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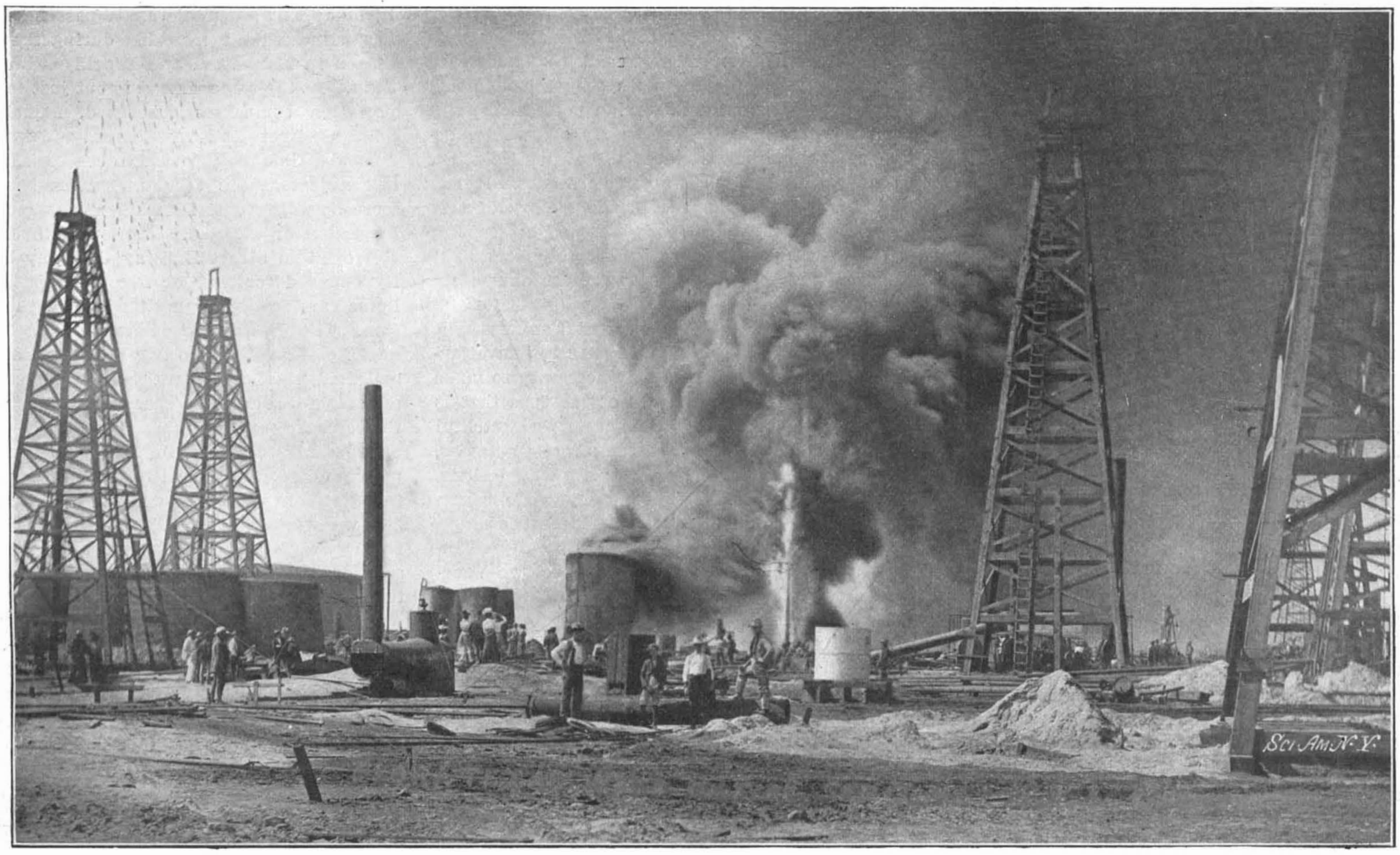
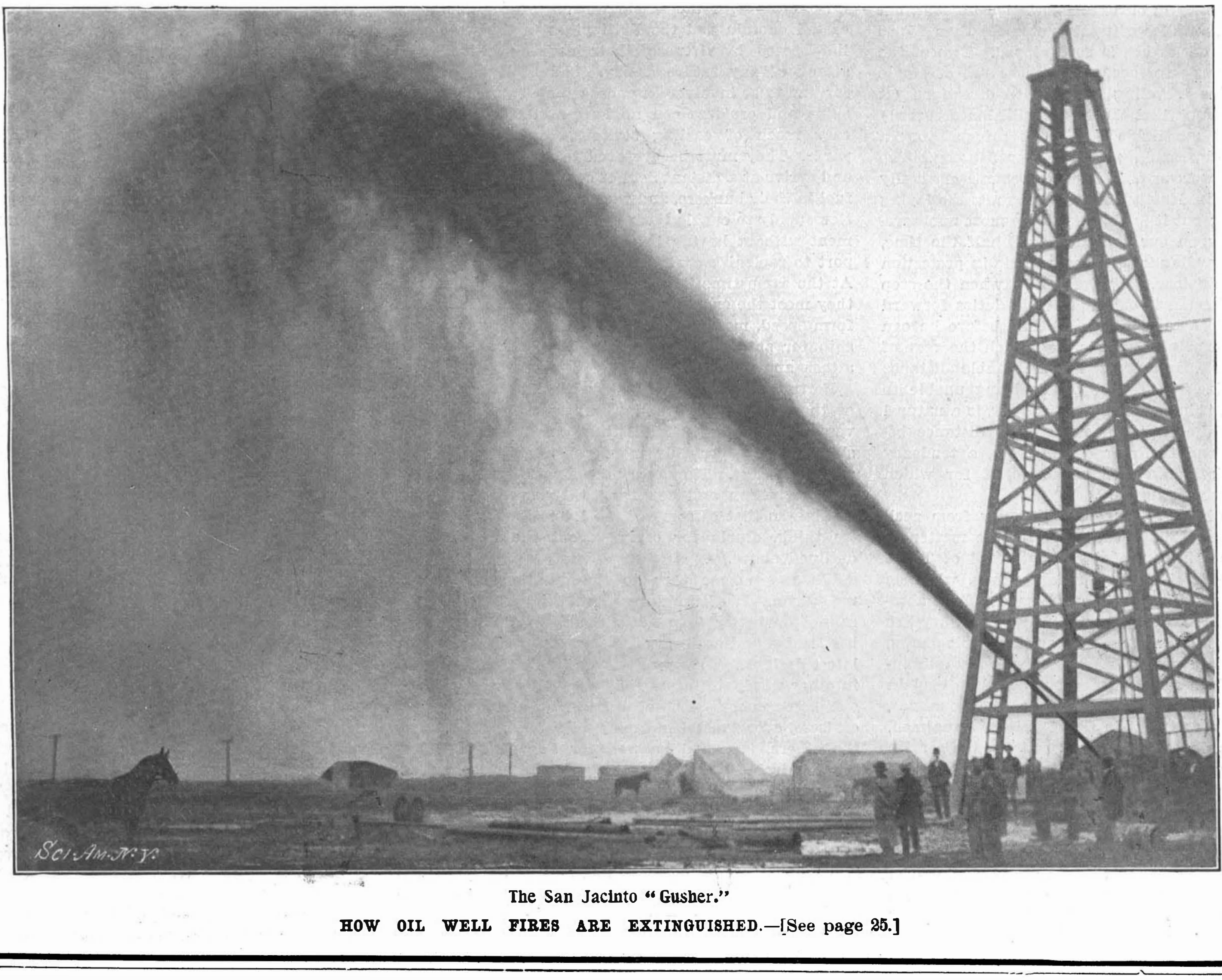


The "Flora" Well in the Texas Oil Field on Fire.



The San Jacinto "Gusher."

HOW OIL WELL FIRES ARE EXTINGUISHED.—[See page 25.]

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NEW YORK, SATURDAY, JANUARY 10, 1903.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RAILROAD ACCIDENTS HERE AND ABROAD.

The truly horrible head-on collision that occurred a few days since in Canada, in which twenty-eight people lost their lives, serves as a shocking reminder that in the matter of safety of railroad travel we have a great deal to learn on this side of the water. Nor is it to the point to argue that because a railroad passenger has to travel so many million miles before his single chance of being killed comes round, railroad travel is as safe as it can be made. The true test of perfection of our railroad safety appliances is to compare our accident statistics with those of some other systems—to take the highest standard of attainment, and endeavor to live up to that. During the past year on all the railroads of the United States, 167 persons were killed in railroad accidents (collisions, derailments, boiler explosions, etc.) and 3,586 passengers were injured. During the same period on British roads not a single passenger was killed and only 476 were injured in railroad accidents. If it be argued that we have nearly 200,000 miles of track in this country as against 22,000 in Great Britain, it must be answered that the liability to railroad accidents increases with the density of traffic. That is to say, the risks of collision, etc., are greater the greater the number of trains that pass over a given stretch of line in a given time. Now, here again statistics prove that the density of traffic over English roads is far greater than that over our own, so that when we have taken this into consideration, we find that the difference in safety of travel is even more marked than the mere statement of the relative total number of persons killed and injured would suggest.

Our railroads have done much of late years in the way of introducing the block signal system, and yet, as was stated recently in our Transportation number, out of nearly 200,000 miles of track, not more than 25,000 miles or about one-eighth is so equipped. Two of the most prolific causes of accident are the use of single track for trains traveling in opposite directions (it was on single track that the recent collision occurred) and that most unreliable system of safeguarding a stopping train by sending back a rear flagman. The first condition we can only hope to remove gradually as the increase in density of traffic warrants the laying of double track; but it is obvious to the most unobservant passenger upon our railroads that, half the time, rear-flag safeguarding is worth very little in protection against rear collisions. Too frequently when the stop occurs the brakeman is engaged at his duties forward in the car and there is a loss of time before he can find his lantern or pick up his flag, reach the rear of his car, drop off, and proceed a reasonable distance down the track. The chance of his being unable to catch his train, if he proceeds back too far, is a natural inducement to the flagman to limit the distance between himself and the rear of his train, a tendency which very effectually defeats the object for which rear flagging was instituted.

One reason of the remarkable immunity from accidents in Great Britain is the fact that the matter of safety appliances is regulated by the Board of Trade under the able presidency of Colonel York, who has made a life-study of his task; and because of the absolute powers conferred upon him, the risk of injury has been reduced to a minimum, and, as the result shows, the risk of death was last year absolutely eliminated. If American railroad men are asked to explain the difference in results between the two countries, they point to the fact that in Great Britain signalmen, and railroad employes generally, remain in the service of the company and at one particular class of work for many consecutive years of service, and, consequently, attain remarkable skill and accuracy. Traffic conditions in Great Britain, moreover, are less variable, whereas in this country the volume of traffic varies greatly with the season of the year, and during the rush attendant on the moving of western crops, for instance, it is necessary to take on a large number of temporary employes whose services are discontinued when the rush season is over. Moreover, there is no question that the sanctity of human life is held very much more sacred abroad than here. We are, or seem to be, willing, for the sake of lower cost and larger profits, to take those risks of life and limb whose results are seen in the long list of injuries and fatalities that are a conspicuous feature of our annual railroad statistics.

PROPOSED INCREASE OF OUR NAVY.

It was inevitable that the present international complications over the Venezuelan affair should very forcibly direct the attention of the people of the United States to the question of the present strength and needed increase of the navy. It was just seven years ago that the affairs of this South American republic involved us in a very definite announcement of the Monroe doctrine, and contemporaneously with that incident it was brought home to the people of the United States that to maintain the position so definitely stated, it would be necessary for us to possess an adequate naval force. Even stronger argument than this was afforded by the Spanish war, which bequeathed to this country some widely-scattered foreign possessions, and rendered us vulnerable to foreign attack, where, before the incident, we might, by virtue of our isolation, have considered ourselves practically secure. It has been the invariable experience in the history of this country that naval appropriations can only be secured, or secured in adequate degree, under the menace of such international complications as are too obvious to be overlooked.

In view of the fact that the present Congress will probably deal with a liberal hand in granting naval appropriations, it becomes increasingly necessary to make sure that the ships authorized are of the type that is most pressingly required. While keeping a watchful eye upon the trend of design among foreign navies, and incorporating the best elements of these designs, we should, above all things, have an eye to our particular necessities—to the nature of the duties which will be required of our ships in view of the altered international conditions brought about by the two Venezuelan incidents and by the Spanish war.

When we commenced the construction of our new navy, we held no possessions not included within our Atlantic, Gulf and Pacific seaboards, and hence our first battleships of the "Oregon" type were very properly designed as "coast-defense" vessels. They were of moderate size, and coal-carrying capacity and speed were sacrificed to extremely heavy armor and armament. We had no designs on the sea coast or foreign possessions of other nations; and we wished to possess a naval force that should suffice for duties of a purely police or protective character. To-day, however, we find ourselves in close commercial and military touch with the whole world. Porto Rico to the east, Honolulu and the Philippines to the west of us, lie exposed, by virtue of their insular position, to the attack of any future enemy. Should it be our misfortune to be involved in another naval war, our battleships and cruisers can no longer elect to lie within easy reach of coaling stations, drydocks or repair yards. They must be prepared to steam far and fast, and arrive at a distant field of conflict with a reserve of fuel in their bunkers, and with a large enough ammunition supply to enable them to fight a successful engagement without having to steam back to some friendly port to replenish coal bunkers and ammunition rooms. At the same time it is desirable that our ships, when they meet the enemy, should be able to steam at a uniform speed, maneuver with equal facility, and present, ship for ship, an overwhelming superiority both for attack and defense.

Fortunately, in our latest battleships and cruisers of the "Connecticut" and "Tennessee" type, we have vessels which amply fulfill these conditions. Ship for ship they are probably more powerful than those of any other fleet. They carry an unusually large supply of ammunition and coal, and their speed, while not so high as that of some of the latest foreign ships, is, we think, ample for carrying out the naval policy outlined above.

When we come then to the question of the immediate needs of the future, we think that Congress cannot do better than authorize a certain number of battleships and cruisers of the exact type of these, our latest designs. To insure this desirable uniformity, or in other words, to insure that we shall possess at least one homogeneous fleet of battleships and another of cruisers, every vessel in each fleet being identical with the others, it would be well for Congress to follow the admirable German method and authorize an extensive shipbuilding programme to cover a certain number of years. A total number of ships, say a dozen battleships and eighteen or twenty cruisers, should be authorized at once, with the understanding that a certain proportion of these, say two battleships and three cruisers, are to be laid down each year, and the money necessary for that year's construction voted regularly for the purpose.

Only by such a method can we insure, first, that our navy shall grow by regular increments, and not by spasmodic effort; and secondly, that the ships as they are completed, shall form homogeneous fleets with the material advantages which are to be secured by such homogeneity.

TRAFFIC CONGESTION IN MANHATTAN.

In the public agitation over the congested condition of street-car and elevated-railway travel in the city of New York, it is difficult to secure a dispassionate expression of opinion from those who have suffered from the present intolerable condition of things. As between the traveling public on the one hand and the transportation companies on the other, it should be remembered that there is something to be said on both sides. That the present crowding is dangerous, distressing and productive of an enormous loss of valuable time; that it is irritating to the men and positively humiliating to the women passengers, no one who has witnessed the crowding during the recent holiday season in Manhattan and Brooklyn can for a moment deny. At the same time it is but just to the two transportation companies concerned, namely, the Metropolitan Street Railway Company and the Manhattan Elevated Company, to remember that the trouble has arisen just at the very time when both corporations were spending vast sums of money either in the enlargement or the reconstruction of their systems. The Metropolitan Street Railway Company has been steadily engaged for four or five years past in abolishing horse cars and equipping its lines with electrical traction. The Manhattan Elevated Company is in the midst of installing electrical traction on all its lines, and had this equipment been completed before the advent of the holiday season and the winter storms, the company would have been able to handle the crowds that flock to its lines with reasonable dispatch and comfort. Add to these facts that the travel in New York city is increasing by leaps and bounds, and we think that even the most aggrieved patrons of the roads must admit that there is something to be said on the side of the Manhattan companies in extenuation of the present congestion.

