to Teutonia, and the Entente holds the key. On the East, Russia, from Riga to the Roumanian frontier, seems solidly athwart the roadway, backed by the numberless man-power of the Czar; there is no egress through Roumania, even though she declare for the Central Empires, a development which seems more remote with the passing of each day. Bulgaria is bound by the waters of the Black Sea, dominated by the Russian fleet, and the circle of steel is complete save for the proportionately narrow pass between the Black Sea and the Agean, Turkish territory, won to the Kaiser's arms through diplomacy and a desperate cast of the die by the Ottoman Empire.

Glance again at the map. The peninsula of Asia Minor extends from the eastward between the Black Sea and the Mediterranean, like a sore thumb. The distance from the Gulf of Alexandretta, where the Mediterranean jabs upward into the peninsula, to the closest point on the Black Sea is but three hundred miles, through the southern part of which the one great artery of commerce and war in that section, the Bagdad Railway, runs. A successful occupation of this neck of land by the forces of the Entente would sever the main portion of the Turkish Empire from touch with its dominating allies, remove all threat to the colonial possessions of Great Britain, the backbone of the Entente, mainly through its sea power, and would forge the last link in a chain completely enclosing Teutonia, block the only existing gap remaining for expansion and the drawing of supplies from without, and complete the *enciente* of a monumental siege.

This peninsula, then, by reason of geography that cannot be denied, constitutes the local desired objective of the Russian operations. Desire and accomplishment are different things, of course; and it is inconceivable that Teutonia will not bend strenuous effort to prevent the latter, even at cost of weakening needed strength elsewhere. The German staff has demonstrated a viciously effective way of doing such things ever since the war began, and the only likelihood of success to the Entente lies in combined operations on several fronts to hold their opponents in place, to deny them the possibility of detaching massive forces for an offensive-defensive in Asia Minor.

As the Russian advance continues, the way will become harder for two principal reasons: as the peninsula is approached the Russian forces must draw farther and farther from their railway line of supply, the railhead base at Kars, and consistently, the Teutonic armies will come into closer touch with their base communications; secondly, the shorter the distance from Teutonia proper as Turkish forces fall back, the easier it will be, the less risk through the time element will be experienced, for reinforcements to be shifted.

Yet the Russians always have the Black Sea. As soon as the coast line is uncovered by advance upon Trebizond, which even now appears to be under way, the railway line in rear of the Grand Duke can be more and more dispensed with for the supply of the entire line, for this sea offers fairly free line of supply, becoming more valuable as more coast is gained.

As the great body of the Turkish country lies to the southward of the present position of the Army of the Caucusus, it is obvious that the pivoting movement which will certainly mark the progress of Russia—if progress it is to be—must hinge on the Black Sea, or, at least, to the northward. Trebizond offers a first foothold as a preliminary pivotal point from which the armies of the Czar may swing in mighty sweep upon the neck of the peninsula, a gigantic hammer driving home one last great plug.

Well to the center of the most likely line across the neck of the peninsula lies Sivas, the next stronghold of moment after Erzerum. It is naturally a conspicuous point in the course of the advance, and it is approximately two hundred miles from the present position of the Russian forces, from ten to fifteen average marches across the rough country if it were not necessary to battle for each step of progress.

But the character of the country over which an advance upon this point is necessary is forbidding in the extreme. The great valleys that gouge the land offer practically the only avenues of approach, for interlocking mountain ranges strew the terrain, from the crags and pass eminences of which stubborn defense may be offered against even greatly superior numbers. The Russian line cannot swing around in its ideal chop toward the peninsula unless it is extended southward to embrace that territory wherein the English forces at Kut-el-Amara are isolated, for otherwise the swinging flank would be exposed to attack and the communications seriously threatened by

The war in Asia Minor

almost any enterprising force of size that might be massed in the vicinity.

It is currently reported that news of the Russian success at Erzerum has effected a burst of enthusiasm in Roumania for the Entente cause. How much of this is true and how much is merely propaganda remains to be seen. It is apparently true that with the reverses experienced by Russian strength resulting from the thrusting back through Poland and Galicia, the faith of the Balkan states in their ponderous neighbor of the North was severely shaken. The Balkan states were strewn with information by Germany, entirely justifiable in war, that magnified the Teutonic success and proclaimed the almost unimpeded progress of their arms. Diplomatic bribes, offers, promises, were scattered broadcast, assuring favor and fortune to these states should they at least remain neutral; and they conveyed dark threats of condign punishment should these same states raise a hand against the Kaiser. As a result, the Balkan people, newly organized states, jealous of one another to the point of hatred, feared for the integrity of their possessions, with the black example of chastised, destroyed Serbia and Belgium dangled before their frightened eyes.

But Roumania, as well as the rest of these states, is ambitious for expansion and development; Russia is in a position to give her desired territory, and the ethnological bonds of the locality on each side of the frontiers are sufficient to inspire a natural sympathy for individual Slav to Slav.

Local success sways the expression of sentiment which has necessarily been kept concealed through expediency; more and more, according to the reports of observers, it is coming to be recognized, even in the Balkans, that Germany's desired Place in the Sun must be found toward Asia, with the concomitant deduction that should it be gained the lesser states that line the roadway from the heart of Teutonia to Asia must in the end become but dependencies of the preponderant might of the Kaiser—or possibly of an expanded Teutonic empire so strong that no power on earth could upset it. And also the belief that if such a result should obtain, these little states would lose their individuality and independence, despite every promise given in the agony of supreme effort or by evanescent tracings on "Scraps of Paper." That unfortunate phrase is likely to cost an empire.

To the analytical minds of the statesmen who guide the destinies of the Balkans, Germany's definite check must be apparent; the power of vastly superior numbers, on a ratio of two to one, cannot be ignored, for even the machinations of desire cannot juggle with cold, impassive figures; and the drain, drain, drain of the countries at war, in finance, commerce, treasure and blood, leads to comparison: one contender has the entire outside world upon which to draw for supplies—the other has but its own definite territory, limited by bayonets, for the sum of its resources.

Dispatches state that Russia is massing force in the vicinity of Roumania, not as a threat, but as a guarantee that the Roumanian forces may be concentrated on the Bulgarian frontier. Roumania is practically mobilized; without doubt she is approaching a decision of some sort, and the recent Russian successes in the Caucasus are apt to have a much more far-reaching effect than merely upon the local issue in Turkey.

Saloniki has become formidable in strength and it lies in a very threatening proximity to Bulgarian territory. That the city has not been attacked, as threatened, by Teutonia, leads to the belief that the Kaiser regards the Roumanian situation so threatening that he cannot dare unguard it, and has not himself sufficient strength to launch attack upon the Grecian city. And, furthermore, that the fear that Greece itself might be forced to declare actively for the Entente should Bulgaria, hated of Greece, invade her soil, acts as a restraint. The situation is fraught with moment.

If it be true that Roumania is to declare for the Entente actively with the completion of an understanding with Russia, a new line of attack across its frontiers, upon Austria-Hungary, will be opened, supplemented by offensive action from Saloniki that might easily result in clipping Turkey from the alliance, force the Teutonic line back to within its own territory and mark the beginning of a second stage of the war, wherein Teutonia becomes definitely besieged in grim, overwhelming strength.

And this *possibility* exists to-day through the latest success of Grand Duke Nicholas with his Army of the Caucasus at Erzerum.

As we go to press the great German drive at Verdun is in progress. A discussion of the strategic importance of this movement is reserved for the next issue.

Climatic Statistics for Canada

AMONG countries that have long maintained meteorological services there is great diversity in the extent to which the observations collected by these services have been digested and published in the form of climatic statistics. Canada, though it possesses an excellent meteorological service, has been quite backward in this respect. Hence much interest attaches to the recent publication of a substantial quarto volume entitled "The Temperature and Precipitation of British Columbia," constituting the first of a series of works which the Canadian Meteorological Office plans to issue for the various divisions of the Dominion. The next volume in the series will deal with the Northwestern Provinces.

The American Conquest of the Air

Shall the United States Pay Further Tribute to Other Nations for Her Supply of Combined Nitrogen?

By Prof. Thomas H. Norton, Ph.D., Sc.D., Bureau of Foreign and Domestic Commerce, Washington, D. C.

THERE is something galling in the word "tribute" to a free people. It recalls the exactions of Assyrian, Egyptian and other Oriental potentates, as recorded in Holy Writ, and in the monumental records of ancient civilizations. It recalls the streams of gold flowing from every quarter of the globe into the treasury of Imperial Rome, or the chief sources of income of aggressive barons, kinglets and kings, through medieval history to the present day.

And yet, the American nation has been regularly paying tribute for years to foreign interests, in a sense of the word quite as real as that characterizing the exactions of roving Vikings or Algerian Deys.

The contributions do not take the form of chests of gold or silver, as in the olden times. They cross the oceans in a steady stream of drafts and bills of exchange, representing just as truly the toil of American brain and brawn, as would the precious metals.

In an economic sense, I do not hesitate to designate as "tribute" whatever we pay to foreign producers of staple articles of consumption, when our needed supplies can just as advantageously be produced on American soil, and especially when they can be made from American raw materials.

A careless, neglectful policy in this field subjects us to a triple handicap. The latent natural wealth of the country lies dormant and a magnificent national asset fails of utilization. The various industries dependent upon foreign supplies in this category must contend with all the uncertainty and vicissitudes attendant upon alterations in the economic conditions of distant lands, and lack the confidence and assurance resultant from the existence in our own country of a well-rounded cycle of productive activities. Finally the entire industrial fabric of the United States is exposed directly or indirectly to the dangers of paralysis, through any interruption in maritime communications with other parts of the globe. The evidence in proof of these theses has been brought abundantly to our attention in the form of scores of uncomfortable object lessons during the last eighteen months.

We have paid a heavy tribute to the great factories on the Rhine, the Main and the Spree, for artificial colors and other coal-tar products. The present dislocation of our vast textile interests, in the throes of an acute "dyestuff famine," shows vividly the punishment---economically and literally—for the folly and unwisdom of violating the fundamental precepts outlined above.

We have paid a still heavier tribute to the potash mines of Stassfurt and to the Prussian government. The faltering harvests of our cotton and tobacco fields tell the tale of our penalty.

The heaviest tribute is paid to foreign countries for our supply of combined nitrogen, imperatively necessary for a multitude of industries, and, above all, for maintaining the fertility of our farms.

The tribute has amounted annually to over $29,000,000. *Every cent of this sum should have remained within our own borders!*

For what and to whom has this vast toll been paid?

Prior to the present war our annual imports of crude nitrogenous material averaged as follows:

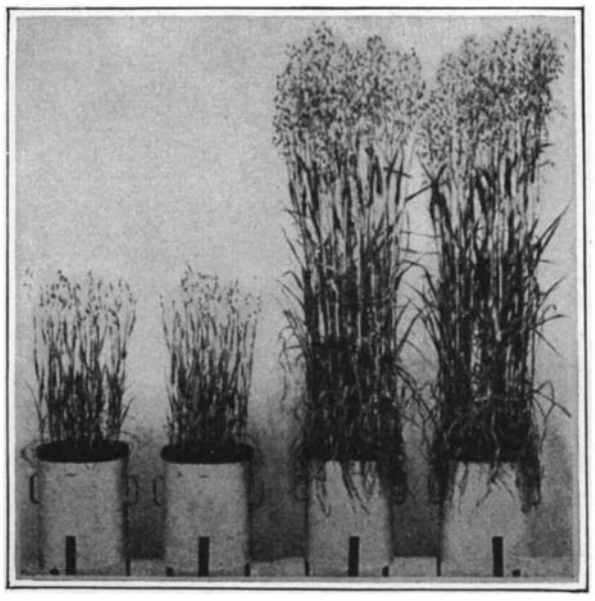
	Long tons	Value
Sodium nitrate (Chile saltpeter)	546,000	$17,660,000
Ammonium sulphate	67,200	4,416,000
Calcium cyanamid	29,500	1,590,000
Divers nitrogenous fertilizers		5,464,000
Total		$29,130,000

The sodium nitrate came entirely from Chile. The export tax on their shipments of this product forms about two thirds of the regular income of the Chilean government. In Europe about 80 per cent of the imports of the nitrate is used for fertilizing purposes. In this country the proportion is much smaller. In 1905, when the importation was much less than at present, Prof. C. E. Munroe estimated that it was consumed in the following manner:

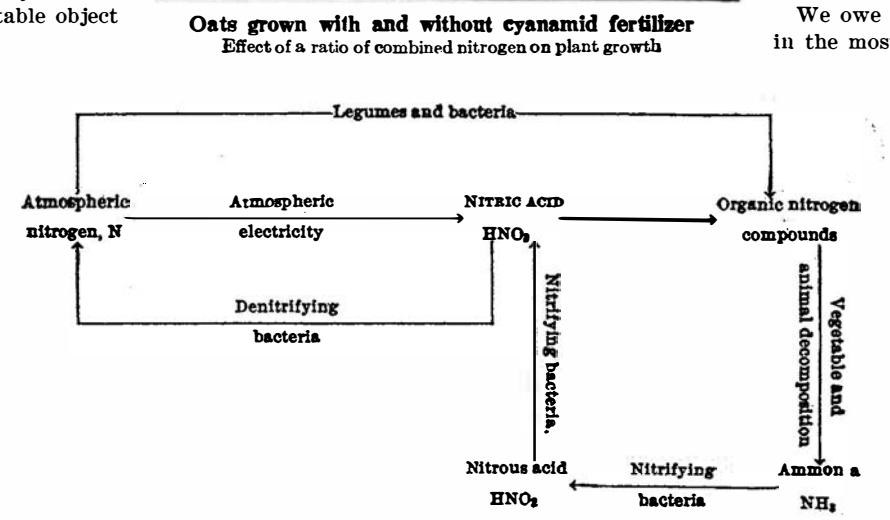
	Short tons
Explosives	133,000
Enameling, fluxing, pickling, etc	68,000
Fertilizers	42,000
General chemicals	38,000
Nitric and sulphuric acids	29,000
Glass making	12,000
Dyestuffs	260
	322,260

THE author of the accompanying article is well known to the readers of the SCIENTIFIC AMERICAN *through his contributions on "The Dyestuff Famine" and "The Potash Famine," and on allied economic problems. His extensive report on "The Utilization of Atmospheric Nitrogen," published by the Department of Commerce in 1912, is regarded by electro-chemists, on both sides of the Atlantic, as the most complete and exhaustive treatise on the subject in any language.*—EDITOR.

Ammonium sulphate is supplied chiefly by Great Britain—70 per cent; Germany has furnished 20 per cent of the import and Canada 7 per cent. Its chief use is as a fertilizer.



Oats grown with and without cyanamid fertilizer
Effect of a ratio of combined nitrogen on plant growth



Nature's cycle of changes, furnishing plant life with its supply of combined nitrogen

The American supply of cyanamid comes from the extensive works located at Niagara Falls, Ontario. The cheap electricity generated at Niagara Falls led to the location of the industry at that point. The annual output is 64,000 tons, all used as a fertilizer.

A large amount of nitrogenous material, chiefly refuse animal matter, fish scrap, tankage, etc., from all quarters of the globe, valued at $5,464,000, is imported exclusively for use as a fertilizer.

The above survey covers simply our imports of nitrogenous compounds in a crude form. A separate category of the more valuable chemicals, in which combined nitrogen forms an essential part, such as the coal-tar dyes and other coal-tar derivatives (medicinals, etc.), the explosives, collodion, celluloid and other pyroxylins, the prussiates, the cyanides, the nitrates, etc., would include imports valued at about $12,500,000. These come entirely from Europe, chiefly from Germany.

We are thus dependent upon other countries for wares containing nitrogen in a combined form, to the value of nearly $42,000,000 per annum.

To what extent are we producing nitrogen in a crude, combined form?

The direct production is limited chiefly to the recovery of ammonium sulphate among the by-products of the distillation of coal, in connection with the manufacture of gas, and especially of coke. The annual output for 1913 and 1914 was 190,000 short tons.

The utilization of waste nitrogenous material of animal and vegetable origin in American fertilizer works is considerable. Thus in 1909 it amounted to 1,085,000 short tons, valued at $20,277,000. Nearly three quarters of this is of domestic origin.

Summarizing the nitrogen situation in the United States, as far as crude nitrogen compounds are concerned, we consume waste animal and vegetable matter valued at about $20,300,000, of which imported materials are worth about $5,500,000. We consume 265,000 short tons of ammonium sulphate, of which 75,000 tons are imported. We consume 33,000 short tons of cyanamid, all imported. Finally, we consume 610,000 short tons of sodium nitrate—all imported.

It is not difficult to realize what would happen to our agriculture, and to our whole industrial system, should for any reason our maritime communications with Europe to the east and with Chile to the south be interrupted for any length of time.

We can picture the effects on simply our means of protecting the nation from foreign invasion.

Our entire supply of nitric acid is obtained from Chile saltpeter. In the manufacture of powder for cartridges, or for use in cannon, in the preparation of high explosives for use in shells or torpedoes, nitric acid is the most important, the all-essential material. We may start from glycerin, from cotton lintners, from wood pulp, from carbolic acid, from aniline, from toluene or from divers other coal-tar products—in every case nitric acid is the agent needed to transform inert substances into powerful explosives.

Modern warfare, as exemplified in the terrible world conflict across the waters, is a battle of engineers and chemists. In its ultimate analysis war is reduced to a simple term—nitric acid! The nation engaged in a struggle for life or death becomes helpless the day its stock of nitric acid is exhausted, no matter what its population may number, no matter what their bravery, skill and resoluteness.

In almost as strong terms may we postulate the conditions of existence for a nation's industry or agriculture.

We owe much to the examples of German efficiency in the most diversified fields of human efforts. What lesson can Germany teach us in this connection? That empire is as effectually cut off from supplies of Chile saltpeter as our own country might be under certain contingencies.

