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

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

The Citizens' Naval Bill

THE remarkable bill for the increase of the naval forces of the United States which has recently been passed by Congress is a notable tribute to the fact that, when the people of this country at large want something done which Congress and the Administration is unwilling to grant, they have the power and the means to force their will upon Congress and secure the desired legislation. For it is a fact which cannot be disputed that the forthcoming rehabilitation of our navy is due directly to certain patriotic and non-political associations, which were formed with the single purpose of revealing to the country at large the weakness, insufficiency and unprepared condition of our naval and military forces and bringing about an appeal from the country to Congress and to the President, which should result in immediate and drastic legislation. It is sufficient in this connection to refer to the worthy efforts of the Navy League, the National Security League, and the Chamber of Commerce of the United States of America. It is safe to say that, had it not been for the work of these and similar associations, the naval and military bills passed by this Congress would have been determined, as usual, by questions of political expediency, and would have contained the usual meager provisions which, continued through a series of years past, have brought our naval and military strength to its present low ebb.

It is well to remember at this time that in the beginnings of this great popular demand for preparedness, the movement was characterized by the present administration as being political in its motives, unneutral in spirit, and altogether unjustified by the existing international conditions. It was only as the wave of popular agitation gathered in volume that Congress and the Administration began to swing into line; and this change of heart reached its highest expression when the President, during a recent tour in the West, went far beyond the demands of this citizen movement, and stated that we ought to have a navy not second but first among the great navies of the world.

It is fitting, just here, to pay tribute to the patriotic stand taken by Congressmen Lodge, Gardner, Tillman, Lippitt and Swanson, with many another, to whose vision and effort the passage of this bill is due.

The three-year building program calls for the construction in three years of 10 battleships, 6 battle-cruisers, 10 scout cruisers, 50 destroyers, 58 submarines, and certain other auxiliary ships which are to be commenced during the first year. Of the major vessels, the construction of the first year includes 4 battleships, 4 battle-cruisers, 4 scout cruisers, with 20 destroyers, 27 coast submarines, 3 fuel ships, 1 repair ship, 1 transport, 1 hospital ship, 2 destroyer tenders, 9 fleet submarines, 2 ammunition ships, and 2 gunboats.

The enlisted strength of the Navy is to be raised from 51,500 to 72,000, and the President is authorized in the event of emergency to increase the strength of the Navy to 87,000 enlisted men. The personnel of the Naval Academy is to be raised to 1,760, and the total number of apprenticed seamen at our Naval Training Stations is to be increased to 6,000. Last year's bill providing for a naval reserve failed to produce adequate results, only 300 to 400 men being secured. The poor results are considered by naval officers to be due to inherent defects in the bill, which, it is hoped, have been remedied in the bill just passed.

The four battleships will be generally similar to our latest ships of the "Tennessee" class, of 32,000-tons displacement and 21-knot speed; but with the important exception that they will carry eight 45-calibre, 16-inch guns in place of twelve 50-calibre, 14-inch guns. The present is a fine opportunity to provide a fast battleship wing for our fleet, which can be done by an increase of the displacement to accommodate motive power sufficient to drive these ships at 25 knots.

The four battle-cruisers, 850 feet in length and with 35-knot speed, mounting either 50-calibre, 14-inch or 45-calibre, 16-inch guns, if they are at once laid down and rushed to completion, will provide the United States with a division of ships of such speed and power that they will have a crushing superiority over any of the high-speed fighting elements (battle-cruisers, scouts, light cruisers and destroyers) of any other navy.

The four scout cruisers will be unique. They, also, will have a speed of 35 knots, and they will carry a heavy battery of 50-calibre 16-inch guns. To secure this combination it was necessary to raise the displacement to about 7,500 tons. We could wish that the whole ten were to be laid down this year; for we have not a single scout worthy of the name in our fleet today. If we possessed an adequate number of these remarkably fine vessels, the Commander-in-chief of our fleet would be pretty certain to have the fullest information regarding the enemy, and in a great engagement, such as the Jutland Battle, these vessels would be able to break up light cruiser and destroyer attacks before they approached that point-blank range which somehow seems to be necessary if a torpedo is to get home effectively. The provision for 20 destroyers, 27 coast submarines and 9 fleet submarines, all to be laid down this year, is eminently satisfactory; although we could have wished that the whole of the submarine displacement had been put into fleet submarines of about 800-tons displacement.

The passage of this bill puts us in a fair way to regain the position of second in strength now held by Germany. The addition of these 16 capital ships to the 17 that we have now, authorized, built, and building, will give us 33 capital ships, built and building, by the year 1920.

The minimum estimate of German losses in capital ships, made by Admiral Jellico, is six vessels of the dreadnought type, reducing the total number of dreadnoughts in commission in the German navy to seventeen or eighteen, with some three dreadnoughts under construction. Obviously we are within measurable distance of regaining the rank which we held in the year 1904-1905.

Anti-Dumping Legislation

IT is generally agreed that an international trade war is at hand, comparable in magnitude and ferocity to the military conflict now in progress in Europe. In this war our country will not enjoy the character of a neutral. Temporary conditions have developed American export trade to a pitch never before approached, and our merchants will make every effort to retain the grip they have gained on foreign markets.

In such a struggle knowledge is power, and it is therefore fortunate that abundant light has recently been shed upon the methods by which the nations of the Old World have conducted their commercial campaigns —methods that will be revived with increased vigor in the coming struggle. For this struggle the belligerent countries are already actively preparing. Rumors reach us of enormous stocks of goods accumulated in Germany—of toy factories and metallurgical establishments running on full time—with the aid of government subsidies and with a view to fresh conquests in the world's markets.

The practice known as "dumping" had been reduced to a science by the German cartels before the suspension of their activities in the fateful summer of 1914. Nothing is more spectacular in the history of international trade than the invasion of foreign markets by this drastic process. By systematic underselling, without profit or at a loss, a German syndicate would not only annihilate competing exporters, but would even crush the rival producer in the latter's home market. Thus Germany not only forced France to buy German machinery instead of American, but also to buy German carbolic acid instead of French. A German cartel would deliberately sink hundreds of thousands of marks in unprofitable sales in a foreign market, biding its time until it had the field to itself, and then raise prices *ad libitum.*

This method of competition has now come to be regarded as so formidable a menace to the countries against which it is directed that special legislative measures have been evolved to combat it, and such legislation will be more necessary than ever before in the approaching trade war.

Canada adopted anti-dumping legislation as early as 1904. The Canadian law, in its present form, provides that "in the case of articles exported to Canada of a class or kind made or produced in Canada, if the export or actual selling price to an importer in Canada is less than the fair market value of the same articles when sold for home consumption in the usual and ordinary course in the country whence exported to Canada at the time of its exportation to Canada, there shall, in addition to the duties otherwise established, be levied, collected and paid on such article, on its importation into Canada, a special duty equal to the difference between the said selling price of the article for export and the said fair market value thereof for home consumption; and such special duty shall be levied, collected or paid on such article, although it is not otherwise dutiable." This "dumping duty" must not, however, exceed 15 per cent *ad valorem* in any case. An almost identical law was enacted in South Africa in 1914.

A curiously elastic anti-dumping law has been adopted in Australia, where any form of competition is regarded as "unfair" in the legal sense if, in the opinion of the comptroller-general, or of a justice of the High Court to whom the question may be referred, such competition threatens the existence or prosperity of any Australian industry the preservation of which is "advantageous to the commonwealth, having due regard to the interests of producers, workers and consumers." It is especially provided that competition must not "result in an inadequate remuneration for labor in the Australian industry" thereby affected, nor in throwing workers out of employment. The government does not take measures against dumping of its own initiative; but if complaint is made to the comptroller-general that any person is importing goods to the detriment of Australian industries, a hearing is given to the importer, and the High Court then decides whether such importation should be prohibited or limited. The decision is final, unless overruled by the governor-general.

While in Canada and South Africa dumping is taxed, and in Australia it is prohibited, though only in a desultory way, a third method of protecting the home industry has been established by law in New Zealand in connection with the sale of agricultural implements. This method consists in granting a bonus, from public funds, to the domestic manufacturer to enable him to compete successfully with his foreign rival. This law has, however, apparently never been put in operation, though it was adopted in 1905.

The latest and most energetic legislative provision against dumping is that embodied in the revenue bill introduced in our own House of Representatives on July 1. Under the head of "unfair competition" it is provided "that it shall be unlawful for any person importing or assisting in importing any articles from any foreign country into the United States to commonly and systematically sell or cause to be sold such articles within the United States at a price substantially less than the actual market value or wholesale price of such articles, at the time of exportation to the United States, in the principal markets of the country of their production or of other foreign countries to which they are commonly exported, after adding to such market value or wholesale price freight, duty and other charges and expenses necessarily incident to the importation and sale thereof in the United States: Provided, that such act or acts be done with the intent of destroying or injuring an industry in the United States or preventing the establishment of any industry in the United States or of restraining or monopolizing any part of trade and commerce in such articles in the United States. Any person who violates or combines or conspires with any other person to violate this section is guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding $5,000, or imprisonment not exceeding one year, or both, in the discretion of the court."

This appears to be very effective "preparedness" for the new Armageddon.

The Channel Tunnel

THE present war has given new life to the enterprise of building a railway tunnel beneath the English Channel between Dover and Calais. Had the tunnel been in existence in 1914, the problem of conveying troops and supplies to the Continent would have been greatly simplified, and the burden laid upon the British Navy, in keeping open a channel ferry, would have been lightened. There are growing indications that one of the first engineering works to be undertaken at the conclusion of peace will be the driving of this tunnel through the underlying chalk formation which exists in an unbroken stratum between the French and English coasts at this point. At a dinner recently given by the Chairman of the House of Commons Channel Tunnel Committee, Mr. M. Yves Guyot stated that every one in France was in favor of the tunnel, and that as far back as 1874 an agreement was entered into between the English and French Governments, and progress was made toward the signing of a treaty. Soon afterwards a French construction company made thousands of soundings, a shaft was sunk, and an experimental tunnel 2,000 yards in length was driven.

Sir Francis Fox stated, at the same gathering, that the military objection of an invasion by way of the tunnel could be met by putting in a "dip" within a mile or so of the coast, which could be flooded by a sluice. The dip would be under military control and could be filled in five minutes' time.

Radio Communication

Radio Station at Navassa Island.— A radio station has been installed and is now in operation at Navassa Island Light Station, West Indies, now under construction. This radio station is operated at present by the contractors for the erection of the light station, and it will be operated by the United States Lighthouse Service when the light station shall have been completed. The call letters of the station are WQN.

New Naval Radio Service Regulation.—The Superintendent of the Naval Radio Service announces that, effective on and after July 1st, 1916, it will be obligatory on the part of a sender of radiograms to be handled by the Naval Radio Service to indicate in the address of the message the class of vessel it is desired to reach by this service, such as "SS" (Steamship or steamer) or "USS" (United States ship), as the case may be.

Radio Telephony Simplified.— Five years ago the wireless telephone was struggling to assert itself as a fairly successful laboratory experiment; to-day it is on the verge of competing with the wire telephone. Proof of its present high state of development is found in a little panel set suited to the needs of amateurs and motor boat owners, with a range up to about five miles. So simple is this wireless telephone that it may be operated by the veriest layman. Needless to state, the troublesome arc generator has been replaced in the present system with an oscillating vacuum valve, whose operation is most reliable.

Aeroplane, Wireless and Gun Spotting.— From the numerous reports that have been received from the Allied front in the Picardy district—the scene of the great drive—it is learned that the French have made extensive use of aeroplanes equipped with wireless for the purpose of gun spotting. One report states that a French battery dropped four shells in succession on a bridge 14 miles away, the accuracy of the fire being due to an aeroplane flying above the mark, fitted with wireless equipment. The observer signaled back the effect of the fire to the battery commander with apparently telling results.

Aeroplane Wireless Tests.—Capt. C. C. Culver, U. S. A., aeronautic radio expert attached to the signal corps training school at San Diego, Calif., recently succeeded in transmitting a radio message 20 miles from a military aeroplane while flying at an altitude of 5,000 feet. Capt. Culver sent his messages from an aeroplane piloted by Sergeant William Ocker of the army aviation school, while Dr. R. O. Shelton, an amateur wireless operator, picked up the dots and dashes. Dr. Shelton stated that in his opinion, judging from the clearness and loudness of the signals, he could have received the same signals at double or even triple the distance covered. It is reported that the set used was a modification of the apparatus carried by French aeroplanes.

Compact Wireless Set for Aviators.—Elmer A. and Lawrence B. Sperry, of gyroscope fame, have perfected a new wireless instrument which, although of such compact dimensions as to permit it almost to be placed in one's pocket and weighing but seven pounds, is said to have an effective range of communication of 16 miles. Henry A. Woodhouse, an authority on aeronautic matters, has recently stated that he believes the present wireless instrument will revolutionize the entire field of radio communication applied to aeroplanes. "Heretofore," states Mr. Woodhouse, "radio sets have weighed from two to four pounds for every mile radius. It always has been thought that an ideal set would be one that would weigh one pound for each mile radius. This instrument, as it has been shown, has far outstripped even the hopes of other inventors, and the most hopeful part of the invention is the fact that its radius may be increased with but a proportionate increase in weight."

Crystal Detector Observations.—Writing recently in the *Physical Review*, Victor A. Hune and Laurens E. Whittemore disclose several interesting points relative to the operation of crystal detectors. Galena, perikon, silicon and carborundum detectors were tested by the authors. Change in air pressure has no effect upon rectifiers. The effect of temperature is shown in a series of diagrams. One of the peculiarities noticed was that certain crystals did not always rectify the oscillating current in the same direction. With one adjustment the rectified current would flow from crystal to point and with another would flow in the opposite direction. Once during a test on the effect of change of temperature upon carborundum the rectification actually reversed, although no change had occurred in the adjustment. The most common direction of rectification for silicon and for galena was from the crystal to the brass point which was used. In the case of carborundum the ordinary sense of rectification was from needle to crystal. The perikon detector was the only one of the four which showed no reversal, always rectifying from chalcopyrite to zincite.

Astronomy

Variation in the Sun's Rotation.— From measurements made at the Mt. Wilson Observatory it appears that there is a marked variation in the rotation period of the sun at the equator. The same group of spectral lines gave in 1906 a speed of 2.064 kilometers per second, and in 1915 1,949 kilometers.

The Martian Encyclopaedia.— Thanks to a grant from the French Academy of Sciences, M. Camille Flammarion has found it possible to resume the publication of his monumental encyclopædia of Martian observations, which had come to a halt after the publication of two volumes.

The Red Spot on Jupiter.— The speed of rotation of Jupiter's great red spot has sensibly diminished since 1914. Its rotation period is now about 2.5 seconds shorter than it was a few years ago. The length of the spot has also diminished. A small oblong red spot has made its appearance on the northern border of the equatorial belt.

Prof. Karl Schwartzschild, director of the Astrophysical Observatory at Potsdam, Germany, died recently of illness contracted while on military service. Though a comparatively young man, having been born in 1873, he had attained an international reputation for his investigations in stellar photometry, his study of stellar motions, and his views on the structure of the universe. He dissented from the hypothesis of two star streams, advocated by Kapetyn, and proposed the so-called "ellipsoidal hypothesis" as an alternative.

Martian Ice Caps and Sunspots.— Recent observations made by M. Antoniadi, the well-known authority on Mars, show that the melting of the polar caps of Mars proceeds at different rates in different years, and when the statistics of the shrinkage of the caps is compared with those of sunspots it is found that there is a very slow melting when there are few spots, and a rapid melting when the sun is at maximum activity. This seems to be a striking confirmation of the view of Abbot and others that the output of radiant energy from the sun is greatest at spot maximum and least at spot minimum. The effect is masked in the case of the earth by secondary atmospheric phenomena, but on Mars, with its rarer atmosphere, the response to solar fluctuations seems to be more direct. M. Antoniadi has carried his comparisons as far back as 1856, and finds that the association holds good "as a rule." Further details of the discovery will be anxiously awaited by astrophysicists.

Early Observation of the Companion of Sirius.— The first actual observation of the companion of Sirius, the existence of which had been previously assumed on theoretical grounds, is commonly stated to have been made by Alvan G. Clark, Jan. 31, 1862, while he was testing the 18½-inch refractor which he had built for the Dearborn Observatory. Attention has, however, recently been called to a possible earlier observation by Professor Antonelli with the reflector of the Osservatorio Ximeniano, in Florence. In March, 1861, while trying this instrument at the invitation of its maker, Professor Gonnella, Antonelli noticed a minute point of light close to one of the stellar rays, and directed the attention of several other persons to it. Little notice was taken of the matter, as the luminous point was attributed to an optical defect in the telescope. Clark's discovery, ten months later, led Antonelli to suppose that he had actually seen the Sirian satellite.