At the same time the companies must remember that the traveling public of New York that is now clamoring so loudly for redress is, and for years has been, known as the most patient and long-suffering in the world. Visitors from the metropolitan cities of Europe have time and again expressed their astonishment at the uncomplaining way in which the New York traveler endures the inconveniences of travel in the city. This being so, it may be taken for granted that when the public does give voice to its grievances with a unanimity and earnestness such as characterize the present agitation, it does so because it has very good reason to believe that the conditions are much worse than they need be. Now, while it cannot be denied that the transportation companies are doing a great deal to accommodate the growing traffic, we are also satisfied that they could, in some respects, do a great deal more.

In the first place, the demand of the citizens that a larger number of cars or trains be run between the rush hours of travel is a perfectly reasonable one. If there were a more frequent schedule during the late morning and early afternoon hours, there is no question that many of the traveling public would delay their entrance to the city, or hasten their exit, who now prefer to avail themselves of the more frequent service of the rush hours. There is absolutely no excuse for crowded cars between the rush hours. The policy of the companies has been apparently to reduce the number and frequency of trains or cars between the rush hours to a point at which these cars shall be filled not merely with seated, but with standing passengers. For this they should be called sharply to account. The public is fully justified in its complaint before the Railroad Commissioners against the too great reduction in the train service which takes place during this part of the day.

It is claimed by the management of the two roads that the frequency of cars in rush hours is governed by the number of cars that can pass certain intersecting points, or junction points on their systems in a given time. One of these points is at the intersection of the Broadway and Sixth Avenue surface lines at Thirty-fourth Street. In a conference between the Metropolitan Street Railway Company and the chairman of the Merchant Association's Committee on Franchise and Transportation, the committee made the very sensible suggestion that to avoid this intersection of traffic, north-bound Broadway cars should be turned into Sixth Avenue and north-bound Sixth Avenue cars into Broadway at Thirty-fourth Street. It is probable that at other points of intersection on both elevated and surface lines, re-arrangements of travel having a similar object in view, could be made. Another reform by which the frequency of trains and cars could be considerably increased would be by sandwiching in more short-distance trains among those which run the full length of the city. It is true, some sandwiching is done at present; but there could be more of it done, especially on the Sixth Avenue lines as far as Fifty-eighth Street, and on the Third Avenue line, say as far as Forty-second Street. To give an example, a few years ago, a car starting from Fifty-eighth Street for the downtown journey, arrived at Forty-second Street with ample capacity for taking on the Forty-second Street passengers; while to-day these cars are almost as crowded as those that have come down from Harlem. Yet the interval between cars at Forty-second Street is amply sufficient to allow of doubling the number of trains that are started from Fifty-eighth Street even in the rush hours. This is but one instance, which doubtless could be duplicated at other points on the elevated system. Considerable relief would follow the construction of a third track on the Third Avenue Elevated and the running of express trains on the Second Avenue line.

The management of the Metropolitan Street railways have complained, and with very good reason, that a prolific cause of the crowding of the cars on the main thoroughfares is the interference of trucking with the running of cars. Nobody can deny that this is to-day a most serious obstruction on such a thoroughfare as Broadway. To prove the point it is merely necessary to imagine Broadway cleared of all trucks, and it is easy to see that instead of crawling along at an average speed, below Fourteenth Street, of say three miles an hour, the cars would readily make from nine to twelve miles an hour, and the increased speed would mean, of course, an increased number of cars passing a given point in a given time. It is not an uncommon sight to see a truckman leisurely driving his team on the car tracks with four or five cars held up behind him, and holding to these tracks until he reaches some particular street down which he wishes to turn. The Merchant Associations have requested that there should be proper police regulation of trucking and traffic on all car line streets. We do not know what the limits of authority of the police are at present, but if they can be extended, they should be to the very limit. Truckmen, cabmen and other drivers should be liable to penalty if they monopolize the street car tracks longer than is absolutely necessary for passing around a stationary or slower-moving vehicle in front. Moreover, as far as is consistent with the necessities of merchants living on Broadway, trucking should be restricted by law to the adjacent streets on either side. While we do not for a moment suppose that restrictions of this kind will entirely solve the difficulty, they will unquestionably assist in easing the congestion. Indeed, as regards the whole question affecting Manhattan in general, it may be said that relief is to be sought rather in a multitude of minor changes than in any panic legislation, which might be liable to defeat the very object at which it is aimed. Meanwhile we repeat the warning which was published in these columns a week or two since to the effect that unless *immediate* steps are taken for the construction of other Subway lines, north and south of Manhattan, we shall be confronted within three or four years with a congestion compared with which the present troubles will be mild indeed. In conclusion it must be admitted that in view of the present deadlock, the question of the construction of additional express elevated structures on the extreme eastern and western avenues of the city demands serious attention.

THE GERMAN-AMERICAN WAR GAME.

How thoroughly the various navies of the world study, and keep in touch with, the naval situation in other countries than their own, is shown in the latest events of the German-American conflict, which is now being played under the rules of the naval war game by officers of the British navy. In the last meeting, as described in the current issue of the SUPPLEMENT, a most important feature of the naval situation was that the American fleet in European waters was on its way, by the Suez Canal route, to the protection of the Philippines, with a more powerful German fleet bound hot-foot for the same destination. In view of the superior power of the German fleet, the admirals representing the American navy wished to dispatch the powerful North Atlantic squadron to join the European squadron in the Philippines, so as to present a combined force superior to that which Germany could gather. The umpires of the game, however, disallowed the move, and insisted upon the North Atlantic squadron being maintained off the Atlantic coast for the defense of the Atlantic coast cities. When the admirals of the American fleet protested, urging that it would be good strategy to make the move, the umpires replied that the force of American public opinion, particularly in the seaport cities, in favor of retaining the North Atlantic squadron for their defense would be so powerful that the Atlantic fleet would be kept in home waters, at least until the monitors could be suitably placed for their defense. Evidently the umpires had studied the conditions that existed during the Spanish-American war, when our Atlantic cities were clamoring so loudly for protection, that the old iron monitors of civil war times were resuscitated and distributed for seacoast defense. The umpires decided that at least three weeks must elapse from the opening of the war before the North Atlantic fleet should be allowed to sail for the Philippines. The necessity for maintaining it on the home station was found in the existence of a German home squadron composed of the "Brandenburg" coast defense battleships, and some powerful battleships of the "Kaiser Wilhelm" type.

PROF. IRA REMSEN, PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BY MARCUS BENJAMIN, PH.D.

For the first time since the civil war, the American Association for the Advancement of Science has held a winter meeting. This meeting was the fifty-second meeting of the Association and was held in Washington. The retiring President, Professor Asaph Hall, famous for his discovery of the moons of Mars, at that gathering yielded the chair to one who has been honored by the Association in consideration of his researches in the domain of chemistry.

Ira Remsen was born in New York city on February 10, 1846. He studied for a time at the College of the City of New York, and then entered the medical department of Columbia University, where he was graduated in 1867. He then went to Germany and entered the University of Munich, where he devoted his attention chiefly to the study of chemistry, and a year later passed to the laboratory in Göttingen, where, in 1870, he received the degree of Ph.D. On the invitation of Professor Rudolph Fittig he went to Tübingen, and for two years continued as assistant in the chemical laboratory of that university.

He returned to the United States in 1872, and was promptly called to the chair of chemistry and physics

in Williams College, remaining there four years. On the organization of the Johns Hopkins University in 1876, he was invited to the chair of chemistry of the new university, and has since continued in that place. He organized the chemical department, and since, with facilities that are not excelled in the United States, has directed the many chemical researches that have emanated from the Johns Hopkins laboratory.

Notwithstanding the very great amount of executive work that has devolved upon him, he has nevertheless still found time to do much original work himself, which may be summarized as follows:

1. Oxidation of Aromatic Substitution Products.—This investigation showed that the position of an oxidizable group in an aromatic substitution product has much to do with the effect of oxidizing agents upon it. When such a group is in the ortho position with reference to some negative group that is not oxidizable, it is not materially changed by the action of acid oxidizing agents; while the same group in the meta or para position is easily changed by such agents. This protective influence of negative groups in the ortho position was tested in a large number of cases, and although a few apparent exceptions were brought to light, the influence was clearly established. Later work by Victor Meyer showed a similar effect in the case of esterification, and still later work in the laboratory of the Johns Hopkins University showed that a similar protective influence is exerted in the action of hydrolyzing agents on acid amides.

2. The Sulphinides.—These bodies form a new class of compounds with interesting chemical and physical properties. The best known member of the class is the substance that is popularly known as saccharin. This has come into extensive use on account of its intensely sweet taste. Some members of the class are extremely bitter. Others are both bitter and sweet. The chemical properties of the substances have also been shown to be of considerable interest.

3. Double Halides.—These were for many years regarded as molecular compounds. The investigations on this subject have made it clear that they are analogous to oxygen salts, and that in them two halogen atoms acting together play the same part as an oxygen atom in the oxygen salts. This relationship is now recognized by all who have occupied themselves with investigations in this field, and by chemists generally.

4. Decomposition of Diazo Compounds by Alcohol.—This series of investigations led to conclusions at variance with those that had been previously held. The alcohols have been shown to act in much the same way as water in most decompositions of diazo compounds, the normal product being in each case a phenol ether, though in some cases, which are exceptional, hydrogen is substituted for the diazo group. This was formerly supposed to be the normal reaction in such cases.

His scientific attainments have frequently led to his services being sought for as an expert in cases of unusual importance. In 1881, he was invited by the city council of Boston to look into a particular condition of the city water, which was unfit for use, owing to a disagreeable taste and odor. Dr. Remsen showed that the trouble was due to a large quantity of fresh-water sponge in one of the artificial lakes from which the water was drawn. He was also intrusted with special researches by the National Board of Health, including "An Investigation of the Organic Matter in the Air" and "On the Contamination of Air in Rooms Heated by Hot-Air Furnaces or by Cast-Iron Stoves."

The exceptional ability shown by him in the care of the department under his supervision led to his being appointed vice-president of the university, and frequently, during the absence of Dr. Gilman, he served as acting president. In June, 1901, he was chosen to the presidency of the Johns Hopkins University, in succession to Dr. Gilman, which place he still holds.

Dr. Remsen founded the American Chemical Journal in 1879, and has edited that periodical ever since. He has also found time to prepare a valuable series of text books. These began with his translation of Fittig's "Organic Chemistry" (Philadelphia, 1873), which was followed by "The Principles of Theoretical Chemistry" (1877); "Introduction to the Study of the Compounds of Carbon, or Organic Chemistry" (1885); "Introduction to the Study of Chemistry" (1886); "The Elements of Chemistry" (1887); "A Laboratory Manual" (1889); and "Chemical Experiments" (1895). Of nearly all of these several editions have appeared, and translations into German and Italian have been made of them.

The degree of LL.D. was conferred upon him by Columbia in 1893, and by Princeton in 1896, and since 1882 he has been a member of the National Academy of Sciences, of which organization he is now foreign secretary. He is also a foreign member of the Chemical Society of London, and an honorary member of the Pharmaceutical Society of Great Britain. A year ago the American Chemical Society, recognizing him as a worthy successor to Draper, Lawrence Smith, Genth, Chandler, and other distinguished chemists, chose him as their president, and this year he will deliver a retiring address before that body.

His connection with the American Association began with his election at the Portland meeting in 1873. Two years later he was made a fellow, and in 1879 he presided over the chemical section at the Saratoga meeting, presenting on that occasion, as his retiring address, a strong appeal for the study of organic chemistry, in which he contended that in the educational institutions in this country the pursuit of that branch of chemistry had been sadly neglected. Since then he has been a frequent attendant at the meetings, and his interest in science was recognized at the Pittsburg meeting by his elevation to the presidency of the largest of the American scientific organizations.

Further Marconi Transatlantic Messages.

On December 28 Marconi published the text of some messages sent across the Atlantic between Table Head and Poldhu. The messages were addressed to the Queen of Italy, Sir John Lane, Heniker Heaton, and the Italian Minister of Marine. They were all New Year's greetings.

The first allotment of grants by the Carnegie Institution, which has been endowed by a gift of $10,000,000 from Andrew Carnegie, has been made to Prof. Atwater to enable him to continue his investigations with the Wesleyan calorimeter. The trustees of the Carnegie Institution have also made awards to Yale University. The departments of the university which are to be benefited are those of paleontology and psychology. The work of Prof. Marsh in the former and of Prof. Scripture in the latter has undoubtedly done much for Yale.

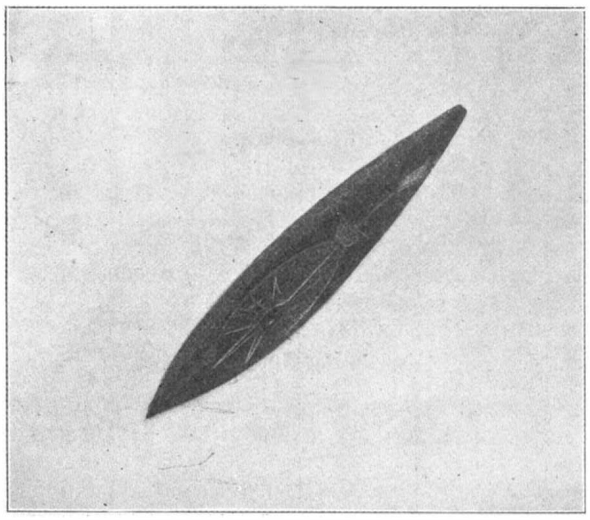
THE LEBAUDY DIRIGIBLE AIRSHIP.

Since the period of the first trials of the dirigible balloon constructed by MM. Julliot and Surcouf for the Lebaudy brothers, the inventors have been continuously carrying on their experiments with their airship, which is now complete and provided with its vertical rudder. The favorable predictions that it was possible to make from the first ascents have now been realized. Proceeding as in the past, the cord was first actuated in order to test the steering apparatus. Then a free ascent was made, but with the guide rope trailing upon the ground and capable of being easily seized by men who followed the balloon afoot.