A decade ago the manufacture of cyanamid from the nitrogen of the air was successfully started at several points in Germany. The industry has steadily expanded. Four years ago Professor Haber's charmingly simple process for the synthetic manufacture of ammonia from hydrogen and atmospheric nitrogen was perfected, and a large plant for the industrial production of this important compound was erected. At about the same time the equally brilliant and simple process of Professor Ostwald for the catalytic transformation of ammonia, in the presence of air, into nitrous and nitric oxides (yielding nitric acid on contact with water) was brought to a state of technical perfection.

Ordinarily, Germany produces from her coke and gas works large amounts of ammonia, a notable surplus being available for exportation. Cyanamid, on contact with steam, gives off all of its combined nitrogen in the form of ammonia. To cap the climax, Haber's process renders it possible to manufacture from the air ammonia in unlimited quantities. There were, therefore, no bounds set to the stock of raw material available for transformation into nitric acid by Ostwald's method, in 1914.

Is there not here a magnificent example of how a nation can free itself from the shackles of dependence upon foreign sources for supplies vitally essential to its agriculture, its industries and to national defense?

Let us note our own preparedness for the unexpected in regard to sources of combined nitrogen, and in the equipment needed to render it available for use in the arts and in the preparation of fertilizers.

First of all, our assets:

In the vast deposits of coal in this country there is enough nitrogen stored up to meet our normal demands for many years, if carefully recovered in connection with coking and gas manufacture. In these branches every short ton of bituminous coal should yield on distillation about 21.4 lbs. of ammonium sulphate. In 1913 over 75,000,000 tons of coal were distilled. If the by-products had been carefully recovered, the output of ammonium sulphate would have slightly exceeded 800,000 tons. The actual amount recovered was

(*Concluded on page* 258)

The Heavens in March, 1916

Our Neighbor Mars and Its So-Called "Canals"

By Prof. Henry Norris Russell, Ph.D.

THE most interesting object in the skies is still the planet Mars. Though rather far from us—67,000,000 miles at the beginning of March, and 85,000,000 at its close, he is very conspicuous to the naked eye, outshining all the stars but Sirius. He is in the eastern part of the constellation Cancer, moving westward, ever more slowly, until the 22d, when he reverses his course, and starts upon a long eastward sweep which will quite encircle the heavens.

Telescopically, he shows a disk 14 seconds of all in diameter the 1st, which shrinks to only 11″ on the 31st, as he recedes. Toward the end of the month he will look like the moon about two days before the full, showing thus a conspicuous phase.

The discussion of the surface features of the planet has been revived in the popular mind by his present return to the evening skies, and it may therefore be appropriate to speak of them here.

With a small telescope, it can easily be seen that, while the general surface of the planet is of a ruddy hue, there are dark markings upon it, which, if watched for two or three hours will be seen to pass across the disk, carried by the planet's rotation, which is a little slower than that of the Earth. At the pole is a brilliant white spot, the "polar cap." more conspicuous than any other feature. Even with a small telescope, the amateur may see that this cap, at the present time, is steadily shrinking. The north pole of Mars is now turned toward the sun, the season there corresponding to the end of May at the Earth's north pole. By midsummer from the Martian standpoint, the cap will have shrunk to be only about 200 miles in diameter, if it follows the same law which has governed its behavior with regularity during the past. Towards the end of the Martian summer the cap begins to reappear; first, in the form of isolated white patches, which extend till they grow together and cover the surface in a great white sheet 1,500 miles across, which in mid-winter enlarges still, only to shrink again with the approach of spring.

It has been observed for many years that, after the polar cap grows smaller, the darker areas of the planet increase in size and depth of color—another clear instance of seasonal change. But public interest is centered, not in these conspicuous markings, but in the delicate and elusive ones which are beyond the power of small telescopes to reveal, or untrained eyes to see.

All observers who have studied the planet long, with instruments of sufficient power, and under good conditions of atmosphere, agree in testifying that, in the moments when the ceaseless unrest and turmoil of the wind-swept arc through which the rays that reach us must pass subsides, a great amount of fine detail becomes visible on the planet, which, except at these times, is so blurred by the aerial tremors that it can not be detected. Concerning the nature of this detail, however, the reports of competent and skillful students differ widely.

Most widely known, in all probability, are the results of Dr. Lowell, who, during his many years of work in Arizona has consistently seen these markings as fine, sharp, dark lines, traversing the surface, not quite on straight lines, which would be impossible on the spherical surface of the planet, but almost always in "great circles," the shortest and straightest courses possible on a sphere—so that they will merit Schiaparelli's designation of "canals." His drawings, too, show these lines converging, three, five, or more at once, to definite points, marked often by a small dark spot, or "oasis" so that they form a geometrical network, covering the whole surface of the planet from pole to pole, in the ruddy areas and the dark alike.

It is not so generally known to the public that many other observers, also provided with telescopes of sufficient power for the purpose, and experienced in the study of the planet, describe what they see on its surface in quite different terms.

Practically all of them have seen small dark spots, and streaky markings connecting them, in some regions of the planet, which are clearly the same things as "oases" and "canals." But some of them, notably Prof. Barnard—whose graphic description of the planet's appearance is that it looked like a pinkish globe on whose surface "the dark details had been painted with a grayish colored paint, supplied with a very poor brush, producing a shredded or streaky and wispy effect in the darker regions"—have never, during years of study, seen any trace of a system of fine narrow dark lines. Others, such as Prof. W. H. Pickering and Monsieur Jarry Desloges, who have made extensive series of observations in the last few years, have seen a few narrow straight "canals," but find the great majority to be broader markings, often with diffuse edges, in many cases curved, and in some instances according to the last named observer, broken up, at the moments when the "seeing" was at its best, with a patchwork of finer details which, as soon as the trembling of the air blurred the image once more, merged into an apparently uniform grayish streak.

It is quite beyond belief that, among these numerous observers—some of whom see the canals always as fine lines, others always as diffuse bands, while still others see some in one form and some in the other—only the members of one of these groups have ever seen the planet, during years of observation, well enough to make out the real features of its surface. The explanation must be sought elsewhere, and a clue is given by the one observation in which all students of Mars agree—that the details in question are very elusive, and can be seen only during the moments of good definition and steady images—on good nights only, and even then for but a few seconds at a time.

Even in direct observational matters, such as pressing a telegraph key to record the moment when a star, moving through the field of view of a telescope, appears to cross a fixed thread, psychological differences between observers—known in astronomy by the general term "personal equation" are present and important. If an observer wants to see the star on the "wire" before he presses the key, he will give the signal too late, by perhaps a fifth of a second, because the complex processes which intervene, in the nerves and in the brain, in such an apparently simple action, will take at least that interval of time. If, realizing this, he tries to avoid this error, and to press the key so that the action shall be completed at the moment when the star crosses the wire, he may overshoot the mark, and form a fixed habit of observing early. By observations on an "artificial star"—a spot of light which is caused, by suitable devices, to move in the field of the telescope so as to resemble exactly a real star—it is possible to determine the amount of this "personal equation" for a given observer; and if, as is the case with an experienced worker, the amount of the correction varies but little from day to day, his observations, after correction for the known influence of this personal peculiarity, can be used with entire confidence, and combined successfully with those of others.

It is very probable that similar principles apply to the far more intricate matter of observations of delicate planetary detail—indeed, there is direct evidence that such is the case, for Dr. Lowell and Prof. Pickering, observing at the same station, and with the same telescope, have consistently recorded the canals, the one as fine lines, the other as relatively wide and diffuse bands or strips.

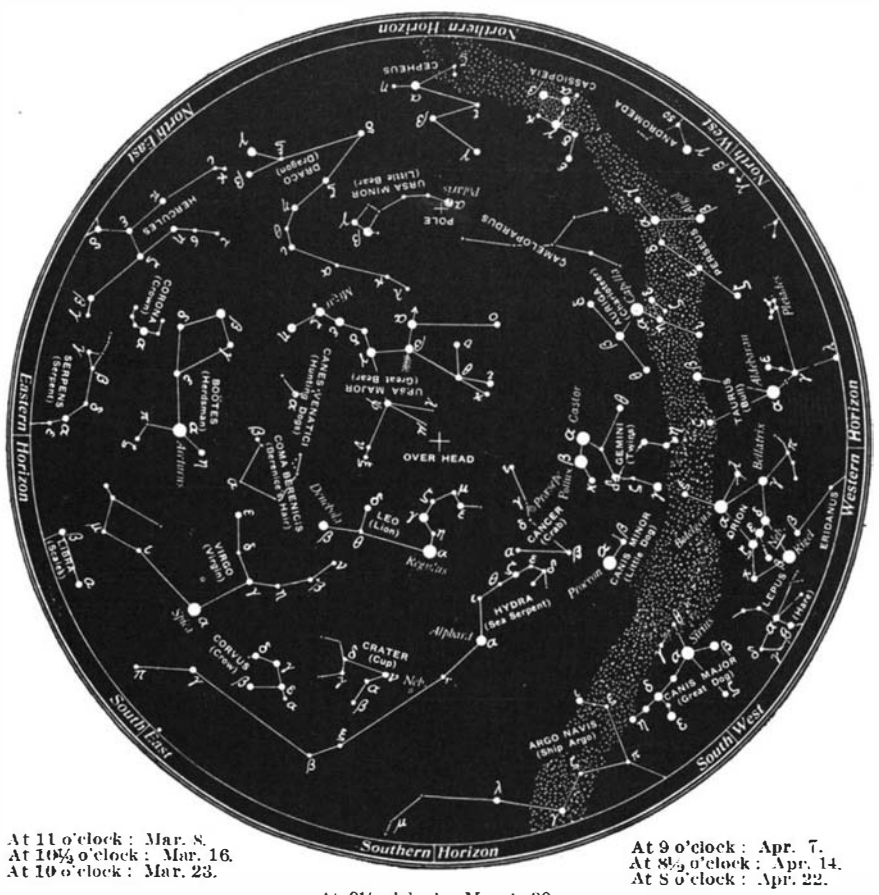
It seems altogether reasonable to assume that some men's visual and nervous mechanism is so constituted that it reports to consciousness that a faint line, seen by glimpses in moments of good definition, is fine, sharp, straight, and continuous, unless, in these favorable moments, the image presented to the eye is clearly or definitely broad, diffuse, crooked, or broken; while another man's mental apparatus may be so built that, under similar circumstances, it refuses to report a line as sharp, straight, etc., unless, during the best moments, it appears unquestionably and rather conspicuously so.

On a planet whose surface is covered with detail of many kinds, the first observer will see more fine, sharp, straight lines than actually exist there, and the second fewer. Neither one will be at all conscious of these peculiarities on his records, for the psychological processes involved are sub-conscious, and take place automatically, whether the subject is thinking of the matter or not. So when the two observers take pencil in hand to sketch what they see—*i. e.*, what their perceptive apparatus reports to consciousness—the pictures they draw may look very different, though they may be using the same telescope by turns, and be to the highest degree open-minded in all their work.

No other explanation appears to the writer of the present page adequate to account for the facts. If this one be true, it follows that we can not attain certainty regarding the real nature of these elusive Martian markings by any amount of telescopic study of the planet, unless this be supplemented by tests which bring out in some way the nature of the observers' personal equation.

Just as the meridian-circle observer determines this by means of an "artificial star" so the planetary student might well spend a cloudy evening now and then in drawing "artificial planets." These should be disks, roughly resembling Mars in general color and shading, but provided with fine details of the most varied description, of whose nature the observer knows nothing at all until he looks with his telescope at the desk, placed at such a distance that it looks about as big as Mars, and that the effects of atmospheric disturbances of definition are about the same.

If a series of such disks, prepared by a competent committee, could be observed in this way by a number of the most experienced students of Mars, and their drawings collated with one another and with the originals—which, up to that moment, no one of the observers would have seen at close range—the results might advance us far towards a knowledge of the real nature of the planet's finer details. Until such tests have been made, it is unsafe, in the writer's judgment, at least—and, as he believes, in that of a large number of astronomers—to draw any conclusions either from the supposed linearity, straightness, or geometrical arrangement of the Martian canals, or from their supposed lack of these characteristics.



At 11 o'clock: Mar. 8.
At 10½ o'clock: Mar. 16.
At 10 o'clock: Mar. 23.

At 9 o'clock: Apr. 7.
At 8½ o'clock: Apr. 14.
At 8 o'clock: Apr. 22.

At 9⅓ o'clock: March 30.

NIGHT SKY: MARCH AND APRIL

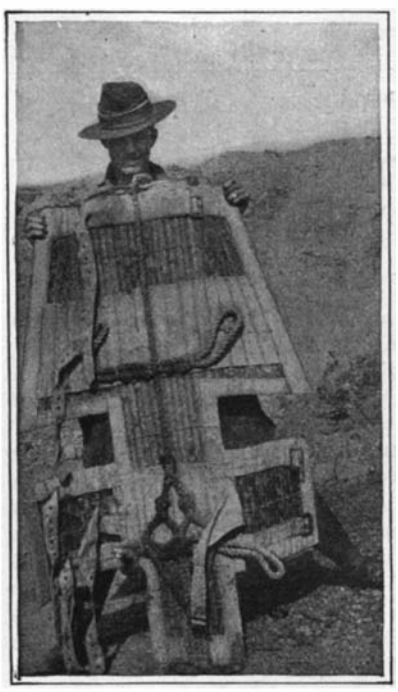
The Heavens

As our map shows, the constellations most nearly overhead on the latter part of the evening are Ursa Major, vertex of the zenith, and Leo, south of it. In the northern sky, below the Great Bear, are the Little Bear and the Dragon, and still lower are Cepheus and Cassiopeia, on the northern horizon. In the south, below Leo, is the huge extent of Hydra, with the smaller groups of Crater and Corvus. Virgo and Boötes are the most conspicuous groups in the eastern sky, while the western is far more brilliant, containing Orion,

(*Concluded on page* 266)

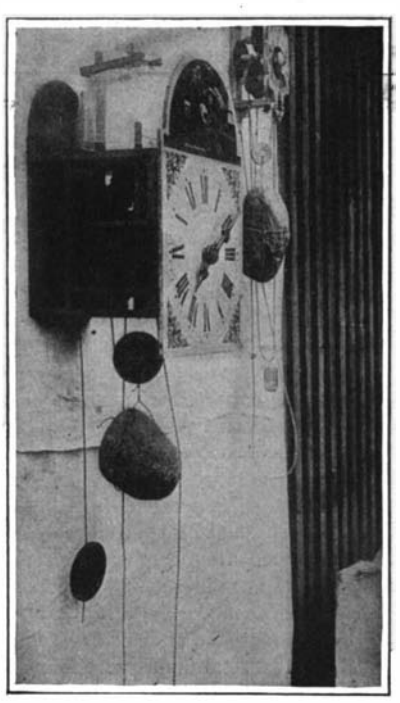
Fastening bombs to a Russian aeroplane, preparatory to starting on an air raid

Austrian sharpshooter aiming and firing rifle at an angle, using a periscope

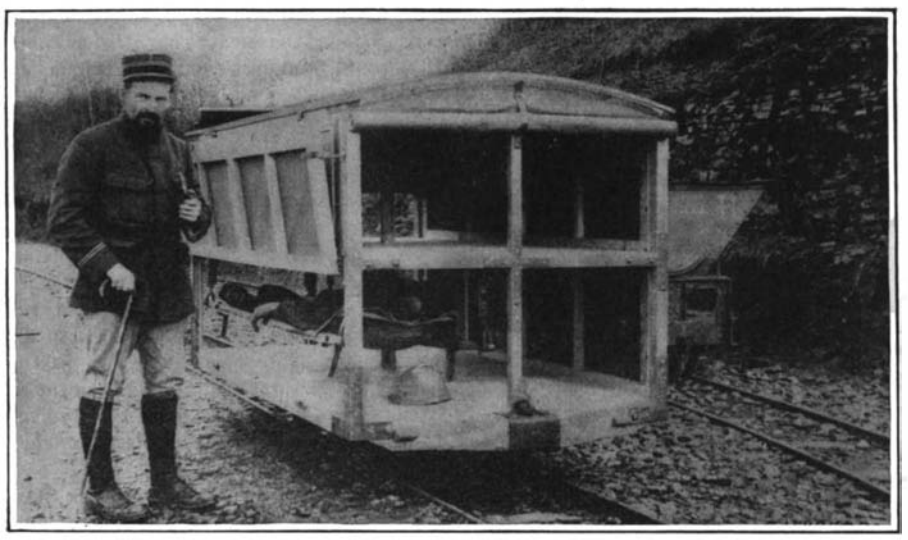


Stretcher used at Gallipoli for removing wounded from the narrow trenches

Post of the commander of artillery in the Champagne district, showing the thoroughness of the defensive works



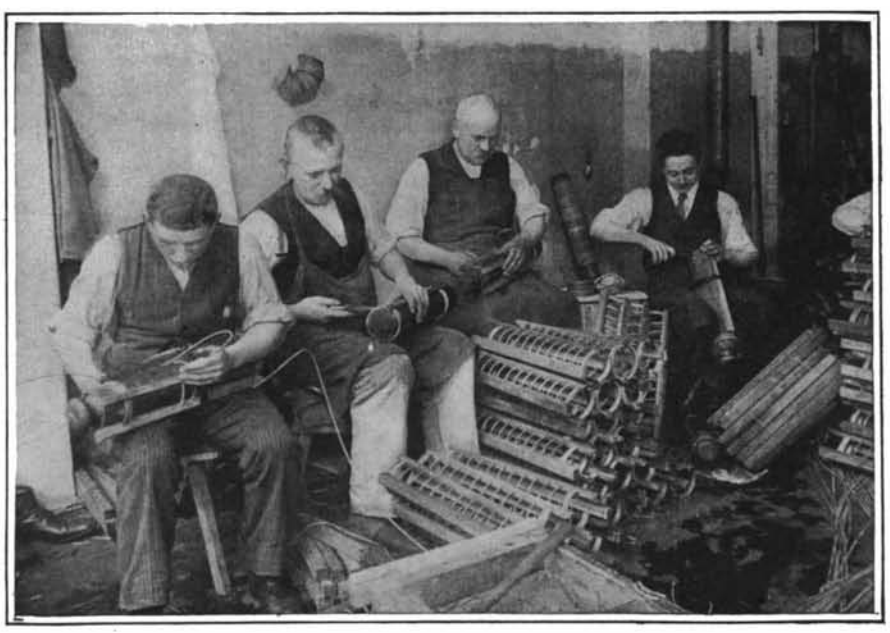
Copper clock weights converted into German shells, replaced by stones