Some Interesting Facts About Meteorites, gleaned from a recent work by Dr. O. C. Farrington, are as follows: About 700 recognized meteorites are found in existing collections, but only about half of these were actually seen to fall. Of the observed falls only 10 were of iron meteorites, yet among meteorites not observed to fall iron meteorites largely predominate. The explanation appears to be that iron meteorites attract the attention of the ordinary observer much more quickly than stone meteorites. The latter look like ordinary terrestrial rocks and are therefore commonly overlooked. No human being has ever been known positively to be killed by the fall of a meteorite. Probably the narrowest escape was that of three children in Braunau, at the time of the fall of an iron meteorite in 1847. This object, weighing 40 pounds, fell in a room where the children were sleeping, and covered them with débris, but they were not injured. In each of two celebrated meteoric showers—those of Pultusk and Mocs—more than 100,000 stones fell. All observed showers were of stones, but the finding of numerous individuals of iron in single localities, such as Toluca and Cañon Diablo, indicates that showers of iron meteorites sometimes occur. The largest known meteorite is one brought from Cape York, Greenland, by Peary, weighing 36½ tons. It is in the American Museum of Natural History, New York. Twenty-nine chemical elements have been found in meteorites in quantities sufficient for accurate study.

Invention Notes

Machine Takes the Place of the Yardstick.— The long reign of the yardstick in the dry goods and trimming store threatens to be ended by a new invention known as the measuregraph, which is a mechanical means of indicating yardage and simultaneously indicating the total cost of the material being measured.

A Pair of Rubber Boots that Fit the Pocket.— A pair of lightweight rubber boots which may be rolled up and carried in the pocket is principally designed for the use of amateur fishermen. For wading through streams they are worn over the leather shoes, affording all the protection of the heavy boots without the inconvenience of the latter, while on the way to and from the fishing ground. The boots are made of pure gum, fashion lined, and have an elastic top, thus fitting tightly around the leg.

Non-Losable Bottle Stopper.— A non-losable stopper for a hot-water bottle which is devoid of the inconvenient feature of the chain to secure it to the bottle consists of a scheme by which the stopper is disposed of inside the bottle, with its handle protruding outside. To open the bottle it is simply necessary to unscrew and push the stopper down far enough to allow a free passage of the water either in or out. To close, the handle of the stopper is pulled and turned and a tight seal is effected.

Periscopal Gunsight.— The principle of the periscope has been applied to the use of the soldier in a recent invention, by which the marksman is enabled to take accurate and careful aim from behind the sheltering protection of a tree or similar shield, without making the least exposure of his own body to the fire of the enemy. The tube is mounted at right angles to the weapon, with one end over the rear sight and with facilities for accurately adjusting it. Thus, from behind his shelter, the gunner is enabled to pick out his target, aim the gun and watch the effect of his shot while remaining entirely concealed. The invention is that of a Canadian resident who has just taken out patent papers in this country.

Color Effects in Rubber.— The street cleaning gangs working on thoroughfares in the business section of Philadelphia recently appeared uniformly attired in rubber coats and boots, all of a rich terra cotta shade not usually encountered in rubber goods. The appearance of a squad of fifteen or twenty men so clad was so striking that nearly all who saw them had some comment to make. The explanation is in the fact that recent developments in rubber-curing make it possible to obtain a variety of color effects, which was not hitherto possible; and the rubber men anticipate that by making their goods thus more attractive they will enlarge their field. As a result, some very pretty garments have recently appeared for the use of ladies at the seashore, to be worn over their bathing costumes while passing to and from the bathing beach.

More Cotton from the Cotton Plants.— It is hoped to get a greatly increased cotton crop from the same acreage by means of a method devised by John B. Hall of Philadelphia, Pa., who has been recently awarded a patent on his system. There is a great deal of loss in the cotton fields in the shape of cotton bolls which, for one reason or other, never mature. Mr. Hall contemplates turning the pickers into the fields a little earlier than is usual and picking all the bolls before they open. They are then treated to a bath of a solution in which starch and talcum enter largely, and in a moderately warm temperature the bolls are artificially opened and the burden of fiber is removed in the usual manner. The cotton recovered in this manner is said to be superior to that allowed to remain longer on the plant, in that it has a beautiful luster. Another interesting feature of this process is that it is said to bring about the downfall of the boll weevil, which requires to be matured in the boll.

Quick Growing Putting Green.— The demands of the golfer are so exacting that the matter of the composition and structure of the soil on the putting green has been made the subject of profound investigation. A patent has recently been granted on an arrangement found to be the most suited for the purpose. The patent has been issued in the name of Frederick W. Taylor of Philadelphia, Pa. The general object of the invention is to provide a bed on which the desired growth of grass may be quickly developed and easily maintained, and which has the necessary firmness and elasticity properly to receive the ball when hurled onto it. The bed is formed essentially of three layers—a top germinating layer, which may be from three-sixteenths to one inch thick; a deep-rooting subsoil about twelve inches thick, and an intervening layer from one inch to an inch and three-quarters in thickness. The invention prescribes the exact composition of all the different layers, and by this means it is claimed that it is possible to develop a putting green in one year to a mature and permanent stage which it has heretofore taken from three to eight years to obtain.

Possibilities and Conditions of Crossing the Atlantic by Airship

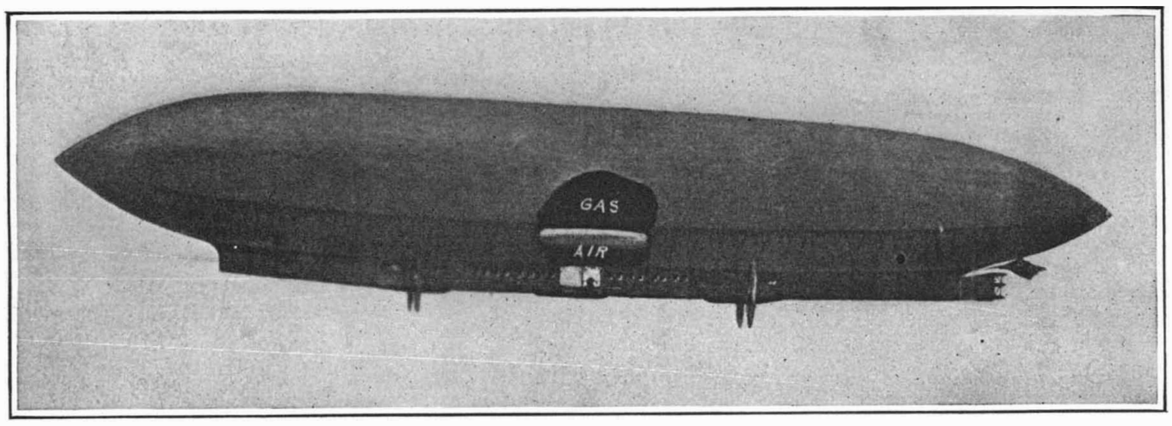
By Baron Ladislas d'Orcy, Member, American Institute of Aeronautical Engineers

IF certain rumors which have persistently been circulating of late may be credited, the Atlantic will shortly be crossed by a Zeppelin airship.

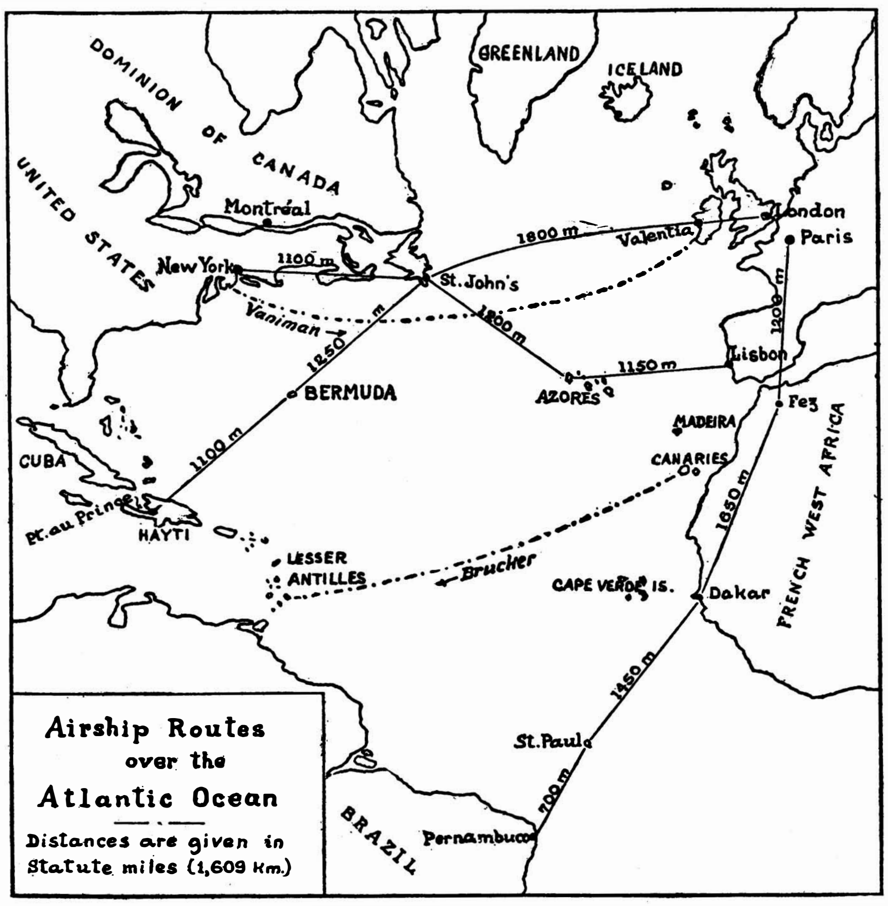
To be sure, one might be permitted to express some surprise that the Zeppelin Works of Friedrichshafen and Potsdam should dispose of sufficient leisure to carry out such an ambitious venture at a moment when all their resources are being exploited to the utmost in the production of military aircraft. Be that as it may, the fact remains that since the days the history of airship navigation was enriched by the spectacular exploits of those two glorious American adventurers of the air, Walter Wellman and Melvin Vaniman, Count Zeppelin has been perfecting plans for an overseas expedition that was to eclipse all former performances.

The creator of the rigid airship originally intended to send one of his vessels to explore the North Pole; but when Admiral Robert E. Peary got ahead of him—and incidentally of Walter Wellman—in reaching the northern apex of the earth, Count Zeppelin changed the plans of his contemplated overseas expedition so as to comprise the crossing of the Atlantic.

The organization of this enterprise was placed in charge of a special committee headed by Prof. Hergesell, the famous German meteorologist, and although no public report ever emanated from this body, one might assume that its labors received no mean inspiration from the lessons of Wellman's and Vaniman's ventures. For Wellman's airship, the "America," although she failed to accomplish the performance expected from her, nevertheless succeeded in establishing the longest endurance run—70 hours—any airship has ever effected to this day; while Vaniman's craft, the "Akron I," probably embodied the most comprehensive features for crossing the Atlantic by air, although due probably to some error of calculation, the latter enterprise ended in a terrible catastrophe. Mention might also be made here of the German-American Transatlantic Flight Expedition, headed by Joe Brucker, whose airship, the "Suchard," was to start from the Canaries and drift with the trade winds to one of the Lesser Antilles. For reasons which shall be examined later, this airship never started.

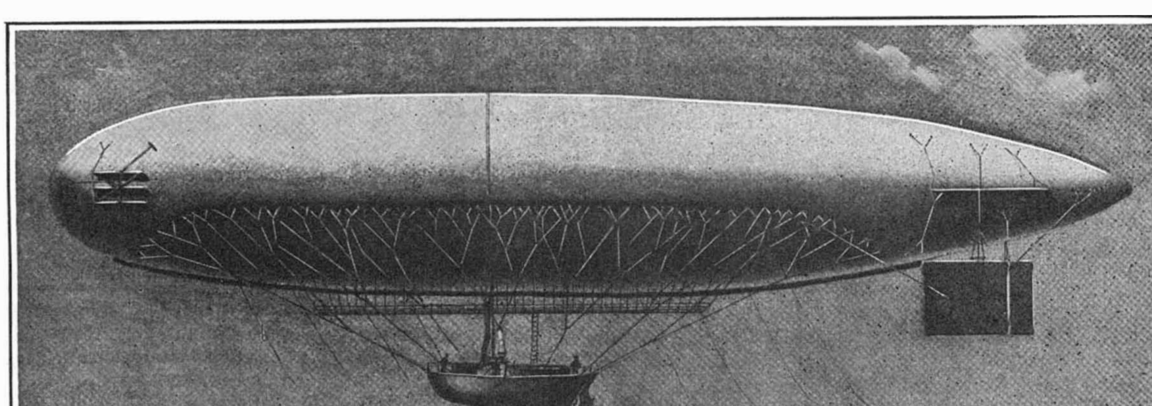


Wire-wound airship designed for transatlantic service by Vaniman



Map of transatlantic airship routes

The lay press has made much stock of these "spectacular failures," whereas any unbiased person should have realized that the story of these exploits does nothing but emphasize the difficulty of the attempt and the necessity of neglecting no detail which might be instrumental in insuring the success of the enterprise.



The "Suchard," designed for the Brucker transatlantic expedition

Summed up, the problem of crossing the Atlantic by airship consists in selecting an overseas route characterized by the most favorable meteorological conditions and by the shortest possible distance.

The meteorological requirements of such a route should be: (1) greatest possible constancy of temperature and barometric pressure and (2) winds of limited intensity.

Sudden changes in temperature and barometric pressure cause the gas to contract or to expand and the resulting difference of buoyancy must be compensated if the airship is to be kept at the same altitude. To attain an efficient control of this so-called "vertical equilibrium" has ever been the greatest worry of the aeronaut. If the gas contracts, the resulting loss of displacement and deformation of the envelope can be compensated by blowing air under forced draught into the ballonet; the lift decreases, but no gas is lost thereby. When the gas expands, its volume can increase only by a compression of the ballonet from which the air is forced out by the growing pressure of the hydrogen. But if the gas continues to expand after having taken up the volume of the ballonet, it becomes necessary to take care of the rising pressure within the envelope. On most airships this is done by one or more automatic valves through which the gas may escape once it has reached a certain pressure. Thus pressure is reduced within the gas-container and the vertical equilibrium is regulated automatically; unfortunately this process involves losses of gas which cannot be compensated.

Several systems have been devised for overcoming this deficiency of the ballonet. Wellman's "America" was fitted with a weighted trailing-rope, called "stabilizer," which was to compensate losses of buoyancy by its greater or lesser immersion in the sea. This apparatus was not found satisfactory in that it submitted the vessel to a terrific pounding whenever the sea was choppy to any degree.

Vaniman who had ample occasion for witnessing the ill effects of this "stabilizer" when he was Wellman's chief engineer, planned to replace it on the "Akron II" by an invention of his own, a steel-strand woven envelope which would not allow the gas to escape or expand, but would hold it at a uniform volume under pressure.

In Vaniman's own words "if the sun heats the gas, the pressure rises within the gas-bag, but the volume remains the same, consequently the lifting power is the same. When the gas is cooled or night approaches the pressure within the gas shell decreases, but the volume still remains the same as the gas is originally placed in the envelope at a minimum temperature. The altitude of the airship is controlled by collapsible ballast tanks into which air may be pumped; and as this gas is 14 times heavier than hydrogen, the added weight would cause the airship to descend until the air-blower is stopped."

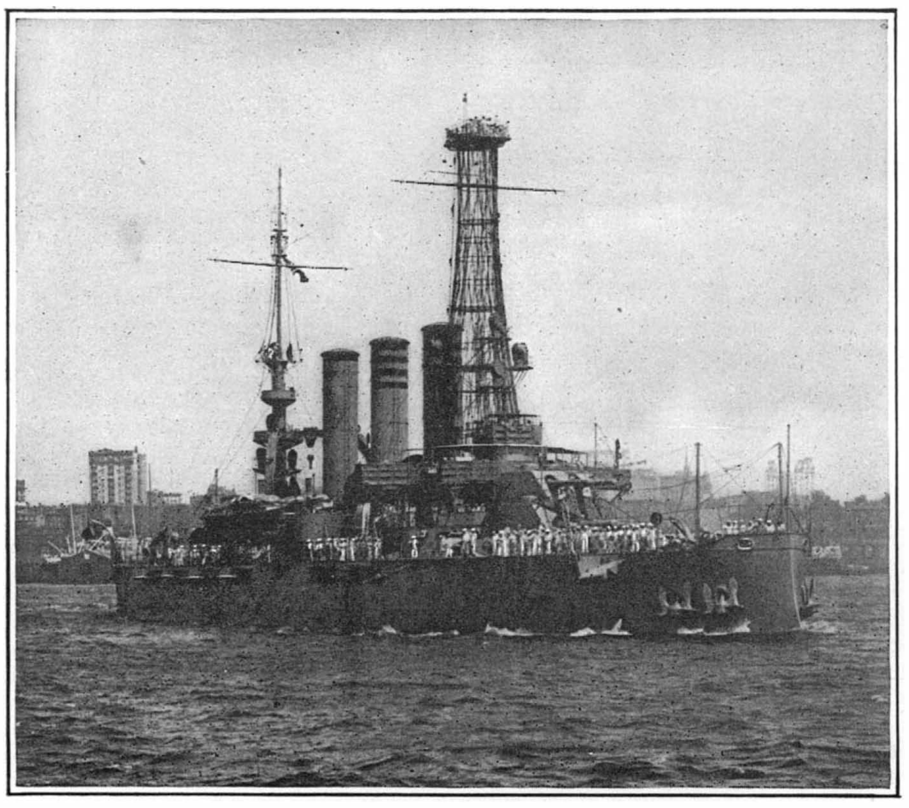
It seems most unfortunate that Vaniman should have perished in the catastrophe that destroyed the "Akron I" and her gallant crew, for nobody can tell whether the "Akron II," which was to be a non-expanding hydrogen shell from which the gas could not escape and which would be equilibrated by air ballast under pressure, was not the one culminating feature which would have solved the problem of the airship by making it as invulnerable to meteorological conditions as any transatlantic liner.