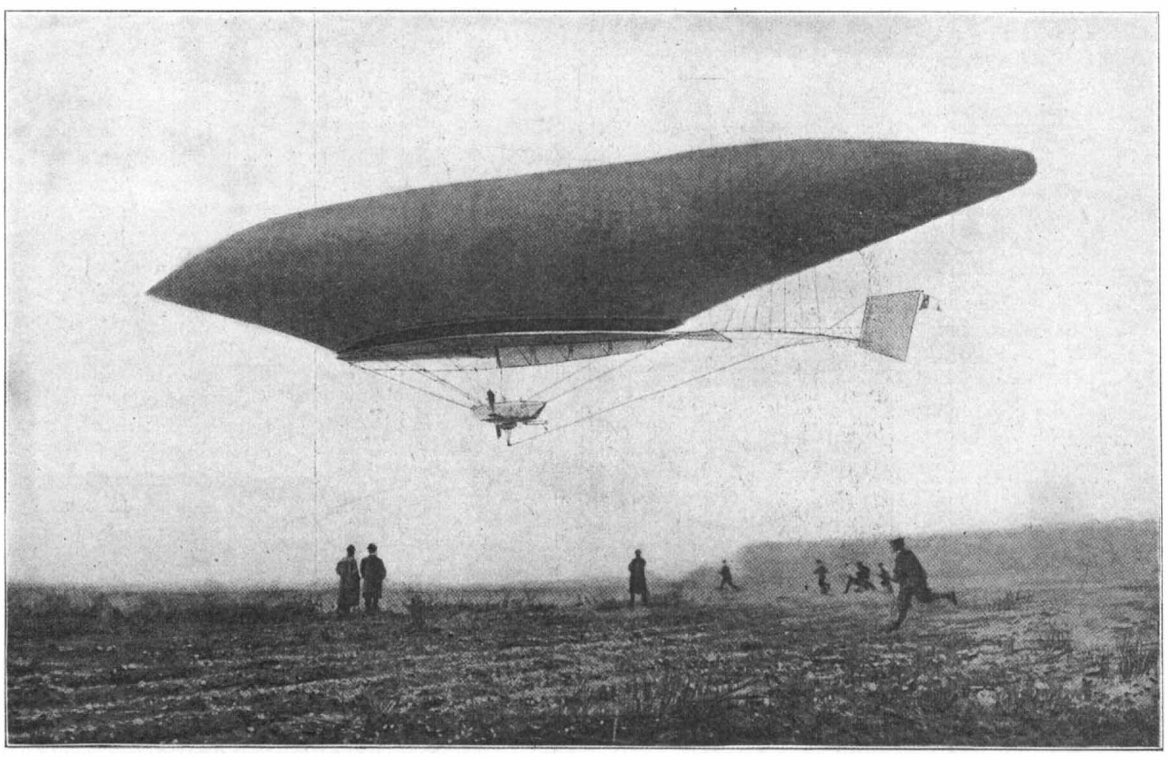
The start has been made every time from the cemented trench in front of the shed. In this trench a suitable guideway enables the car to start smoothly and without shocks that might harm it or strain its external pieces. The trench thus greatly facilitates both the starting and landing maneuvers.

Sure of the proper working of the gasoline motor, propellers, and rudders, it was now possible for MM. Julliot and Surcouf to trust themselves to the air with the balloon absolutely free. In an ascent that followed, the guide rope was pulled into the car, but was so arranged that it could be instantly thrown to the ground. Upon this occasion, MM. Julliot and Surcouf took along but one assistant, and compensated for the weight of the one left behind by means of ballast. The fog, in fact, was quite dense, and the aeronauts were afraid that its condensation upon the exterior of the balloon might load the latter and render the use of ballast necessary. Such fear, however, proved groundless, and the airship returned to its starting point fully inflated. It had not even been necessary to force air into the small compensating balloon of 7,000 cubic feet capacity, which is housed in the interior of the balloon proper for the purpose of remedying the reduction in volume due to leakages of hydrogen.

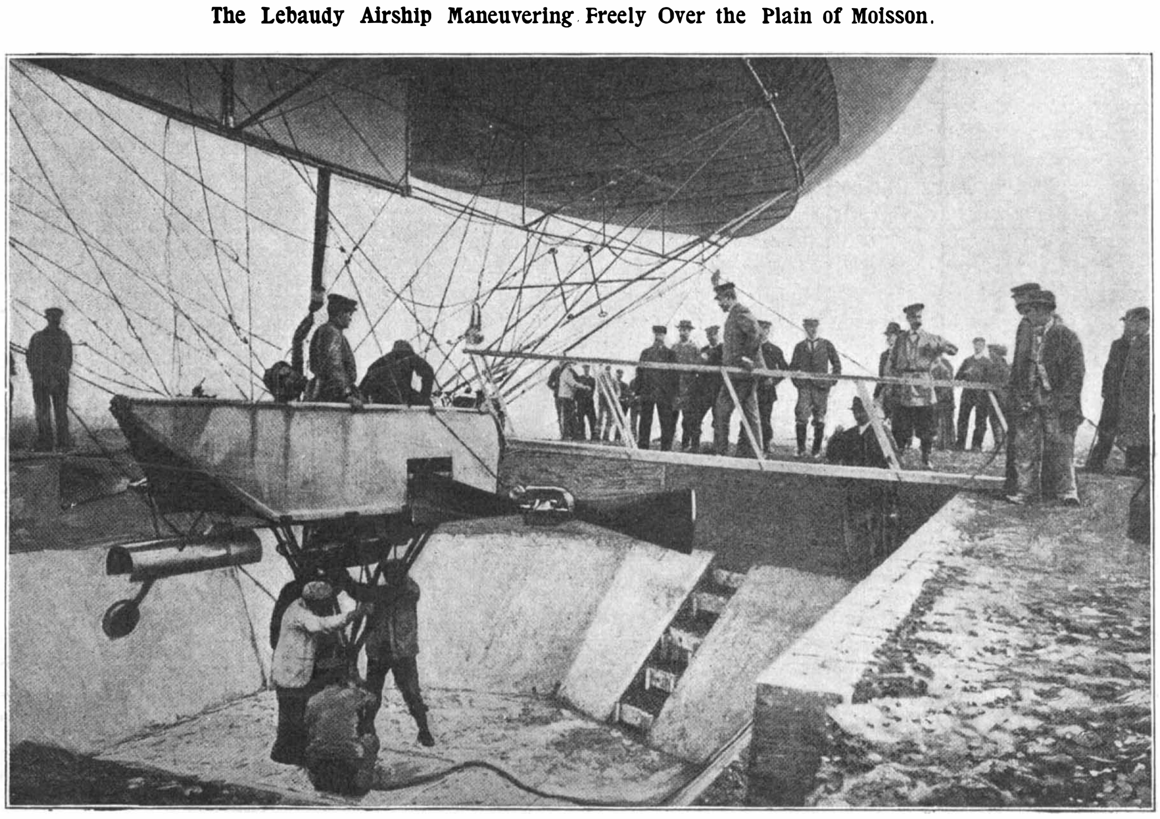
MM. Julliot and Surcouf were then desirous of noting, while on *terra firma*, the behavior of their balloon. So M. Juchmes, accompanied by two assistants, took charge of it, and, with great dexterity, caused it to make a trip in the form of the figure 8, which constituted a new experiment. MM. Lebaudy, Julliott, and Surcouf watched this evolution and expressed themselves as delighted with the maneuver and with the manner in which their balloon had behaved. The airship then landed again triumphantly and entered its shed. This may be said to have been the end of the preparatory experiments, and MM. Julliot and Surcouf have announced their readiness to attempt the journey from Moisson to Mantes and back on the first fine day that occurs.—Translated for the Scientific American from L'Illustration.



The Airship Under the Management of M. Juchmes, Describing a Figure 8.



The Lebaudy Airship Maneuvering Freely Over the Plain of Moisson.



The Start of the Airship from the Trench in Front of Its Shed.

THE LEBAUDY DIRIGIBLE AIRSHIP.

Utilization of Iron and Steel Slags.

The utilization of iron and steel slags is discussed in "Mineral Resources of the United States, 1901," by Mr. Edwin C. Eckel, of the United States Geological Survey. Mr. Eckel says that although the greater portion of the slag annually produced by iron and steel works is not available, a great deal of slag is used in the manufacture of cement and of slag brick, as a fertilizer, and in the form of mineral wool; also, to a less extent in the manufacture of paint stock, alum and glass, and a considerable quantity is disposed of less profitably as road material, railroad ballast, and in land reclamation.

The most important of these uses of slag is in the manufacture of structural materials, especially in the manufacture of hydraulic cements. Slag cement is produced by pulverizing, without calcination, a mixture of granulated basic blast-furnace slag and slaked lime. This product, although really a pozzuolanic cement, is usually marketed as "Portland cement," in spite of differing from true Portland cement in manufacture, composition, and properties. Six or eight plants are at present engaged in manufacturing slag cement in the United States, the production for 1901 being 272,689 barrels. As slags cooled slowly are only feebly hydraulic, the slag used in the manufacture of slag cement must be cooled as suddenly as possible. This is done by bringing the slag, as it issues from the furnace, in contact with a jet of cold water. This granulates the slag, renders it strongly hydraulic, and removes most of the sulphur. True Portland cements can be made from mixtures of which one element is blast-furnace slag, in which case the slag is ground, intimately mixed with powdered limestone, and the mixture then calcined and reground. Two plants are engaged in the manufacture of Portland cement from slag and limestone in the United States. In England, blast-furnace slag has been somewhat largely employed as an adulterant of Portland cement.

Slag run into molds on issuing from the furnace furnishes blocks which have been used for paving, notably in Philadelphia. These slag blocks are very durable, but objectionable because of their slipperiness, which, in English practice, has been overcome by the form of the mold used.

The manufacture of slag brick can hardly be considered as being more than a specialized phase of the manufacture of slag cement. On issuing from the brick machine, the bricks are placed on racks to dry, which takes from six to ten days, at the end of which time the bricks are ready for use. Slag bricks are light in color; they weigh less than clay bricks of equal size, require less mortar in laying up, and are equal to clay bricks in crushing strength.

The highly phosphatic slags produced by basic Bessemer converters are valuable fertilizers, and in Germany, especially, large quantities are annually sold under the name of Thomas silicate. These phosphate slags are more efficient as fertilizers than the mineral phosphates. The slight development of the basic Bessemer steel industry in the United States necessarily renders the use of these phosphatic slags of less commercial importance than in Europe. During 1901 about 1,000 tons of phosphate slags produced in the United States were sold as fertilizer. This American material has been tested by the American Agricultural Experiment Station, which reports that slag phosphate gave a greater total yield than did any of the other insoluble phosphates. The slags produced in steel plants using the open-hearth process are less valuable as fertilizers than those produced by basic Bessemer converters, as they contain less phosphoric acid and more silica and lime than the basic Bessemer slags. Over half the material marketed as "mineral wool" or "silicate cotton" is derived from slag, the remainder being manufactured from natural rocks of several different types.

Tea Growing in the United States.

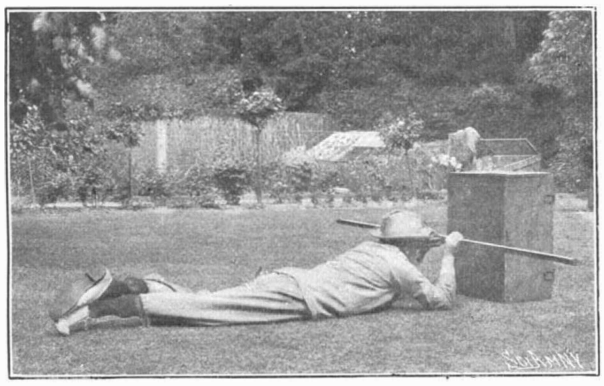
The United States Department of Agriculture has been carrying on the work of introducing tea culture in the United States. Experiments conducted at Pinehurst, Summerville, S. C., in co-operation with Dr. Charles U. Shepard have yielded interesting results. Dr. Shepard now has at his place about 100 acres in tea gardens. His factory is well equipped for carrying on the work on a commercial scale and for accurate scientific experiments. The yield of tea in Dr. Shepard's gardens last year was 4,500 pounds. For 1902, there were about 9,000 pounds of marketable tea. Some of the gardens have proven very prolific and profitable, while others have given very slight yields of tea of pure quality. A tea farm is soon to be established in Texas if suitable land can be secured. Whether or not tea growing in this country can be made a commercial success will depend in a large measure upon the most rigid attention to the details of field and factory work.

According to a French contemporary, a good, simple test for the poles of an electrical apparatus is a slip of ferro-prussiate paper moistened and held on the pole. The negative pole makes a white mark on the paper, which, by the way, is the same as that used for making copies of engineering designs, where the lines appear on a blue ground. Old blue diagrams of this kind cut into slips will serve as test papers.

DESTRUCTION OF STEAMSHIP "PROGRESSO."

BY ENOS BROWN.

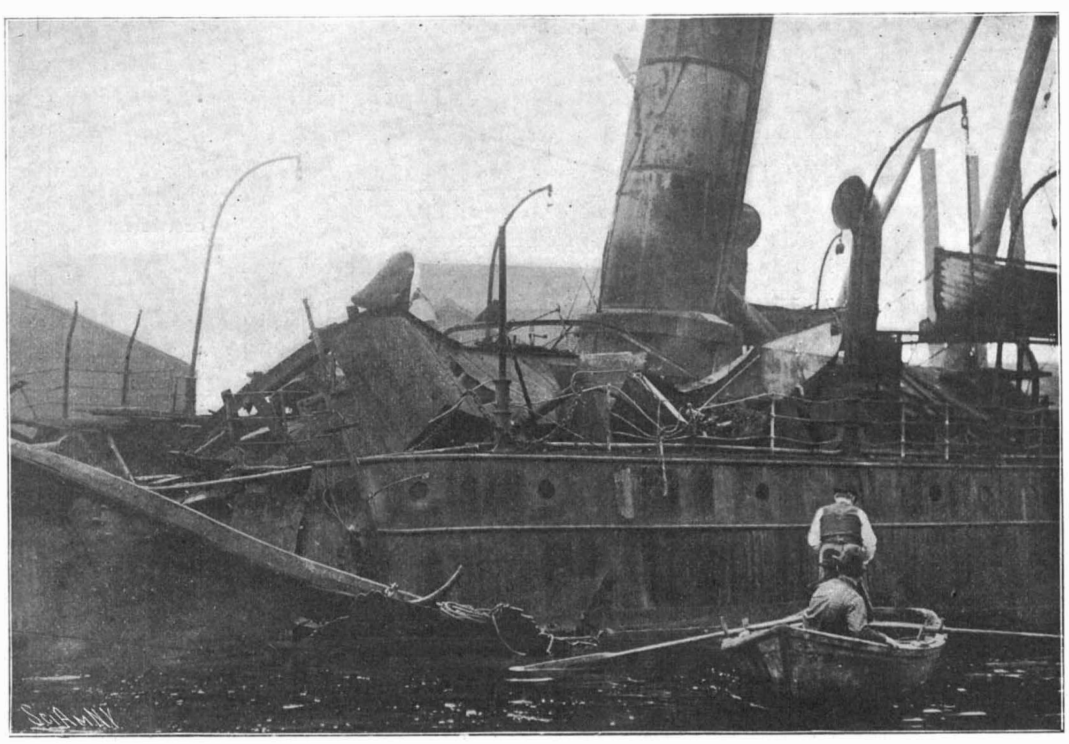
The destruction of the steamship "Progresso" at San Francisco on the morning of December 3, with a lamentable loss of life, was a catastrophe that has excited much comment, particularly in the West, where a general movement for the installation of oil in place of coal for fuel was in process of accomplishment. The "Progresso" was an iron steamship of about 3,000 tons capacity, and had been employed as a collier and government transport Six months ago she was withdrawn from traffic and taken to the ship yards of the Fulton Iron Works, San Francisco, to be converted into an oil-burning and oil-carrying steamer. She was to be employed in conveying oil in bulk from Texas to northern Atlantic ports. New boilers and engines had been installed. Storage and supply tanks had been provided and in a few days the repairs would have been completed and the steamer turned over to her owners. Engines and boilers were inclosed in a compartment with iron coffer dams or bulkheads provided with water backing. Every customary protection had been employed to make the "Progresso" safe in any contingency. Steam had been raised to test the new machinery. The system of ventilation was thought to be perfect. The storage tanks were empty, as it was intended to carry the steamer to her destination with water ballast. The only oil aboard was about 400 barrels that had been pumped into the supply tank but a few hours before. This oil is said to have come from the wells of Fresno and Fullerton districts. Its specific gravity was 24 deg. California oils vary in specific gravity from 18 deg. to 30 deg. From 18 deg. to 24 deg. is regarded as a fair average.