"Beehive" car for transporting wounded to the field hospital

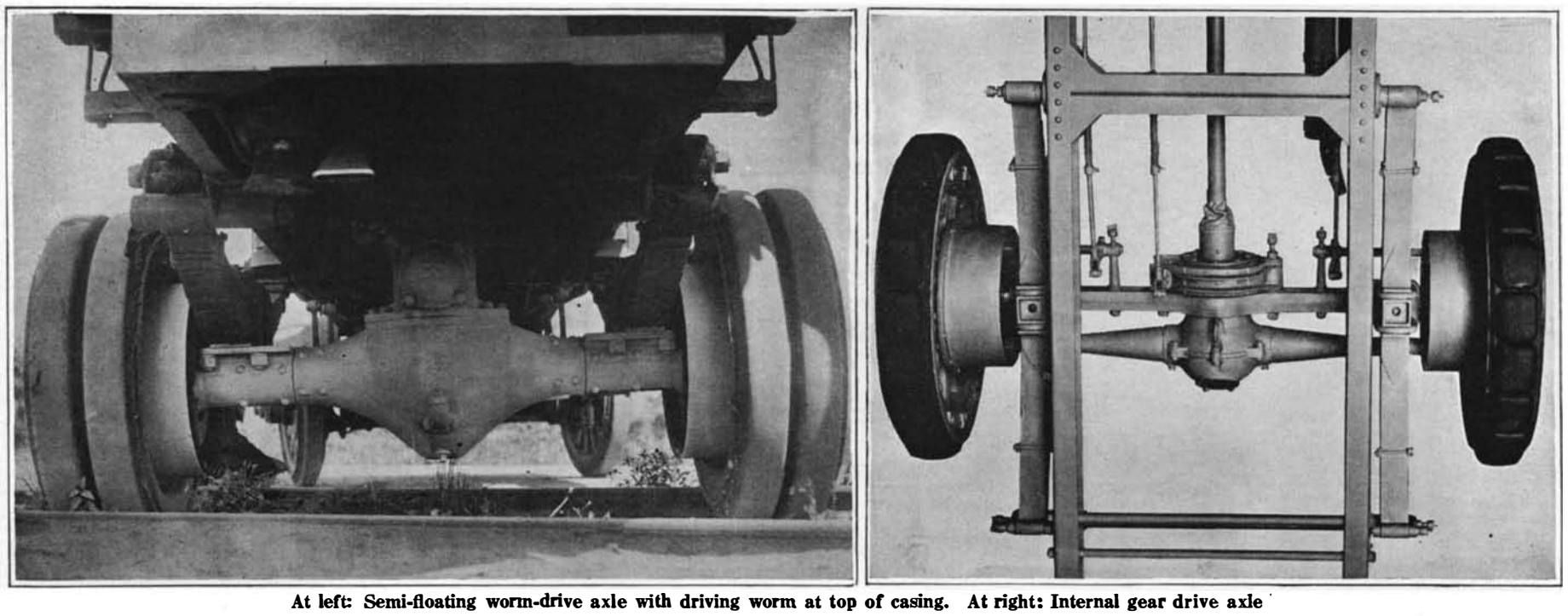
French Alpine soldiers using dogs for transportation of machine guns

German workmen engaged in making wicker containers for artillery shells



Another step in the making of wicker containers for artillery shells

ODDITIES OF THE WAR AS RECORDED BY THE CAMERA



At left: Semi-floating worm-drive axle with driving worm at top of casing. At right: Internal gear drive axle

Features of 1916 Motor Truck Design

A Comparison of This Year's Offerings with Those of Previous Years

By Victor W. Pagé, M. S. A. E.

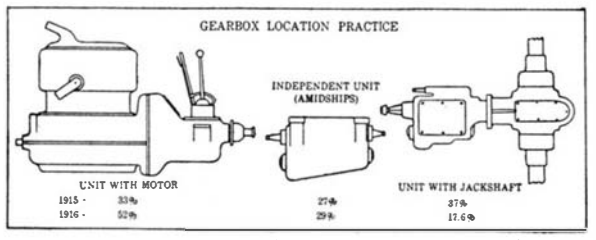
IN the annual automobile number of this journal published the first of the year a brief discussion was presented forecasting some of the features of design that could be expected in gasoline motor truck construction for the coming year. At that time a large number of makers had not given out announcements of their new models, so it was only possible to forecast the trend of practice in a general manner. At the present time, however, practically all builders of commercial vehicles have furnished details of their product for the coming season, so it is not difficult to define the trend of 1916 practice in a more definite manner by giving percentages of increase or decrease for the different structural features. A number of the most striking developments are shown graphically in accompanying diagrams and indicate the progress of design over a period of several years.

Those in the market for commercial vehicles can obtain more for their money this year than at any previous time. The general design of practically all trucks has been greatly simplified as these follow what might be regarded as standardized rules of practice. This is because a large part of the motor trucks offered to-day, with very few exceptions, are assemblies of components produced by specialists in their respective lines.

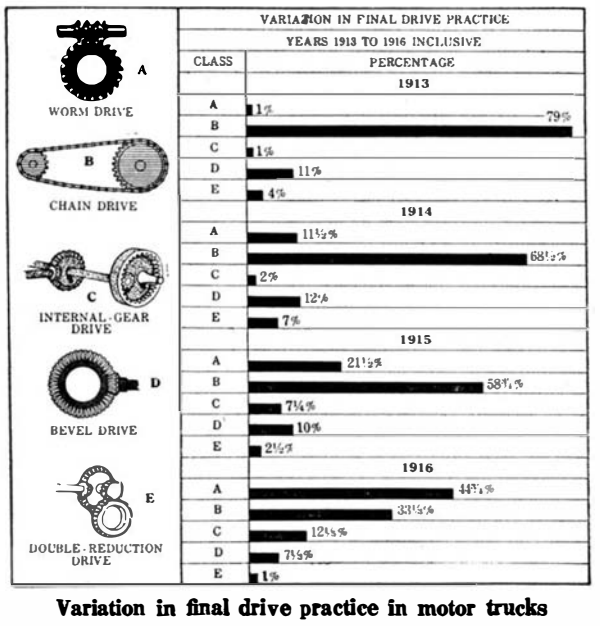
While the prices of trucks have been materially reduced, the quality has been increased, this being due to the simplification of design as well as to quantity production. Last year the average price of a motor truck was somewhere in the neighborhood of $2,500, this being based upon the number of different models offered at that time by the leading makers. The price for the average truck, this year, has been reduced to about $2,250, which is remarkable when one considers the rising price of materials of construction and greater cost of labor owing to reduction in the length of the working day and in many cases an increase in the workman's remuneration, which is greater than was formerly paid for more hours of work.

Decline in Light Delivery Models

After analyzing the figures given in a recent issue of one of the well established motor truck papers, *The Commercial Vehicle*, which have been based on painstaking computations extending over that period of years covering the most important developments in truck design, one can outline the trend of present-day practice in an authoritative manner. The first thing to consider is the variation in carrying capacity of the models offered for a number of years. One notes that most of the makers favor trucks of about 4,000 pounds load rating this year. There is a marked decline in the number of light delivery models of less than 1,000 pounds capacity. In 1913, 13 models were offered; the next year the number had increased to 15, and in 1915 there were 19 light delivery wagons available. This year there are but 8 listed. Nineteen models of 1,000 pounds capacity were marketed in 1913; 28 in 1914; 31 in 1915, and the number has been reduced slightly to 28 for the coming year. The number of models in the 1,500 pounds class has not varied much, though fewer models are available this year than last. In 1913, 47 models were built; the next year, one more maker added a 1,500 pound truck to his line. This high point of 48 models was reduced to 44 in 1915 and 40 in 1916. The year 1914 was also the banner year for the one-ton truck, as there were 72 models available as compared to 59 models of the year previous. Last year there were 68 trucks of this capacity; this year there are but 65 models listed. The year 1915 indicated the high point in number of 1½-ton models as 66 of this type were then obtainable. This was an increase of 16 over the number marketed in 1914 and of 20 over the 1913 figure of 46 types. This year 54 models of this capacity are available.



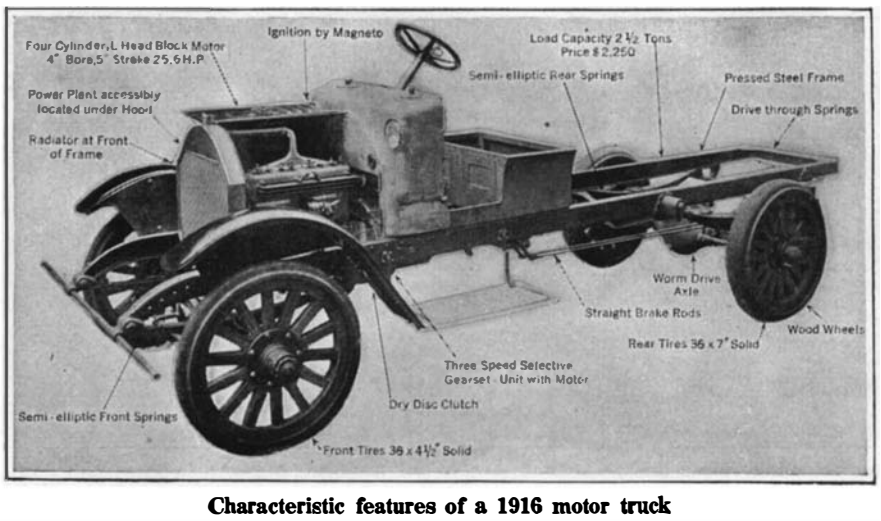
Location of gearbox in 1915 and 1916 models



Variation in final drive practice in motor trucks

For two years, 1913 and 1914, there was no increase in the number of 4,000-pound trucks, the figures remaining at 62 models for each of those years. Last year there was a marked increase to 76 models; this year the number has been further augmented, so 93 2-ton models are manufactured. There has also been an increase in the number of trucks of 5,000 pounds capacity. Five models of this size were listed in 1913; the number doubled in 1914; the year following it was nearly four times as large as in 1913 as the number increased to 19 models. There has been a slight decline to 17 models this year. A gradual decline has been noted in the number of 3-ton, or 6,000-pound models. In 1913, 55 were listed; the next year the number fell to 48; in 1915 to 43, and this year even a sharper decline is noted as only 33 models are announced. The 3½-ton truck was made in 14 models in 1913 and 1914; the number increased to 28 in 1915, and is now 38 models. The 4-ton truck is an odd size, because very few people would have use for a truck of this capacity that could not use the next larger, or 5-ton type to equally good advantage. We find 19 models listed in 1913; 17 in 1914; 16 in 1915, and 14 in this year's list. The number of 5-ton models has not varied as much as some of the smaller trucks, though fewer models are made this year than in the past. In 1913 there were 49 makes; in 1914 the number was reduced to 44 models. Last year the number increased to 45; this year it has declined to 43 models —not a very pronounced variation.

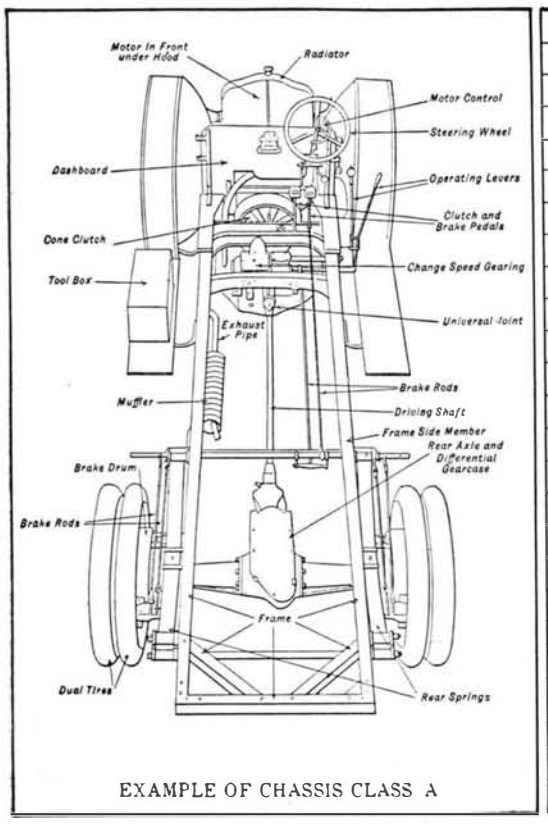
The makers of trucks have discovered a falling market for 6-ton trucks because the number of models is less than last year. In 1913 nine models were marketed; a year later the figure was increased to 16; this was augmented by two more models in 1915, and has fallen off to 14 models this year. Of larger models, including the 7-ton capacity and over, the limited demand for these sizes is well exemplified by the small number of models available. There were 6 makes of these large trucks available in 1913; 8 in 1914; 12 in 1915, and but 10 for 1916.



Characteristic features of a 1916 motor truck

Lowering of Prices; Increasing of Values

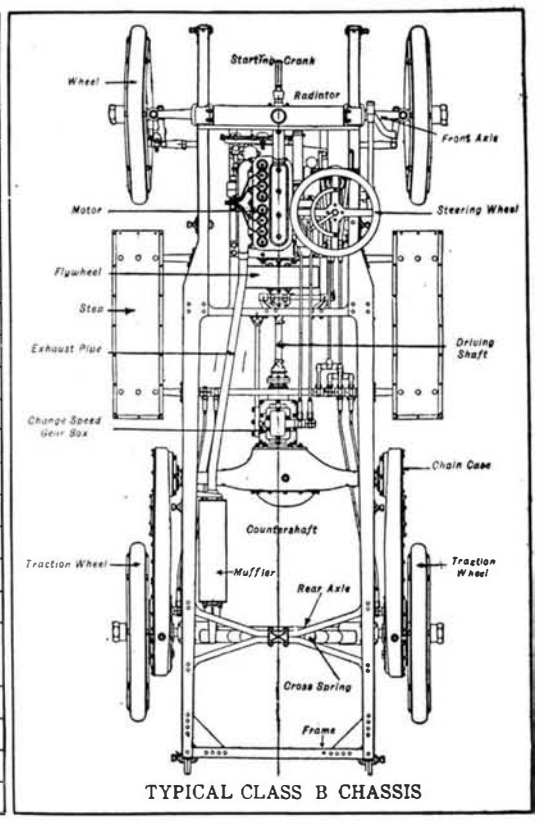
Considering prices, the average cost of a smaller truck than one-half-ton capacity in 1915 was $439.50. This year it is $429.17. The price of a 1,000-pound truck was $862.77 in 1915; this year it is $766.43. The cost of 1,500-pound models has been likewise reduced from $1,329 to $1,234. The reduction is not so marked in the 1-ton class, the 1915 price of $1,661 having diminished but little as it is $1,642 this year. The average one-and-one-half-ton truck sold for $2,057.50 last year; this year it is priced at $2,004. The increased production of 2-ton trucks has resulted in a substantial reduction this year, the figure of $2,288 being considerably less than the 1915 charge of $2,434. A decrease of about 9 per cent



EXAMPLE OF CHASSIS CLASS A

VARIATION IN ENGINE LOCATION PRACTICE
YEARS 1913 TO 1916 INCLUSIVE

CLASS	PERCENTAGE
	1913
A - UNDER HOOD	65%
B - UNDER FLOOR	30%
C - BETWEEN SEATS	3%
D - UNDER SEATS	2%
	1914
A	52%
B	30%
C	15%
D	3%
	1915
A	77%
B	14⅔%
C	5%
D	3⅓%
	1916
A	86%
B	5⅕%
C	4⁹⁄₁₀%
D	3⁹⁄₁₀%



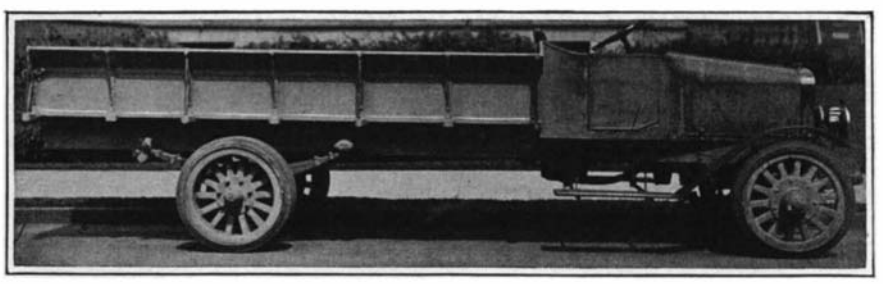
TYPICAL CLASS B CHASSIS

Variation in engine location practice in 1913, 1914, 1915 and 1916 motor truck models

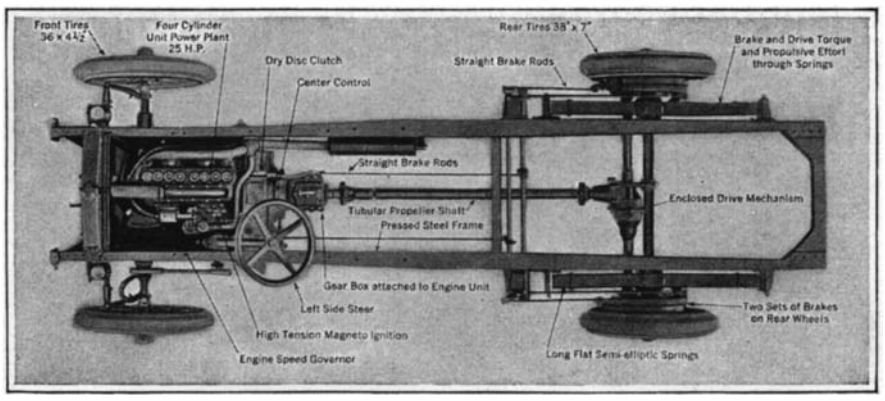
is found for the 5,000 pound class. In 1915 these sold for $2,740; this year the average price is $2,481. Three-ton trucks now sell for $3,147; last year they were priced at $3,271—not a very great reduction as it is only about 3 per cent. The reduction in price of 3½-ton trucks is greater, the difference between the 1915 and 1916 prices being $213 or 6 per cent reduction. Last year's average for this size was $3,489; this year's price is $3,276. The 4-ton truck has not been reduced in price, this size costing about 2 per cent more this year than last. In 1915 the price was $3,337; this year it is $3,417 or an increase of $70. There has been practically no reduction in price of 5-ton trucks; in 1915 they sold for $4,312, while this year the average is $4,311. Six-ton capacity trucks now sell for $4,555, a reduction of $359 from the 1915 price of $4,915, this representing a reduction of 7¼ per cent. The average price of trucks over 6 tons capacity has been increased 6 per cent, the 1915 figure of $4,394 being increased this year to $4,687.