Indeed the means of statically regulating vertical equilibrium which are to be found on all other airships seem conspicuously crude in comparison with Vaniman's genial conception. On Brucker's transatlantic airship constancy of pressure within the envelope was to be insured by a water-spray which was to keep the gas under a constant temperature. It is said that on the latest Zeppelin airships the same result is attained by a double skin or cellular wall through which air is circulating under forced draught at a uniform temperature. This air may be slightly heated by the engine exhaust; it thus constitutes a very efficient insulation between the 20 or more gas-bags, which it surrounds with a continuous flow, and the atmosphere.

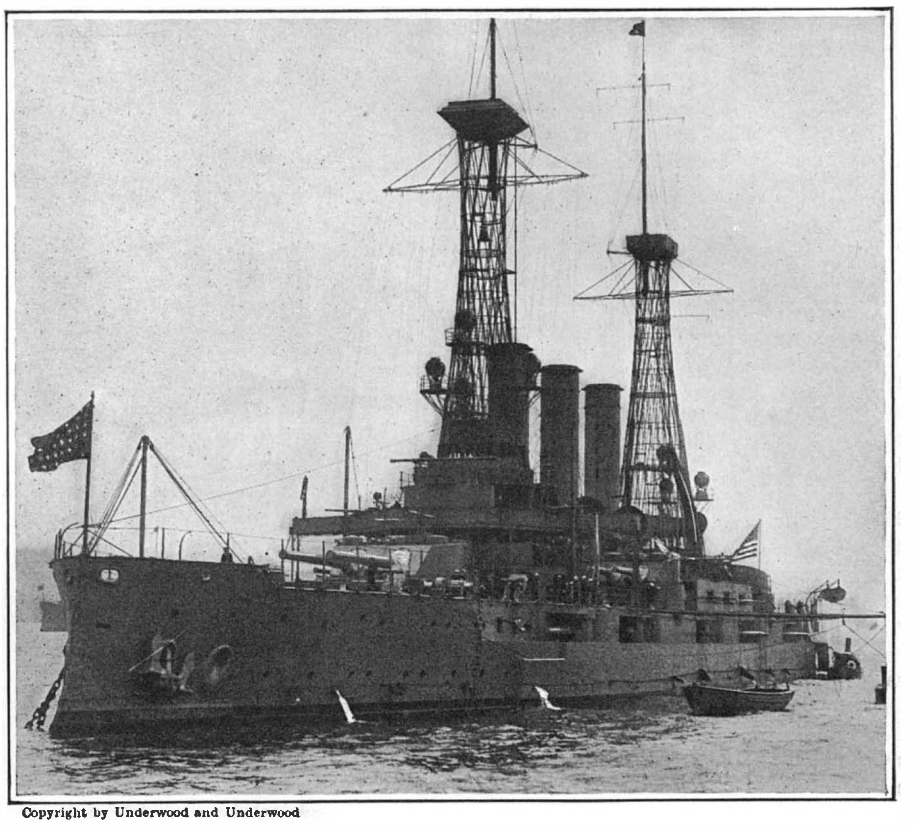
The newer Zeppelins are credited with still another feature which should go a long way towards enabling one of these craft to cross the Atlantic. This consists of a double-acting pump connecting each gas-container with a compensating tank from which hydrogen may be pumped into the gas-bags whenever the gas contracts, whereas when the latter expands the superfluous hydrogen can be forced back into the tank. This device has two advantages: (1) no gas is lost in compensating variations of buoyancy and (2) the tank may be used for making good the losses due to osmosis.

We now come to consider the second condition required for a successful crossing of the Atlantic by an

(*Concluded on page 196*)



Rhode Island: Flagship of the Civilians' Volunteer Squadron
Date: 1902. *Displacement:* 14,948 tons. *Trial speed:* 19 knots. *Guns:* four 12 in.; eight 8 in.: twelve 6 in.



Louisiana: Carrying southern volunteers
Date: 1904. *Displacement:* 16,000 tons. *Trial speed:* 18.8 knots. *Guns:* four 12 in.; eight 8 in.; twelve 7 in.

The Cruise of the Civilian Naval Volunteers

A Movement to Provide Reserves and Promote Interest in the Navy

ON August 16th there steamed out from several ports on the Atlantic seaboard, nine battleships of the reserve, carrying among them 2,800 civilian volunteers who had enlisted for a four-week's cruise, during which they were to be trained in the discipline and duties of a naval seaman, and acquire as much knowledge and facility as might be during that limited period.

It is noticeable at Plattsburg that the officers of the Regular Army disclaim any expectation of making a thoroughly qualified soldier out of the Plattsburg volunteer during the brief period he is in camp; so, in the Navy, the line officers do not expect to do anything more than give to these civilian volunteers a certain amount of knowledge and of facility in the duties of a seaman—sufficient to enable them, in case of war, to go aboard ship with a sense of familiarity with their surroundings and a working knowledge of how to fall into their proper stations aboard ship and perform their duties free from the shyness and clumsy ways of an absolutely green hand.

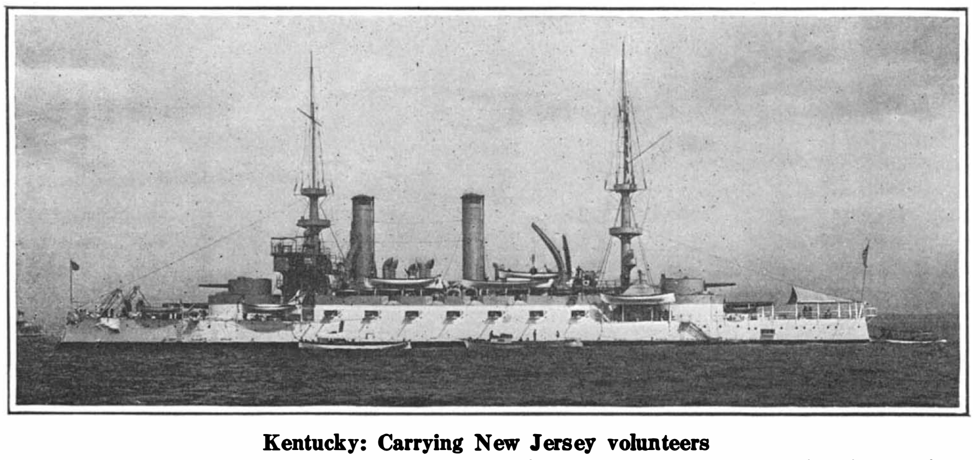
As at Plattsburg, so here, aboard ship, the character of the recruits will render the training of these four weeks extremely valuable because of its "intensive" effect. These young men, representing all walks of life, possess an unusually high average of education and intelligence, and their month aboard ship, in the majority of cases, will represent an amount of training and acquired knowledge which it would ordinarily take some three or four months to impart.

It is considered by those who were the sponsors for this movement that the most valuable result will be the quickened interest in the Navy acquired by a group of civilians, a large part of whom will be destined to play an important role in the future political and industrial activities of the country. In the last analysis, the question of the future of our Navy is directly related to the interest taken in the Navy by the taxpayers; and there is no earthly way of stimulating that interest that compares in its quick and lasting result with the plan of putting the citizen aboard ship and letting him learn at first hand just what is the meaning of naval strength and efficiency.

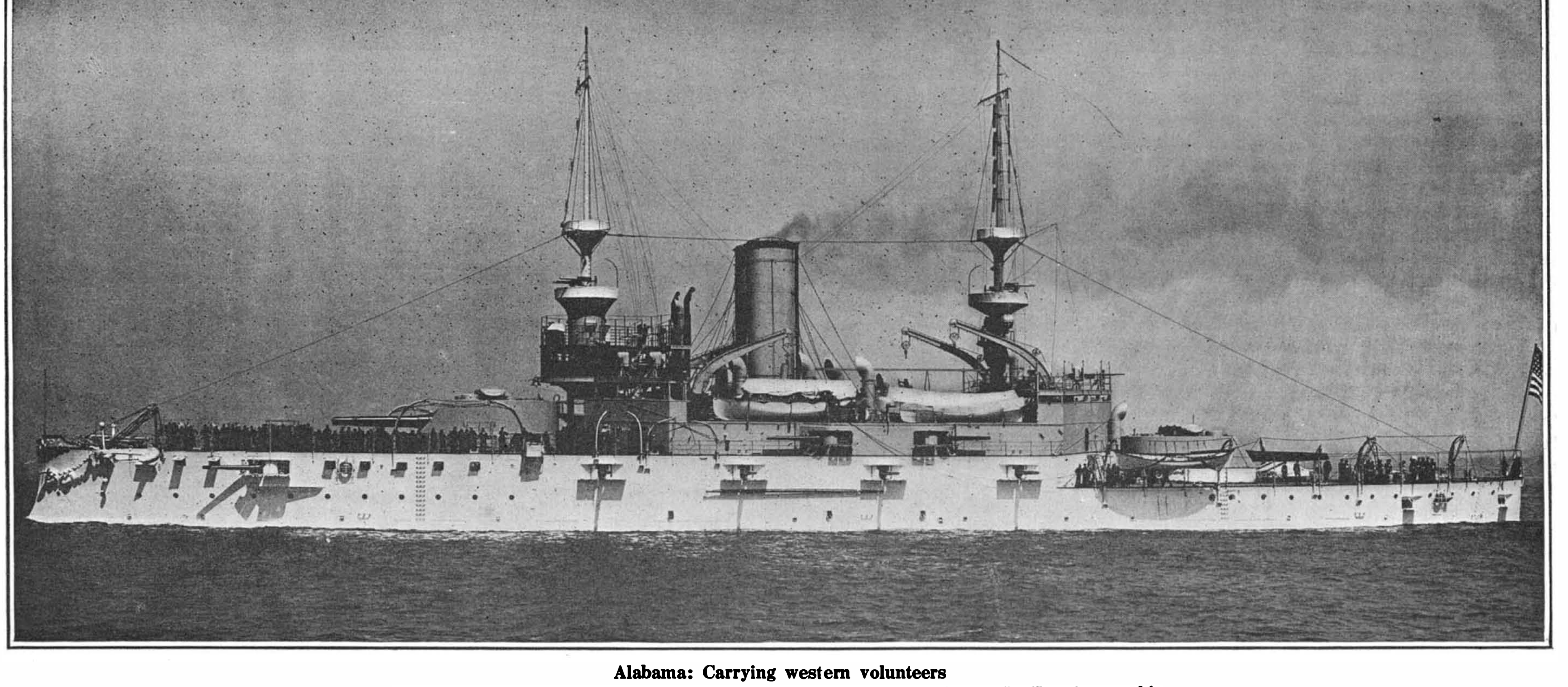
The objects of the cruise, as stated officially by the Secretary of the Navy, are as follows: First: To help equip properly qualified men to act as reserves in time of war or national emergency, by giving them a course of training on warships under naval officers and naval discipline. Second: To foster a patriotic spirit and give to civilians some knowledge of the navy and naval requirements of the country. Third: To interest civilians in naval matters so that by taking future courses of training and by study many can qualify for acting commissions after taking the necessary examination.

The ships on which the civilian volunteers have gone to sea are the

(*Concluded on page* 198)



Kentucky: Carrying New Jersey volunteers
Date: 1898. *Displacement:* 11,520 tons. *Trial speed:* 16.8 knots. *Guns:* four 13 in.; four 8 in.; eighteen 5 in.



Alabama: Carrying western volunteers
Date: 1896. *Displacement:* 11,550 tons. *Trial speed:* 17 knots. *Guns:* four 13 in.—35 caliber; fourteen 6 in

Strategic Moves of the War, August 18th, 1916

By Our Military Expert

THE power of a great name is something stupendous; and when such a name has been consistently attached to masterful performances, one is inclined to anticipate momentous results from its re-employment. This is apropos of the fact that Field Marshal von Hindenburg has taken over personal command of the greater portion of the Teutonic line on the eastern front.

In the east, the day seems going against Teutonia. Austria, having suffered tremendous losses by death, disablement and capture by the masses of the czar, being assailed on her weakened Italian front by the armies of General Cadorna, appears scarcely able to hold her own even with the great advantage of the passive defensive maintained by the modern small arm and artillery. In her hour of great need, her ally, Germany, has bent every effort toward bolstering up the tottering lines with large bodies of her own soldiery; and where Germany has stepped into the breach in force, the tide of assault seems to have been stemmed. Only a short time ago Russia forced the evacuation of the Styr-Stokhod sector and crossed at numerous points the latter river. It looked as though the lines were almost broken and that the Slavs were about to overwhelm their opponents. Germany sent her legions to the Stokhod—and the Russian lines in the sector have scarcely gained a foot in days. So much for the ultra-magnificent German organization.

And now, after his successes of the first and second years of the war, when he first cleared his own land of invaders and later wrested thousands of square miles of their territory from them, comes von Hindenburg—the man long retired from active service on account of his radical views as to warfare, then summoned to save East Prussia and Silesia. He has not been placed in his high command merely as an honor; he is expected to do something, something spectacular, something masterful. Will he?

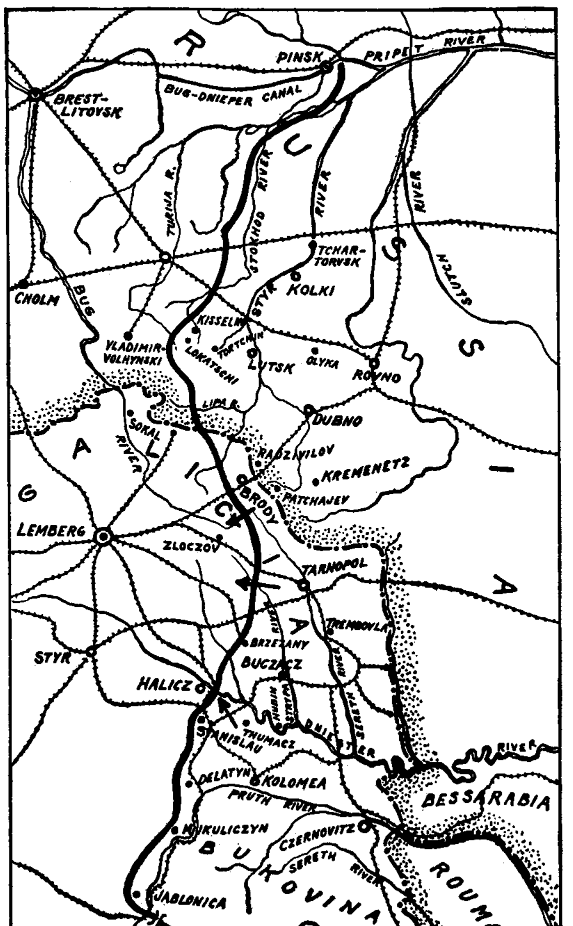
Germany is far from being exhausted. Tooth and nail she has fought against daily increasing odds to maintain that initiative in the prosecution of the war which has made her the mistress of vast territories east, west and south, taken from her enemies. The combined offensive of the Entente has actually thrown her on the defensive, yet it goes sorely against the grain for her to be compelled to acquiesce in any such condition. The effect upon the neutral nations, those distant from the theatre of war as well as those closer at hand, is injurious to Germany's prestige; and there are nations which are small but so situated strategically that if they are swayed by the tale of Teutonic reverse on a major scale, their entry into the war will almost certainly spell disaster to the kaisers.