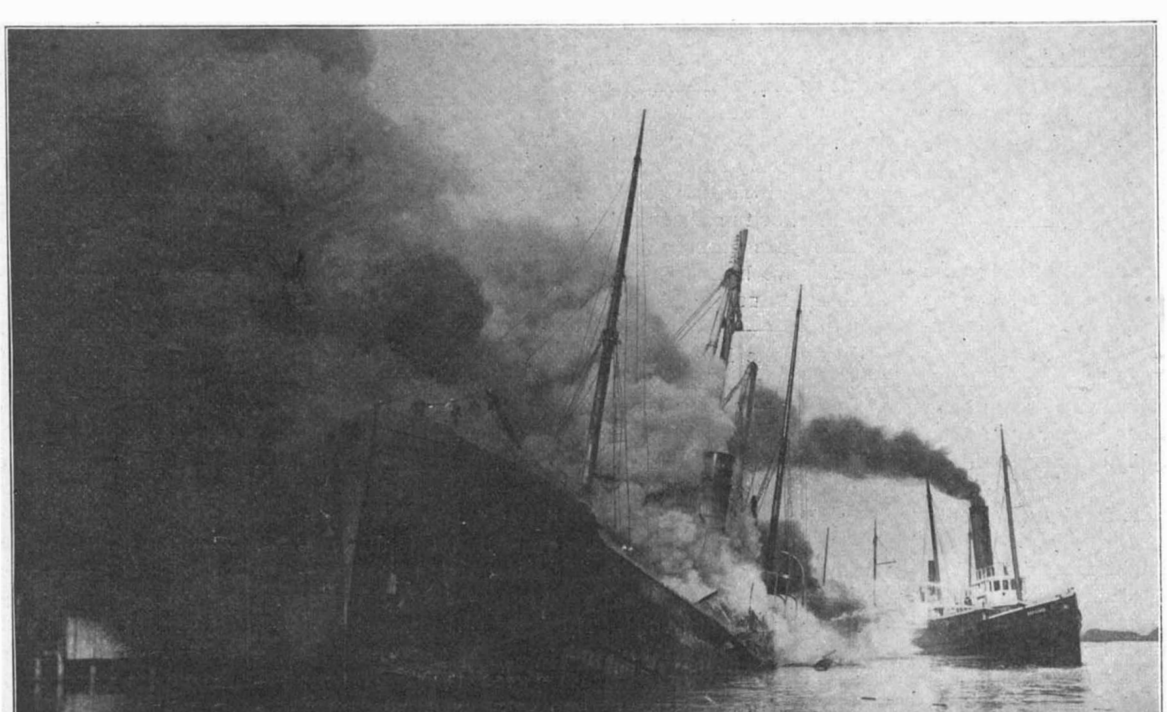
PROF. FORBES AND HIS RANGE FINDER BEHIND COVER.

The weather on the day of the explosion, and while the oil was in the tank, was noticeably cold for the latitude, and the oil, consequently, extremely sluggish in flowing. Two or more qualities of oil were mixed in order to overcome the low gravity of the heavier, though the seller refuses to admit this, and claims that the oil supplied was such as the buyer ordered to be delivered. The tank containing the oil was uncovered at the time the catastrophe occurred. Some sixty mechanics and men were employed about the steamer, mostly in the hold, where the light was dim and the temptation to employ artificial illumination was great. Early in the morning, a violent explosion took place, tearing out the sides of the vessel and completely wrecking the interior. A conflagration followed, blocking all egress from the hold and suffocating a dozen men, who were unable to make their escape. The destruction is so complete that any attempt to raise the steamer will be abandoned. As she lies, her value will only be realized as scrap iron, and the only method of removal will be by the use of dynamite. The responsibility for the catastrophe will probably never be located. It seems to be the confirmed opinion of experts that an unfortunate workman struck a light, for some purpose, which, communicating with the volatile gas arising from the oil contained in the uncovered tank, caused it to explode. The company supplying the oil deny their responsibility, inasmuch as the oil was the same as that burned on many steamers, and heretofore without accident of any kind. The contractors, whose men were employed in making the repairs, assume no responsibility whatever. They are heavy losers by the calamity. A great deal of litigation over the affair is in prospect, and a long investigation by government inspectors is in progress.

Although public confidence in the safety of fuel oil on steamships has received a rude shock, expert opinion is inclined to the belief that the disaster was the result of carelessness in breaking the rules which govern the safe use of liquid fuel.



The wreck of the "Progresso" amidships. The men in the boat are grappling for boilers.



The "Progresso," with her back broken, sinking under the weight of the water thrown into her.

THE BURNING AND THE WRECK OF THE "PROGRESSO."

Prof. Bell's Aerial Experiments.

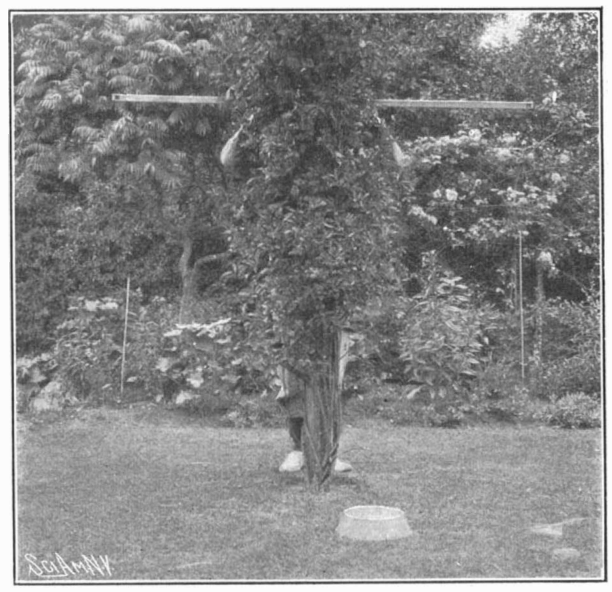
Rumor has been rife for a long time that Prof. Alexander Graham Bell, of telephone fame, is the inventor of a flying-machine. In the interviews which he has given to representatives of the daily press, Prof. Bell has been extremely reticent. He states, however, that he has not invented a flying-machine, but that he has been engaged in experiments in kite-flying which he believes will have some bearing on the invention of an operative aeroplane. It is understood that Prof. Bell and Prof. S. P. Langley have collaborated to a certain extent in carrying out these experiments.

The tangible result of Prof. Bell's experiments to the present time has been the construction of a kite capable of carrying up into the air a weight equivalent to that of a man and an engine, and of such construction that it is capable of being used as the body of a ship.

THE NEW BRITISH ONE-MAN FOLDING RANGE FINDER.

BY AN ENGLISH CORRESPONDENT.

During the past few weeks the writer had, owing to the kindness of Prof. George Forbes, F.R.S., M.I.C.E., exceptional opportunities for witnessing the working of a new one-man folding range finder, of which Prof. Forbes is the inventor. Although no official statement has been made on the subject, we have the best authority for stating that the new instrument will very shortly be adopted by the British War Office as the new service range finder for use both with infantry and artillery. It is a curious fact that although the trekometer, which is the present British service range finder, is served out to the British troops in the field, neither this nor any other range finder is ever used by the infantry or cavalry in the field. Even if the trekometer be ever used with artillery, British officers seldom rely upon it because the time taken is excessive, the exposure of the men is objectionable, and the errors introduced by two men dependent upon each other are fatal.



TAKING A RANGE BEHIND A BUSH.

Prof. Forbes in the early part of this year went out to South Africa at his own initiative and at his own expense to test his new range finder, which was the result of work on which he had been engaged, intermittently, for the past few years. After a series of practical trials with his new instrument at the front, the reports were sent to Lord Kitchener, who had taken a great interest in the invention. The Commander-in-Chief's reply was as follows: "Reports sent in on your range finder seem most exhaustive, and I do not think anything further is necessary. I will submit them to the War Office in due course. Regret that I cannot make a personal inspection of the instrument."

The following description of the range finder has been taken from a lecture delivered by the inventor before the Royal United Service Institution:

The range finder consists of two parts, the base and the binocular. The base, which is a tube of rectangular cross-section, consists of two half bases hinged together; each half base is one yard long. On the left half base at the hinge there is a vertical slot facing the range-taker to receive the tongue of the binocular. On the two halves of the hinge facing the range-taker are the middle openings, closed and opened by the middle shutters, which expose to view the glass faces of the middle prisms which are mounted in the tubular base. At the outer end of the base are two cylindrical shutters, which may be rotated to expose the glass faces of the two outer prisms mounted in the tubular base. The outer prisms face the target, and the middle prisms face the rangetaker. The binocular consists of two telescopes which are connected by a hinge, so that they may be adjusted to varying angles with each other. Between the eye caps is a horizontal rod on which is a graduated scale called the "distance-of-eyes scale." On looking through either telescope at the sky, a balloon is seen with the tail-rope hanging down. The bottom of the tail-rope is at the middle of the field of view. There are really two balloons seen as one by the two eyes. Each eye cap can be revolved to focus the telescope to suit the eye, and this adjustment may be read on focal scales on each eye cap from +10 to —10 divisions. Adjustment of the left eye cap provides for raising or lowering one balloon relatively to the other. On the right side of the binocular there is a drum head carrying a dial with a flat, spiral distance-scale, registering the number of hundred yards from 500 yards upward. This scale is read by a pointer which moves along the spiral radially, to read successive revolutions. On the left side of the dial is a graduated circle, divided into a hundred parts with a fixed pointer.

Fig. 1 shows the shape of the prisms and the path of the two beams of light from the target entering the two outer prisms, suffering a double reflection at each prism, passing along the tubular base, thence through the middle prisms and entering the binocular parallel to their original direction. The two beams of light pass through the object glasses *GG'* of the binocular, and form two images of the target at *I* and *I'* on the line of the beam of light passing through the center of the object glass. In Fig. 2, if *T* be the target, *AA'* the base, then *II'* are the images of the target. By swinging the telescope at the right so that the light travels along *G i*, which is parallel to *G' I'* then the two

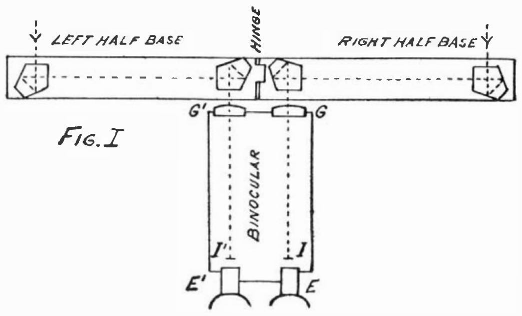


FIG. I

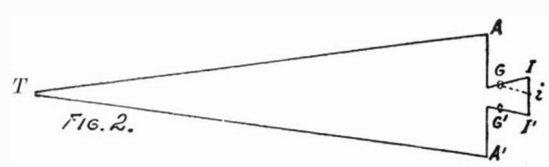


FIG. 2.

images at *I'* and *i* would be seen as one. We measure the distance *I i*, by the drum-head which works a micrometer screw.

$$\text{Now } AT = \frac{GI}{Ii} \times AA'$$

$$\text{or distance of target} = \frac{GI}{Ii} \times \text{length of base} =$$

$$\frac{GI}{Ii} \times 2 \text{ yards.}$$

$$\text{In the binocular used } \frac{GI}{Ii} = \frac{810}{\text{number of revolutions of drumhead}}$$

So for any distance of target *D* we have to mark that distance on the spiral scale when it and the micrometer screw have turned through a

$$\text{number of revolutions} = \frac{810}{D} \times 2 \text{ yards} = \frac{1{,}620}{D} \text{ yards.}$$

For 1,000 yards it is 1.620 revolutions; for 2,000 yards it is 0.810 revolution, and so on. In this way the graduations for different distances have been calculated.

In order that the range finder may be properly used, it is necessary that every man in the army should have his optical constants determined once a year and given to him on a card for reference. These may read as follows: *L* —1

R 0 This means that left focal scale should

D 66

in this man's case be at —1, the right focal scale at 0, and the distance-of-eye scale at 66 divisions. To take a range the binocular is directed toward the target, and the man is virtually seeing the target by means of eyes placed at the two ends of the base six feet apart. He can then judge relative distances of objects. In looking at the balloon he lays the tail rope of the balloon just above the target and not on any account on it. He notes that he sees both *R* and *L* on the balloon, else he is using only one eye and cannot work. Then by twisting the milled head one way or the other, he brings the balloon near to him or moves it away from him. He should begin with the balloon nearer than the target (by setting the distance scale to 500 yards) and watch the balloon going away as he turns the milled head, always keeping the tail rope above, and never on, the target. He stops turning when the balloon is over the target, and then he reads the difference on the scale in hundreds of yards.

New Chemical Compound.

The aluminate of magnesium is a new product which M. Emile Dufour has succeeded in obtaining. An account of the method used has been presented to the Académie des Sciences. In an electric furnace, using a powerful arc of 1,000 amperes and 60 volts, is heated a mixture of 100 parts of alumina and 230 of oxide of manganese, the heat lasting for 3 minutes. In this way is obtained a porous mass of a brownish-black color, with a metallic reflection. When broken it presents an irregular surface which is of a fine light green color and shows a number of geodes of a brown color lined with brilliant crystals of the octahedral system. To separate the compound the material is broken and treated with hydrochloric acid; gases are given off and the liquid takes a brown tint, which changes gradually to a light yellow. A crystalline deposit is thus obtained which is still further purified and analyzed; its composition corresponds to the formula Al_2O_4Mn. The aluminate of magnesium has the form of small transparent crystals of a light yellow color, having the appearance of octahedra, but somewhat modified on the angles. Their density at 20 deg. C. is 4.12. This body is harder than quartz, and its powder is of a light yellow color. It is quite stable under ordinary conditions, but oxidizes easily when heated in air. At a red heat it gradually changes color to a dark brown, becoming somewhat lighter upon cooling. In oxygen this oxidation, which was before only superficial, is more rapid and takes place below a red heat. Fluorine attacks it with incandescence at a red heat, but it is not acted upon by bromine, iodine or sulphur. It is insoluble in hydrochloric acid, but is easily attacked by nitric and hydrofluoric acids, and especially by sulphuric acid. Oxidizing agents, such as chlorate and nitrate of potash in fusion, and also the alkaline oxides or carbonates, decompose it easily.

Test of a Steel Road.

The new steel trackway on Murray Street, between Broadway and Church Streets, New York city, was recently tested with a two-horse ashcart with a hopper body of sheet iron, the whole weighing 3,700 pounds. Instead of a dynamometer a short ice balance was used. It was found that the cart was started on the steel by a pull of 320 pounds. The wheels were somewhat too wide for the track, so that it was difficult to keep them from binding on one side or the other against the flanges of the steel plates. It was while they were thus bound that a pull of 320 pounds was required to start the cart. Later it was found that only 200 pounds was required. After it had gathered way, the cart was kept moving by an average pull of 100 pounds.

The Current Supplement.

The current SUPPLEMENT, No. 1410, is distinguished by the usual variety of articles on engineering, electrical and mechanical subjects. The opening of the Assouan Dam is commemorated fittingly by a discussion of its engineering features and by illustrations of its more prominent portions. The English correspondent of the SCIENTIFIC AMERICAN continues his discussion of water-tube boilers. The present installment deals with the British Stirling boiler. Sir W. H. Bailey discourses in a scholarly way on the mechanical inventors of Lancashire, England. "Irrigation" is the title of a copiously illustrated article on a matter which, to the western portion of the United States in particular, has been of immeasurable importance. The article describes painstakingly the best methods of irrigation which have been followed in this country. Mr. F. T. Jane continues his interesting fictitious naval battles.