Engine and Drive Details of Present Models

The most marked development has been the practically general adoption of the



Side view of typical truck design for 1916, showing simple chassis construction made possible by the use of shaft drive axles and elimination of radius rods and torque members



View looking down on a typical 1916 model truck chassis

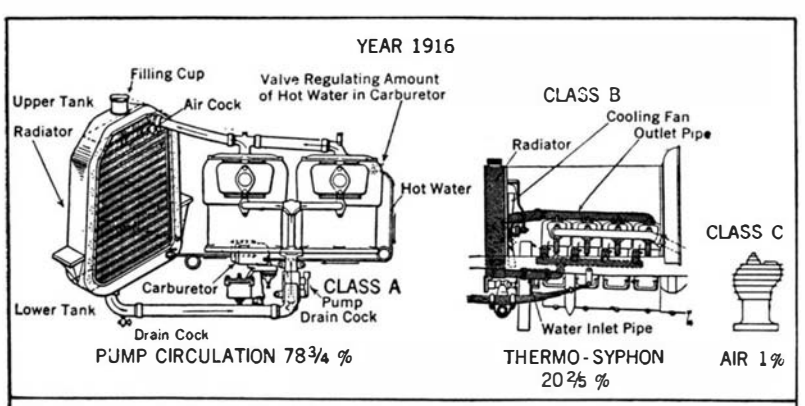
European type of construction in which the power plant is mounted at the front of the chassis under a hood. In one of the accompanying illustrations are shown the variations of engine location practice for the years from 1913 to 1916, inclusive.

The truck frame construction has been considerably simplified because of the wide adoption of the Hotchkiss drive and of rear axles in which the drive gearing is entirely enclosed. In fact, a pronounced tendency is noticed in the great increase of worm gear drive. The variation in final drive practice is clearly outlined in an accompanying diagram which covers a period of years from 1913 to 1916, inclusive.

A consistent increase is noted in the internal gear drive principle, this not being as marked as that of the worm drive but showing that truck makers were forced by public demand to use those types of rear axles that were most efficient and in which the drive gearing was completely enclosed. The falling off in the number of cars equipped with bevel gear drive is due to the lessened use of pleasure car types for motor truck purposes.

The greatly reduced percentage for the double reduction drive, which is but one

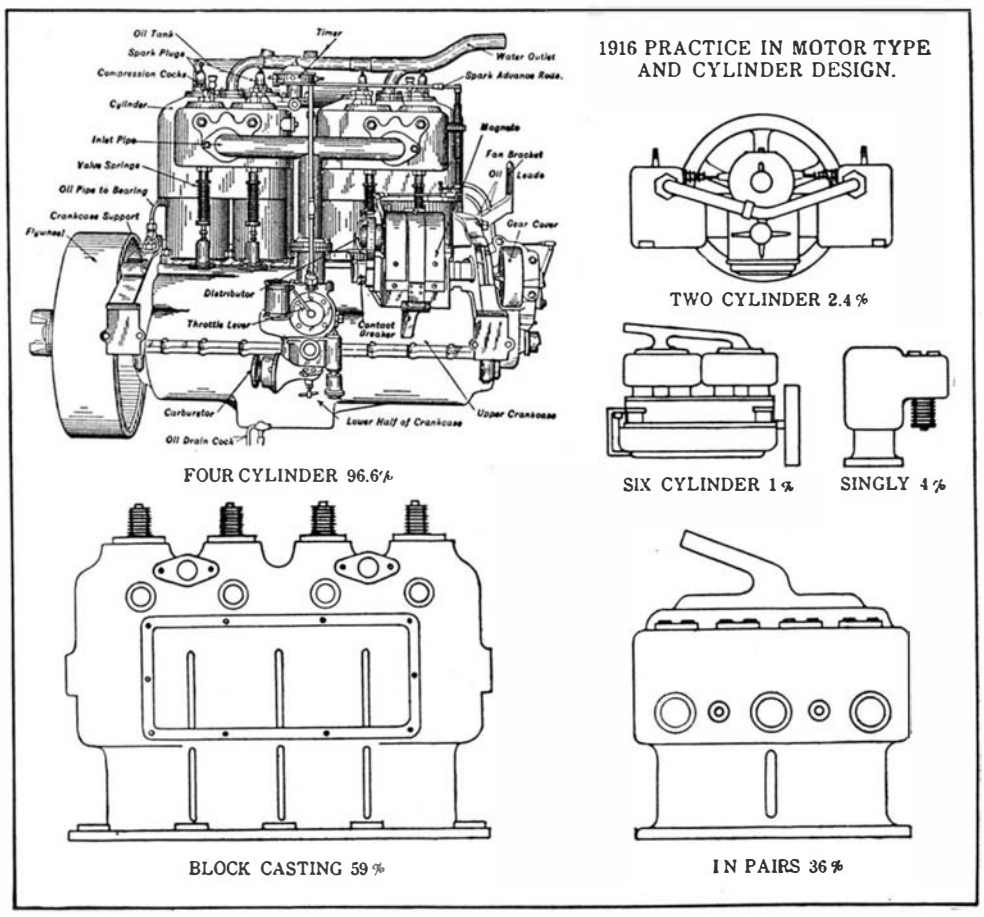
(*Concluded on page* 263)



VARIATION IN ENGINE COOLING PRACTICE
YEARS 1913 TO 1916 INCLUSIVE

CLASS	1915
A	81%
B	17⅔%
C	1⅓%
	1914
A	68%
B	26%
C	6%
	1913
A	65%
B	23%
C	12%

Variation in engine cooling practice



Motor and cylinder design practice in 1916 models

PREPAREDNESS

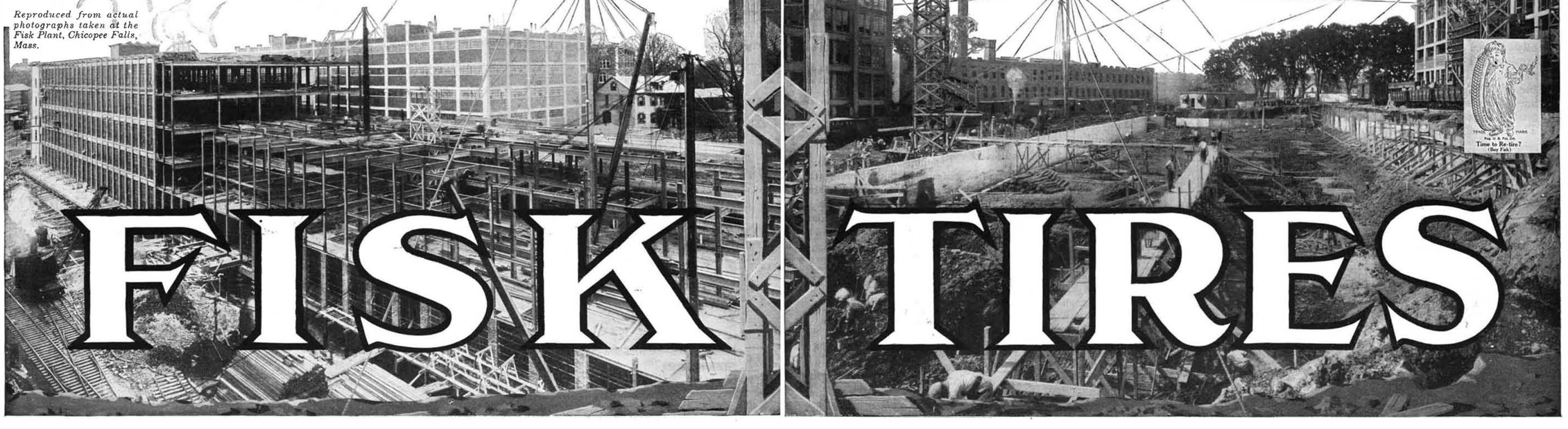
PREPAREDNESS—what a world of meaning in this word! Our country is entering on an era of prosperity that is unprecedented. The demand for our goods has necessitated expansions in plants and equipments that have broken all records.

In this era of prosperity the automobile will assume far greater importance than ever before and in this The Fisk Rubber Company plans to be an important factor.

Fisk Preparedness is due not alone to this general prosperity but also to the growth in the demand for Fisk Tires which has been created by the policies adopted and the goods manufactured.

Twenty-nine acres of modern factory, where tires only are built, seventeen years of manufacturing experience and more than 100 Direct Fisk Branches so located as adequately to serve the whole country, put us in the front rank of Commercial Preparedness.

Reproduced from actual photographs taken at the Fisk Plant, Chicopee Falls, Mass.



FISK TIRES

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

SLEEPING GARMENT. — FLORENCE J. BLENIS, Valhalla, N. Y. This invention provides a garment especially adapted for use upon infants while sleeping, the garment being

SLEEPING GARMENT.

provided with means for preventing its displacement with relation to the bed or the wearer. The intention is to securely fasten the bed coverings to the person of the child, so that while freedom of motion is assured it is impossible to kick off the coverings or to get out of bed.

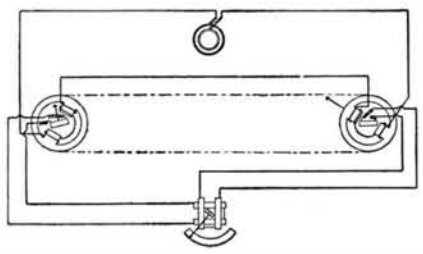
RETAINER FOR HAT PROTECTORS.—J. W. JACOBS, 6 Willow Place, Far Rockaway, L. I., N. Y. The main object of the invention is to improve the means for temporarily holding or supporting the protector within the crown of the hat in such a manner as to be readily and quickly removed for application when required in the case of a sudden shower for instance.

WASHABLE CORSET.—Y. SAYNISCH, 325 3rd Ave., New York, N. Y. In the present invention the improvement has reference to washable corsets, and the object thereof is to provide a simple, inexpensive and sanitary corset which will be provided with removable corset steels whereby the fabric can be washed as any other garment.

Electrical Devices

ELECTRIC RAT AND ANIMAL TRAP.—O. WEISS, P. O. Box 768 Butte, Mont. The invention provides a device having a hinged portion which will move under the weight of the rat or other animal so as to connect the primary of an induction coil, the movable part being so constructed that the animal will come in contact with oppositely charged portions connected up with the secondary in such a manner that death will result.

RANGE FINDER.—A. M. KENNEDY, Edison Laboratory, Orange, N. J. The salient features of this range finder are: the long base gives accuracy; direct reading avoids time lost in



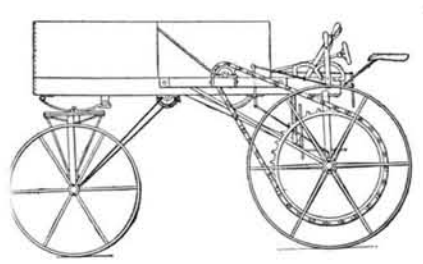
RANGE FINDER

computing the range from the angles read; readings independent of wattage or frequency of source or resistance of circuit render these readings accurate, though the speed of generation or conduction of the line should change.

Of Interest to Farmers

CHECK ROW ATTACHMENT FOR PLANTERS.—W. JELSEMA, R. F. D. No. 2, Sioux Falls, S. D. The invention provides an attachment that may be applied with facility to standard makes of planters; provides for making quickly and with facility, the necessary adjustments in the attachment, whereby to time the dropper elements at the beginning of successive rows, to accord with the positions of the hills in preceding rows.

MOTOR VEHICLE.—E. L. FOLSE and S. E. ROBICHAUX, R. F. D. No. 1, Box 16, Raceland, La. In this case the invention is an improvement in motor vehicles for farm work, and



MOTOR VEHICLE FOR FARM WORK

has for its object the provision of a simple inexpensive vehicle of the character specified, having means adapted to support cultivating mechanism, and adapted to be driven by the same motor that drives the vehicle.

Of General Interest

GROMET.—W. A. YOUNG, 198 Eleventh Ave., Astoria, New York, N. Y. The invention provides an article having even resistance throughout; simplifies the construction of devices to reduce the cost of such construction; and provides an article having structural, grouped packing members of different thicknesses for utilization in different ways.

FOLDING PACKING BOX.—A. MISROCH and A. KAHN, 291 Grand St., New York, N. Y. This invention has reference to packing boxes of that type which are folded from flat blanks into box form when desired for use, and the invention has to deal more particularly with a closing or locking means for boxes of this character.

PIPE COUPLING.—E. J. MAIRÉ, Lima, Ohio. This invention is more particularly intended for gas lines but may be employed for connecting pipes generally for conveying oil, water or other fluids. An object is to provide a coupling which may be readily applied to the plain unflanged ends of pipe sections and insure a fluid-tight joint.

NURSERY RATTLE.—AMELIA MORSE, Nursery Novelty Co., 32 Union Square, New York, N. Y. This device is of an unusually pleasing appearance and is provided with several parts adapted to move relatively to each other around a common axis, one part being within the other and provided with a plurality or series of illustrations adapted to be viewed in succession through one or more windows formed in or through the outer part.

BILL FOLDER.—E. P. O'HARA, care of John Mehl & Co., Jersey City, N. J. This invention provides a folder which is characterized by the provision of a central slit on the outer surface thereof where through bills are entered into the folder, and a cut-out covered by a flap on the inner surface of the folder where through bills can be extracted with great ease.

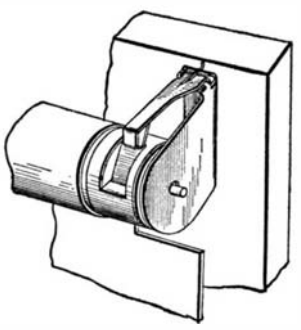
METHOD OF MANUFACTURING DEHYDRA ZINC SULFID.—C. RANSON, 2 Rue Poncelet, Paris, France. In carrying out the process the resultant product is freed from flourin compounds by washing in water. If hydrochloric acid has been used, an alkali or alkaline earth must be added to the washing water for the purpose of eliminating the whole of the chlorin which is present for the most part as zinc chlorid.

Heating and Lighting

PORTABLE ELECTRIC LAMP.—J. L. STRAUSS, 532 E. 88th St., New York, N. Y. The invention provides a lamp having a flexible connecting wire, with means for automatically and at will gathering a portion of said wire; provides a gathering mechanism for electric lamp cord, said mechanism being adapted to wrap said cord in a coil of small compass; provides a lamp having a hinged standard rotatable to carry the plane of the swing of said standard; and provides electric current connections disposed in a supporting base to permit independent movement of the lamp-supporting standard.

Household Utilities

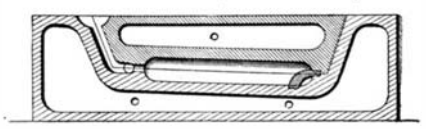
SHADE ROLLER.—D. A. LANE. care of Edwin H. Yeiser, Suite 816 Littlefield Bldg., Austin, Tex. Window shades are generally



SHADE ROLLER.

very insecurely fastened to their rollers, and often times by pulling a shade full length it is sipped or torn from the roller, thus necessitating either the purchase of a new shade and roller or the expenditure of time and labor in repairing the torn shade and securing it to its roller.

SASH WEIGHT MOLD.—S. J. SULLIVAN, P. O. Box 293, Hot Springs, Ark. This invention provides a mold adapted for permit-



SASH WEIGHT MOLD.

ting the simultaneous casting of a number of weights, each of the desired shape and size, and provided with the eye for the passage of the cord, wherein the mold is so arranged that it may be heated or cooled during the operation of molding and wherein air vents are provided for preventing the formation of air bubbles, flaws and the like on the cast article.

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

Emergency Power in Abundance

Compare a Jeffery QUAD with the best of rear-wheel-drive trucks under *average* conditions and you will be tremendously impressed by its superior economy, convenience, and general all-'round efficiency.

Compare it under *emergency* conditions—conditions which *cannot be foreseen*—and there can be no comparison, *because the Jeffery QUAD stands alone.*

Why?

Because the power is applied on all four wheels through M. & S. Locking Differentials which direct the full power into any wheel or wheels that can get traction.

Pulls on all four wheels.

Brakes on all four wheels and drive shaft.

Steers on all four wheels.