For these reasons it is believed to be not at all unlikely that the recent appointment of von Hindenburg to command of the Eastern line will bear fruit in yet another Germanic attempt to upset the czar's dispositions and wrest some gain, good for barter or compromise, from an ominous situation. It will be a gallant thing, an accomplishment which will stir to admiration the military world, if Germany can confute her critics who say that she is done, by the initiation of a master movement in sufficient power of sledge-hammer blows to check the Russian advance. But it is mainly a question of resources, of reserves in man-power. It is so certain a thing that Germany would strike had she the men, that if she does not it is safe to assume, to believe, that the tales are true and that almost her last general reserves have been eaten up by the voracious battlelines.

While the Lotsk sector of the eastern line has been practically at a standstill for some time, appreciable Russian gains have been registered farther south. Very slowly the Russians have been working southward and southwestward below Brody in the attempt to drive home the northernmost claw of the military pincers which are trying to nip the Austrian army before Tarnopol. From the south, the nether claw is driving northward and westward. Stanislau, an important center on a strip of railway which controls valuable junctions to either side connecting the battered Austrian right with the main elements of the line, has fallen almost without a local shot, by sheer force of strategic developments; and the army which gained Stanislau is pressing northward until now its guns are pounding the lines before Halicz, the fall of which town will seriously embarrass Teutonic operations on that stretch of front.

Between the claws of the pincers was a badly battered Teutonic army. Even after the first onslaughts of the Russian offensive, these forces held grimly to the Tarnopol line, held until there arose serious danger of total loss by the bending in of the wings of the salient to north and south, thereby threatening to gnaw a huge chunk from the general alinement. At last the pressure on the flanks became so unbearable that the line of the Strypa was abandoned—almost at the last moment. But the forced retirement was so precipitate that the fairly strong line of the Koropice to the southward could not be consolidated in sufficient strength for more than a brief delaying action; and the northward reaching of the Russians from the Dniester swept the Teutons back to the lower Zlota Lipa, and beyond it.

To all purposes therefore, the Zlota Lipa too now is turned from the south. A successful northward drive on the west bank, where the Russians are established in strength above the Dniester cannot easily be met, and the country between the present position and Lemberg, though hilly and broken, offers scarcely any well defined line of defense. The passage of the Zlota Lipa, in addition, has a more far-reaching result than the mere territorial and local gain. The strong line of the Bug, the next general line of Teutonic defense, breaks near Sokal into numerous and divergent streams, many of which flow through broad marshes. These streams which reach southward find their sources practically west of Brody, and between that city and Lemberg. If the turning of the Zlota extends far enough northward, far enough to take Lemberg's defenses, the line of the Bug is practically turned as well.



Russian battle front on August 18th, 1916

While the principal Russian forces were massed in the thrusts against von Bothmer's flanks, those detachments of the czar which had the duty of hanging on in the Carpathians were subjected to a concentration of superior Austrian strength on the mountain crests and were compelled in several places to give ground. Those mountain ridges and passes were far too valuable as flank guards in case of a possible advance through Galicia to be given up, and the latest reports indicate that the Russian forces in the Carpathians have been strengthened until they have been able to overcome their opponents and thrust deeper into the mountains beyond Jablonitza.

In the Italian drive upon Trieste, the pounding seems to continue; but until there is another ample breathing space during which the assaulting forces may be reorganized for another massed drive, the work must necessarily be slow. The Italian lines are gnawing a way forward along the Carso and the shore line and at the date of writing are reported as within 12 miles of the objective seaport.

The most pointed activities however seem now to be directed upon Tolmino. From this point the Austro-Italian frontier curves southwestward; the late successful drive upon Gorizia has carried the Italian line so far forward that as a result a well-defined salient exists. The customary method of attack upon a salient is being followed, which accounts for the shifting of Italian force upon Tolmino. This city lies about at the foot of the Julian Alps and its surrounding terrain is forbidding. Its capture promises to be no easy matter.

On the western front there seems to be a lull; but there is none. Ceaselessly the allies of the Entente keep driving at local point after point; and as constantly the Germans launch counter attacks. The territorial gains have become so small in comparison with those on the eastern front that one is apt to lose sight of the fact that the western lines are in a much higher state of consolidation, and that, as has been well said, an acre in France is the equivalent of a mile in Galicia.

It seems pretty well demonstrated that Verdun is a dead letter. Even with the perspective of months it is impossible to see clearly what Germany hoped to gain by her efforts there, more especially after the French defenses stiffened and held firmly. The countless assaults which were launched upon the lines of Verdun cost towering fortunes and inestimable losses in men. The pause in operations at this point demonstrates rather clearly the state of Germany's reserves; she cannot hold her entire line and make two highly organized fights at one and the same time.

Students of the war got this last week a considerable thrill when they read of activities on the Macedonian line and of the taking of the Doiran station by General Sarrail's forces; they have been expecting a crashing blow at this point so long that, while it now seems evident that the operations were but preliminary feelings to test out the stiffness of the Bulgar and Teuton defenses, it looked as though the moment of attack had come. To-day that line seems the most important strategically in all Europe; watch it. The war began in the Balkans and it seems probable that this turbulent section may exercise a decisive hand in its termination.

Discovery of New Diamond Fields in Transvaal

CONSIDERABLE interest is manifested in a report of the discovery of a new diamond field in the Transvaal, about 6 miles distant from the famous Premier diamond mine and 18 miles from Pretoria. It is stated that the initial finds were exceptionally good, and there has been a rush of diggers to this new diamondiferous ground, which is on the farm Kamselfontein. One of the owners has cut up his section into plots 15 by 20 feet, which he lets out to diggers at $10 per month each.

De Volkstem, published at Pretoria, states that in the course of three weeks a few diggings have sold $1,500 worth of diamonds. It is said that one man brought to light 31 diamonds in two washings, and as far as known only one washing thus far has produced a blank. About 40 acres of ground have been wired in and given out in claims. During the early part of June 40 claim licenses were issued in a week.

The government mining engineer, at the time of the report from which this article has been prepared, had not yet visited the ground, and it was stated that it would likely be some time before anything official could be made public. While diamonds are admitted to have been found, there are at present no data as to the extent or payability of the diamond-bearing area. The undertaking as it stood up until the time of the report, June 19th, was regarded as of a purely private and speculative character.

A Village Devoted Entirely to the Making of Paper

IN some parts of Indo-China the natives employ various fibers in the attempt to supply their own paper. The Village du Papier, a suburb of Hanoi, owes its name to the fact that most of its 2,000 or 3,000 inhabitants make paper from the bark of a small "paper tree," a species of mulberry, found on the Black River in upper Tonkin. This bark is soaked in lime made from the limestone of the village, heated by crude furnaces fashioned by hand under natural limestone vats, pounded by pestle into a fine mash, then dissolved in water until a thin paste is reached. This paste is dipped by bamboo-screen sieves, about 12 by 24 inches in dimensions, until a slight film covers the screen. This film is spread on top of others and each is taken separately or several together and spread with a brush on cement radiators to dry. A single sheet of paper is almost as thin as tissue; but the desired thickness may be obtained by spreading several films on the radiator and drying them together, or by pasting the requisite number of sheets together, after drying.

Correspondence

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

The Jutland Sea-Fight

*[We are privileged to publish the following vivid and picturesque description of the Jutland sea-fight, which was written to a friend by a participant in the battle. How the "Warspite" (sister to the "Queen Elizabeth") escaped with so little injury to her crew or herself, after enduring the concentrated salvos of five German dreadnoughts, is a mystery. By all the rules of the game she should to-day be at the bottom of the North Sea—where the Germans, according to their reports, very naturally believed she had gone.—*EDITOR.]

H. M. S. "Warspite,"
G. P. O.,
June 5th, 1916.

Dear Old Jack:

I'm afraid that the forsaken fool who issued the first Press Bureau report may have given you a rather depressing time. He certainly ought to be strung up, whoever he is. Even if it had been true, it couldn't have been put worse; as it was, however, it was absurdly pessimistic. I think there is yet every chance of our hearing of further Hun losses by the time this reaches you, and anyhow, they got such a hammering that I don't think they will appear again for some time. My own impressions of the whole show are rather vague, as my whole attention was devoted to just the particular ship we were on, and the mist made it very difficult to get a comprehensive view of anything. However, briefly, what happened is this:

We started out suddenly from here on what we presumed was one of the usual barren stunts, I being particularly bored as I was expected to meet mother in Edinburgh the following day. Next day about 4 P.M. we went to Action Stations, still very skeptical, as we have so often been disappointed. A little later, however, the enemy was reported in sight and we soon had the pleasure of at last loosing off at the Hun.

The first ship we could get onto was a light cruiser, which we opened on at 25,000 and undoubtedly hit very hard, and which disappeared from the scenes; whether she sank or not I don't know, as we at once got busy with a battle cruiser which then hove in sight. We had quite a hard go at her and our director gunner aloft is convinced we hit her hard and often; she dropped out of the line burning nicely, and there was at any rate one ship less in the line. Again, we don't know whether she sank or not, as it was so confoundedly hazy, that, going at 25 knots, the moment you left anything behind it disappeared.

Shortly after this I received the unpleasant news that the whole High Sea Fleet was joining the party and as I had no idea where the Grand Fleet was I began to think we were probably going to hand in our checks. Very shortly, we turned round and started to retire on the Grand Fleet, with the whole ruddy lot loosing off at us. We started to pay attention to their leading battleship. We had got two very nice salvos into her, when our helm jammed and we started to go round in circles, upon which, about five of them concentrated on us, and we had about as hot a time as anyone could hope to have. All who saw us say they never expected us to come out of it for a moment. The shots simply drenched us all, right up to the foretop even.

However, just when I was quite convinced of it being either Heaven, Hell or a Hun Prison, the Grand Fleet, which had arrived, began to open fire and they left us alone, imagining, to judge from their communique, that we were a dead bird. We then lay more or less helpless for a considerable time, during which a Fritz tried to plunk a mouldy into us without success. Then, having more or less repaired our steering gear, and found we were quite fit to fight, we started off to look for the G. F. On getting into W. T. touch, however, we were told to proceed into harbor, and we thereupon set course for this place, it then being about 10 P.M. We did not get in without a bit more excitement, however, as we had three bickers with submarines before we got in, one of which we missed ramming by only 20 yards. As we hadn't got a boat that would float and were unescorted, I can't say I was sorry when we got inside the defences. I forgot to mention that I saw the "Defence" go up just before our helm jammed, and it did not make the ensuing strafing we got any more pleasant. One curious thing that I saw was that, through sheering out of the line, we took all the fire from the "Warrior," who was on the enemy side of us, and we undoubtedly saved her from sharing the "Defence's" fate. Their captain, in fact, thought we had done it on purpose, mentioned our "gallant action" in his report, and came on board to thank our skipper, who was regretfully compelled to disillusion him. Our casualties were marvelously light, only about 25 killed and wounded all told. As you have heard, they had very much the advantage of the light. It was perfectly clear behind us, so that they must have been able to take splendid ranges, while they were partly in the mist, in which they kept, almost disappearing, so that you could see nothing but their flashes, and it was extraordinarily hard to range or spot.

The Huns' shooting and ranging were extremely good at the start; but the moment they commence getting hit, they go all to pieces. Whether it's morale or instruments I don't know. As to our own men, they were absolutely topping the whole time, down to the youngest boy, and we have about a hundred under 18. They were as cheery and unconcerned as if they had never done anything else in all their life. And it takes a good deal of real courage, when you are down in the bowels of the ship, as some were, with water up to your knees and nothing but sickening crashes coming from above to keep your courage up. What the G. F. did to them of course I did not see personally, as we had left the entertainment when they got going; but I understand they pounded them properly and suffered practically no harm themselves. The Boche hog had a belly full, and put up a smoke screen from his destroyers that absolutely obliterated him, and made off for all he was worth.

Our destroyers bustled him all night with some success, but with how much it's difficult to say till all the reports are analyzed. Next morning he somehow managed to give us the slip, how, I don't quite know, and escaped. If only we could have got him then, I think there would really have been an end of things, as he was properly rattled by that time. Our damage, considering what we went through, is really extraordinarily slight, and we are all about for another tap at them as soon as possible.

I met your old chief yesterday and had a long yarn with him and Lady A. He is very sick at being out of it; but I must say he doesn't look strong enough to run a big show at present. I am hoping to have a few days' leave shortly, which will be rather welcome, as pneumatic rivetters are unpleasant shipmates. One has just started outside my cabin now, so I shall cease and fly elsewhere. Best of luck.

Thine,

Railroad Items

To the Editor of the SCIENTIFIC AMERICAN:

In reading your recent issue to-night there were one or two statements that met my eye that perhaps need a slight correction.

First in regard to that fire-fighting car on the Intercolonial Ry. of Canada. Fire-fighting is not a new thing here on the Pennsylvania R. R. For several years past we have had our yard locomotives equipped with powerful pumps to extinguish fires that may arise in the most difficult places, viz., the yards. The company realizes that one line of hose if brought promptly to the scene of the fire is worth a great deal more than several lines of hose say 30 minutes later. I am advised that in 1914 the Pennsylvania R. R. extinguished 427 of their own fires involving a loss to property of $18,468.11, wherein the insurance value of the property involved was $9,516,434.00 and that the Insurance Fund of the Pennsylvania System is greater than the Net Surplus of the third largest fire insurance company in this country.

With regard to the longest passenger runs as mentioned on page 663, I wish to advise you that at present we are running our steam locomotives on trains from Manhattan Transfer to Washington, D. C., a distance of 226.9 miles, and from Manhattan Transfer to Harrisburg, Pa., a distance of 195.6 miles. It should be remembered that this applies to those trains that do not enter the Broad Street Station in Philadelphia. While it is true we do keep spare locomotives on hand at Philadelphia, ready at a moment's notice in case of heating or any other emergency, still these runs are regularly maintained and with no difficulty whatever.

A PENNSYLVANIA R. R. EMPLOYEE.

Philadelphia, June 24th.

Importance of Rapid Naval Construction

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest your description of the battleship cruisers that are to be built under this year's naval programme, and I note with pride and satisfaction that they are to be of unprecedented size and extraordinary power and speed—that is to say, compared with anything afloat to-day. But will they still possess that distinction when they are ready for service? I doubt it very much.

If I am not misinformed, it takes us from thirty months to three years to build a first-class ship of war, as compared with twelve to eighteen months for England (the first dreadnought was, I believe, built in twelve months). The consequence is that if we plan a big ship (and all our plans are immediately published) all that foreign navies have to do is to begin the following year to build a bigger one. Their ships will be commissioned as soon, if not sooner, than ours. We are always *going to* build a world beater, but we never *do*. While they are building, our ships are invariably eclipsed by foreign ships of later design.

Now there is only a sentimental importance in having the largest ship. But there is a very practical importance in having ships of the most up-to-date design. And it seems to me that our ships are generally about a year out of date when they go into commission. For instance, if we commission a ship in 1916, it will be a "1913 model," whereas the ships commissioned this year by foreign navies will be of the design of 1914 or even 1915. Our ship will represent the best that was known before the war, while the foreign ships will embody the lessons of the first year of the great struggle.

Is any further argument needed to prove the importance of rapid construction for naval vessels? Yet I have never heard the subject referred to or seen it mentioned in your columns.

Very truly,

KENNETT E. STUART.

[The importance of the rapid construction of warships was formally a frequent theme of discussion in our columns. That was in the days when it took from five to six years to build a battleship. Of late years, thanks largely to the policy of stimulating competition by building some of our ships in Government yards, we have caught up with Europe in the rate of construction. The delay is not in the ship-building goods. It is due to Congress and to the manipulations of such politicians as the present secretary, who is responsible for many months delay in starting construction on our latest battleships.—EDITOR.]

A Lesson in Commercial Chemistry

To the Editor of the SCIENTIFIC AMERICAN:

We would call your attention to an inaccuracy in the account of the foam fire-extinguisher in your issue of July 8th.

You speak of one solution being alkaline while the other is a solution of soda and the licorice extract. It is obvious that as soda is an alkali and the licorice extract is alkaline there would be no reaction between two alkaline solutions. The account should have said that one solution was an acid solution produced by dissolving aluminum sulphate in water while the other solution is composed of bicarbonate of soda and the licorice extract. Upon mixing the two a reaction takes place between the acid and the alkali producing aluminum hydrate, sodium sulfate and liberating carbonic acid gas in the form of foam which flows over the surface of the burning oil, cutting off the supply of oxygen and thus inhibiting combustion.

M —— & F —— Co.

(Manufacturers of the licorice extract.)

A Hint for Auto Manufacturers

To the Editor of the SCIENTIFIC AMERICAN:

Until that happy time arrives when gear troubles shall not exist why don't manufacturers give some instructions? If the mechanism was illustrated and explained, to say nothing of instructions, a large part of all troubles would vanish. It has just cost me $75 to learn matters that could have been explained in three minutes, or if in printed form the responsibility would have been easy.

It is quite possible that I do not even now know how to change gears properly, and that through no fault of my own. And there are many other sufferers.