One of the latest long-distance and high-speed electric railways is that from Seattle to Tacoma, which has recently been completed and put into operation. The power is furnished from the Snoqualmie Falls plant, which is thirty-one miles from Seattle. The line is about thirty-four miles long, and the current is transmitted outside of the cities at 27,500 volts; and at substations distributed along the line, this alternating current drives motors direct-connected to direct-current generators, which will supply the third rail with current at 600 volts. The third rail weighs about one hundred pounds to the yard. It is expected to maintain an hourly service between the two cities. The trains will consist of two cars, as a rule. The motor consists of a combination baggage and passenger car about 42 feet long equipped with motors with an aggregated capacity of 500 horse power, and it is expected to make a speed of a mile a minute.

Correspondence.

The Aerodrome.

To the Editor of the SCIENTIFIC AMERICAN:

The article on aerodromes by S. D. Mott, in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1399, while containing some very ingenious ideas incorporated in the machine therein described, makes the following statements, which I believe are ill-founded, viz.: "In conclusion, it must be acknowledged that this conception eliminates from the problem of manflight the confusing devices usually considered indispensable for maneuvering a so-called airship; . . . or, as it has been more scientifically stated by a practical, conservative engineer, one of the faculty of Columbia University, 'The plan of controlling the direction of the lifting components of your machine by shifting the center of gravity is sound.' "

An examination of the drawings leads me to believe that although if the aeroplanes were rigidly fixed to the body of the machine, including the circular ways of the operator's seat, the center of gravity of the machine *might* be shifted, still, according to the construction of this machine, this is not the case. It seems to me that the only effect of moving around on the circular ways would be to turn the whole body of the machine around the axis of the areoplanes, and that the operator would remain at the vertically lowest position, on the principle of a mouse in a wheel; or to give a comparison more nearly representing the conditions, it would be like a swimmer trying to climb up the side of an empty barrel in the water; the barrel would turn, and the swimmer sink to the lowest position and remain there.

Now, as the aeroplanes in this machine must necessarily have almost frictionless bearings, it seems to me that although you may pull the circular ways around, you cannot alter your relative position toward the line of flight, or raise it above the lowest vertical position.

Furthermore, I believe that unless a rudder of some kind is fixed to the machine, the machine would be absolutely unmanageable, being turned in every direction by the wind, like a windmill or weathervane.

I would suggest to Mr. Mott that he might construct a much simpler machine on the same lines by the use of the marine turbine of Col. J. J. Astor, described in the SCIENTIFIC AMERICAN of November 8, 1902, instead of the motive power he describes.

F. McC., Mining Engineer.

Mexico, December 10, 1902.

Effect of Electricity on Plant Life.

To the Editor of the SCIENTIFIC AMERICAN:

It has long been a matter of speculation with me just why a rain will help plants so much more than any form of artificial watering. The popular theory is that when water is applied to vegetation by the latter method, the heat of the sun causes a kind of steam to form, which scorches it. This is obviously incorrect. My own conclusion, which I reached some time ago, and which may, for all I know, be the accepted scientific explanation, is that rain stimulates the plants on which it falls because it is charged with electricity, and that the mere wetting of a plant has little effect on it.

A few weeks ago I was reading, in your journal, I believe, of an experiment that confirms my view, and incidentally suggests an idea, which, if carried into execution, might prove of immense value. It appears that some experimenter passed a current through some pots in which plants were growing, with the effect that they showed a decided gain in size and fertility over those similarly situated, but not so treated. The difference, if I remember aright, was forty per cent.

Now, why would it not do to apply water electrically charged to the vegetation, and thus simulate, as nearly as could be, nature's method? The water could be placed in a vessel from which the electricity could not escape, an insulated barrel, for instance, or a pail bottomed with rubber or glass. After the water was charged, it could be applied with the aid of an ordinary rubber hose, with a non-conducting nozzle; and that would be all that was necessary.

Now, I am not an electrician, and have not the means of trying this experiment myself, but if some experimenter would follow my suggestion, I believe discoveries of great practical value might be made.

SYDNEY C. HALEY.

Eustis, Fla., December 18, 1902.

Within the past few months, the Rogers Locomotive Works at Paterson, N. J., have been enlarged by the addition of two large tracts of land. On one of these a new erecting shop is being built, and the other piece will be used for yard purposes principally, although some new buildings will be erected thereon. An imposing building for the construction of tenders will soon be under way, and extensions are being made to the boiler and hammer shops.

Our Foreign Commerce.

The figures of the foreign commerce of the United States during the eleven months ending with November, which have just been completed by the Treasury Bureau of Statistics, indicate a phenomenal activity among the manufacturers of the country and exportations quite as large as could be expected in view of the crop shortage of last year. The value of manufacturers' materials imported into the United States during the eleven months ending with November this year is $407,603,599, against $353,417,288 in the corresponding months of last year, and forms 46½ per cent of the total imports, against 44 per cent of the total imports in the corresponding months of last year. Manufactures exported during the eleven months of 1902 amount to $377,635,961, against $362,392,181 in the corresponding months of last year, and form 31.8 per cent of the total, against 27.8 per cent of the total exports in the same months of 1901. The total imports are $75,000,000 in excess of those for the corresponding months of last year, and of this increase of $75,000,000, $54,000,000 was in the class "manufacturers' materials" and the remainder manufactures and luxuries, articles of food and animals showing a reduction of $10,000,000, as compared with the importations during the corresponding months of last year.

Nearly all of the great articles required for use in manufacturing, with the single exception of india rubber, show a marked increase in importations. Importations of raw silk, for example, amount to $40,905,393 in the eleven months of this year, against $35,411,000 in the corresponding period of 1901; hides and skins, $53,022,521, against $50,877,797 in the eleven months of last year; tin for use in manufacturing tin plate, $19,532,807, against $17,415,302 in the corresponding months of last year. India rubber importations show a slight falling off, the total for eleven months being $22,568,786 this year, against $25,929,985 in the same months of last year.

The most striking increase in importations is in manufactures of iron and steel, which amount, for the eleven months, to $36,766,961 in value, against $18,267,677 in the corresponding months of last year, the value of the importations having thus more than doubled this year as compared with last year. Practically every item in the list of iron and steel manufactures shows a marked increase. The export figures of iron and steel manufactures show a reduction, the total exports for the eleven months being $90,136,024 this year, against $94,091,967 in the same months of last year and $119,604,848 in eleven months of 1900.

The total exportation of the eleven months falls $116,000,000 below that of the corresponding period of 1901. This reduction occurs in agricultural products, of which the exportations during the eleven months of this year fall $130,000,000 below those of last year, indicating that in the other great classes, especially manufactures, there is an increase. This reduction of $130,000,000 in agricultural exports is due in part to the increased home demand, in part to the loss of a part of the corn crop of last year, corn exportations having fallen from $49,501,374 in eleven months of 1901 to $6,745,151 in the corresponding months of this year. There is also a considerable reduction in the value of wheat exported, due to the fact that last year's exportations were exceptionally large.

Governmental Aid in Improving Our Highways.

The system in vogue in some States, of appropriating sums of money for road improvement in towns and villages, provided the taxpayers of these places pay one-half or other proportionate amount of the expense involved, has been found to operate so well that the bill recently introduced in the House of Representatives by Mr. Brownlow, for the purpose of establishing a National Bureau of Road Construction, appears to be the logical outcome of it. This bill provides for a new Bureau of Public Roads in the Department of Agriculture, whose object shall be "to instruct, assist, and cooperate in the building and improvement of the public roads, at the discretion and under the direction of the Director of said Bureau, in such States, counties, parishes, townships, and districts in the United States as shall be determined upon by said Director. The general policy of such Bureau shall be to bring about, so far as may be, a uniform system of taxation for road purposes and a uniform method of road construction, repair, and maintenance throughout the United States, and to co-operate with any State or political subdivision thereof in the actual construction of permanent highways."

The new Bureau is to be under the general supervision of the Secretary of Agriculture, and is to have a Director and suitable corps of clerks, civil engineers, field and road experts, a chemist and assistant in charge of the road material laboratory, a petrographer, and such other officers, agents, and servants as may be required for carrying out the provisions of the Act.

The bill provides an appropriation of $75,000 for salaries and general expenses of the Bureau, and for the purpose of enabling the Director "to make inquiries in regard to systems of road building and management throughout the United States; to make investigations and experiments in regard to the best methods of road making and the best kinds of road-making materials; to co-operate in the building of object-lesson roads in the several States; to employ local and special agents, clerks, assistants and other labor required in conducting experiments and collecting, digesting, reporting, and illustrating the results of such experiments; to investigate the chemical and physical character of road materials; to purchase necessary apparatus, materials, supplies, office and laboratory fixtures; to pay freight and express charges and traveling and other necessary expenses; to prepare, publish, and distribute bulletins and reports on the subject of road improvement; to enable him to instruct and assist in the building and improving of the public roads and highways in such States, parishes, counties, townships, and districts in the United States as shall determine to follow the plans and methods directed and determined upon by the Director of said Bureau; and to enable him to assist agricultural colleges and experiment stations in disseminating information on the subject of improved roads.

"Any State or political subdivision thereof, through its proper officers having jurisdiction of the public roads, may apply to the Director of the Bureau for cooperation in the actual construction of a permanent improvement of any public highway within the State, by presenting an application accompanied by a properly certified resolution stating that the public interest demands the improvement of the highway described therein, but such description shall not include any portion of a highway within the boundaries of any city or incorporated village. The Director of said Bureau, upon receipt of any such application, shall investigate and determine whether the highway or section thereof sought to be improved is of sufficient public importance to come within the purposes of this Act, taking into account the use, location, and value of such highway or section thereof for the purposes of common traffic and travel, and for the rural free delivery of mail by the United States Government, and after such investigation shall certify his approval or disapproval of such application. If he shall disapprove such application, he shall certify his reasons therefor to the public officer or officers making the application; but if he shall approve such application, he shall cause the highway or section thereof therein described to be mapped, both in outline and profile. He shall indicate how much of said highway or section thereof may be improved by deviation from the existing lines whenever it shall be deemed of advantage to obtain a shorter or more direct road without lessening its usefulness, or wherever such deviation is of advantage by reason of lessened gradients. He shall also cause plans and specifications of such highway or section thereof to be made for telford, macadam, or gravel roadway, or other suitable construction, taking into consideration climate, soil, and material to be had in the vicinity thereof and the extent and nature of the traffic likely to be upon the highway, specifying in his judgment the kind of road a wise economy demands. The improved or permanent roadway of all highways so improved shall not be less than eight nor more than twenty-four feet in width, unless for special reasons it is required that it shall be of greater width. He shall, if requested by the application, include provisions for steel-plate or other flat-rail construction in double track."

Upon the completion of the maps, plans, and specifications, an estimate is to be made of the cost of construction and submitted to the officials from whom the application for assistance proceeded. These officials must then file a second application, confirming the first, before the Director is authorized to advertise for bids in the vicinity of the work. In case the line of the road is to be changed and a new right of way has to be obtained, the applicants must secure this.

In regard to the expense of the construction, the Federal government bears one-half of this. The other half may be divided between the applicants, the county, and the State, if so desired, or may be borne by either alone. An appropriation of $20,000,000 is asked for to cover the cost of construction, with the provision that no State shall receive a greater proportion of the total amount appropriated than its population bears to the population of the United States.

The results of governmental supervision in road construction will in time be far-reaching and of vast importance. A scientific study of materials and methods of road building, aided by experience which will soon be had as to the most suitable construction for varying conditions of soil and traffic, will enable the government to build roads that will last indefinitely, if properly maintained. The only weak point in the present bill seems to be, that no provision is made for such maintenance and keeping in repair of roads thus constructed. This, however, can be easily added, and doubtless will be before the bill is passed. With its passage, the construction of a splendid transcontinental highway will become a possibility which, let us hope, will be realized in the near future.

Sociological Aspect of the Irrigation Problem.

In a paper read before the American Association for the Advancement of Science, Mr. Guy E. Mitchell stated that the reclamation of arid America through government construction of irrigation works will furnish for years to come an effective outlet for the industrious surplus population of our great cities. The irrigation sections of the West present almost ideal rural conditions. The tendency is, where water is used for farming, to subdivide land into small individual holdings, which gives to a community a prosperity and stability not found in larger farming districts, nor in cities. This is not a new idea. But while this is being done, the people of the entire United States will become so educated in irrigation matters and irrigation methods that there will be a gradual spreading eastward of the irrigation idea. This will eventually result in the subdivision of great numbers of large eastern and southern farms and plantations which are now farmed without thought of artificial water supply, into smaller irrigated farms. Never a season goes by, even in the best watered districts of the rain belt, that there is not some period of plant growth where the judicious application of water would very greatly increase the yield, and in some years double and treble it. It takes only a year of excessive drought among eastern farmers to get them talking about irrigation, but little comes of it for the reason that they are entirely unfamiliar with irrigation methods and have no idea how to go about the practice of supplementing the natural water supply. The irrigation, then, of the one hundred million acres of western plains and valleys, while it will create innumerable small rural homes of five, ten, twenty or thirty acres each, will serve further to encourage subdivision of larger areas in the East and South and tend to make the small farm and home a general rule throughout the entire country.

Under wise administration, arid America has a glorious future. With her countless small farms and rural homes, communities where people live in the open air, till the soil with their hands and yet enjoy the privileges and advantages of the city, she will prove the sheet anchor of the republic in any time of national peril; while from her will radiate eastward the same idea of the division of the large into small farms, and the utilization of the stream and the pond in making certain and increasing an oftentimes unreliable crop.

Science Notes.

The contract for replacing the great telescope that was destroyed by fire recently at the Yerkes Observatory at Williams Bay, Wis., will probably be given to Prof. John Brashear. Six months will be required to complete the work.

It is very doubtful whether the splendid work carried on at Ben Nevis will be continued. Want of funds threatened an interruption in the observations some years ago. Then Mr. Mackay Bernard, of Dunsinnan, came to the rescue. Since 1883 the Ben Nevis Observatory and the Low-Level Observatory at Fort William, connected with it, have altogether cost £24,000, some of the observers giving their services for the cause; £17,000 were received by subscription. The Meteorological Council has allowed £100 yearly for the Ben Nevis Observatory, and, since 1890, £250 for the Fort William station. The directors were officially informed this summer that the latter sum would be stopped.