Carries 2 tons on its back.

Goes through mud or snow up to its hubs.

Climbs difficult grades.

Turns within 42 feet.

Economizes tires.

Consequently the four-wheel drive constitutes a tremendous valuable reserve, an increased factor of safety—a reserve and a factor of safety existing solely because of the construction and design of the QUAD, *not because* of any costly increase in motor power.

It will go where no other rear-drive truck ever built can follow—through hub-deep mud, over plowed fields, up incredible grades, over desert sands and rock-strewn mountain trails.

There are 3000 Jeffery QUADS already in use—built, bought and delivered in the last two years.

Right now—and for some weeks to come, when the slush and mud of Spring are harassing the owners of rear-wheel-drive trucks—QUAD owners are reaping their reward of their sagacity in overwhelming measure.

At your request we will tell you the whole interesting QUAD story.

Address THOMAS B. JEFFERY COMPANY, Dept. S. A.- 3, Kenosha, Wis.

Read What Users of the Quad Say:

Does the Work of Four Teams

"Our Jeffery Quad with two men during one season's run did approximately the same amount of work as would have taken four teams and five men to do. Dyresville is centrally located in our territory which includes a number of inland towns connected by soft clay roads. Rain or shine, cold or warm, we drove the Quad and covered the territory. The facts show that we get the business."—Standard Oil Company, Reif Bros., Dyresville, Iowa.

Through 32 inches of Snow

"The Jeffery Quad Truck has operated in this territory with great success and has proved efficient in every respect. On December 14, 1915 this truck was operated along the main streets of Pittsfield, going through thirty-two inches of snow and mastered the situation very nicely."—The Texas Co., Pittsfield, Mass.

Clipping from Pittsfield paper:—The Texas Oil Company delivery truck was out this morning at seven o'clock plowing its way through the snow in fine shape in sharp contrast to the difficulty experienced by other vehicles.

Wonderful Performance

"We have used the Jeffery Quad on road building for the past four months and find that it not only does the work of hauling gravel, shells, etc., used in the construction of roads in this country, but owing to the traction it gets, due to the power on all four wheels, its performances in getting in and out of places are really wonderful and on this account alone we find the Quad almost indispensible. We find that the Quad does everything claimed for it by the Jeffery Company; in fact, we believe it does more."—Office of Revenue and Road Commissioners, Mobile County, Ala.

Goes Where Teams Could Not Go

"We like the Jeffery Quad very much. In summer we use it for sprinkling the streets and it did the work of two teams and covered twice the ground; that is it went on all side streets and over hills where teams could not go."

"October 1st we changed it to a fire truck and to try it out went up a twenty-five per cent grade with twenty-one men on the truck through a foot of snow. As an all around business truck it is the best I have ever seen."—H. M. Tucker, Chief, Lebanon Fire Department, Lebanon, N. H.

Low Gasoline Record

"The Jeffery Quad we bought for our Kansas City Plant has been in constant service since August, 1915 and is giving us most excellent results in efficiency and economy of operation. The very steep hills of Kansas City have been a serious problem in the matter of motor truck deliveries, but our experience with the Quad has been most satisfactory and we attribute its success to its additional traction. This truck has run an average of 4.56 miles per gallon of gasoline which we consider very satisfactory considering the service in which it is employed.—Morris & Company, Union Stock Yards, Chicago.

Does Work of Ten Mules

"Our Jeffery Quad trucks have each made approximately ten thousand miles. We have been hauling sand, cement, lumber, machinery, reinforcing material for concrete work, together with supplies and provisions for the men from Del Rio to a point sixteen miles south on the Rio Grande. These trucks are both running on the original tires, which apparently have a great deal of wear left in them. As nearly as we can estimate, these two trucks are each doing the service of ten mules."—Val Verde Irrigation Co., San Antonio, Texas.

Over Mountain Roads 25% Grades

Our regular run with the Jeffery Quad is between Alturas and Cedarville, Calif., a distance of twenty-five miles, for the most part of steep mountain roads varying from eleven to twenty-five per cent. Over these roads in the wettest season the Quad could always haul its capacity load without trouble. The conditions under which we work were severer by far than those ordinarily encountered.

"The Quad gave very good satisfaction and we give it our heartiest endorsement to every prospective buyer"—Intermountain Transportation Company, Alturis, Calif.

Through 3 Feet of Snow—Impassible to Rear-Wheel-Drive Truck

"Our Jeffery Quad goes over roads impassable for rear wheel drive trucks. We have had experience with both and have a rear drive truck in our business. The Jeffery Quad is now negotiating roads through three feet of snow. Our rear-drive truck is laid up on account of the snow. The Quad has been in service we purchased it."—Paulos Brothers Express Co., Salt Lake City, Utah.

Jeffery Quad

Power on All Four Wheels

Economic Preparedness

(*Concluded from page* 237)

of our size and need and opportunity. To increase the yield of our farms and to give us an independent and adequate supply of nitrogen for the explosives used in war, we must set water wheels at work that will fix nitrogen in lime.

Two resources of little or no value alone, but together constituting wealth, we have in abundance. Land without water is not available for agriculture; water, master and not servant, destroys property, industry, wealth and lives.

Many rivers, great potentially as sources of irrigation, in periodical overflows and floods do incalcuable damage. When we have conquered our rivers and made them serve by spreading out at our will, not theirs, over the land we wish to make blossom under the beneficent influence of irrigation, we will have added to our national preparedness a factor the value of which cannot be computed.

No one can take the yearly toll of lives lost and property destroyed by the furious and unrestrained sweep of our rivers without realizing that the people of this country cannot regard themselves as owning this land, really possessing it, until they have brought these waters under subjection. And in doing this they will literally create new land by the millions of acres, lands that will support millions of people as against the thousands which live upon it to-day. And in saying this I am not speaking without authority, for a year ago we enjoyed the value of a visit from the renowned builder of Assonan Dam, Sir William Willcocks, who has spent his life in India, Mesopotamia, and Egypt, as a river tamer. And after he had seen our problem he sighed with regret that it might not be his fortune to see the day that he said would surely come, when the valley of the Mississippi would be another valley of the Nile, only greater in area and more perfectly adapted to the white man's life. This is the largest task that the Government must undertake soonor or later, and the sooner, in my judgment, the better.

How these great works can be carried on calls for constructive thought, not merely on the engineering side, but more immediately upon the financial side as to those ways and means by which the lands reclaimed shall be made to bear in some degree the burden of the expense. As to the funds which will be needed, they mount into such figures as to be staggering. And I can see no hope that this work will be adequately undertaken without the Government advancing its credit and investing directly some of its own funds. We are conducting this government from day to day out of current revenues. Only the richest of people could pursue such a policy. No private enterprise attempts it. No railroad system has been built that way. But few of the states now construct their highway systems out of the year's revenues. The permanent improvements which the whole people undertake are a legitimate charge against capital account, not against maintenance. A commission to devise the ways and means by which the states and private land owners and the National Government can coöperate in paying for the work done seems to me a more needed body than one which will report upon engineering methods.

There are other sides to the question upon which I have not touched: the conservation and development of our twenty-two millions of children, the men and women of to-morrow; the proper use of our forest reserves and the wise enactment and administration of laws regarding timber as well as minerals; the commercial development of the incredibly rich territory of Alaska, without its exploitation for the benefit of the few; the broad visioned development of inland waterways and rivers for commerce; the problem of good roads, which the automobile, and especially the automobile truck, is gradually working out.

But enough has been said to indicate that no country in the world has better material with which to work. I believe that conservation, in its broadest term, means not the mere saving of a resource against the possible future need, but making of the conserved resource as widely useful to the greatest possible number in the shortest possible time consistent with the elimination of waste. It is along this highway that this nation must move, in my judgment, if it is to be economically, commercially, humanely prepared for any future, whether of peace or war, which is to be commensurate with the opportunities nature has given us, and worthy the American character.

The American Conquest of the Air

(*Concluded from page* 247)

195,000 tons. Our coke plants allowed about 600,000 tons, worth over $38,000,000, to go to waste! Germany, the leading producer of ammonium sulphate, reported 604,000 tons as her output for 1913.

Much of our arable territory still depends upon nature's mechanism for maintaining a minute fraction of the nitrogen present on our globe in the active service of the animal and vegetable kingdoms. This small amount, about two one-millionths of the entire supply of nitrogen, is largely in the soils in the form of nitrate. It is a chief factor of plant food. With the plants it passes into the bodies of animals, whence it returns to the soil. Through the action of certain bacteria, a slight portion reverts to the elementary form of atmospheric nitrogen. Through the action of other bacteria, with the aid of certain legumes and by electric discharges in the air, a corresponding amount is constantly brought into a combined form and enters the cycle of charges. On an average, about two-thirds of one ounce of this "nomadic" nitrogen, as it has aptly been termed, is present in each square yard of land.

Prior to this age of dense population in many countries, nature's adjustments proved ample for insuring an adequate food supply. Now it is an imperative necessity in many regions to treble and quadruple the weight of grain or of vegetables obtainable from a given area. To this end plant life must have an adequate ration of combined nitrogen, accompanied by the requisite amounts of potash and phosphoric acid. This ration may be in the form of nitrates or of ammonium compounds. Cyanamid naturally falls into the latter category.

The world's supply of coal is not inexhaustible. The day may arrive when coal will be a precious commodity. Some countries are totally lacking in coal.

For the time being the regions in which intensive agriculture is practised have depended largely on Chile saltpeter for their supplies of combined nitrogen. The deposits in Chile are, however, distinctly limited. This century may witness their total exhaustion.

Farsighted economists feel, therefore, that the time has come to profit from nature's example, and to establish upon a large scale the technical transformation of atmospheric nitrogen into a combined form.

Electricity is essential in two of the technical methods found susceptible of industrial application. The first depends upon the interaction between pure nitrogen and calcium carbide, at a somewhat elevated temperature. The product is cyanamid. The second method is based upon the exposure of air in a rapid current, for an instant, to the very high temperature of the electric arc. Nitric acid is the direct product. For fertilizing purposes it is usually changed into the form of the calcium salt.

The latter method is exploited on a grand scale in Norway, where hydroelectric power is exceedingly cheap—$3.00 per horse-power annually. There are small plants at several points in Austrian Tyrol and in the French Alps.

The manufacture of cyanamid is pursued regularly in Germany, Austria, France, Italy, Switzerland, Norway, Sweden, and Japan. The only factory on the American continent is at Niagara Falls, Ontario, to which reference has already been made. In the fifteen existing works there is an annual production of 333,000 short tons.

The synthetic production of ammonia

by Haber's method, based upon direct action between nitrogen and hydrogen, at a temperature of 500 degrees C., under very high pressure, has not been attempted outside of Germany.

Coming now to the feasibility of establishing upon American soil the fixation of atmospheric nitrogen on a grand industrial scale, it is to be noted that we possess the requisite water power to an extent but remotely approached in Europe.

The present consumption of nitrogen compounds is large; the prospective consumption will be enormous.

Historically, American inventors blazed the trail for the introduction of the electric synthesis of nitric acid from the air, when Bradley and Lovejoy, in 1902, erected their plant at Niagara Falls, New York. Technically it was a success. Financially the venture was a failure.

And now, in 1916, this country is without a single factory of industrial rank occupied with the fixation of atmospheric nitrogen. We still pay the heavy tribute to foreign producers of nitrogen in a combined form. We are still exposed to the dangers of wide-spread disaster for a multitude of interests, should communication with Chile be severed. We still fail to recover the 600,000 tons of ammonium salt allowed to go to waste in our coke plants.

Is not the time ripe to consider among our plans for "preparedness" adequate measures for rendering our nation's industries and our nation's munition plants absolutely and permanently free from this ignoble dependence upon the one source under the Southern Cross, scientifically of such fascinating interest, geographically so distressingly remote?

Shall we still lag behind, while Japan, Switzerland and Scandinavia offer to us examples of how nations can create the industries vitally necessary for economic and military independence and defense?

There are rays of hope. Ambitious plans seeking to create in North Carolina a plant on a generous scale for the fixation of atmospheric nitrogen were formed some years ago, and the initial steps undertaken. The foreign capitalists in control of the fine water power involved have finally abandoned their half-hearted attempts. The property has passed into the hands of a prominent and forceful American capitalist and manufacturer, under whose guidance the long-delayed project may be revived and brought to early completion.

In a wild valley of a western state, alongside a picturesque waterfall, a purely American solution of the problem of conquering the air has also recently been worked out on a fairly adequate industrial scale. It appears of much promise to those familiar with the details.

In the most diverse quarters deep interest is being manifested in the question, as one of pressing and paramount importance.

I can but hope that, simultaneously with the creation of an American dyestuff industry and the evolution of an American potash industry, we may witness the triumph of American skill and enterprise in perfecting the conquest of the air, in transforming the invisible medium in which we live and breathe, into one of the most useful and most important factors of the country's comprehensive and self-contained chemical industry.

Commercial America and the War

(*Concluded from page* 241)

own optical glass, our own chemical porcelain, our own photographic materials, our own china, our own brushes, our own scientific apparatus, our own souvenir postcards, etc. We must utilize more and more of our own raw material. We must send less cotton abroad to be manufactured. We must send less wheat abroad and more flour. We must send abroad less of the raw materials and more of the finished manufactured products. We must make our plants more efficient, so that we may more effectively compete with our European competitors in our own markets and in neutral markets and in their own markets. We must introduce more labor-saving machinery. We must educate our workers to higher standards of technical skill. We must

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eliminate the unskilled and find and train the skilled. We must make our whole industrial organization more efficient and more economical. We must have confidence in ourselves and in our ability to compete with the other countries of the world.

But the crux of the whole matter lies in our foreign trade. It was our foreign trade which was interrupted at the beginning of the war, and it was in our foreign trade that we experienced the most serious economic effects, effects which for a time seemed likely to bring about the most serious economic consequences. The war indicated in unmistakable terms that our domestic prosperity is vitally linked up with the prosperity of our foreign trade. We found what to many of us was astounding, and to some unthinkable, that a small segment of our total business, very small when compared to the vast amount of our total trade, held the key to our prosperity.

Factors on Which Success in the Coming Commercial Strife Will Be Based

Our success in foreign trade in the future and in competition with the nations of Europe will rest on certain elemental factors:

(1) The first and most important factor is men. We must find a supply of trained men who will be able to carry on our foreign trade. Such a supply of trained men does not exist to-day. We must, therefore, find means of training men for foreign trade. We must have men who not only know business, who not only know their particular business, who not only know foreign languages, who not only are able to sell goods, but men who are able to go into foreign markets with a sympathetic point of view, and represent American manufacturers as they should be represented. In foreign trade we need business diplomats.

(2) The second factor in the success of our foreign trade is our ability to finance foreign trade. By financing foreign trade I do not refer merely to the extension of credits, or to the establishment of branch banks, or to the discounting of paper, but I refer to the whole mechanism of foreign exchange, a mechanism with which the average American business man or the average American banker knows very little, and I refer to what is even more important—that is, the investment of American capital in foreign countries. It will not be possible for us to get foreign trade in any large way until we have provided the funds with which to build railroads, docks, public utilities, factories, mines, warehouses, and the other public improvements in which capital must be invested.

(3) The third element in a successful campaign for foreign trade is the establishment for this country of a conventional tariff system. For the very reasons which I have already pointed out, it is impossible for the United States to maintain an isolated economic position. We inevitably have certain relations with other nations. We import their commodities and we export our commodities. Many nations are able, by means of their tariff systems, not only to prohibit the sale of or to handicap the importation of commodities from nations which may be economically unfriendly, but they are also able to encourage the exportation of their own commodities by advantageous bargains with countries which are economically friendly. The conventional tariff system means a tariff system with an international point of view. It is the kind of a tariff system which, because we lack that international point of view, we could not have up to the present. It is the kind of a tariff system which, with the present enlightened administration of our foreign affairs and with the intelligent interest in our commerce that is being taken by Congress, we can now have.

(4) In the fourth place, we must prepare to become the market place of the world for certain staple commodities. In spite of the fact that we have consumed about half of the world's output of crude rubber, we have imported a large part of that rubber from England. In spite of the fact that we have consumed over one-third of the world's total output of tin, we have never smelted any tin, and we have purchased it from Europe. In spite of the fact that we are the largest consumers of wool in the world, we have purchased more than half of our imports from England. In spite of the fact that we are the largest producers of cotton in the world, we have permitted certain European middlemen to handle a goodly proportion of our output of cotton. We must be prepared with all the machinery of an international market to handle these world supplies. We must have at our important markets the machinery for handling these commodities. We must have ample warehouse facilities. We must be able to handle the commodities economically. We must be able to grade the articles. We must have exchanges where they can be readily bought and sold. We must have arbitration committees for the settlement of disputes between sellers and purchasers. All of these things must be done before we can take our place as the leader of the world's commerce.

(5) The final factor in the development of our foreign commerce is the necessity of an American merchant marine. American capital, for one reason or another, has been reluctant to enter this field of economic endeavor. We have frequently heard that our navigation laws are antiquated and operate to the disadvantage of American boats. Yet recent investigations have disclosed the fact that there are no important differences between the laws of the United States and those of other countries having large merchant marines. It is high time that private capital went into the business of supplying the United States with a merchant marine. If private capital is not willing to go into that business, and to go into it quickly, the Government should come to the aid of our manufacturers who wish to export their commodities under conditions which are substantially equal to those of their competitors. We should not be left at the mercy of other nations who may wish, from whatever motives, to prevent the exportation of American goods to foreign countries and to control the marketing and handling of these commodities.

What We Have Accomplished in Preparation for Peace

Let us take a brief account of stock. The United States has made some preparation for peace, and there are other preparations planned and under way.