Referring to your article "Changing Gears."

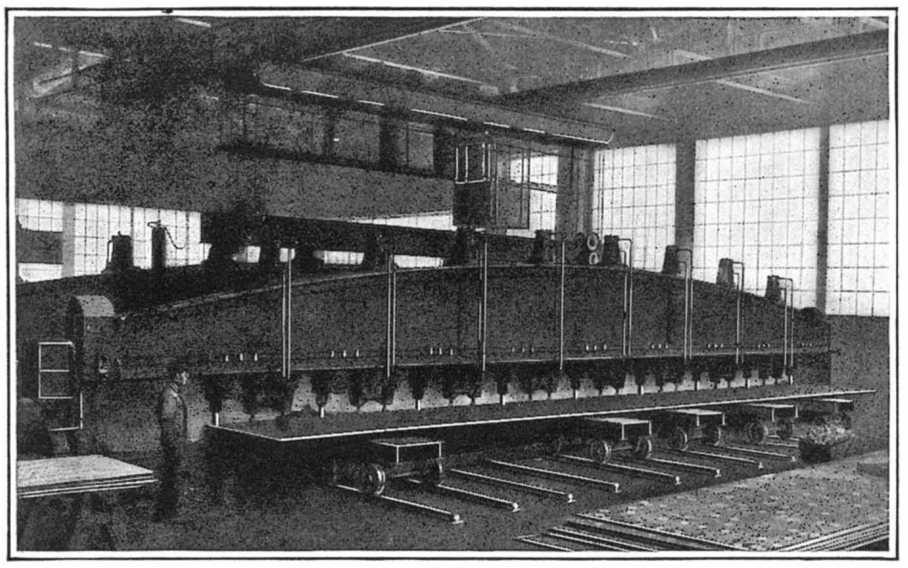
L. B. BAKER.

White Signal Lights to Be Abandoned on Leading Railroad

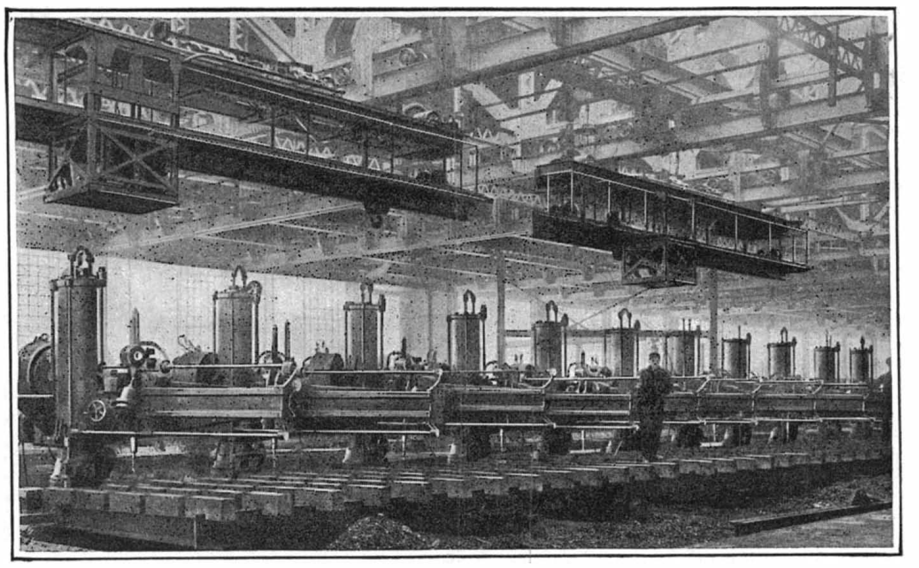
IT is announced that the white signal lights, which, in the past, have signified a clear track ahead to locomotive engineers, are to be abandoned by the Pennsylvania Railroad. This decision has been reached because of the increasing use of white light in buildings and thoroughfares close to the railroad's right-of-way, which has a tendency to confuse the engineers and result in accidents.

The white lights are to be replaced by green, which are visible at a great distance; and this revision will make necessary an extensive change throughout the signal system of the railroad. A bright yellow, which is visible for miles, will henceforth be used for caution; red, on the other hand, will remain as it is at present, the signal to stop.

Yellow lights would have been resorted to before this but for the fact that up until recently it had not been possible to secure a stained glass which would retain its distinctive coloring when seen at a great distance. Yellow lights have hitherto been mistaken for white at a distance because of the similarity of the two. After years of experimenting, however, a yellow glass, which produces a vivid yellow light that can be distinguished from white even at a distance, has been produced, and is now available for railroad signals.



Forty-five-foot plate-edge planer capable of making a 3-32 inch cut on a nickel-steel plate 1 1-2 inches thick by 45 feet long



Battery of sixteen non-vibrating radial drills in the punching and drilling section of the shop

Bridge Building in the Shop

How the Gigantic Members of the Quebec Bridge Are Fabricated

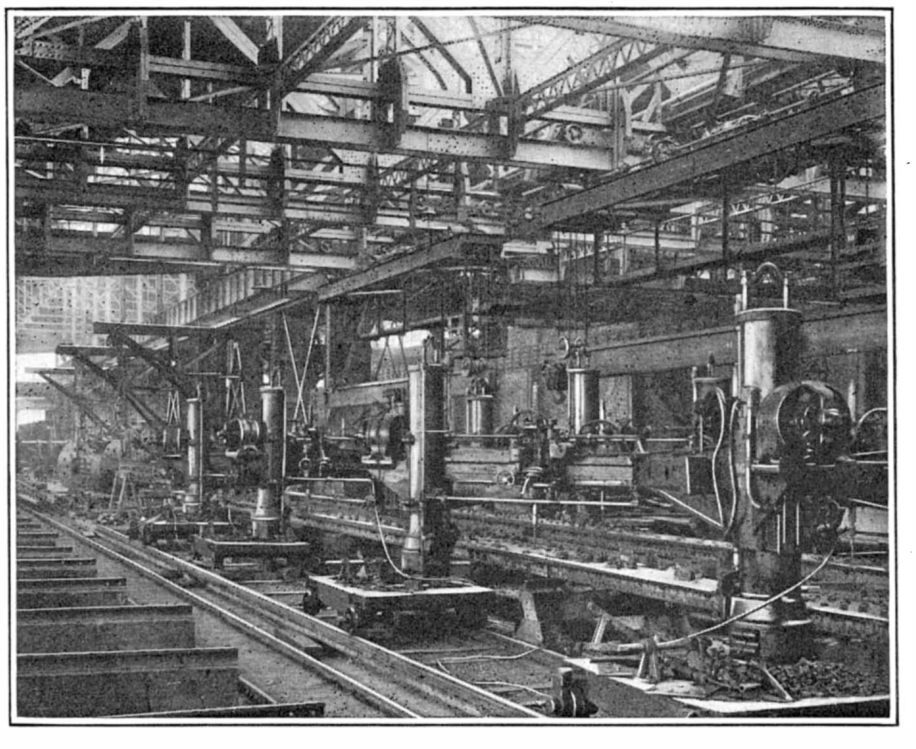
IT is always difficult to portray a large structure, in such a way that we can visualize it and appreciate its enormous dimensions. In our issue of May 6th, last, we pictured the Quebec Bridge, endeavoring by figures and photographs to convey some idea of the gigantic proportions of this greatest of great cantilever bridges. But it is only by an intimate acquaintance with the huge individual members of the structure and by mentally fitting these members into place in the great bridge that we may obtain a true conception of its size. It is with this in view that we are taking our readers into the shop where the bridge members are being fabricated.

Everyone knows that before a bridge is built it must be constructed on paper, and in the case of a bridge of these enormous dimensions, much of the building and fitting of parts must be done in the shop, so that they may more readily be assembled in the field.

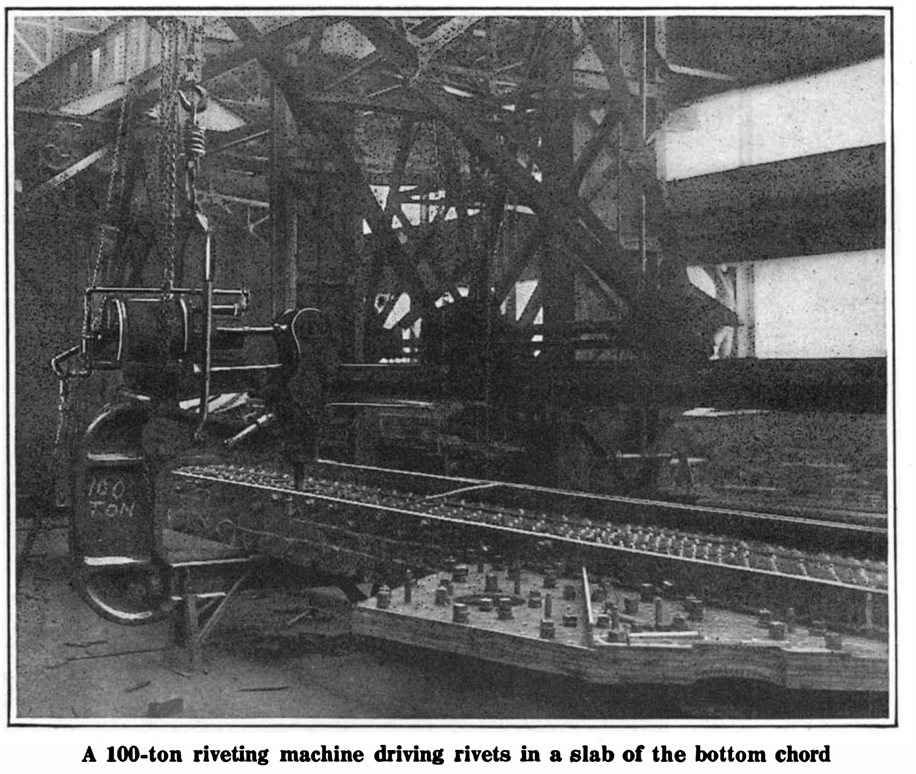
In the design of a large bridge, an engineer is more concerned with the weight of the bridge members themselves than with the load that the bridge will have to support. It will be recalled that the Quebec Bridge measures 3,239 feet over all, and has a clear span of 1,800 feet between piers, which is equivalent to more than seven ordinary New York city blocks. This span of 1,800 feet is divided into three parts; there are the two cantilever arms running out from the piers on opposite sides of the river, each arm being 580 feet long, and they support between them a truss 600 feet long, which is commonly spoken of as the "suspended span." The bridge is a two-track structure designed to carry on each track two powerful heavy locomotives each followed by a train weighing 5,000 pounds per foot; but this load is small compared to that of the "suspended span," which rests upon the two cantilever arms. The weight of this span is 5,000 tons, and is really a very light structure considering its size, for it is made of nickel-steel. The addition of 3¼ per cent of nickel to the composition of the steel increases the strength of the members 40 per cent over a carbon steel of the same section. Thus there is a material saving of weight in this portion of the bridge. The heavy compression members of the main span cantilever arm are also made of nickel-steel so as to reduce their weight as much as possible. However, the anchor arms, that is the arms which extend shoreward from the piers, are made of carbon steel, because, here, it is an advantage to have weight; for the heavier these arms are the better they counterbalance the weight of the main span arms and the easier is the task of anchoring the shore ends of these arms to earth. There is also the added advantage that carbon steel costs less than nickel-steel.

Most of the truss members of the bridge are so heavy that, for purposes of fabrication, shipment, and erection, it has been necessary to divide each member into several separate sections, the largest of these several sections weighing in completed condition over a hundred tons. Large as the bridge is, the several parts have to be constructed with absolute accuracy and the finest of workmanship because in so large a number of members, even a very slight departure from exact measurement would foot up to a serious total.

Because of the great size and weight of the pieces, the severity of the specifications and the fact that 65,000 tons of nickel and carbon steel, which make up the bridge, have to be manufactured in about three years, a special shop had to be erected, in which the members could be fabricated, near the site of the bridge. This shop is 160 feet wide and 650 feet long with a storage yard for the material as it comes from the mills at one end, and a shipping shed and storage yard for the completed sections at the other end of the building. Here, the raw material, in the form of rolled steel plates and shapes, is machined by means of a number of specially constructed machine tools, and emerges from the shop as a finished product ready for erection in the bridge with practically no further finishing necessary.



The reaming section of the shop, showing a set of portable drills in action and the jib cranes handling the heavy riveting machines



A 100-ton riveting machine driving rivets in a slab of the bottom chord

First, the heavy plates are flattened out by means of heavy plate-rolls, served by a 60-foot roller table with five 3-ton air hoists, which are capable of straightening a nickel-steel plate 120 inches wide by ¾ of an inch thick or 84 inches wide by 1⅜ inches thick. All the material has to be thoroughly straightened before applying the templates, so that the templates will lie flat, without distortion, while the laying out is being done.

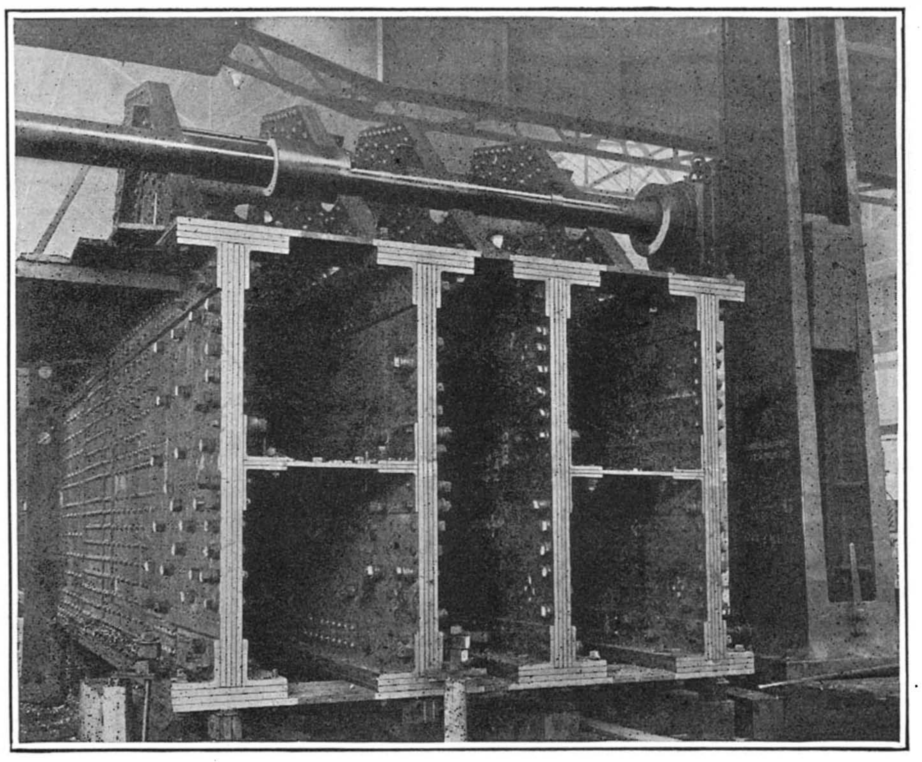
Among the giant machines, at this point, is an 84-inch gate shears, which will cut a nickel-steel plate 1¼ inches thick and 84 inches wide at a single cut. All the sheared edges of plates must be planed off at least ⅛ of an inch and a rotary planer is used for this purpose. The edge of the plate is planed by special machines, one of which is shown herewith. This is capable of taking a 3-32-inch cut on a 1½-inch steel plate 45 feet long.