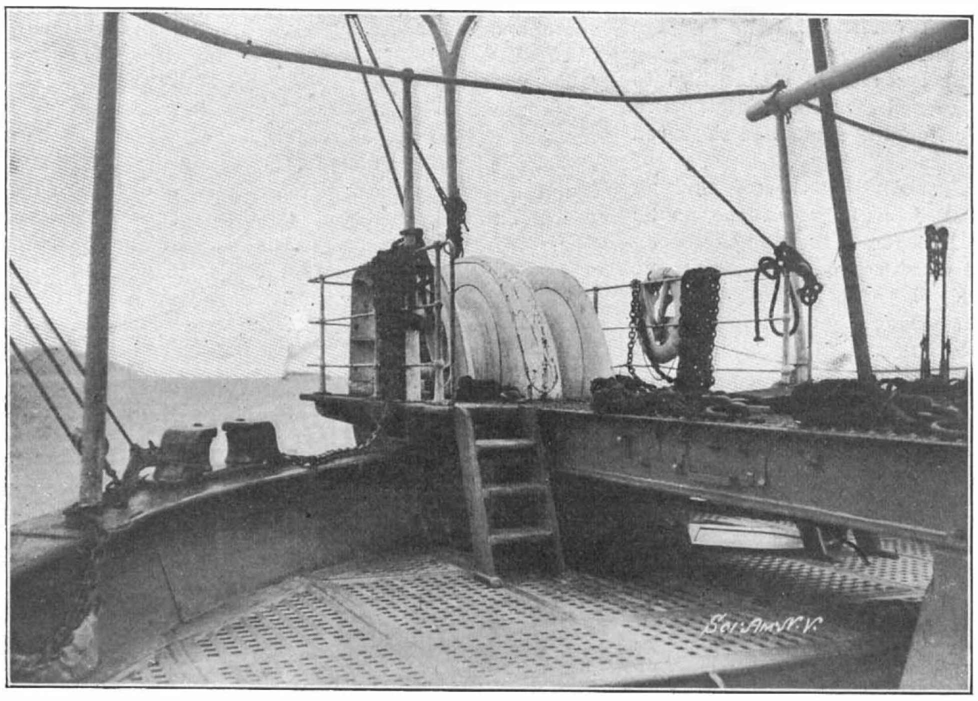
The Department of Vertebrate Paleontology of the American Museum of Natural History has come into possession of three specimens of rare interest. The first is the complete skeleton of a small dinosaur, which has been named "the bird catcher," by reason of its apparent ability to run fast and its long, slender, grasping fore limbs. The second specimen is the great *Portheus molussus*, secured by Charles H. Sternberg in Kansas in 1900. The fish is 16 feet long, and is one of the most striking specimens of a fossil to be found in any of the world's museums. The third exhibit is a superb pair of tusks of the great *Elephas imperator*, found last year in Texas. The tusks are 13½ feet in length and about 2 feet in circumference.

Floyd J. Metzger makes a preliminary announcement on a new method of separating thorium from cerium, lanthanum and didymium. He finds that from a 40 per cent alcoholic solution, thorium is precipitated quantitatively on the addition of fumaric acid, while no change is produced by that reagent in cold solutions of cerium, lanthanum or didymium. When thorium is precipitated in this way in the presence of the above-mentioned elements, traces of these are carried down with the thorium, but may be removed by a single reprecipitation. A number of other weak organic acids are being investigated in the same way, and several of these show interesting results.—Journ. Amer. Chem. Soc.

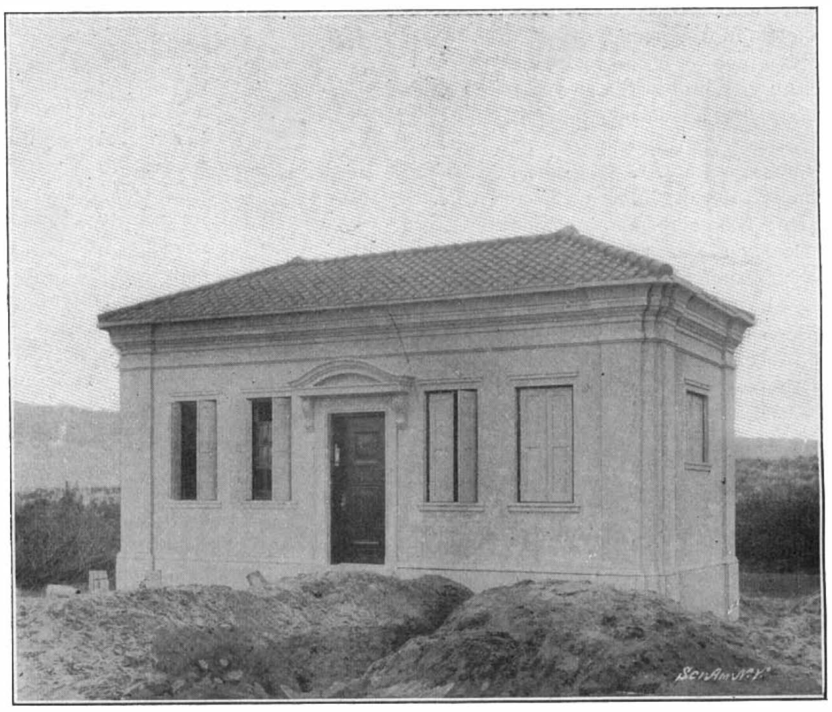
OPENING OF THE FIRST SECTION OF THE PACIFIC CABLE.

A Pacific cable, which was, for many years, the dream of the late John W. Mackay, at length is nearing accomplishment, the opening of the first section from San Francisco to Honolulu having occurred on New Year's day. The cable, when completed, will reach from San Francisco to Manila, in the Philippine Islands, a distance of 6,912 miles. A branch to Hong Kong, China, is contemplated later. The second section is to extend from Honolulu to the Midway Islands, the third from the latter point to Guam, and the fourth from Guam to Manila. Cable for the last three sections will soon be laid in order, now that the first has been completed. The total cost of the cable will exceed $12,000,000.

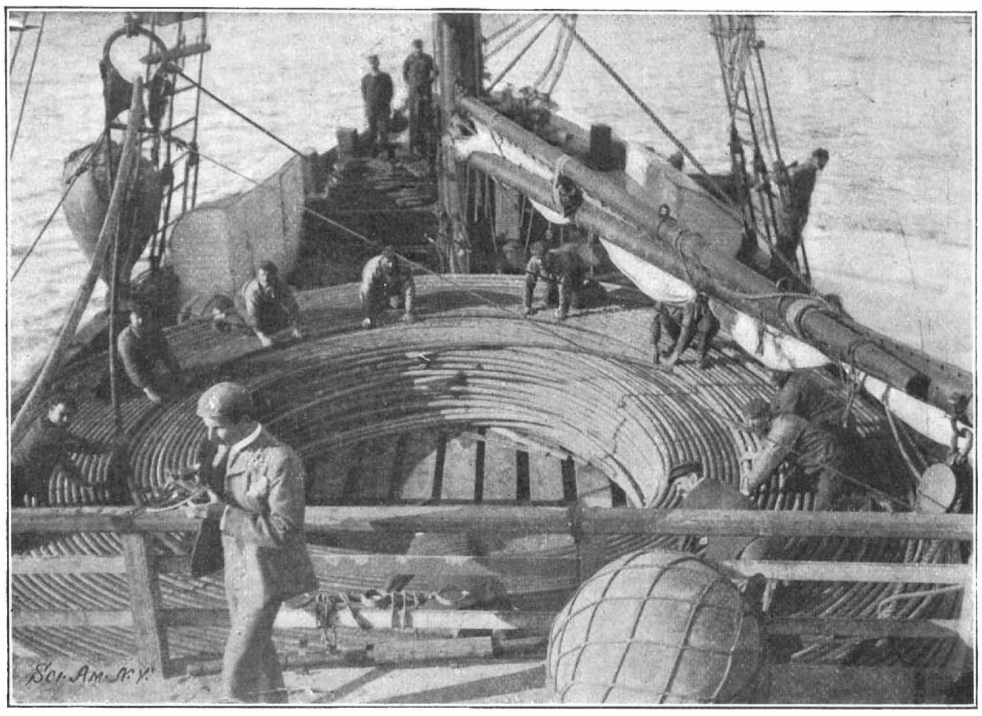
Beyond the extreme depth met with in places, the bed of the sea along the route of the cable presents no extraordinary difficulties to laying the cable, or to its subsequent maintenance. The most hazardous portion is that between San Francisco and Honolulu, where depressions of 5,160 and 5,269 fathoms have been encountered. This part of the route is extremely irregular in profile, and is marked by mountains of immense elevation and by valleys of great depth. A level plain, with an average depth of 2,700 fathoms, extends all the way from Honolulu to the Midway Islands; the bottom being of soft mud and extremely favorable for cable laying. Toward Guam, an average of 3,200 fathoms is found. Favorable conditions are maintained throughout the entire distance. The last section is similar in its profile to section 1, though the depth averages less, being from 1,400 to 2,700 fathoms. The sea bed in this section is extremely irregular in outline, with many reefs and depressions. From the central office in San Francisco to the ocean beach, a distance of 37,000 feet, the shore end of the cable is laid in an underground iron conduit 3½ inches in diameter. Four independent wires, perfectly insulated, are inclosed in the iron conduit. The landing station at the shore is a plain, substantial structure, and contains, besides rooms for the operators, testing rooms for the necessary instruments. The sea cable itself is built around a core formed of copper wire insulated by gutta percha covering, around which layers of jute yarn are wound. This, in turn, is sheathed in small cables, each formed of several strands of steel wires. An outer covering of jute yarn, the whole saturated with a bituminous compound, binds together the conducting and protecting wires in one solid mass, thus forming the complete cable.



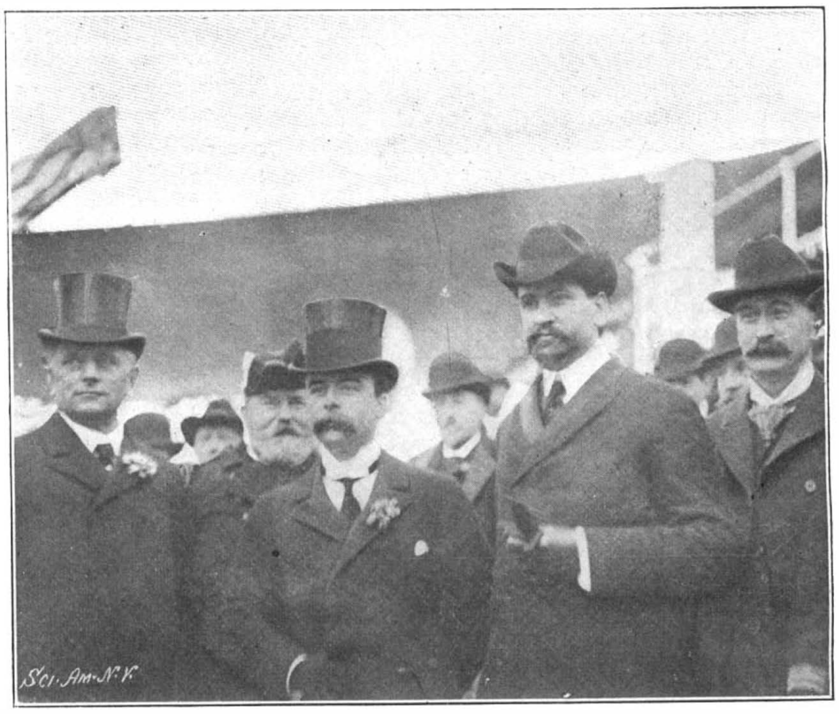
Stern of Cable Ship, Showing Big Sheaves over which the Cable is Paid Out.



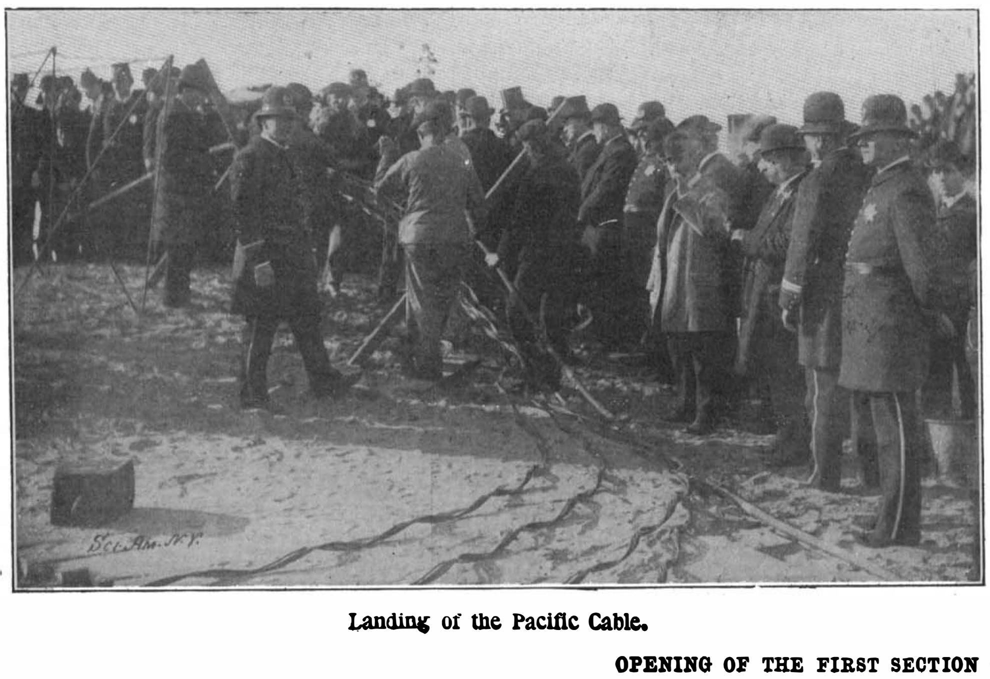
Landing Station of Pacific Cable, on Ocean Beach, San Francisco.



Coil of 6½ Miles of Cable on the Deck of the Steamer "Newsboy."



Mr. Clarence H. Mackay. Mayor of San Francisco.
Notables at the Landing of the Pacific Cable.



Landing of the Pacific Cable.

The Cable Ship "Silvertown" Loaded with the San Francisco-Honolulu Cable

OPENING OF THE FIRST SECTION OF THE PACIFIC CABLE.

The first section of this new cable was opened late in the evening of January 1, when the splicing of the deep sea portion to the shore end on the island of Honolulu was accomplished. The cable steamer "Silvertown," after successfully laying the 2,400-odd miles of cable in the depths of the Pacific Ocean, was obliged to stand by for several days and wait for a sufficiently calm sea in which to lay the Honolulu shore end, before the final splicing could be made. The laying of the shore end on the island was much more difficult because of the nature of the bottom, on which are many coral reefs; and if a calm sea was necessary to accomplish this successfully on the sandy San Francisco shore, it was imperative on the Hawaiian coast. As the shore ends of a cable are the most difficult portions to lay, the method of procedure being much the same, however, in every case, a brief account of the opening of this great enterprise by the laying and christening of the San Francisco end of the new cable, will be of interest.

An attempt was made on Friday, December 12, to bring the cable ashore, but this was frustrated by the strong currents and heavy surf breaking on the beach.

On Saturday, December 13, a piece of the cable, the total length of which is 2,413 miles, was cut off and coiled up on the deck of a light draught steamer, the "Newsboy." This piece used for the connection was 6½ miles long. As the "Silvertown" could not approach any nearer shore on account of her heavy draught—28 feet—it was necessary to employ a smaller steamer for laying the first six miles of cable.

Soon after 5 o'clock on Sunday morning, December 14, the "Newsboy" steamed out of San Francisco Harbor; and a little after 7, the anchor was dropped about half a mile to the south of Cliff House and about one-third of a mile from the ocean beach, to the west of the city of San Francisco. The morning was bright and full of sunshine, and the surf rolled in lazily in three lines, breaking gently. A boat of the United States Life-Saving Service rowed out through the breakers, carrying a light line, one end of which was given to the "Newsboy." This line was bent to a heavier line, to which the cable was attached. At 9:15 A. M., the end of the cable, with a balloon buoy attached to it, was dropped into the ocean, and a team of twelve horses began to haul it ashore. As the cable was paid out from the "Newsboy," balloon buoys were attached to it at intervals of ten fathoms, seventeen of them intervening between the vessel and the line of breakers.