(1) Under the Federal Reserve Act and with the creation of the Federal Reserve Board, our financial resources are for the first time in our history mobilized for foreign trade. The creation of a discount market and the establishment of branches of national banks in foreign countries are new tools, invaluable in our campaign for foreign trade, as well as in preparation against difficulties at home.

(2) The creation of the Federal Trade Commission opens up another avenue of approach to the goal of a better and a bigger business. It is to the Federal Trade Commission that we look for guidance and advice in the matter of combination for foreign trade, and it is to that body that we look for protection against international unfair competition. The Trade Commission is also prepared to set our domestic business right and to lay down the rules of the game. We all look forward hopefully to the results which this Trade Commission will obtain in making the conditions of business in this country more stable and more certain, and hence better prepared.

(3) Definite constructive work in advancing our trade frontiers is being done by the Bureau of Foreign and Domestic Commerce. The chief function of that Bureau is to promote our foreign trade. The actual practical results, too numerous to mention, are the best tests of the success of its work. The Bureau collects information about foreign markets for American goods. This information comes from the consuls, from the commercial attachés, and commercial agents. The office in Washington is the warehouse or distributing depot, and the staff there and in our branch offices is a selling organiza-

tion, a selling organization engaged in selling that information for action. Action is the price, and results are the objects of our work. We have asked Congress for a large additional appropriation, in order to put our equipment in this respect on a par with that of the other great countries of the world.

(4) Now we come to two arms of our service which do not exist, but which, if you, the public, and Congress, your representatives, desire, will soon come into existence. The creation of an expert and practical Shipping Board will do much to make possible the establishment of a merchant marine for the United States. The first and primary function of this Board is to discover what needs to be done, and the second is to do it. Large powers are to be entrusted to the Board, powers which even compass the purchase and operation of vessels. These are powers, however, which are to be used only in case of emergency, and only when the establishment of a merchant marine can be attained in no other way. The establishment of a Federal Shipping Board is a very important part of our preparation for peace, and one which we cannot safely delay.

(5) If it is true that we are no longer an isolated nation, capable of living for and within ourselves, alone; if it is true that we want to conquer and can conquer foreign markets; if it is true that we have acquired an international point of view and are prepared to take a leading rôle in the concert of nations, we can no longer use the present unwieldy and unscientific machinery of tariff making. If we wish to make our tariff an aid to our foreign trade rather than a hindrance, there must be some continuous and thorough body empowered to collate and assemble the facts for the use of Congress. Under our form of government and under our Constitution, the actual making of the tariff must be done by Congress, naturally through a committee. A Congressional committee, however, is not fitted to make the careful investigations and scientific researches which should be the preliminary to any tariff making.

If we are going into the world's markets, we must throw off the swaddling clothes which have protected us from the world's competition. It is only in rare cases that our industries may find it impossible to compete on equal terms with industries abroad. A tariff board can but determine these questions. A tariff board is another link in the chain of our preparedness for peace, and is another link which should soon be added.

Let us look forward to the coming of peace, and let us prepare for the results of that peace which we can already see are inevitable. Let every manufacturer and business man in the United States decide for himself what the results of this war will be, and let him make adequate preparation for peace. I, for one, believe that the United States is entering on a new period in her economic history. There was a time when the United States consisted of a few struggling colonies on the Atlantic coast. She gradually expanded into a great agricultural nation, and of late we have developed industrially and our manufactures have become important. Now we are entering upon a period of international commerce, when the United States will take her position at the head of the commercial nations of the world.

Features of 1916 Motor Truck Design

(*Concluded from page 251*)

seventh of what it was two years earlier, is because most of the truck makers have considered it more advantageous to use the simpler and more efficient worm gear drive. As this form of axle is now produced in large quantities, and as the power is transmitted through but one set of gears, it can be built actually cheaper than the more complicated double reduction drive. It is not only more efficient, but it is a quieter form of drive gearing.

Considering power plant design, we find that the four-cylinder motor is practically supreme in the truck field as 96.6 per cent of the 1916 trucks are equipped with this efficient and time proven power plant. The two-cylinder opposed motor is found in but 2.4 per cent of the truck models, while the six-cylinder type meets with but little favor as it is used in only 1 per cent of the trucks.

Taking up various details of engine design, the block casting predominates as 59 per cent of the trucks utilize engines having the four cylinders cast together; 36 per cent of the truck engines have the cylinders cast in pairs, while but 4 per cent have the individual cylinder castings. The L head type of motor in which all valves are carried at one side of the casting predominates, as 78.5 per cent of the truck engines are of this type. The T head form where the valves are carried on opposite sides of the cylinder is found in 14 per cent of the truck motors. The valve-in-the-head type is used on 3 per cent, while that form in which one valve is mounted in the cylinder head and one at the side is used in about 3 per cent. The average engine size for the coming season is almost the same as that for the past year. In 1915, the average bore was about 4¼", the average stroke 5¼", and the rating about 28-horse-power. The average bore for 1916 is 4", the average stroke 5", and the average capacity, 25-horse-power.

Ignition, Lubrication and Cooling Systems, and Methods of Engine Control

In considering ignition practice, the high tension magneto used in conjunction with but one set of plugs and no auxiliary battery is found on 73 per cent of the truck power plants. The dual system in which the battery is used in connection with a transformer coil as an auxiliary to the magneto is found on 27 per cent of the truck engines. Double ignition systems in which two sets of plugs are used, each system being entirely independent of the other, which had a representation of about 5 per cent in 1915, are not found at all in 1916 practice.

Lubrication is for the most part by the constant circulation-splash method which is found on 57 per cent of the power plants. The splash-pressure system is used on 30 per cent, while the pressure system without splash is used on 10 per cent of the engines. The average engine speed of the 1916 truck motor has been increased over that of last year to some extent, since in 1915 the speed was about 1100 R. P. M., while this year the speed is 1300 R. P. M. The average gear ratio is such that about 15 miles per hour speed of the truck is obtained when on direct drive.

Water-cooling by pump circulation seems to be the accepted practice, although thermo-syphon cooling has made a slight increase. A point to be noticed, which is clearly brought out in the graphic chart, is the almost entire elimination of the air-cooled class.

The finned-tube type of radiator in a cast metal case is becoming more popular than the cellular or honeycomb type enclosed in the less substantial sheet metal case. This is because the honeycomb type of cooler is a much more delicate structure than the tubular type and is also a more difficult type to repair.

A feature of some importance in connection with the motor truck power plant is the method of control. Hand spark advance is found on 58 per cent of the trucks, this year; fixed spark on 25 per cent, and automatic advance on 15 per cent. Governors are also being applied more generally in securing an automatic control of the truck engine. In those trucks using governors the centrifugal type is the most popular.

Trend of Power Transmission Practice

The next point to consider is the trend in power transmission practice. The demand for cleaner chassis lines has greatly increased the percentage of unit power plants. In one of the accompanying illustrations are shown the variations in practice for 1915 and 1916.

The selective type of gear box in the three-speed pattern predominates in this year's motor trucks. The selective sliding gear form is found on 83.6 per cent of 1916 commercial vehicles. The individual clutch type is found on 7 per cent; the progressive sliding gear on 5 per cent, and the

planetary on 1 per cent. Friction drive is losing ground very fast, but 1 per cent of the 1916 trucks using this change speed gearing.

There has been a marked increase in popularity of the dry disk clutch and a decrease in the use of the cone clutch. In 1915, the various clutch types were represented as follows: Dry disk, 28 per cent; cone, 42 per cent; multiple disk in oil, 18 per cent; dry plate, 8 per cent; expanding shoe, 2.1 per cent; plate in oil, 1 per cent. In 1916, 48 per cent of the clutches are the dry disk pattern; 26.3 per cent are of the cone design; 13 per cent are of the multiple disk in oil type; 9 per cent are dry plate forms, and 1 per cent each expanding shoe and plate in oil constructions. The gain in the dry disk clutch percentage has been made at the expense of both the cone and multiple disk in oil types.

Frame Construction and Spring Suspension

In considering some of the features of the truck chassis we find that the pressed steel frame is by far the most popular form except on very heavy trucks or those of exceptionally long wheel base where the frames are built up specially of structural iron shapes. The great increase in the application of the Hotchkiss drive principle is shown in the pronounced augmentation of the semi-elliptic spring percentage. The rear springs of 88.5 per cent of the 1916 trucks are of the semi-elliptic form. The platform spring suspension is used on 6.5 per cent. The full elliptic is used on 2.7 per cent, the three-quarter elliptic on 1.4 per cent, and the cantilever on but .7 per cent. Semi-elliptic springs are practically universal for supporting the front of the chassis as these are found on 96 per cent of the 1916 trucks. The full elliptics are found on but 2 per cent. These springs are called upon to resist driving and braking torque in 81 per cent of the trucks this year, while a torque arm is provided on 10 per cent and a torsion tube on about 7 per cent. Propulsion through radius rods is noticed on 48.6 per cent of the trucks this year, which is a material reduction from the 72.7 per cent of last year. Propulsion through the springs is found on 47 per cent of the trucks, which is a material increase over the 23 per cent of 1915 practice.

Tire Equipment, and Simplification of Body Design

The loads are carried in practically all trucks on solid rubber tires and there seems to be a tendency to use single tires on the rear wheels as well as on the front wheels, except in those trucks where the capacity is so great that a single tire cannot be obtained of sufficient width to carry the load successfully. During the past year, single tires, 8-inch, 10-inch and 12-inch in width have appeared and while these have not been generally applied, tests have shown that they are practical and some tire manufacturers recommend them instead of the 4-inch, 5-inch and 6-inch dual tires. In 1915, 51 per cent of the truck models on the market had single rear tires. This year, 55 per cent of the trucks are so equipped, despite an increase in the average carrying capacity.

In conclusion, attention is directed to the bird's-eye view and side elevation of typical truck chasses illustrated herewith. These show in a readily understandable manner the trend of average practice. The clean cut appearance and simplified design made possible by the use of the unit power plant, Hotchkiss drive and completely enclosed drive gearing are apparent at a glance. The main features of development are pointed out so that even the reader without a general knowledge of automobile construction should readily identify the various improvements. The graphic diagrams should also assist materially in comprehending the general trend of 1916 truck designing practice.

Holland in the Grip of Its Old Enemy

(*Concluded from page* 235)

submerged districts were used as refuges for people and cattle because the church is always on the highest spot of a village and it is often spared by the waters; in any case, it is the last bit of ground to be submerged, so that rescue can be awaited there. The Queen and the Prince Consort went at once to the inundated districts and were untiringly busy visiting all the places that have suffered by the catastrophe.

Experts say that the great calamity would have been spared North Holland and the districts along the opposite side of the Zuyder Zee if the plans for reclaiming the sea had been executed. The Great Dyke and embankment with the sluices closing off the Zuyder Zee to the north most certainly would have prevented the excessive piling up of the water and ensured an outlet for the overplus. In some places the flood stands three or four meters above the land, in others a few inches. So alas! It is again the World War that is responsible for this disaster, for owing to political uncertainty and the necessity of keeping the defensive inundation system in constant readiness, it was impossible to even begin parliamentary discussion of the Zuyder Zee plan.

De Kieft Kamp, Hierden, Holland.
January 20th, 1916.

Making the Desert Bloom

(*Concluded from page* 243)

of stagnation in development prevailed all over the west.

In the passage of the Reclamation Law on June 17th, 1902, a new impetus was given to desert subjugation. Three years later found the federal engineers engaged upon a number of the greatest irrigation works in the world, and since that time progress has been steady and substantial.

To-day the whole world is cognizant of the fact that through Government effort we have constructed four of the highest dams, two of the largest irrigation tunnels, and two of the most capacious storage reservoirs on earth. A million acres of desert have been transformed into fruitful farms tilled by 29,000 families.

A summation of the work of the Reclamation Service to the beginning of the present fiscal year, June 30th, 1915, shows that it has dug 9,592 miles of canals and ditches, and excavated 89 tunnels with an aggregate length of more than 25 miles. Dams of masonry, earth, crib, and rock fill have been erected with a total volume of 12,200,000 cubic yards. These include the four highest dams in the world. The available reservoir capacity at this time is approximately 6,500,000 acre feet, or sufficient to cover the states of New Jersey and Delaware to a depth of 12 inches. The Service has built 4,622 bridges with a total length of 19 miles. Its culverts number 5,714, and are 36 miles long. There are now in operation 298 miles of pipe line and 85 miles of flumes. The Service has built 784 miles of wagon road, much of it in what was before inaccessible mountain regions, 82 miles of railroad, 2,534 miles of telephone lines, 429 miles of power transmission lines, and 1,068 buildings, such as power houses, pumping stations, offices, residences, barns and storehouses.

The excavations of rock and earth amount to 130,149,368 cubic yards. The Government has used 2,501,382 barrels of cement, and has manufactured 1,177,215 barrels of cement and sand cement. The power development amounts to approximately 35,000 horse-power.

The projects now under way or completed embrace approximately 3,000,000 acres of irrigable land, divided in about 60,000 farms from 10 to 160 acres each. During the year 1915 water was available from Government ditches for 1,450,407 acres on 29,017 farms, and the Government was under contract to supply water to 1,088,003 acres. The net investment of the Service to date is approximately $100,000,000. The assessed valuation of the land and improvements is probably double this sum.

A Few of the Larger Projects

In the variety of the engineering problems, in the magnitude of the works, and in the extraordinary character and number of difficulties encountered in prosecuting the work, the Salt River Project in Arizona ranks among the great achieve-

ments of the Service. The principal and most imposing structure is the Roosevelt Dam, which blocks a narrow canyon at the confluence of Tonto Creek and Salt River. The structure of rubble masonry, arch, gravity type, is 280 feet high, 1,115 feet long on crest, and contains 342,325 cubic yards of material. All materials for the dam were found at the dam site, including the cement. The latter was manufactured in the Government's own mill above the dam, and a saving of $600,000 resulted from this unusual enterprise. The flood waters of both the Salt and Tonto are stored in the enormous basin created by the dam, its capacity being 1,427,000 acre-feet, or sufficient water to cover Delaware a foot deep.

The site of Roosevelt Dam is 62 miles from the nearest railway, and the region was without trails or roads. A fine highway costing $350,000 was built through the mountains before work on the dam began.

Irrigation is not from the reservoir direct. The valley lands are 70 miles below and stretch out in the form of an enormous fan. As needed, water is passed through the tunnels in the cliffs which form the abutments of the dam, and flows in the stream channel to Granite Reef, at which point a million dollar diversion dam has been built. From this canals take out on either side, extending down the river and covering about 220,000 acres of the valley. In connection with the canal system several large power plants are in operation developing about 20,000 horsepower and utilized for all purposes, pumping, lighting, street cars, and manufacturing. The gross expenditures on this project to date are about $13,600,000. The annual gross returns from the lands in crop is more than $4,000,000. Less than 175,000 acres are in crops. There are 3,600 farms irrigated from this system and the valley has become one of the show places of the southwest.

Arrowrock dam in Idaho is probably the most spectacular structure the Government has built. Completed last October, it ranks all other dams in the world in its height, 350 feet above bed rock. It is of rubble concrete, arch gravity type, and contains 585,130 cubic yards of material. It was built by Government forces in record time and at a cost of a million dollars less than original estimate. Before actual construction began the Government built a standard gage railroad 24 miles long to transport the machinery, cement, and the supplies for an army of laborers employed at the camp. This railway doing a regular transportation business shows a profit of $9,000 annually for five years. In connection with the project three other dams were built, one for diversion and power, and the others for supplemental storage. The cubical contents of the last two exceeded 2,700,000 yards. Boise project contains the largest area of irrigable land included in any Government project, 255,000 acres. It is a region renowned for the fertility of soil, charming climate, and excellent markets. It contains 2,600 farms, and from 58,064 acres actually cropped in 1914 the gross returns were $1,033,447. The Government investment to June, 1915, was $11,503,563, at which time the project was 85 per cent completed. There are exceptional opportunities here for homeseekers, as large tracts of state land remain to be sold.

Elephant Butte dam blocks a canyon in the Rio Grande, New Mexico, just below the black butte from which it takes its name. This wonderful structure will be dedicated in September, and the Southwest is preparing a fitting celebration for the occasion. The dimensions of this dam are impressive. It is of rubble concrete gravity, without curve, 1,250 feet long on the crest and 300 feet high. Its volume is 610,000 cubic yards. It takes its place among the greatest structures of the age by reason of the enormous capacity of the reservoir created by it. The lake behind the dam has an area of 2,627,700 acre-feet, or enough to cover the state of Connecticut 10 inches deep. It is the largest irrigation reservoir ever built. The stored water will be diverted to four valleys containing 180,000 acres of fertile land, a large portion of which is now virgin desert.

The Minidoka Project designed to irrigate 150,000 acres, in southern Idaho, has a large power plant utilized to pump water to 5,500 acres. Surplus power is sold by the Government so cheaply that it is quite commonly used in four towns for lighting, heating, and cooking. Groups of farmers have built their own power lines and now enjoy the use of electricity on their farms. Probably more farm houses on this project, which was desert in 1904, are to-day using electricity for general purposes than in any other section of the world.

Proud as we are of the great work done in the desert, let us refrain from boasting. We should remember that Argentina is constructing a single irrigation system which will cost $60,000,000; that English canals water 15,000,000 acres in Egypt and 35,000,000 acres in India, and a revenue of 5 to 7 per cent is collected each year on the investment.

American people cannot rightly claim to have measured up to their opportunity until the deserts and the swamps have been replaced by vistas of prosperous farmsteads.

Industrial Preparedness for Peace

(*Concluded from page* 240)

ally compete with vastly different conditions in foreign competition. I say this with a full desire to see the condition of the laboring men in this country kept to a high standard, but to do this by coöperation with the employer rather than by coercion against him supported by legislators catering for votes.