After the plates have been laid out and cut to proper form, they must be punched or drilled. No punching is allowed in carbon steel material over 11-16 of an inch thick. All nickel-steel, together with all eyebeams and carbon steel above 11-16 of an inch in thickness, must be drilled from the solid after the parts have been assembled. Prior to assembling, a few small holes are drilled to permit of bolting the parts firmly together. In some cases, the holes are drilled 3-16 smaller than the diameter of the rivet and then, after assembling, are reamed out to a diameter 1-16 of an inch greater than that of the rivet. The greatest care must be exercised to have the reaming and drilling done with such perfection as to obtain a hole perfectly cylindrical and perpendicular to the plane of the metal. Twist drills are used for this purpose, working without vibration. The drilling machines are arranged in batteries. One of our illustrations shows a battery of

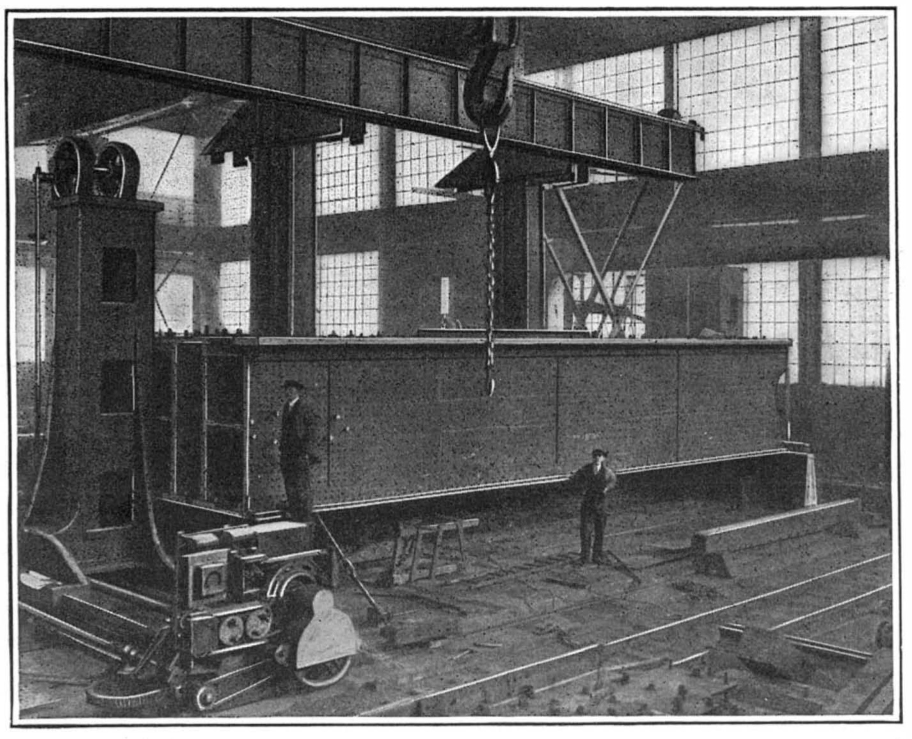
16 of these drills. The rivets used throughout the bridge are principally from 7/8 to 1 1/8 inches in nominal diameter. They are heated in oil or gas furnaces to the highest possible temperature without burning, and are driven without delay, after removing any scale formed during the heating process. Among the interesting machines, pictured herewith, is a duplex rotary planer, capable of planing simultaneously both ends of a member up to 90 feet in length, thus insuring absolute parallelism of the two faces. Our illustrations also show some of the special means used for boring the pin holes in the various members. The boring of a pin hole in a riveted member is done after the riveting is completed, at one operation through all the webs and component parts and at as nearly a constant temperature as possible. From the finishing end of the shop the members pass out into the shipping shed and storage yard where they are painted and stored for delivery to the railroad. In this shed members which are spliced together in the field, are temporarily assembled, and their splices reamed and matchmarked to insure a perfect fit in the field.

The workmanship and finish demanded throughout the shop is the best that the most suitable modern machinery and skilled labor could give. All finished measurements are made with standardized tapes lying flat and supported at frequent intervals, firmly held at one end and under a tension of 10 pounds. The policy of assembling, reaming and matchmarking all members that are to be spliced in the field, has been found to give the best of satisfaction even though it involved considerable extra expense in the shop. The connections in the field are made with so little trouble and loss of time that the extra shop cost is considered to be fully warranted.

We are indebted to Mr. A. J. Meyers, Chief Draughtsman of the Board of Engineers of the Quebec Bridge Company, for the accompanying photographs and the information upon which this article is based.



Boring a half pin-hole for the connection of a compression diagonal to the bottom chord



Duplex facing machine finishing both ends of a huge chord member at the same time

Motion Pictures in the Schools

How the Iowa Children are to Benefit from the Cinema

By O. R. Geyer

TWENTY years from the present time the students in thousands of Iowa schools will be learning their state history lessons with the aid of motion pictures. This is the promise held out for the future by Curator Edgar R. Harlan of the Historical Department of Iowa, who has founded the world's first motion picture library for purely historical purposes. To date it has more than 200 volumes—or perhaps reels would fit in better—which total more than 50,000 feet. These films show various local happenings of importance of the last three years and, in the belief of the founder of the library, will be a valuable aid in enabling the future generations to understand Iowans of the early part of the twentieth century.

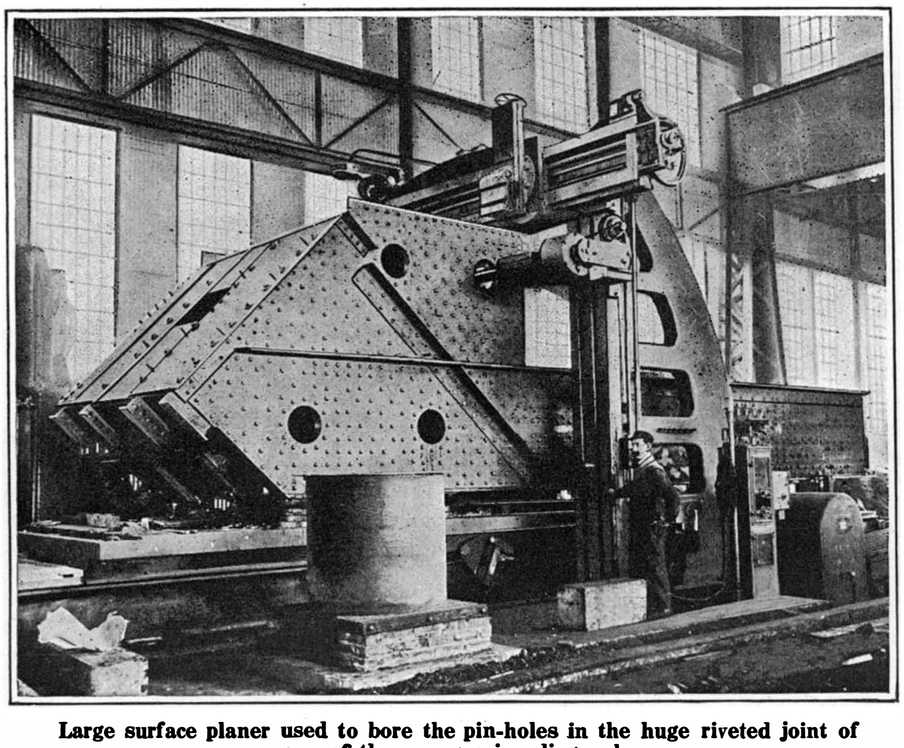
The popular hold taken on the general public by motion pictures has encouraged various educators to believe that the art could be used with most satisfactory results in school work. It is with this idea in view that the curator has announced the founding of his new library. These films will be held subject to the call of Iowa schools and will be used solely for educational purposes.

The class in history will be able to see the inauguration of a governor of a quarter of a century before, reproduced in the living figures with which they have become acquainted in their studies. Iowa's fame as a farming and live stock center will be illustrated clearly by the showing of the motion pictures of the "million dollar" live stock parade which features each annual state fair.

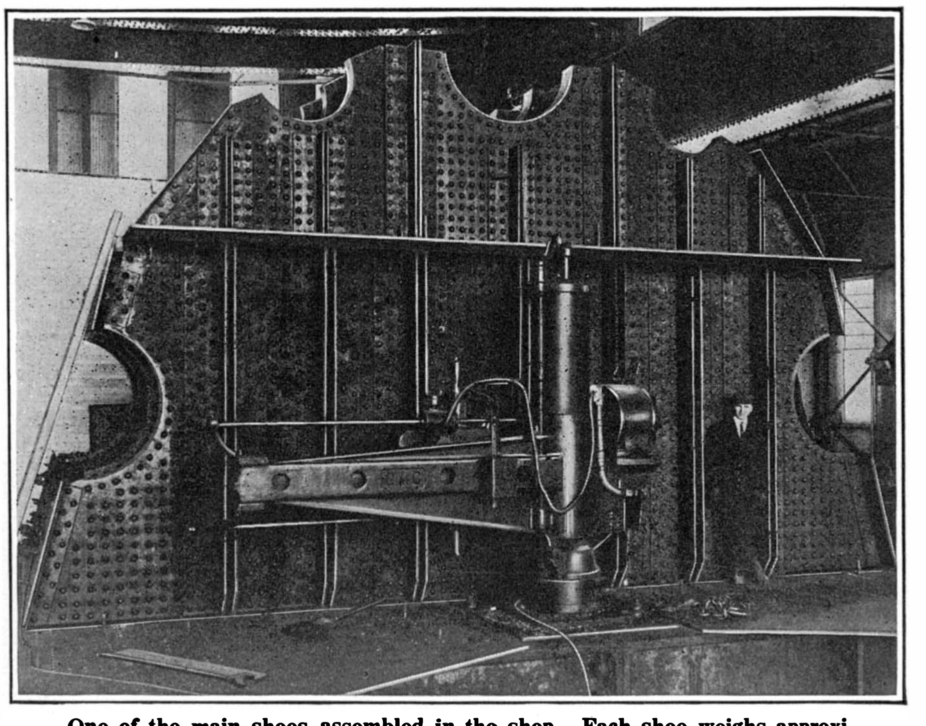
But the value of these pictures will not be enjoyed solely by the classes in state history. Students interested in mechanical and manufacturing subjects will be able to see the workings of the great Keokuk dam and some of the state's largest manufacturing plants. The progress of the better babies' movement can be studied most interestingly in the moving pictures showing the annual contest at the state fair grounds. Other pictures will show the destructive nature of a tornado, or a train wreck may be thrown upon the screen to illustrate some point in the lesson. Street scenes in some of the larger cities of the state also form an important part of this unique library. Some of the more important football games between the state colleges and schools will be saved to entertain and instruct future Iowans in the customs and manners of their forefathers at a favorite form of sport in the former century.

Arrangements have been completed with Iowa film companies by which the state is able to secure the films which may be of some historical interest in the future at no cost to itself. As soon as the commercial value of the current-events films depreciates to a degree where there is no profit in showing them, they are turned over to the motion picture library. These films are subject to recall by the manufacturer should they at any time regain some of their former commercial value, otherwise they remain the property of the state.

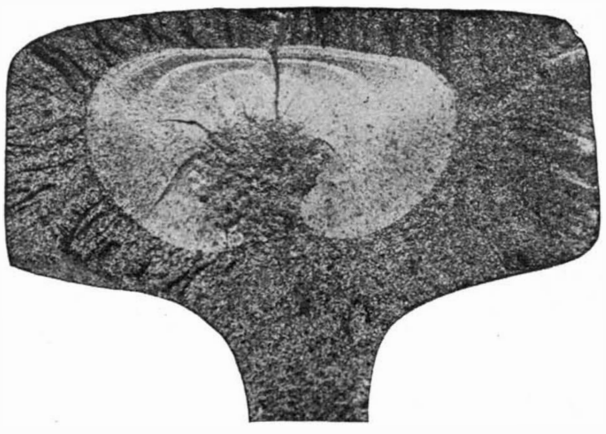
The film negatives are filed away in air-tight tin containers, which are stored away in fireproof vaults. Two plans of cataloguing them are under consideration at the present time. One is to cut the film into as many sections as there are distinct subjects pictured, and the other is to prepare a calendar of the contents of each reel. The film cases are mantained at a temperature and humidity suitable to books and valuable papers, and the negatives are thus removed from the realm of danger. Though highly inflammable in character, the library can be preserved for indefinite periods without fear of destruction from ordinary accidents. The historic value of this library is inestimable. Motion pictures present in a single minute more than can be portrayed in a chapter of printed matter.



Large surface planer used to bore the pin-holes in the huge riveted joint of one of the compression diagonals

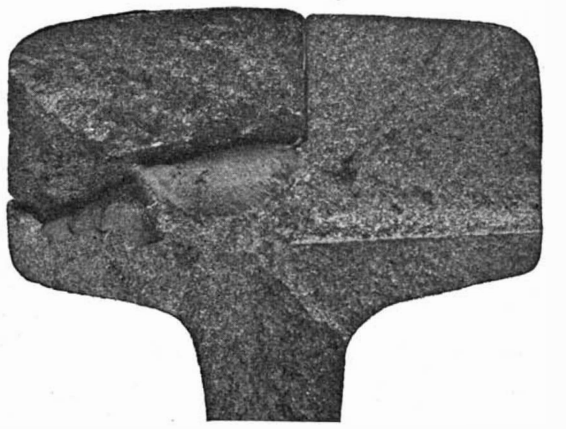


One of the main shoes assembled in the shop. Each shoe weighs approximately 500 tons



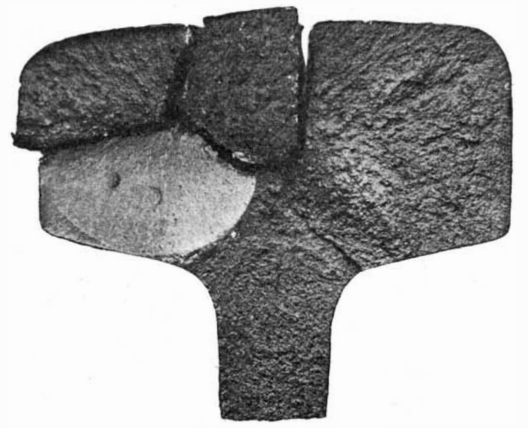
Induced Interior Transverse Fissure—Intergranular Type

Rolled November 8, 1910. Failed March 5, 1915. The nucleus is over five-eighths of an inch in diameter, though smaller in a majority of the specimens.



Section of a 100-lb. rail

Rolled February 23, 1911. Failed January 3, 1916. The crack enlarged by being uncapped for investigation, as exhibited.



Section of an 80-lb. rail

Rolled January, 1905. Failed September, 1913. The induced interior transverse fissure did not develop until 8½ years after being rolled.

A Frequent Cause of Broken Rails

Incipient Internal Fractures Due to Faults of Manufacture

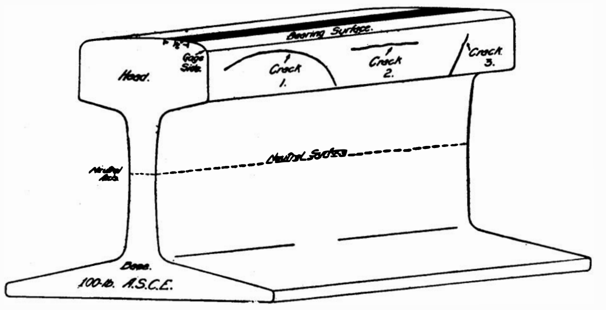
IT is now generally accepted among railroad engineers that rails which break in the track under service do so, almost invariably, because of some inherent defect induced in the rail itself during the process of manufacture. Generally speaking, these defects are not visible in the completed rail as it leaves the rail mills, and therefore cannot be detected by the railway company's inspectors.

From time to time the Scientific American has brought this subject to the attention of the public, and some ten or twelve years ago, when the breakage of rails in the State of New York was so frequent as to cause general alarm, we published a series of articles in which it was shown that the rail failures were due, generally, to an inherent and hidden fracture running longitudinally through the body of the rail. These defects were due to the fact that, in those days, an insufficient amount of the top of the cast ingot was cut off and discarded before the ingot was rolled into the rail. A "pipe," or depression, in the head of the ingot, which latter consisted largely of metal that was chemically defective, and which was apt to include a certain amount of slag, would be rolled into the body of the rail and form a hidden, longitudinal line of cleavage, which, under the heavy hammer blows of the traffic, would develop until the rail split open. To-day, due to the making of a larger discard of the ingot and to other improvements in manufacture, split rails due to a "pipe" are far less frequent than they were a decade ago.

Of late years increasing attention has been directed to another form of rail failure, in which the fracture is more transverse than longitudinal. Investigation of rails that break transversely has shown that there must have existed in the broken rail, as it left the mills, an incipient transverse fissure, which, while of considerable dimensions, did not extend to the exterior surface of the rail, and therefore was not visible to the inspectors. This matter has been very thoroughly studied by Mr. P. H. Dudley, the well-known rail expert of the New York Central system. His investigations, he says, "show that interior transverse fissures in rail heads are induced by a combination of two or more exceptional conditions of manufacture in an occasional rail head by direct rolling, which can and should be avoided." These fissures, he says, are due in part to the hot rail being cooled so rapidly by the rolls as to cause a lag or delay in some of the transformations of the metal in the interior of the head. The first effect of this is loss of strength and the production of initial strain, resulting in a non-ductile core of heterogeneous metal near the center of the head. A contributory cause is mechanical injury to the heterogeneous metal due to the interior nucleus being fissured when the cold rail is straightened by the gag. The second effect is the production of an interior, invisible portion of fractured metal near the center of the head, before the rail leaves the steel plant.

One-half size, 5 1-8 inch, 80-lb. rail

Rolled January 12, 1912. Failed January 16, 1915. The final fracture of rupture extended down through the web into the base before the latter failed.



100-lb. A. S. C. E. Section

Crack No. 1 shows a form found in a few rails. Crack No. 2 is general for the Coalescent type of fissure, and may be from 2 inches to 3 feet long. Crack No. 3 shows that the nearly vertical interior transverse fissure has worked out to the surface. It has been found in several rail heads.