Shortly before 10 o'clock Mr. Clarence Mackay, Mr. Gage, the Governor of the State, his daughter, and others reached the beach, and the end of the cable was dragged out of the ocean on to the sand, and Miss Gage then christened the cable, dedicating it to the memory of Mr. John W. Mackay. The end which had just been brought ashore was then spliced to the end already in position. Meanwhile the steamer "Newsboy" was making her way out to the cable-ship "Silvertown," paying out the 6½ miles as she went. When all was paid out, the end was attached to an anchor buoy and dropped overboard till the "Silvertown" should be ready to pick it up and begin the work of splicing it to the main cable. It was past 6 o'clock in the evening before this work was finished and the "Silvertown" had started on her voyage to the Hawaiian Islands. At 8:55 P. M. a message from Mr. Benest to Mr. Mackay announced that all was well. During the whole trip, the cable was tested, night and day, in a cable hut built on the sand dunes about two blocks distant from the spot where the cable was landed.

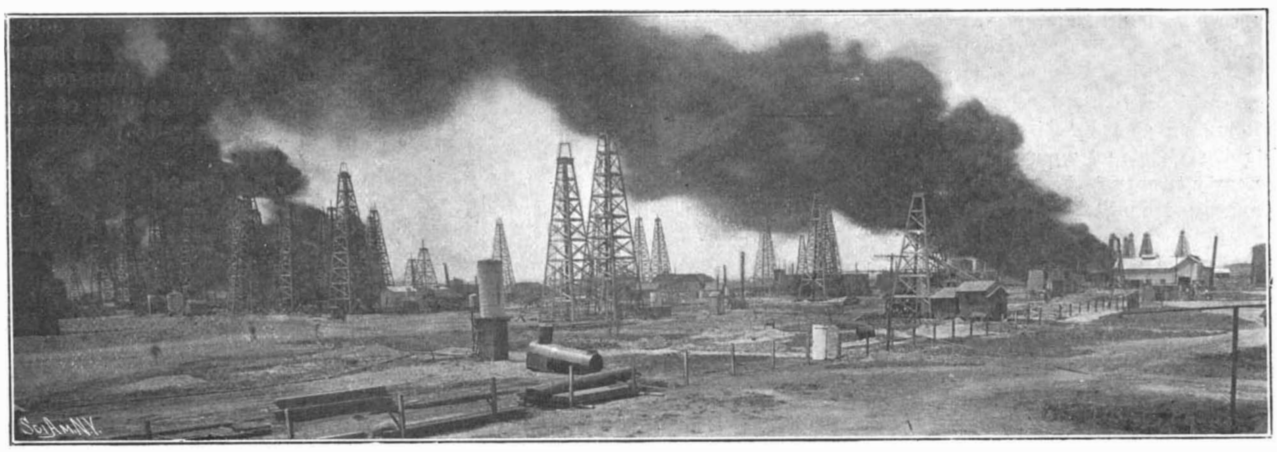
A Typical Pipe Line, and an Open Ditch for Conveying Oil to the Earthen Reservoir

OIL FIRES IN THE SOUTHWEST.

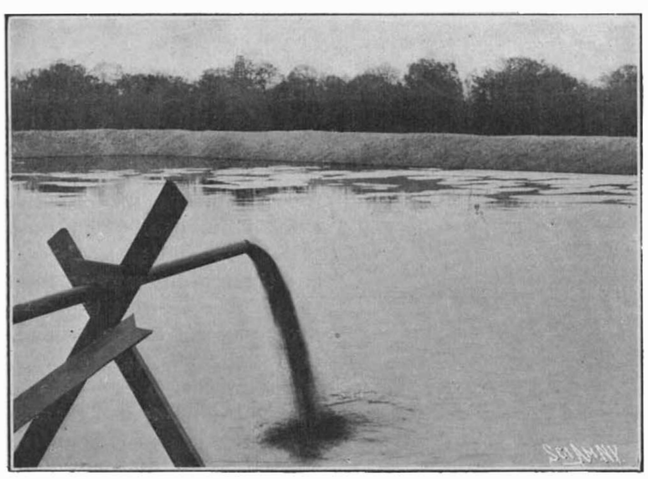
BY DAY ALLEN WILLEY.

Since the discovery of oil in large quantities in the Southwest several of the principal districts have suffered great damage by fire, conflagrations being started by carelessness of employes of the oil companies as well as others, which have spread over an extensive territory and have proved very destructive to not only derricks but the pumping plants and reservoirs. Several fires of unusual magnitude have occurred in the Spindle Top district, while a few months ago one of the largest wells in the Jennings, La., region caught fire, the flames only being extinguished after several weeks had elapsed from the time the fire started.

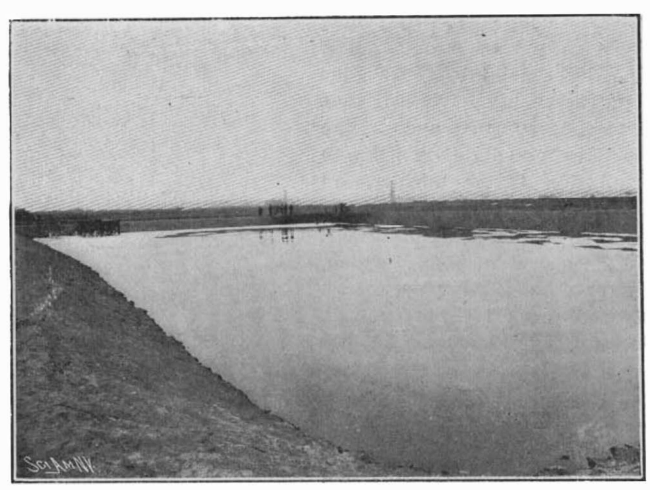
The conditions, especially in the Beaumont district, are such that the utmost precaution must be taken, owing to the highly inflammable character of the plants, also to the fact that much of the soil is literally saturated with oil. At present it is estimated that about 220 wells are being operated at Spindle Top, but fully three times as many derricks have been erected, some of them so close together that the end of one framework almost touches another. The area of Spindle Top is comparatively small, and for two years oil has been secured through a natural flow and by pumping. When the gushers were first brought in, it will be remembered that so much enthusiasm was manifested over the great yield that some were allowed



A Fire in the Spindle Top District.

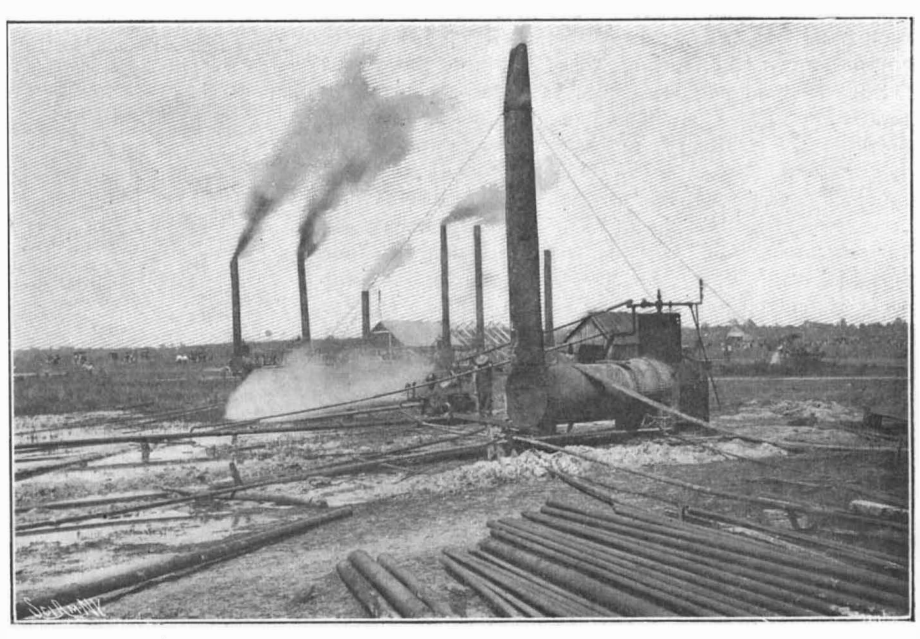


A Lake of Oil.



The Great Higgins Reservoir in the Beaumont District.

Fighting the Jennings Oil Fire.



Boilers Used at the Jennings Fire, Showing Connections with the Pipe Lines.

HOW OIL FIRES ARE EXTINGUISHED.

to discharge their contents into the air merely in order to allow people to witness the spectacular display, which attracted crowds from the vicinity and advertised the region throughout the country. It would be impossible to estimate the immense quantity of oil which was wasted in this way, for no effort whatever was made to force the supply into tanks or even earthen reservoirs. It spread over the surface of the ground, filling the natural depressions in the prairie and even covering the beds of streams in the vicinity. It was stated that some of the great wells, like the Lucas gusher, flowed fully 50,000 barrels in 24 hours, but as there was no means of gaging the flow, these statistics are merely guesswork. There is no doubt, however, as to the enormous quantity which was wasted, probably aggregating over a million barrels.

After the flow had been controlled and the work of providing storage for the fluid was under way, months elapsed before sufficient reservoir capacity was afforded to provide for the yield, while the pipe lines to the seacoast were not finished until nearly a year after the discovery of the Spindle Top field. Not only were large tanks of sheet metal constructed, but reservoirs dug in the prairie and surrounded with merely earthen embankments to keep the oil from escaping. While some of these were served by pipe lines, a very large quantity of the oil was conveyed to them through narrow trenches dug in the prairie, ranging from a foot to four and five feet in width and from two to six feet in depth. They were not completely filled with oil, but such a proportion of the overflow from the wells was diverted to them that the quantity conveyed in these ditches at times was far more than that carried by the pipe lines. One of the earth reservoirs, known as the "Higgins," covered several acres in extent, and in fact was a lake of oil, in some places being nearly twenty feet in depth, while tanks were built ranging from 1,000 barrels upward.

Such has been the abundant yield of the fluid that gross carelessness has prevailed, especially in the Spindle Top district, in husbanding the supply. Much of the oil has escaped through leaks in the trenches; the pipes have frequently burst, discharging their contents over a large area, while many of the tanks have been so hastily constructed that they were not tight. In short, the oil has saturated everything, and merely the flame of a match thrown upon the ground has been sufficient, in several instances, to start disastrous fires. The first great fire in the Texas field is said by people in the vicinity to have been caused by a man going into a settling tank with a lighted lantern, the door by which the wick was ignited being carelessly left open. The flames coming in contact with vapor in the tank caused an explosion which immediately set fire to the interior. Another explosion threw burning oil against several derricks, which ignited, according to the statements of spectators, as if composed of tinder. Sparks were carried to a 4,000-barrel reservoir, which, in a few hours, was reduced to a mass of twisted metal. This fire practically destroyed property covering ten acres of the most valuable territory, and raged for two weeks. The greatest fire in the history of the Texas field was undoubtedly that in what is known as the Hogg-Swayne tract, which occurred in September last. At one time fifty wells were ablaze, and over one hundred derricks were destroyed, while twenty workmen employed in the vicinity lost their lives before they had time to escape.

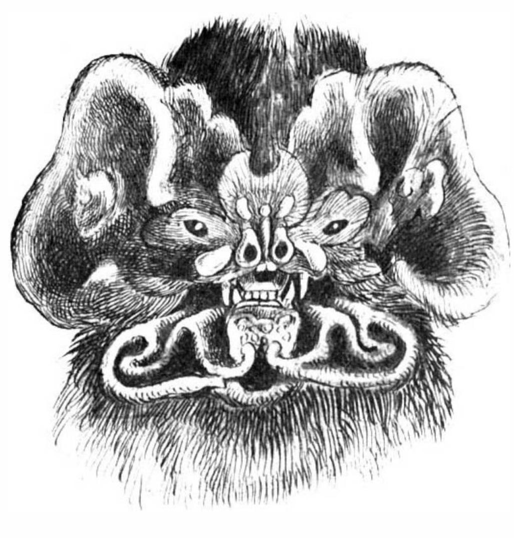
The great damage done by the first oil fires in the Southwest was in a measure due to the ignorance of the best means of fighting them. At first water was tried, but it merely made matters worse by spreading the burning liquid, having no effect whatever in extinguishing it. Then earth was used to confine the flames to a certain district. The "Ten-acre fire," as it is still called, was finally confined in this manner, several hundred men throwing up a bank of earth about the burning area which kept it from spreading to other portions, and finally the fire became exhausted for want of material on which to feed, when the embers were smothered by shoveling earth upon them. Soon after the drilling of the first gushers at Spindle Top, fire broke out during an exhibition near one of the small derricks. Fortunately it was extinguished by the spectators, who realized the great danger, and not only threw earth upon it but in some instances stamped it out with coats and blankets.

In recent attempts at fire fighting in Texas and Louisiana, however, steam has been used to good effect, and it appears to be the only effective means of extinguishing oil flames, as the earth is useless except after the fire has died down sufficiently to allow the shovelers to approach closely to the burning area. It was first tried near Beaumont by John Ennis of that city, the steam being applied through an iron pipe hastily laid and connected with the boiler of a portable engine removed to a safe distance from the fire. After the Jennings fire had raged for over two weeks Mr. Ennis was sent for to plan some means of extinguishing it, for, on account of the quantity of oil in the burning wells, it threatened to continue indefinitely. The nearest towns were searched for boilers which could be brought to the location, and twelve were secured in all, ranging from 20 to 30 horse power. They were set up in a semi-circle and a group of three or four connected to lines of iron pipes, which were laid to points as near the burning area as the men could venture in safety. Then fires were lighted in the furnaces and a full head of steam generated, which was turned upon the flames in jets. One group of boilers was continually held in reserve, so that its jet could be used when it was necessary to suspend operations in another group. In this way steam was continually applied to the fire for several days until the flames were so reduced in volume that they could be smothered with earth. Since then steam has been used in a number of instances, but in the Jennings fire the horse power of the combined boilers was far greater than in any other case.

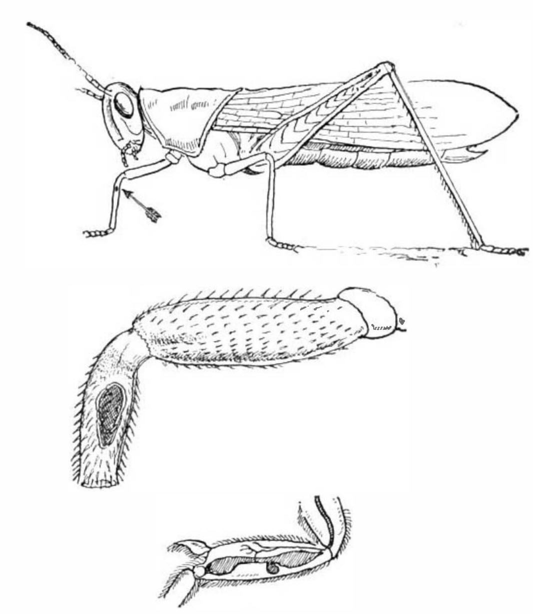
ARE THE SENSES OF THE LOWER ANIMALS SUPERIOR TO OURS?

BY J. CARTER BEARD.

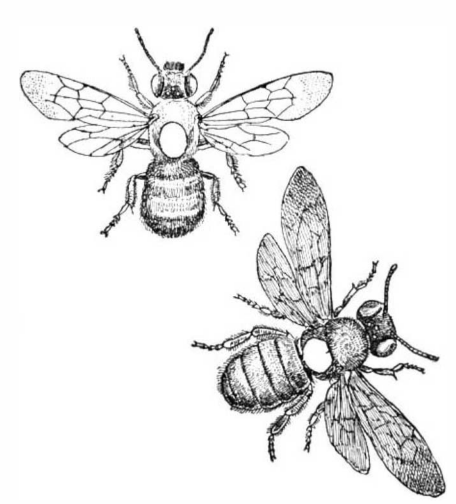
It will at once be recognized that as we can possess no other knowledge of external things than that



Head of Bat (Mormopos blainvilli) showing peculiar sense organs.