"During the past ten years I have seen much destructive legislation and very little constructive. I have seen much interference with business to its disadvantage and very little to its advantage. I have seen highly specialized businesses, covering enormous detail, requiring training of years, suddenly legislatively thrust under the control of politically appointed commissioners. I cannot believe that this condition can continue to exist and prosperity continue to be maintained in this country, particularly after the area of foreign competition sets in, and but for conditions brought about by the present war in Europe. I had looked to see a very disastrous condition financially in this country during the present administration. The war has temporarily, in my opinion, staved off these conditions, but danger still exists and it will be accentuated, I believe, after the war.

"I believe one of the most important and urgent of all necessities is that of a Merchant Marine, not Government owned, but supported in such a way as to make competition with foreign nations possible, and with the many restrictions which now surround the American shipowner removed so that he may have the same opportunity to exist as a foreign shipowner. I refer more particularly to recent legislation which, but for the abnormal freight rates due to war conditions, would have unquestionably wiped the American flag, not only off the East and West coasts of the country, but off the Great Lakes as well. I do not know that anything is being done intelligently in this direction, and believe it must be sooner or later, if we are to successfully compete."

William W. Lawrence, President, National Lead Company, New York:

"I would be very glad to favor you with my views on the various subjects mentioned in your letter and the memorandum attached, but in order to treat them properly I think I would have to abstain from attending to my business duties for from two weeks to a month. Therefore, I trust you will excuse me from giving my views on this very comprehensive programme.

"I will, however, take occasion to call your attention to one matter which has often occurred to me in connection with what you call 'Industrial Preparedness.' It is this: This country has had a fair example of what it means from an industrial point of view to be unprepared when they look at the case of England and France in the recent past. Both of these countries

tries, consumers of immense quantities of munitions of war, as compared with the United States, found themselves at the beginning of the war in a state of utter unpreparedness, and it is only now, after a lapse of eighteen months, that they are commencing to reach the point, by expansion of their manufacturing facilities, where they can, with the aid of the United States, come somewhere near meeting the demands made upon them."

The Heavens in March, 1916

(*Concluded from page* 248)

Canis Major, Canis Minor, Gemini, Taurus and Auriga,—all marked by stars of the first magnitude,—while Mars and Saturn add to the splendor, the latter in Gemini, the other higher up, in Cancer.

The Planets

Mercury is a morning star all this month, but is best seen at its beginning, being at his greatest elongation (22°) on the 1st. Though south of the sun, he runs more than an hour before him, and is easily visible in the dawn. He is in Capricornus, moving into Pisces later in the month, and appears about as bright as Capella or Rigel.

Venus is an evening star in Pisces and Uries, and is exceedingly conspicuous, being about seven times as bright as Sirius, and remaining in sight until 9:30 P.M.

Mars is in Cancer, past opposition, and retreating from the Earth, but still very bright, and visible until nearly 4 A.M. even at the end of the month.

Jupiter is an evening star, and is visible just after sunset early in the month, but later becomes lost in the twilight. On the 31st he is in conjunction with the sun, and becomes a morning star.

Saturn is in Gemini, almost stationary among the stars, and is well placed for observation, coming to the meridian at 8 P.M. at the beginning of the month and 6 P.M. at its close.

Uranus is a morning star in Capricornus. On the 4th he is in conjunction with Mercury, being 8 minutes of arc north of him, but it will be practically impossible to see the fainter of the planets in the strong light of the dawn.

Neptune is in Cancer, about 12° east of Mars, and is well visible telescopically.

The moon is new at 11 P.M. on the 3d, in her first quarter at 2 P.M. on the 11th, full at noon on the 19th, and in her last quarter at 11 A.M. on the 26th. She is nearest us on the 26th, and farthest away on the 12th. She passes near Mercury on the 1st, Uranus on the 2d, Jupiter on the 5th, Venus on the 7th, Saturn on the 13th, Neptune on the 14th, Mars on the 15th, and Uranus once more on the 29th.

At 5:47 P.M. (eastern standard time) on March 20th, the sun crosses the celestial equator, passing through the point called the vernal equinox, and, as the almanacs say, "Spring commences."

PRINCETON UNIVERSITY OBSERVATORY.
February 22d, 1916.

A New Fire-Damp Tester

NUMEROUS attempts have been made of late years to construct apparatus which will enable miners at any time to test the air of the shaft in which they are working at any moment in order to determine its percentage of methane, so as to avoid the danger of an explosion from the deadly fire-damp. Such an apparatus was devised in 1913, by Haber, according to *Naturwissenschaften* (Berlin), by means of which the methane content of mine air is ascertained by physical acoustic methods. This was given the name of the fire-damp whistle (Schlagwetterpfeife).

Now, however, investigations by Prof. Beckmann and C. Steglich to determine the content of combustible substances in air have led to the invention of one or more forms of apparatus to test mine air for such matter. Prof Beckmann gives an account of this work in a recent number of the *Chemiker Zeitung* (Berlin). In this new fire-damp tester the methane content of the air is determined by chemical means, by the burning of a definite volume of mine-air and observation of the alteration of pressure thus produced within the combustion vessel. The first apparatus made was a "preliminary explosion tester," a device whose purpose is to determine whether the air contains a sufficient quantity of methane to make an explosion possible. The inventors call this a "fire-damp pistol." It is made entirely of metal and consists of a small air-pump, a manometer and a "cereisenzündung," or cerium-iron priming. When the piston of the pump is drawn out the mine-air is sucked into its cylinder, then the stopcock of the air channel is closed and the mixture of air and methane is exploded by means of the priming. When a reaction takes place it is indicated by the warming of the metal cylinder, with a higher methane content by an increase of pressure on the manometer; this is so arranged that its pointer remains at the highest point of pressure reached. A cut-off device (sperro-ovichtung) prevents the priming of the gas mixture before the apparatus is shut off from the surrounding air, thus avoiding a spread of the explosion. Combustion takes place only when the air contains from 7 to 10.3 per cent methane.

But since it is sometimes of importance in mining operations to detect a methane content in the air of 1 to 7 per cent, or of percentage higher than 10 per cent, there was a demand for the construction of suitable apparatus. In this the gas mixture is kindled by means of a platinum spiral heated to a red glow. The complete combustion of methane results in the formation of carbon dioxide and water vapor, both of which are easily absorbed. Hence, after such absorption, there will be a diminished pressure, which affords a means of testing the methane content of the burned gas mixture with sufficient accuracy for practical purposes.

The explosion chamber of this apparatus is also made of metal, and its lower part contains about 100 grammes of caustic potash; the space for gas above this has a capacity of about 140 cubic centimeters. By the aid of a suction force pump (Sangdruck pump) the metal vessel is filled with the gas mixture to be burnt. After continued pumping has caused the gas mixture to drive all the air out of the vessel the cock of the gas feed tube is closed and the platinum spiral attached beneath the cover of the vessel is brought to a red heat by two accumulator coils. A special device is employed here also, so that the current can be withheld till the explosion chamber is shut off from the outside air. The combustion chamber is connected with a mercury manometer, which shows the alteration of pressure that takes place during the burning of the methane.

The warming of the gas mixture causes at first an increase of pressure, which decreases to a diminished pressure in exact ratio with the absorption by the caustic potash of the products of combustion.

The burning of the methane takes two minutes, therefore the electric current which heats the platinum spiral is automatically interrupted at the end of two minutes. At the expiration of one more minute the apparatus has cooled off sufficiently for the manometer to be read. The manometer can be so gaged that the methane content can be immediately read. It can also be connected with an alarm arranged to indicate a given percentage of methane in the air.

The greater the danger of explosion the quicker the apparatus shows it. This is a special advantage of this new testing process. The degree of diminution of pressure read on the manometer was 8 millimeters for 0.5 per cent of methane, 46 millimeters for 3 per cent, and 100 millimeters for 6 per cent, the lowest boundary for explosion.

Another advantage of the apparatus is that all its parts are easily packed in a box. A simplified form, called a "Wettermes-lampe," has a rubber bulb in place of the metal suction force pump, and is also provided with an incandescent lamp,

so that it can be used as a mine lamp. The chief tester can be connected in a simple manner with a registration apparatus so as to work automatically.

The apparatus can also be used to test the presence of other inflammable gases, such as hydrogen and ordinary illuminating gas.

NEW BOOKS, ETC.

COMMUNITY DEVELOPMENT. By Frank Farrington. New York: The Ronald Press Company, 1915. 8vo.; 257 pp. Price, $1.50.

It is indeed a good work which the author would further—to make the small town a better place to live in, and a better place in which to do business. His suggestions will enable the local business men's organization to start right, and to meet that problem which sooner or later is sure to arrive—the question of what to do next. They are assisted in finding out what their particular community most needs, and how to supply those needs. It is demonstrated that in many ways the small town may have the advantage of the larger one, particularly if there is intelligent coöperation in town affairs. Wise advertising and an occasional celebration will do wonders. The preacher, the doctor, the lawyer, all may learn through the pages of Mr. Farrington's chatty dissertation how best to avail themselves of the little town's opportunity while in turn contributing his share to the common happiness and prosperity.

THE ENGLISHWOMAN'S YEAR BOOK AND DIRECTORY. 1916. Edited by G. E. Mitton. London: A. & C. Black, Ltd. 8vo.; 408 pp. Price, 2s. 6d. net.

The influence of the war is plainly apparent in this thirty-fifth issue of the Year Book. The section dealing with sports and games has been discontinued, and the space devoted to the more serious activities of Englishwomen as these bear upon national liberty and the same standard of honor between nations as between individuals. American women who wish to keep informed upon English law, social problems, and modern movements as they relate to woman, will find the Year Book edifying and instructive.

HEATON'S ANNUAL. The Commercial Handbook of Canada and Boards of Trade Register. 1916. Toronto: Heaton's Agency. 12mo.; 504 pp. Price, $1.25.

The twelfth edition of this Annual succeeds in placing before the public an astonishing amount of information on things Canadian. It is a political "Who's Who," and a financial, commercial and banking guide; it describes leading towns and indicates local opportunities. Among the many useful statistics offered are tables dealing with population, illiteracy, railways, the public debt, fur farming, and numerous other conditions and activities. A noteworthy feature is the economic bibliography of government reports and standard publications relating to the Dominion, under the significant caption, "Where to Find It."

THOUGHTS OF BUSINESS. By Waldo Pondray Warren. Chicago: Forbes & Company, 1916. 12mo.; 260 pp. Price, $1.

This is the business man's Book of Proverbs. That executive in embryo—the office boy, and the haughty magnate who commands his humble services, alike might profitably start the working day by reading one of its terse chapters. These put forward the highest ideals without for a moment losing touch with the practical—a most unusual achievement in inspirational writing. The pages are starred with anecdotes that light up obscure places and not infrequently radiate wholesome humor. It is a book which makes one wish to meet the author and thank him in person for the genuine help he has extended.

THE AUTOMOBILE BOOK. By Charles E. Duryea and James E. Homans. New York: Sturgis & Walton Company, 1916. 12mo.; 348 pp.; illustrated. Price, $1.62 postpaid.

There are innumerable books on the automobile, but this association of a skilled writer with the pioneer of the industry brings out certain points of superiority over the average treatise. The work carries a most concise explanation of engine details in plain language, and adds to this the fullest information on the construction, operation, and care of the car. The handy size of the volume is an additional recommendation, and it should prove extremely popular among owners and drivers.

EXPERIMENTAL WIRELESS STATIONS. Their Theory, Design, Construction and Operation. By Philip E. Edelman. Published by the Author, Minneapolis, Minn., 1916. 8vo.; 272 pp.; illustrated.

Designed especially for experimenters, this account of sharply-tuned wireless installations which comply with the new law should fill a definite need. The author aims at establishing a standard design for amateur stations, and addresses only those who pursue the art in a serious and business-like spirit. The principles upon which the systems are based are set forth in some detail, and the treatise, which includes wireless telephony and quenched spark systems, should be directly useful to the earnest amateur. This is a third and revised edition.

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

(14056) A. R. L. asks: Have you any supplements containing articles on the preparation of phosphorescent sulphides; also on the preparation of phosphorescent salts by the action of cathode rays, or in any other manner? A. We have no articles in the Sup. on the preparation of phosphorescent sulphides. The phosphorescent calcium sulphide is prepared from clean oyster shells and flower of sulphur. The shells are calcined to drive off the moisture and destroy the animal matter. Pulverize the clean portions. Put into a crucible alternate layers of the ingredients. Cover the crucible and heat to redness for half an hour. Cool slowly with the cover on. Keep the sulphide in a stoppered bottle. Barium Sulphide may be made in a similar way from native barium carbonate, Witherite; and strontium sulphide from native strontium carbonate, Strontianite. A valuable article upon Phosphorescent Bodies may be had in the Sci. Am. Sup. No. 1684, price ten cents, which can be had from the H. W. Wilson Co., 39 Mamaroneck Avenue, White Plains, New York.

(14057) A. W. asks: 1. Does a given amount of electricity flow faster or slower through the same size and length of wire at 0°C. or at 100°C.? And explain why. 2. When a watch is laid on a table and one putting one's ear on the table a few feet from the watch, the sound of the watch running can be heard. How does the sound travel from the watch to the car? 3. Sound waves travel faster in hot weather than in cold weather; do they travel farther, also? A. 1. The resistance of a metal to the flow of electricity increases with a rise of temperature. A metal would retard the flow of electricity as it was heated. Less electricity would flow through a hot wire in a given time than through the same wire when cold. With carbon the reverse is true. At a high temperature carbon has less resistance than when cold. Some alloys have very slight change of resistance with heating. Manganin and Constantin have practically no temperature coefficient. 2. Sound travels through wood much better than through the air, so that you hear the watch through the table to a greater distance than through the air. 3. The distance to which a sound may be heard depends upon the energy which is given to the sound. With a high velocity the sound would tend to travel to a greater distance, but the acoustic transparency of the air at the time is an important factor in determining the distance to which any sound may be heard. The question is not a simple one.

(14058) C. C. C. asks: 1. C claims that the sun is a source of heat and light and that the closer we get to it the warmer we will be and that the farther we get from it the less heat we get. H claims the reverse, that the closer we get to the sun the colder it is, and vice versa. Who is right? 2. C claims that the point blank range of a rifle is the exact distance it will carry up to a straight line without any drop in the missile, that a modern high power rifle with a point blank range of 1,000 yards will actually carry up to that distance without any adjustment whatever of the sights. H claims that the earth's attraction takes effect on any missile fired from any gun, and that it begins a downward course from the instant it leaves the rifle, and in order to shoot 1,000 yards the sights must be adjusted to shoot that distance. Who is right? A. 1. All astronomers believe that the sun is the source of light and heat and that it becomes hotter at a less distance from the sun and colder at a greater distance from the sun. Some poet has written of the remote planets, "One moment's cold like theirs would chill our bones, Freeze our heart's blood and turns us all to stones." 2. The Century Dictionary defines "A Point-blank Range" as the distance a missile will carry before striking the level from which it is fired, the axis of the gun being horizontal. The modern high powered rifle with its rotating pointed projectile will carry a long distance at point-blank range.

(14059) L. G. L. asks: The writer desires to learn the different principles involved in electric water heating. Particularly those devices wherein an electrically charged body or current is immersed in or passed through the water, either from a storage battery or street current. A. When an electric current is passed through a coil submerged in water, all the current is converted into heat and applied directly to the work of heating the water. There is the least loss in this of any mode of electric heating. The coil is usually encased in a German silver tube, and has a flexible double conductor to connect it to the circuit. The coil does not constitute a charged body. A current of electricity flows through it just as it does through any circuit of wire. There is a leading in and a leading out wire for the current, and the heat is produced by the resistance of the conductor, and the amperes of the current, according to the law that the heat is proportional to the resistance, the square of the current and the time.

(14060) M. M. O'C. asks: Will you please tell me through your "Query" column how cold must it be to be twice as cold as 32 degrees above zero. A. There is no definite scientific meaning to the phrase "twice as cold." Warmer means more heat, and colder means less heat. Twice as cold may, however, be taken to mean half as hot. The degrees of the thermometer as ordinarily used only imply relative intensity of heat. They do not express quantity of heat, as does the expression "twice as cold." There is a scale, called the Absolute Scale, in which the degrees are related as quantities. Its zero is called the absolute zero temperature. A body cooled to this zero will have no heat remaining in it. This zero is 459 degrees Fahrenheit, below the ordinary Fahrenheit zero. A body at 1 degree absolute will have a certain quantity of heat in it, at 2 absolute it will have have twice as much heat in it. 32 degrees Fahrenheit is 491 degrees absolute, and half of this is 245.5 degrees. This may perhaps be called half as hot as 32 degrees Fahrenheit. The Fahrenheit zero was fixed arbitrarily at the temperature of melting salt and ice. It has no natural nor scientific meaning. We had this question many times ten years or more ago. At that time the Chief of the Weather Bureau gave this answer to an inquirer, "The expression 'twice as cold' has no definite meaning, and is not used in scientific language, nor in rational popular English. We simply say 'warmer' for more heat and 'colder' for less heat. He then showed as we have done how the absolute scale might be applied to the case, and proceeded as follows: "It is not possible to say anything more definite than this, as the expression 'twice as cold' can have no real significance until a scale for measuring cold has been adopted. Heat is measured upward from the absolute zero of temperature, but cold must be measured downward from some arbitrary point that has never yet been defined."

(14061) J. S. H. asks: As the result of a discussion it has been decided to refer the matter to you for arbitration. The query being the composition of carbons, such as are used in motion picture lamps.