Now, let us follow the rail into service and observe what happens when it is laid in the track and subjected to the heavy bending stresses and hammer-blows of modern rolling stock. The checked interior metal is no longer able to restrict the strains of the wheel loads within the usual range of the elastic limits of the steel (as in the case of sound metal), but there develops, by detail growth, from and around the checks, the specular surfaces of the induced interior transverse fissures, until the section ruptures. Finally, the fissure extends to the surface of the rail and shows itself as cracks in the rail. The specular surfaces, after this, discolor and darken under the action of the weather, and present the appearance found in ruptured rails by the trackmen. These conditions are shown in the accompanying line drawing of a section of hundred-pound rail.

Dr. Dudley states that interior transverse fissures have not occurred in the countless thousands of rail

(*Concluded on page* 197)

Return of the Scientific Section of the Stefansson Expedition

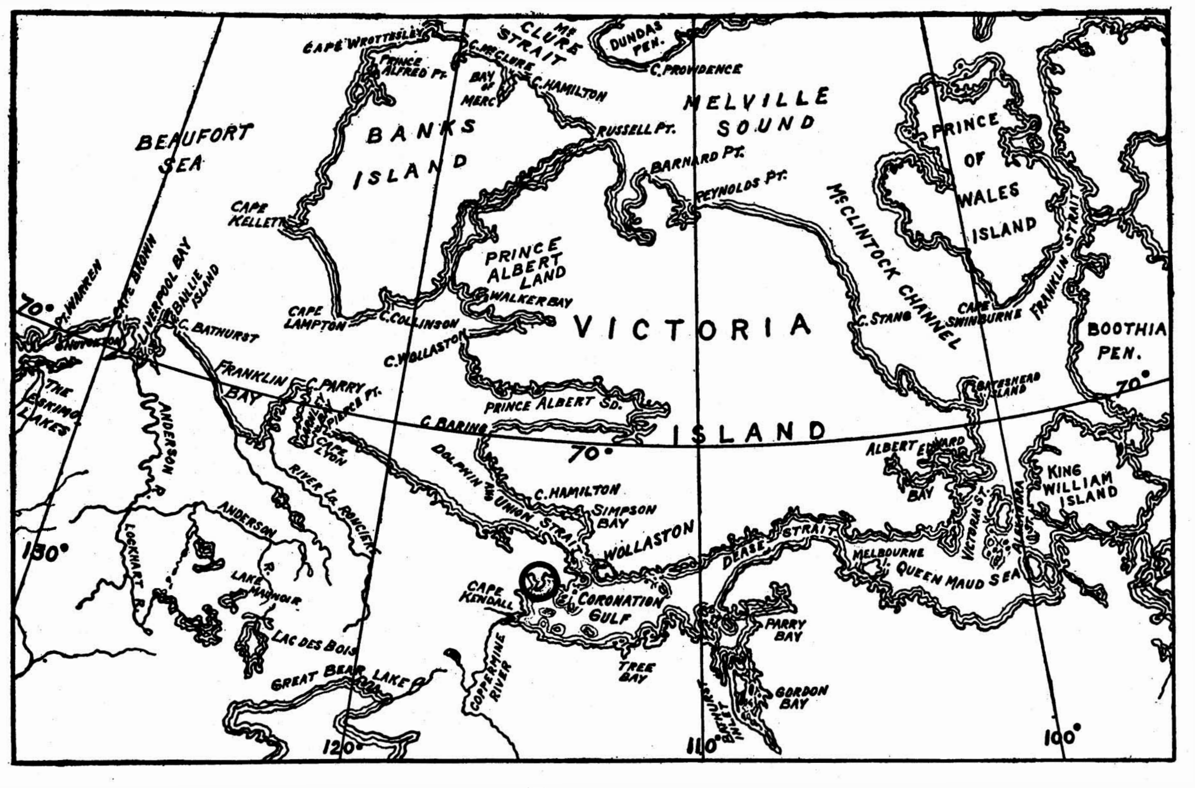
AS we go to press it is announced that the scientific wing of the Stefansson Arctic Expedition has returned to Nome in the power schooner "Alaska," with its work completed substantially as projected. This brings to a close the less spectacular half of the Stefansson undertaking, but what should turn out to be by far the most important part scientifically.

It will be recalled that when the expedition was first organized it was divided into two sections. These were in frequent touch during the three years spent in the field, exchanging men and ships as necessity demanded and occasion offered; but by good rights they may be regarded as two distinct enterprises. The northern party, under Stefansson himself, was devoted to the work of geographical pioneering ordinarily thought of in connection with Arctic exploration—the search for new land and the rectification of the position and coast contour of old lands. We have already given an account of the progress of this wing of the expedition, up to the last word heard from it in September, 1915, and indicating a very considerable degree of success in the attainment of its aims.

The southern party, under the executive headship of Rudolph M. Anderson, is the one which has just closed out its operations. It was charged with a comprehensive scientific investigation of the Arctic coast regions of the Canadian mainland. Some idea of its scope may be gleaned from the catalogue of its members, embracing a marine biologist, a geologist, a topographical expert, an ethnologist, an authority on terrestrial flora and fauna, and a skilled photographer.

The expedition has made its base at Bernard Harbor, in Dolphin and Union Strait. Its general scheme of operations has been to send out parties of two or three whites, with such Eskimos as seemed proper, for dashes along the coast and

(*Concluded on page* 198)



Map showing regions traversed by southern wing of Stefansson expedition

(Reprinted from the Geographical Review, published by the American Geographical Society of New York).

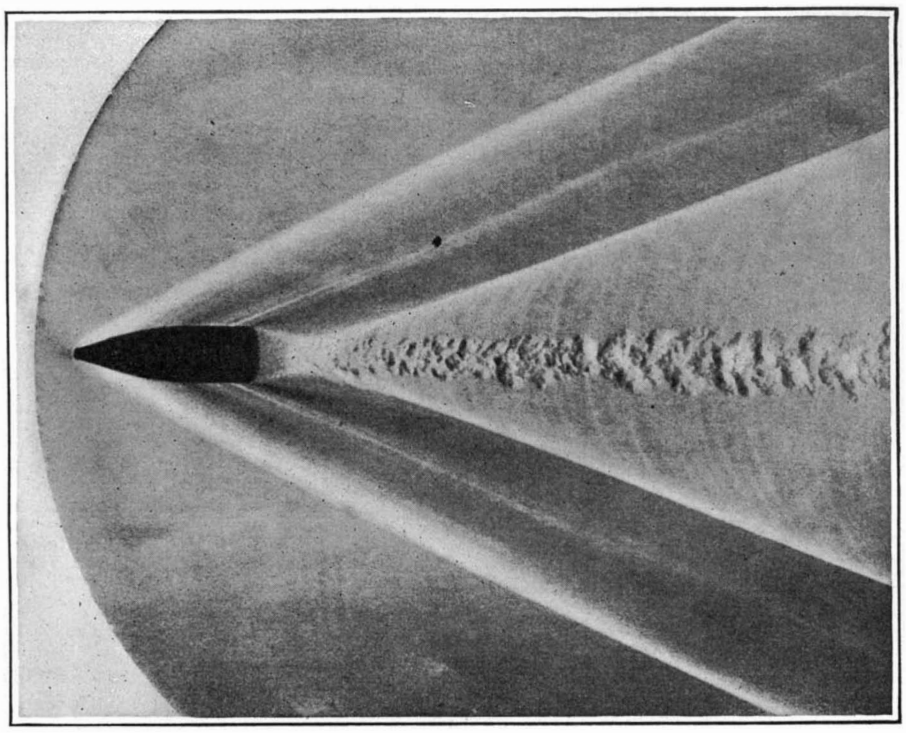
Photographing of High Velocity Phenomena

How Wave Motions of the Air are Caught by the Camera

By William Albert Hyde

IN previous issues of the SCIENTIFIC AMERICAN have appeared photographs of the waves created in the air by the passage of projectiles at high velocities. Inasmuch as these are invisible disturbances of an invisible medium, some readers may have been considerably puzzled to account for their photographing. The solution of the mystery is at once simple and highly interesting. The whole process depends entirely upon the refraction property of light.

Methods of obtaining photographs of such wave disturbances are various. The apparatus for one of them is shown in Figs. 1 and 2. In Fig. 1, M is a concave spherical mirror, S and G are spark gaps in the same circuit, C is the camera. The circuit is closed by the passage of the bullet through G, being so arranged that the resulting spark discharge at S is not instantaneous, but is subject to a definite time lag of about 1/2,000 of a second. The flash of this spark is reflected from the mirror back through the medium, disturbed as it is by the passage of the projectile; and the irregularities in density of that medium due to the presence of the waves lead to refraction of the light thus passing through. This refraction causes the light from the spark to be piled up in parts of the plate and thinned out in others, producing, of course, a photographic image of these invisible disturbances.



Bullet and accompanying waves, photographed with apparatus of Fig. 1

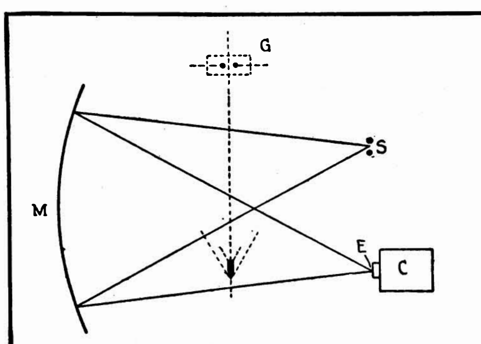


Fig. 1. Apparatus for air-wave photography

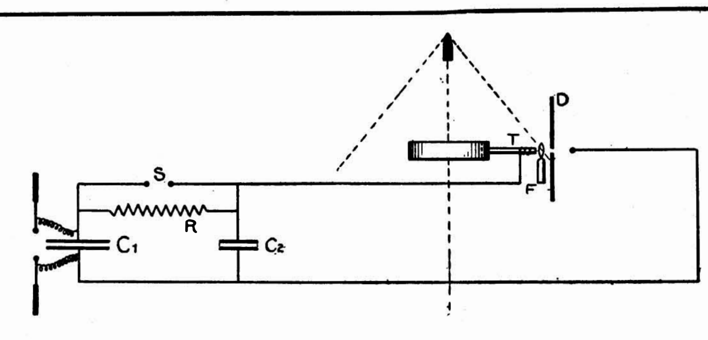


Fig. 3. Simple device for wave photographs

The arrangement of the electric circuit affording the time lag necessary to prevent the spark reflection from passing back in front of the wave-head is rather ingenious. There are three oscillatory circuits (Fig. 2), charged in parallel by a static machine at G; L is a variable inductance and R a very high resistance, preferably a tube of slightly salted water. R permits the charging up of C_3 and prevents its discharge except at the proper time through S. The circuits are all made up of short thick copper wire. The period of I is shorter than that of II, and by strong damping I can be made to discharge before II begins. There results a high difference of potential between m and n, and the voltage across S rises. With the gap at S of proper length, III will discharge when II has made one half-oscillation, which can be varied at I.

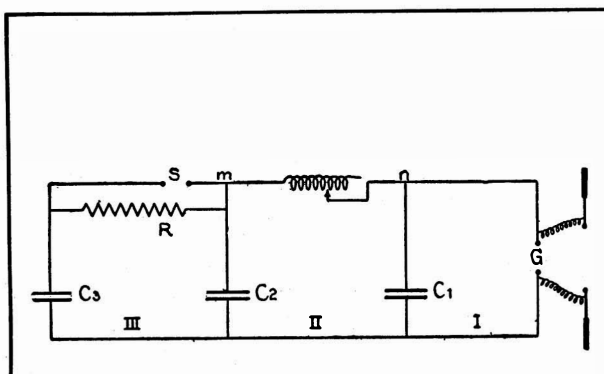


Fig. 2. Electric circuit used in apparatus of Fig. 1

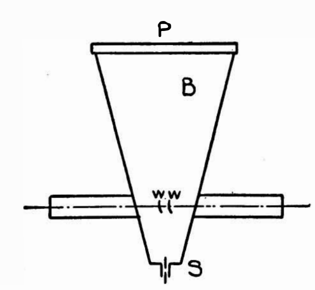


Fig. 4. Third type of apparatus

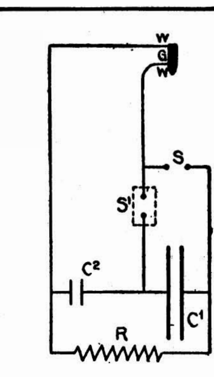
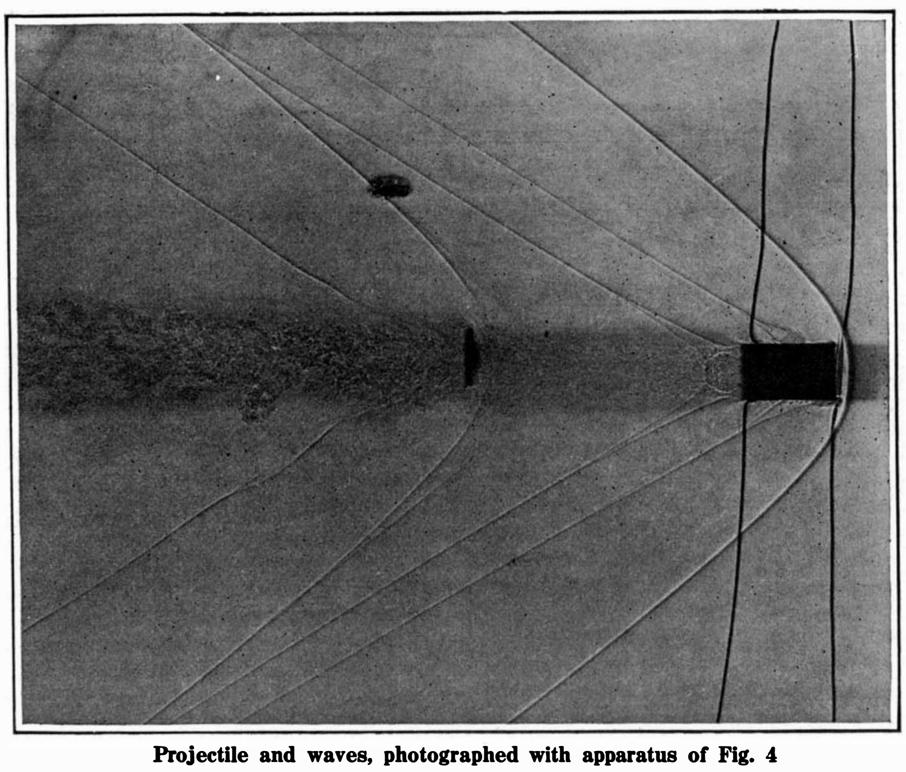


Fig. 5. Circuit for use with apparatus of Fig. 4

Another method, not so precise in locating the bullet but simpler as far as the electric installation is concerned, is that of Fig. 3. C_1 is a large and C_2 a small condenser, S the photographing spark gap, R a high resistance, T a tube connected to a ring A through which the bullet passes, F a gas flame, D a disk with a hole through it. As the bullet passes through the ring a wave traverses the tube and blows the ionized gas through the hole in the disk to the other terminal, thus triggering off the spark at S. The small condenser C_2 is discharged at once, but the resistance R prevents the discharge of C_1 until the difference in potential at S is great enough to break down the gap. The actual work of photographing is accomplished as in the previous case; the apparatus for this is not shown in the present figure.

The results of these methods, as may be seen from the large photograph of a bullet at 2,700 feet per second, are singularly beautiful. Some idea may be formed of the variation in intensity of the front wave from the way the wave shades off. It is rather surprising that such a well defined tail wave is found. The wake at the rear is not smoke, as might appear at first glance, since this type of photograph shows only the variations in the refractive index of the air. It is probably due to the vortex motion of the air rushing in to fill the vacuum; for it has been shown that there is a vacuum at the base of a projectile moving at such velocities as those we are dealing with. During this process the air is heated, with great change in density and refractivity; hence the recording in the photograph of this feature.



Projectile and waves, photographed with apparatus of Fig. 4

The apparatus described is expensive and difficult to obtain. Similar results may be obtained by means of the apparatus shown in Fig. 4. B is a light-tight box, hooded at the ends to prevent light from the bullet holes falling on the plate. S is the spark gap and w, w the wires shortcircuited by the bullet. There is no camera or mirror, the light from the spark passing through the waves and falling directly upon the photographic plate P. The circuit is shown in Fig. 5. The lettering corresponds to that in previous diagrams. S' is an additional gap, enclosed, so that C_1 has to discharge through two gaps in series. The condensers are charged to the desired potential, which is less than that required to jump both gaps in series. If one gap, S', can be shortcircuited, then C_1 will discharge through S, the photographing gap. This is accomplished by means of a secondary circuit through S', C_2 and G. When G is closed by the bullet, C_2 discharges through S' and hence C_1 through S. It will be noted that this gives purely an outline picture, in contrast with the previous methods.

The question suggests itself, whether application cannot be made in the arts and sciences, in research or invention, of these methods. In photographing a bullet, for instance, a movement of 1/100 inch would show a blur on the negative. At a velocity of 2,700 feet per second it would therefore be necessary, under ordinary methods, to have an exposure of

$$\frac{1}{2{,}700 \times 12 \times 100} = \frac{1}{3{,}240{,}000}$$

second in order to get a clear image. This is, of course, out of the question; hence a study of such high velocity might find an application for the methods under discussion. These methods seem applicable for work on air or gases, where the index of refraction is considerable, or even in lesser degree on liquids and crystals. A sound wave passing through a glass rod with velocity 5,000 feet per second has been thus photographed; and it is suggested that light might be thrown upon the theories regarding the formation and growth of crystals by this means.

It is clear that a point source of light is necessary; otherwise the well defined shadows will not be obtained. The range of the methods is surprising. The writer has used the scheme with 20 feet between spark and plate. The spark, projected across a gap of three quarters of an inch, looked to be about a half inch in diameter; but this is an illusion, as the pictures showed it to be virtually a point.

Possibilities and Conditions of Crossing the Atlantic by Airship

(*Concluded from page* 188)

airship, one whose importance has singularly decreased these latter years: limited intensity of winds.

About a decade ago, when the swiftest airship could not exceed a speed of 40 miles per hour, the problem of meeting adverse winds seemed very awkward indeed. An airship cannot make any headway against a wind that exceeds or only equals her speed, because she cannot utilize the resistance of the medium which supports her—air—against the medium itself. The conditions affecting her navigation might well be compared to those of a submarine running entirely submerged.

To-day, however, when the speed of one of the latest Zeppelins is given as 75 miles per hour, the chances of the Atlantic being crossed by an airship may be said to have increased in the very proportion of the increase of speed obtained.

The late Prof. A. Lawrence Rotch, founder of the Blue Hill Observatory, conducted during a long period of years extensive aerial soundings, which enabled him to determine with great accuracy the winds which prevail up to a great height over the Western Hemisphere. The data thus gathered and published under the title *Charts of the Atmosphere*, as well as those compiled by the Observatory of Manchester, England, furnish an excellent basis for plotting one or more favorable air routes over the Atlantic.

Two such routes were suggested by the late Prof. Rotch himself in the April, 1912, issue of the *Aero Club of America Bulletin.* The first of these would link St. John's, Newfoundland, with Valentia, Ireland, a distance of 1,800 miles, which would be divided into two courses. The first from Lat. 47° N., Long. 53° W., to Lat. 42° N., Long. 30° W., a distance of 1,000 miles; and the second from Lat. 42° N., Long. 30° W., to Lat. 52° N., Long. 14° W., a distance of 800 miles. One half of the prevailing winds blow in the first part of the course from a westerly quarter with a speed of 21 miles per hour, and three fourths of the winds in the second part of the course blow from the same quarter at the rate of 28 miles per hour.

Taking a 75-miles-an-hour airship of large displacement, it appears that an air service could be now organized on this route and maintained, running *both ways* for at least six months of the year, if not longer. Obviously the eastward passage will take less time—from 18 to 20 hours—than the westward trip—from 36 to 40 hours; it should also be expected that some time will have to pass before an airship will be able to outride an equinoctial storm or a hurricane, but even that eventuality does not seem so very remote in view of the steadily increasing speed of airships.

The latter feature incidentally deprives Prof. Rotch's other route—westbound this, and following the NE. trade wind from Lisbon to one of the Lesser Antilles, a distance of 3,600 miles—of all *raison d'être.* For if an airship is capable of maintaining a speed of 50 miles per hour in the teeth of a 25-mile wind, it seems more logical to choose a course of 1,800 miles against such a wind than to double this distance for the benefit of a 20-mile trade wind which would speed up the craft till it reached the Antilles and then leave it to its own resources for reaching New York.

In other words, the modern high-speed airship seems to condemn the low-speed, long-range dirigible—a sort of an auxiliary sailing vessel of the air—which relies chiefly on favorable winds for its progress. The latter was the basic idea of the "Suchard" airship; this craft never started because its promoters found out after laborious computations that a spherical balloon would make a much finer drift balloon than an elongated craft fitted with motive power!

Reverting now to the announced trip of a Zeppelin across the Atlantic, the terminals of the All-British route being unavailable for this vessel, its course will be lengthened considerably by the necessity of starting from some place in Belgium and by that of reaching neutral territory on this side, i.e., the United States. Assuming the airship starts from Ghent, Belgium, for Bangor, Maine, the total distance of the course would be about 3,200 miles.

The last and, seemingly, most important question that remains to be answered is: have the Germans an airship capable of accomplishing the unprecedented feat of running 3,200 miles on its own fuel? It seems they have. The 61-ton Zeppelin, in particular (see Scientific American, May 13th, 1916), should have a fair chance to cross the Atlantic from Belgium to this country. This vessel is supposed to carry a useful load of 21 tons, which might be apportioned thus:

Crew (1 captain, 2 lieutenants, 4 helmsmen, 1 engineer, 7 mechanics)	1¼ tons
Fuel (for 52 hours)	19½ tons
Stores	¼ ton
Total	21 tons

As can be seen, no allowance is made in these tables for the usual water-ballast, the writer assuming that for a voyage which will not require a great altitude of navigation the new compensating tanks and the double skin will sufficiently insure a uniform buoyancy and that fuel could be jettisoned in case of need.

A 52-hours' fuel supply would give a 75-miles-an-hour Zeppelin a cruising radius of 3,900 miles, which for crossing the Atlantic would mean a margin of safety of 700 miles. Will this margin prove sufficient for meeting adverse winds? It seems that it may, although the margin of safety does not appear any too liberal and might become the stumbling block of the enterprise. The future alone can tell.

Patents in Great Britain

According to the annual report of the Comptroller-General of Patents of Great Britain, a copy of which has just been received in Washington, the number of applications for patents filed in that country have greatly decreased in the past two years. The exact number of applications filed in 1915 was 18,191, or 6,629 fewer than in 1914, and nearly 12,000 fewer than in 1913. Commenting on the subject the report says:

"With so many engineering firms and textile machinists engaged on munition work, a fall of 40 per cent below pre-wartime figures seems but a reasonable figure, but the real loss to industrial development is not indicated by the mere number of applications, for a great proportion of these since the outbreak of war have been concerned with destructive agents, such as guns, rifles, bombs, shells, and the like, besides those relating to aircraft and submarines. One disturbing feature is the number of applications for patents that continue to be made by persons in this country on behalf of patentees in belligerent countries.

"The number of documents relating to foreign patents, designs, and trade-marks deposited under the arrangements whereby applicants for enemy patents are received and filed, although no formal acceptance is recorded, amounted to no fewer than 286. At the same time, the working of the patents, designs, and trade-marks (Temporary Rules) Act of 1914, which provided for the filing of all such applications, has disclosed a slight ambiguity, for it was found that the practice of filing applications and formally publishing an acceptance resulted in an accumulation of unpublished specifications, some of which might be of importance to our home trade. Further, until such specifications were published they could not be cited by the Patent Office authorities as anticipations to later applicants. Consequently it has been decided to accept and publish in the usual manner all applications on behalf of foreigners for patents, but to suspend all further proceedings thereon."

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The Current Supplement

An important article in the current issue of the Scientific American Supplement, No. 2121, for August 26th, is *The Battle of the Skagerrak*, which reviews the recent notable naval engagement in the North Sea from the German point of view, with comments on its results. It is written by an officer of the German Navy Department, and may be regarded as a semi-official statement. *The Dordogne* tells about a district in the southwestern part of France, where, in the valley of the Vazere, eminent paleontologists believe they have located the earliest evidences of primitive man in Europe. A sketch of the discoveries made here is given in the article, which is accompanied by photographs and drawings made by one of the most eminent authorities in this branch of science in Europe. *The Elements* considers the fundamental attributes of the chemical elements, their atomic theory and what they are. It is from an address of a distinguished scientist. *X-Ray Pictures of Living Plants* discusses a method of studying the vital processes of plants, which appears to be of considerable value to botanists. It is illustrated by a number of photographs. *Perpetual Motion* surveys an elusive problem which scientists deny, but which is constantly in evidence in nature. The illustrated article on *The Iron Basteria* is concluded. *Timbers of the Philippines* gives considerable useful information on a subject of importance to many people. *A 15,000 Horse-Power Turbine* is a short description, with an illustration, of one of the great water-motors that will supply power to the electrified section of the Chicago, Milwaukee & St. Paul Railway in the mountains of Montana. Other articles include *The Genesis and Absorption of X-Rays* and *An Improved Dry Cell Battery.*

A Frequent Cause of Broken Rails

(*Concluded from page* 194)

heads of physically homogeneous metal, and this for the reason that they do not contain the condition of the first contributory cause above mentioned; that is, the delayed transformation of the metal in the head and chemical or mechanical defects; consequently, while the metal is lengthened or shortened by the second contributory cause, that is, violent straightening of the rail when it is cold, it is not checked. He states further that basic open-hearth rails of the composition called for by the New York Central Line's specifications and rolled from reheated blooms, have not, to date, developed interior transverse fissures.

Dr. Dudley recommends that the rails in the track be examined daily for cracks which break through to the outside of the metal, and that when any are found the rail should immediately be removed. These cracks are not all alike in the various brands of rails, owing to the different methods of gagging. The gagging or straightening of the rails is done as follows:

Two supports or abutments are provided, which were formerly 30 inches apart and in later years have been placed 42 inches apart. The bent rail is placed on its side against these abutments. Midway between them a plunger moves forward and straightens the rail, which is placed against the supports with the bend concave to the plunger. The plunger does not bear actually against the rail, its pressure being transmitted by a wedge-shaped piece of steel, which the operator inserts according to his judgment of the amount of bending necessary to straighten the rail. Since this is done when the rail is practically cold, it can be seen that enormous stresses must be set up within the body of the rail, stresses which, as in the case under consideration, may start incipient fractures leading, when the rail is in service, to total rupture. It is recommended that the supports or abutments in this process should be placed farther apart with a view to reducing the stresses.

The Cruise of the Civilian Naval Volunteers

(*Concluded from page* 189)

sister ships "Kentucky" and "Kearsarge," the sister ships "Alabama" and "Illinois," the "Maine," the sister ships "Virginia," "Rhode Island" and "New Jersey" and the "Louisiana." The squadron is commanded by Rear-Admiral John H. Helm, who flies his pennant from the "Rhode Island."

The battleships in reserve are maintained with only forty per cent of their complements, and a typical case of the make-up for the cruise, as the ships went to sea, is that of the "Maine," which sailed from the New York Navy Yard, under the command of Captain Montgomery Taylor, with Lt. Commander C. C. Block as executive officer. The complement is made up of 338 regular enlisted seamen, with 24 officers of the line and warrant officers, and 331 civilian volunteers, among whom, by the way, are two volunteers from this office. The procedure followed on this ship is typical of all others. At first, the volunteers are arranged in divisions by themselves for special instruction; later they will go to battle stations with the regular enlisted men. During the first two days at sea the volunteers will be organized in squads and companies and taught the customs and ways of the ship, such as the salutes, the phraseology, how to keep their clothes, etc., in shipshape—not so easy a matter as one might suppose aboard ship.

The volunteer is identified at the gangway of the ship, and at once passed the Divisional Officer, who gives him his station billet. Next he is taken charge of by a bosun, who gives him his hammock and bag with his number, and he is shown his station billet. He then goes to the Pay Master, hands him his $30.00 to cover his expenses on the cruise for food, etc., and receives a receipt for the same. Next, he draws his uniform and mattress, and having secured these, he is given a stencil with his number, and proceeds to number his various belongings.

The instructions during the cruise consist in boating, target practice with the 3-inch gun, infantry drills, emergency drills and General Quarters, etc. That the "rookies" will not lie on a bed of roses during the cruise is shown by the following list giving the routine of his daily life aboard ship:

5:00	A.M.	Reveille.
5:20	"	Pipe sweepers.
5:30	"	Turn to. Swimming when morning work is completed.
6:30	"	Recall from swimming.
6:45	"	Trice up clothes lines.
7:15	"	Mess gear.
7:30	"	Breakfast.
7:50	"	Call for guard mount.
7:55	"	First call for colors.
8:00	"	Colors. Guard mount.
8:15	"	Turn to. Brightwork.
8:30	"	Sick call.
8:45	"	Knock off brightwork.
9:00	"	General quarters, muster at battle stations.
9:25	"	Secure.
9:30	"	Assembly, physical drill.
9:45	"	Retreat. Drill call. Drill and instructions.
11:15	"	Retreat. Light smoking lamp.
11:20	"	Swimming call.
11:40	"	Recall from swimming.
11:45	"	Mess gear.
12:00	"	Dinner.
1:00	P.M.	Turn to.
1:15	"	Drill call.
4:00	"	Retreat, fresh water, scrub and wash clothes.
5:00	"	Swimming call.
5:20	"	Recall from swimming.
5:45	"	Mess gear. Trice up clothes lines, dry down decks.
6:00	"	Supper.
6:30	"	Turn to
6:45	"	Lectures.
7:30	"	Hammocks.
7:45	"	Drills as ordered.
8:50	"	Secure and first call.
9:00	"	Tattoo.
9:05	"	Taps.

The programme of instruction for the first day at sea, calls for emergency drills in the morning and division and battery drills in the afternoon, with a lecture on torpedo defense in the evening.

After the recruits have been shaken down, the squadron will take part in the general war maneuvers which are held in the Fall of each year. They will learn something of the delights of coaling ship at Hampton Roads, and they will watch and take part in target practice at Tangier Bay in the Chesapeake.

Early in September there will be a general mobilization of the motor boat division, which will take part in problems of defense, both of the fleet of battleships and of the home ports. Our mosquito fleet, consisting of some of the finest and fastest motor boats of the Atlantic coast, is receiving considerable attention from the Navy Department, and its development is being watched by the Department with critical interest. At the close of these maneuvers the ships will return to the ports of embarkation.

Return of the Scientific Section of the Stefansson Expedition

(*Concluded from page* 194)

into the interior of anywhere up to five hundred miles.

Of most direct importance are the cartographical results of the expedition. A detailed survey was made of the entire coast line from Cape Parry to the Rae River, and a less comprehensive one of the region between Capes Barrow and Bathurst. The course of this stream was mapped for seventy-five miles from its mouth, and a number of other unexplored and even unnamed streams gone over. While a good portion of this coast had been mapped before, the present work is bound to afford many corrections. For instance, over a hundred and fifty islands were accurately laid down in one area which was previously supposed to involve only three islands.

Closely allied are the geological findings. Aside from any results of a general theoretical nature, it is to be noted that many copper bearing formations were located, and much information gained of their stratigraphical relations to the sandstones, shales and granites.

Much biological material was collected both from land and water. Large quantities of marine and fresh water specimens were brought back, and in spite of the fact that the permanent base was in a very unfavorable situation, backed by many miles of barren, stony wastes, over five hundred specimens of birds and mammals were got together.

The usual anthropological activities are indicated by a wonderful collection of the weapons, tools and ornaments of the various Eskimo tribes. Among other items, this collection is noteworthy for its stone lamps, its arrows and knives of native copper, and its horn eating implements. It goes without saying that valuable data concerning the language of the peoples is also to be looked for.

But the most striking features of the expedition's work must be the wonderful results attained in the application of the instruments developed during the past twenty years. We say "instruments" with a feeling of apology; for we are sure that the possibilities of the phonograph and the moving picture—perhaps even of the ordinary camera—as scientific instruments are not fully realized by all our readers. These have been of extraordinary value to the ethnological branch of the expedition. Phonographic records in considerable number have been made of the folk-songs, the music, even the language of various Eskimo tribes—notably of the blonde Eskimos discovered by Stefansson himself at an earlier date. Several thousand feet of cinema films have been made showing certain features of Eskimo life. Altogether, these items present a most impressive demonstration of the present status of scientific methods.

NEW BOOKS, ETC.

Chronological Catalogue of Buildings and Associated Arts. A Proposal and a Plan. By Barr Ferree. Published by the Author at 249 West 13th Street, New York City, 1916.

This pamphlet is a plea for the issue of a work that shall catalogue, with some attempt at completeness, the notable buildings of all countries. The work would be a veritable storehouse of architectural information, in which less-known but noteworthy buildings would be given adequate consideration together with those of which everybody has heard. The proposal is commendable, and one that should appeal to all who are interested in the history of structural art. Since much has already been accomplished in this direction, most of the material would be ready to hand. Its collection into one chronological catalogue, while a task of no mean proportions, would seem to promise results which would amply justify the labor. The proposal has already been indorsed by many authorities.

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