1. What is the base of the article, carbon as found in coke or in its purer state of graphite? 2. Does clay of any sort enter into the composition? If so, what is its purpose? 3. How are carbons formed (in molds or through a die)? 4. How is the hardness of carbons controlled? 5. What temperature is used in heating? A. Arc light carbons are made of graphite, pulverized and mixed with some binding substance, such as tar or even cheap molasses, and then forced into molds with great pressure. The soft rods are now baked in a furnace without access of air till all the material is reduced to carbon. Clay would not be used in carbons since it would reduce the power of burning the carbons. Clay is silicate of aluminum largely and this is very difficult of reducing to its elements. The compression in the molds makes the rods compact and hard. The red heat of a coal furnace is used, probably 2000° Fahr. or perhaps higher. Descriptions in full of the making of carbons may be found in Sup. Nos. 1553 and 1827, which may be had from the H. W. Wilson Co., White Plains, N. Y., at ten cents each.

(14062) K. H. asks: 1. Will you answer a question or two for one of your constant readers? What is the *shape* of a light wave? We are told in the text books that light waves are transverse ripples in the ether. Very well. We are also told that waves move outward from the light source in spherical shells. All this is very confusing, indeed. If we hold a bell out in the field and strike it, longitudinal waves move outward as spherical shells, and that is very easy to understand, but how transverse ripples can move outward from the light source as spherical shells is by no means easy to understand, and what becomes of the statement that light moves in straight lines? 2. Are there any books in print dealing with magnetism in the light of the electron theory? What are they? I am a book buyer, and I know that you sell books. I am a private buyer, however, but I have many scientific works. 3. Are the ether waves that give us the wireless telegraph circular or spherical waves? I am told that the wave length may be several miles. Is that true? That would seem to mean that the wave itself has the form of an oscillating sphere, and that the first wave has advanced that distance before the second wave starts. Can that be true? I have attended lectures by advanced monists, and they make one's head feel like a bee hive. Recently one of these lecturers explained that the person who claimed that the electron has an independent material nucleus must produce some positive proof, as all the proof we have of the electron is its electric charge, some kind of *disturbance* in the ether. Can all these things be? A. 1. You may be helped to imagine the motion of a light wave by considering a wave motion in water. The water moves up and down, the wave moves over the water. If you drop a pebble into a basin of water you can see waves proceed from it to the sides of the basin. From the point where

(14063) F. H. asks: 1. Can I make an apparatus for measuring the relative intensity of daylight at different times (not the candle-power)? If not, will you explain how it is done? 2. A friend and I want to communicate by telegraph. Will you kindly explain the apparatus used for telegraphing on a fine uninsulated copper wire with induction currents? Could a railway be used because of the relatively great resistance of iron to high frequency currents, but, as these travel upon the surface of a conductor, could not zinc covered fence wire be used for short distances? 3. Since the yellow flame of an oil lamp and the carbon filament lamp give the softest light for reading I would like to know: which would be most *efficient,* 1, the carbon filament lamp, or, 2, a highly incandescent filament lamp with a ray filter or a colored reflector? 4. In the process of making silage is the heat sufficient to kill all the life or vitamines of the raw material? A. 1. You can measure the relative intensity of daylight with any form of photometer, as compared with the light of a candle. The relative intensity is usually expressed in candles. You will, however, find the light very different at different distances from the sun, and you should record the number of degrees from the sun, approximately at least. You can obtain a photometer from dealers in physical apparatus. You may find a portable form especially adapted for work out of doors. 2. You can use the rails of a track or the wires of a fence for a telegraph line. A zinc coating on the wire will have no effect upon the transmission by the wire. We have no diagram of connections to send you. 3. The tungsten filament lamp is more efficient than the carbon filament incandescent lamp. Its strong light may be toned down by the use of semi-opaque shades to diffuse the light. These can be had from dealers. A mode of lighting, called the "semi-indirect" system, is very pleasant. 4. Dairymen now seek to have the silage kept as sweet as possible so that little acid and no disagreeable odor may be produced. This is brought about by cutting the corn fine, packing it while rather dry, and filling the silo slowly so that it will be packed down as closely as possible. The silage then heats spontaneously to a temperature above 122 deg. Fahr. which kills all ferments and prevents further chemical action.

(14064) R. B. C. asks: Would you kindly inform me what theory or theories are held to account for star-twinkle? A. The twinkling of the stars is produced by the unsteadiness of the air. It is greatest in cold weather, and when a high wind is blowing. It is also due to the fact that a star is a shining point and has no sensible disc. For this you should consult Todd's New Astronomy, which we end for $1.45 postpaid. You will find many interesting explanations of astronomical matters in this book.

(14065) F. E. F. asks: What becomes of the current in the primary of a transformer? It seems to me that since it is changed into a current of another voltage in the secondary it ought to disappear in the primary, else where does the induced current come from in the secondary? Does not the induced current in the secondary itself induce back a current in the primary, thereby strengthening the inducing current? Moreover, would not inductions pass back and forth between the coils an indefinite number of times like the reflections in a pair of parallel mirrors? But then would not the result be zero at least so far

as the current in the secondary is concerned since both currents have to contend with self-induction? In the above I am supposing the lines of force to increase in number. But when they decrease what prevents the currents in both primary and secondary from building each other up indefinitely by induction and self-induction, the direction of the self-induced current being now identical with that of the inducing current, and not reacting against it? Do you call the current induced in the secondary of a transformer a true alternating current, seeing that there are two pulses in one direction, followed by two pulses in the opposite direction? A. The current which does the work in a transformer and induces the secondary current, is constantly supplied by the generator at the station. It requires a continual replenishing of power to the dynamo to produce more current, so that the same amount of current is continually flowing through the line and the apparatus along the line. The induced current in the secondary acts upon the primary, but in both directions, so that the result is zero. It does not replenish the primary current. More power and not less, is required in the primary, or as we say, there is a percentage of loss in the transformer. The current in the secondary keeps step with that in the primary, and is an alternating current.

(14066) J. C. L. asks: Can an ounce of water be destroyed or diminished? Can any matter be reduced in its component quantity so as to apply the word "destroy"? A. It is a fundamental principle of modern science that matter can neither be created nor destroyed. Not a drop of water can be destroyed, that is, its weight be made to disappear from the universe, by any process within the power of man. Water can be changed into oxygen and hydrogen gases, but the gases will weigh just as much as the water from which they were derived.

(14067) L. M. S. asks: May I trouble you to answer the following questions and thereby settle an argument? Can a six-volt storage battery be changed fully by a current of less than six volts? We have a 10-volt shunt wound generator of thirty amperes. Can we change ten 80-ampere hour batteries with it, they being connected in multiple? Kindly recommend a book on the repair of storage batteries. Are both plates, i.e., neg. and pos. of a storage battery pasted with red lead? A. A lead storage battery is charged at the rate of 2½ volts per cell, and discharged to 1.8 volts per cell. A six-volt lead battery would have three cells, and at 2½ volts per cell requires a charging current of 7½ volts. If it is quite discharged a current of 6 volts will bring it part way up, but cannot complete the charging of the battery. It cannot charge the battery fully. Four cells can be charged in series with a 10-volt current, since 4 x 2½ are 10. With your 10 cells you can make 2½ series of 4 cells each, and connect the series in multiple. To complete the half series a wire resistance equal to that of the two cells should be put in series with the two cells. You will then have 3 series of 4 cells each in value, and your dynamo can give 10 amperes to each series. This should be sufficient to charge them, unless they are very large cells. If you are in doubt about this refer the matter to the firm who made the battery. They can tell you wha the proper charging current is. "Lyndon's Storage Battery Engineering" is the authority on the subject of storage batteries. We send the book for $4. One plate is ordinarily pasted with red lead and the other with yellow lead.

(14068) J. H. asks: Will you please tell me the estimated rapidity, at which electrons travel? A. If the modern theory of electricity is true the electron has a great number of velocities. Thompson, in the new edition of his Elementary Lessons in Electricity and Magnetism, which we send for $1.65, says on Page 2, "Electricity is now regarded as consisting of immense numbers of excessively minute atomic quantities equal among themselves, each atomic quantity being called, *one Electron.*" A current under this hypothesis is a procession of electrons, and its velocity is the velocity of the electrons. This velocity through metals will vary and be still different from the velocity through electrolytes and gases. The limiting velocity is that of light, which is but a streaming of electrons. The boldest conjecture in this theory is that electricity comes from the sun shot across space to the earth. Yet there is no reason why this should not be so if light is an electrical phenomenon, as Maxwell demonstrated it to be, and as all physicists have taken it to be since his time.

(14069) G. W. G. asks: I would like to obtain the names of at least three liquids that expand the most upon raise of temperature, and the amount of their expansion. Is the expansion constant; that is, suppose a certain liquid to be in a room whose temperature was 70 degrees, and the temperature of the room was raised 5 degrees; would the liquid expand the same amount as it would in the event that it was in a room where the temperature was 40 degrees and the temperature then raised to 45 degrees? What is the law governing the expansion of liquids? Take for example the case of a small necked bottle completely filled with liquid. The temperature of the liquid is raised 15 degrees. Will that portion of the liquid that is in the neck of the bottle move a greater distance than the portion of the liquid which is in the body of the bottle? Are all liquids compressible? If

not, what is the compressibility of water? What effect has temperature upon the compressibility of a liquid? A. The four liquids which have the largest expansion by heat, as given in the Smithsonian Physical Tables, page 236, are ether pentane, acetone and carbon disulphide. The coefficients are as follows:

	Range of Temperature.	Coefficient of Cubical Expansion.
Ether	—15—38	0.00151324
Pentane	0—33	0.0014646
Acetone	0—54	0.0013240
Carbon disulphide	—34—60	0.00113980

The expansion of liquids is not constant, but varies with the temperature, being larger for higher temperatures. The expansion of each liquid must be determined for itself. There is no law by which the expansion of an unknown liquid can be calculated. If a liquid is in a bottle uncorked, and is heated, the liquid will rise into the neck and the expansion will be shown there. The expansion is apparent, however, since the expansion of the bottle makes the bottle larger and the liquid does not rise so high into the neck of the bottle by the amount of the expansion of the bottle. The real expansion of the liquid is the sum of the expansions of the liquid and the bottle. This is the case with a thermometer. All liquids are slightly compressible. The compressibility of water is given for many pressures and at different temperatures in the tables named above on page 79. A new edition of these tables is in course of preparation. If you desire us to notify you when the volume is ready kindly advise. At 20° C and O—100 atmospheres, the mean compressibility of water is 0.0000468. The compressibility in general increases as the temperature rises.

(14070) A. H. asks: Will you kindly advise me what book is published that gives the best information regarding the relationship of the pigment colors? So far as you know has anyone ever solved the mathematical relationship? If not, would not such a work be of immense value both educationally and commercially? A. There are many books upon colors and their relations. We can furnish them upon your order. You will find a selection of four in our Catalogue of books of which we are mailing you a copy. It does not seem that a book giving the proportions of color mathematically would have a wide sale since all artists mix their colors by the eye, or, as a great artist when asked what he mixed his colors with said, "With Brains." You will find in Vanderpool's Color Problems, price $5, many examples of color mixing, with 117 colored plates.

(14071) F. M. J. asks: Will a bullet dropped reach the level sooner than one fired from a gun? The barrel of gun to be perfectly level. The range of bullet to be perfectly level; bullet dropped to start from same height and at exactly same time as the one fired from barrel leaves muzzle of gun; both bullets alike and all atmospheric conditions the same. A. A bullet dropped and a bullet shot from a gun which is adjusted perfectly level at the same instant, are both of them falling bodies from the instant they are released, and they fall equally, so that they remain at the same level all the time. They will strike a level plain below at the same instant. The velocity given by the powder does not affect the velocity downwards given by gravity. Gravity works on the bullet independently of the powder and produces its effect just as if the powder had not acted upon the bullet at all.

(14072) C. W. D. asks: Does the sun rise at different hours on different days in the year in Porto Rico, and set at different hours in the Philippines? Are the hours of darkness between Porto Rico and the Philippines the same in June as in December. A. The latitude of a place makes considerable difference in the times of sunrise and sunset during a year, especially in places far from the equator. For places in the Torrid Zone the times of sunrise and sunset vary very little from six o'clock throughout the year. Porto Rico and northern Luzon are in the same latitude, and in the Torrid Zone. There is very little difference between these places in the hour of sunrise and sunset.

(14073) N. B. H. asks: 1. Has anyone ever accounted for capillary phenomenon and surface tension of liquids on the basis of gravity or Newton's first law? Or has any such hypothesis been advanced? If so, it is never mentioned in the text-books. 2. When a stove or stove-pipe gets red hot or white hot, does one really see through the iron to see the smoke going up the pipe, or is that just an appearance caused by waves of heated air on the outside playing on the heated metal? It certainly looks like the smoke waves rolling off the fire, but I did not believe that Iron was ever transparent. 3. If an engine should "kick loose" a train of box cars on a level track with a certain velocity, and if a certain number of brakes were on, suppose a brakeman on top should release these brakes—would the cars then go faster than their rate when these brakes were set? That is, would the energy that was being used by the brakes be converted into an increased velocity, or would it merely make the cars go further before coming to rest? A. 1. We have never seen any effort made to account for capillarity or surface tension as an application of inertia. Newton's first law of motion is the expression of the fact of inertia. 2. You can easily find

if an iron stove-pipe is transparent when red hot by hanging a black iron ball in the pipe and seeing if it is visible through the iron while still below a red heat. Arrange the ball so that it can be lowered to the red hot part from some place higher up where the pipe is not red hot. We expect that you will find the flickering which you have observed is in the air on the outside of the pipe. This can be seen over a hot stove or radiator which is far below the red heat. 3. Cars running wild on a level track would not have any increase of velocity upon throwing off the brakes, since no new force would be given to the cars. They would move on with the velocity which they had at the moment the retarding force was removed, and would run till friction on the track brought them to rest. They would run further, but not faster. Since the retardation due to the brakes would cease it would probably seem as if the cars increased in speed, but this would be due to the fact that the slowing down due to the brakes was stopped.

(14074) L. L. B. asks: A cube, 4 inches on the side, weighing W pounds, and perfectly inelastic, rests on a horizontal surface with one side in contact with a perfectly inelastic, immovable, vertical wall. A pressure of *1 pound per square inch* is applied to the side opposite that in contact with the wall. The coefficient of friction between the horizontal surface and the cube is f. Is the reaction between the cube and the wall equal to 16 pounds, or 16-Wf pounds, or has it some other value? A. In the case which you propose to us, it is our opinion that the pressure of 1 pound per square inch is transmitted through the cube to the wall in the same manner as if the cube were connected without a joint to the rod which exerts the pressure. If a beam 4 inches square were pressing against the wall, with 1 pound per square inch, the pressure would be 16 pounds. The cube, 4 inches square, is in contact with the wall and does not move during the experiment. Its friction does not enter into the case till it moves. The cube seems to us simply to serve to transmit a pressure, not motion.

(14075) L. B. M. asks: 1. I understand that the force of attraction of the moon on the earth causes the tides to rise and fall about 58 inches, while the sun causes a rise and fall of about 25 inches. Under these conditions, please explain why the tides rise and fall only 2½ feet at the Atlantic side of the Isthmus of Panama, and about 10 feet at Rockland, Maine. In fact, as far as I know, the tides rise and fall more and more as we come up the Coast. Why do the tides rise so high in the Bay of Fundy? Why do the tides rise and fall on the Pacific Coast end of the Panama Canal 21 feet, and on the Atlantic end only 2½ feet? 2. Gases, liquids and solids, according to the kinetic theory, contract when cooled. Please explain why water when cooling from 4 deg. Cent. to make ice, does not conform to the above theory as most substances do, and bismuth, cast iron and water expand upon solidifying. A. If you will get a Physical Geography at your public library and study the map of the tides you will see how greatly the coast line and the depth of the oceans affect the tides. If the earth were a sphere covered with water the tide would have its theoretical value, but near a shore and in shallow water the tide is greatly changed, as you know by the height of the tide along your coast, and especially in the Bay of Fundy. The tide at the Atlantic end of the Panama Canal is very small, because of the long distance which it flows from the open ocean and the shallow and marrow openings through which it makes its way. It has come a long distance from the Cape of Good Hope, and the moon is long past the meridian of Panama. This last is also true of the Pacific end of the canal, but the flow on the Pacific side is through deep water in the Pacific Ocean, and the funnel-shaped bay makes the tide deeper as it does in the Bay of Fundy. The subject is very complicated, and we have but given hints for starting one in the study of the subject. You will be interested in the Tide Predicting Machine of the U. S. Coast Survey, which takes into account the numerous causes of inequality in the tides at any place, and gives both the time and height of the tide for any day at any date. It is described in the SCIENTIFIC AMERICAN, Vol. 110, No. 10, price ten cents. 2. We are not able to give a reason for the peculiar expansion of bismuth, cast iron and water when changing from the liquid to the solid form.

(14076) G. H. McG. asks: What is the exact nature of the law applying to the secrecy of wireless messages? A. The simple form of expression used in all of the wireless laws makes them easy of understanding to any one. Therefore, in answering this question, the law may be quoted. "No person or persons engaged in or having knowledge of the operation of any station or stations, shall divulge or publish the contents of any messages transmitted or received by such station, except to the person or persons to whom the same may be directed, or their authorized agent, or to another station employed to forward such message to its destination, unless legally required so to do by the court of competent jurisdiction or other competent authority. Any person guilty of divulging or publishing any message, except as herein provided, shall, on conviction thereof, be punished by a fine of not more than two hundred and fifty dollars or imprisonment for a period of not exceeding three months, or both fine and imprisonment, in the discretion of the court."

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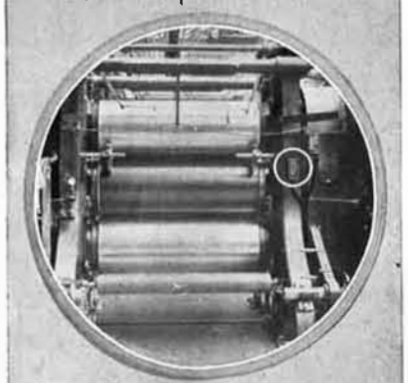

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