Upper figure.—Grasshopper, whose ear is in his foreleg. Middle figure.—Ear of grasshopper, showing thigh and part of the tibia containing the ear. Lower figure.—Tibia of ant, showing an organ of hearing analogous to that of the grasshopper, but formed to hear sounds inaudible to the human ear.



Male and Female Mason Bee, marked with a drop of white paint for identification.

founded upon the reports which our five senses elect to bring us, our information must necessarily be bounded by their limitations.

But, although we cannot have any true or adequate conception of sense discernments belonging to regions beyond the powers and jurisdiction of our own perceptive faculties, we know that such regions exist, and it is demonstrable that they are, in certain cases, to a greater or lesser extent, accessible to many of the lower animals.

It is not easy perhaps to appreciate, in any just degree, the imperfectness of the few faculties we possess of perceiving external things, until a comparison is made between them and the perceptive capacities developed in other animals.

A multitude of living creatures, far below us in the scale of animated existence, might justly consider our senses, as contrasted with those they themselves possess, the veriest rudiments of such powers; an osprey, for example, which from the height of more than a hundred feet discerns beneath the wind-roughened water fishes no larger than the palm of a man's hand, and accurately measures with its eyes the distance its quarry swims beneath the surface; a barn owl, which chases and captures in the dark, bats whose irregular flight your eyes can hardly follow in the early twilight, would doubtless, could it compare our power of vision with its own, appraise it at so low a rate it might be scarcely worthy of the name; a bat, whose wonderfully constructed microphonic ears, nerve-netted wings, and strange foliated face organs, enable it, without coming in contact with the objects shrouded in utter darkness, to perceive and avoid them in its flight, must necessarily, could it know the extent of our powers of hearing and of our tactile sense, consider them extremely deficient; or a dog, which can unerringly select by its sense of smell any one particular duck out of a hundred, were he able to contrast the olfactory capacities of men with those of dogs, might have reason to pronounce the former almost entirely lacking.

The careful study of the sense organs of the lower animals and of the functional power and character of such organs, which has now been carried on for a number of years, has arrived at results that are not only very interesting in themselves, but which form extremely valuable and important data in the sciences of comparative physiology and psychology.

There is a wonderful analogy between the way in which waves of sound affect the ear and the way waves of light affect the eye. A ray of sunlight shining through a prism, and separated into the succession of colors called the spectrum, is only visible in part to human vision. Below the red at one end, and above the violet at the other, as we all know, are rays which are invisible to us.

The lowest tones audible to us correspond to the red end of the spectrum. Like the waves of light which constitute the red rays, those which fall upon our ears as the deepest are the slowest, while notes answering to the rapid, luminous vibrations composing the violet rays, are the lightest and shrillest the ear can distinguish. The possibilities of human color vision are limited to the seven rays of the spectrum, and those of human hearing to sound waves of between thirty (the slowest the ear can distinguish) to forty-five thousand to the second. Beyond these limits we are blind and deaf to sensations, of the existence of which, although our eyes and our ears are not of a nature to distinguish them, there can be no doubt.

A series of experiments was made, several years ago, with light of different wave-lengths on ants, to discover, if possible, whether or not the limits of vision in these insects were the same as in ourselves. After a number of observations demonstrating the fact that ants are sensitive to the ultra-violet rays which lie beyond the range of our vision, the question arose how two media, identical in color to our eyes, but one of which transmitted and the other intercepted the ultra violet rays, would affect the ants. A solution of iodine in bisulphide of carbon, and also one of roseine, carmine and indigo, combined in such proportions as to produce the same shade of the same color as the former, were prepared. To human sight the two liquid solutions were identical; but, in point of fact, the ultra-violet rays, shut out by the bisulphide mixture, passed freely through the other. Exactly equal quantities of these solutions in flat-sided glass bottles of the same size and shape were placed over a nest of the European black ant (*Formica fusca*). In no less than twenty observations the ants showed so decisively a power of discriminating between the two, and so decided a partiality for gathering under the bottle which shaded them from the ultra-violet rays, that no doubt remains that a radical difference between the two solutions was recognized and sensibly felt by them.

This series of experiments, taken in connection with many previously made and described, shows conclusively that the limits of vision in ants are not the same as in ourselves.

Now as every ray of homogeneous light is seen as a separate color, rays of light beyond the violet must reveal to ants a color differing from any we know, as these differ among themselves, a color of which we can form no conception.

Again, as the combination of all the colored rays visible to us in the spectrum makes our white light, it must necessarily vary from the white light seen by these insects, because it wants the supplementary color which they are, but we are not, able to perceive; and as there are few objects in nature in which the blending of several colors does not occur, it is evident that by adding another to the three primitive color elements, red, blue and yellow, we must obtain radically different color effects than any we have ever seen, and that this must make objects look very different to ants from what they do to us.

Many insects, unable to produce sounds which we can distinguish, possess nevertheless sound-producing apparatus, and elaborate organs of hearing analogous to those belonging to other and in general larger species, quite capable of making themselves heard. It is certain that a number of species of animals hear sounds that we cannot hear.

Arthropods in general are indifferent to ordinary sounds. It is possible the compass of hearing possessed by some animals lies in the range of air vibrations above our own, that they can hear no sounds as low as the highest note that is audible to us, as we can hear none as high as the lowest that is audible to them.

But it is without doubt the sense of smell, if indeed we may believe that all the phenomena credited to this sense properly belong to it, which attains its greatest development among insects. Professor N. S. Shaler, of Harvard University, asserts that a female gypsy moth (*Ocneria dispar*) will, by an odor so subtile as to be imperceptible to human olfactories, "attract males from the distance of about a mile away." Albrecht Bethe, the German entomologist, states that a male moth (species not stated) has been known to locate a female several miles distant. Prof. Jordan, president of the Leland Stanford, Jr., University, writes: "In the insectory a few years ago, a few females of the beautiful Promethia moth (*Callosamia promethia*) were inclosed in a box which was kept inside of the insectory building. No males had been seen about the insectory nor in its immediate vicinity, although they had been sought for by collectors. A few hours after the beginning of the captivity of the female moths, there were forty male Promethias fluttering about over the glass roof of the insectory. They could not see the females, yet had discovered their presence in the building.

The sense of smell is most nearly allied to that of taste. Hearing and seeing depend upon nerve responses to vibrations in the air and in the ether. In order to taste a substance, it has to be wholly or partially dissolved; in order to smell a substance, it must encounter the olfactory organs as a vapor, an emanation, a cloud of particles arising from odoriferous matter. An odorous substance can be readily inclosed so that little, if any, odor escapes.

Now in the first instance adduced, a cloud of imperceptible odor arising from an odor-producing organ, situated somewhere about the body of a little insect an inch long, spreads on every side for "about a mile" at least, and is dense enough at that distance to affect the sensory organs of the male moth.

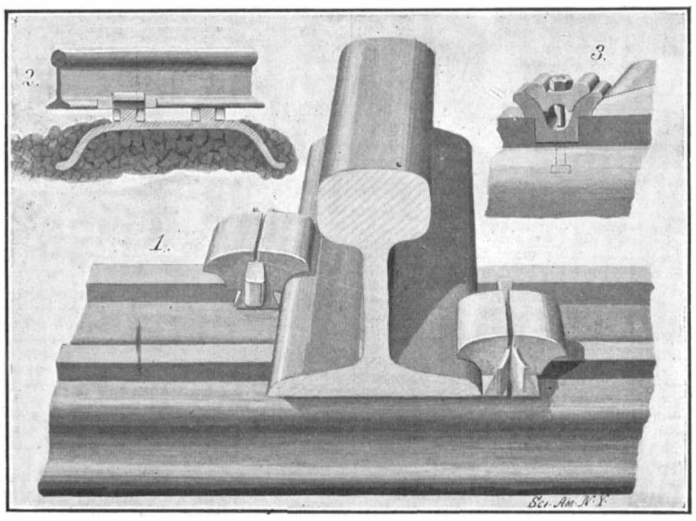
In the second instance adduced, the cloud extends to the distance of several miles without losing its virtue; and in the third, it not only penetrates through the box in which the female insect is kept inclosed, but also the glass roof of the insectory and extending outward to an unknown distance, mingled with, perhaps, as many as a million stronger odors, meets the male moths, which are able to differentiate it from all others, and to know the exact direction from which it comes.

Many animals can follow a scent trail left by another upon the surface of the ground; but to follow unerringly to some distant point in space, from which it arises, an odor extending indefinably in every direction in the air, is a very different proposition.

ONE OF THE LARGEST TREES IN THE WORLD.

BY WALTER L. BEASLEY.

The American Museum of Natural History has now on exhibition one of the largest sections of a tree ever brought from a forest. The fast passing away of the big trees, the majestic relics of the forest primeval and prehistoric times, due to the ax of the commercial lumberman, is rapidly going on, and it will only be a question of time when all save those in government and State reservation groves will be cut down. Recently the government sent an expert forester and secured a magnificent cut from one of the giant Sequoias of the King's River area, Southern California. The tree stood over 300 feet in height, and measured 90 feet at the base. A section 20 feet above ground was obtained 4 feet thick and weighing 50 tons. The diameter of the block is a little over 18 feet, and its circumference measures 56 feet. The specimen is highly polished and will be the main feature of the new wing of the Forestry Hall. Prof. H. C. Bumpus, Curator of the department, has illustrated the life-history of the tree in a striking and unique manner, by placing tags marking every hundred years of growth, which is estimated from the cross-section concentric rings. In addition the great events and happenings in geology and other sciences are likewise recorded in these rings. The tree began to grow 550 A. D., and was 13 feet in diameter when Columbus reached our shores. Some of the trees in the same vicinity are said to be from five

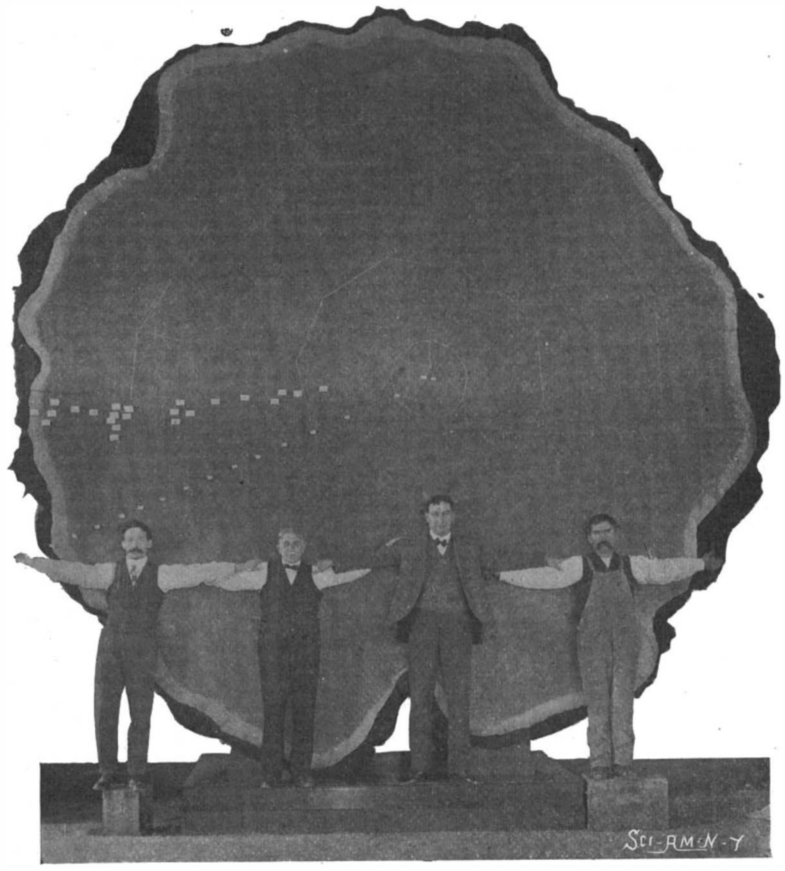


RAILWAY TIE AND FASTENING.

to eight thousand years old. Forest experts have estimated that a tree of this size contains 750,000 feet of lumber, which being cut into telegraph poles 8 and 9 at the base and 4 and 5 at the top, and 24 feet high, would make one pole forty miles long, or enough to supply a telegraph line from Kansas City to Chicago.

RAILWAY TIE AND FASTENING.

A new steel tie that may be readily formed by rolling and then drop-forged into shape, is illustrated in the accompanying engraving. The tie is adapted to be used in connection with a very simple device, by means of which the rails may be quickly and securely fastened. A patent for this invention has just been granted to Mr. G. W. Schellenbach, of Joplin, Mo. The tie has the shape of an inverted trough, so that dirt or ballast may be packed underneath the same. On the top of the tie along opposite sides are ribs provided each with an opening to receive the fastening device. The opposite walls of these openings are undercut, and the fastening devices consist of two



SECTION OF ONE OF THE LARGEST TREES ON RECORD.

jaw portions having the outer sides of their bases inclined to engage with the inclined walls of the opening. These jaws have shoulder portions for engaging on the upper face of the rib. The outer sides of the jaws are made hook-shaped to engage the base flanges of the rails. Of course, only one jaw of a pair will be engaged with the rail, but it is preferred to make the two jaws of similar shape, so that should one become worn, the device may be turned and the other jaw engaged with the rail. After placing the fastening devices in the openings, wedges are forced in between the jaws. The wedges are split at the thin ends so that they may be bent outward to prevent accidental disarrangement. It will be noticed that the act of driving in the wedge results not only in an expansion of the fastening device in its socket, but also in a downward pull of the jaws which serves to clamp the rail down on the tie. These fastening devices are illustrated as short pieces not much longer than the width of the rib on the tie. However, if desired, they may be made sufficiently long to engage in opposite openings or opposite ribs. Obviously by this invention, a rail may be quickly fastened in place and very little packing will be required at the outer sides of the tie. To reduce noise a block of wood may be placed between the rail and the tie. The fastening thus arranged combines great strength and elasticity and is practically indestructible. No spreading of the rails can occur. In Fig. 3 we show a modification of the fastening device consisting of two jaws connected at the bottom by a cross-piece. The jaws are held and slightly spread by means of a wedge arranged between them and forced down by a bolt passing through the tie.

Odd Uses for Rawhide.

It was the great packing and killing houses of Chicago which helped to bring about the present uses of rawhide, says the New York Sun.

Rawhide is a form of leather in which the curing process stops far short of destroying the life of the material. The result of this treatment is a product remarkable for toughness, durability, tensile strength and pliancy. It is used for belting, rope, hydraulic packing, laces of various kinds, pinion wheels, washers, harness, mauls and mallets, flynets, trunks, saddles and artificial limbs.

Rawhide rope is handsome and astonishingly strong, besides having great power of resistance when exposed to the action of the weather. At a little distance it looks like very white and clean new hempen rope. It is delightfully supple, and once tied it holds for a lifetime. The cost of such rope puts it beyond the reach of most consumers, yet for some purposes it is the cheapest material that can be used.

It costs from 10 or 12 cents to more than $2.75 a foot, according to diameter and quality. The cheapest is about a quarter of an inch in diameter; the most expensive, save that made to order in special sizes, is two and a quarter inches diameter. It is largely used for the transmission of power, especially where the line of transmission is long and indirect. Only a close examination brings to light the points where strands are joined, and splicings are so made that they show no change in the diameter of the rope.

One of the most curious applications of rawhide is to the manufacture of pinion wheels for the transmission of power. Such wheels are usually made of iron or steel, but the rawhide can be made sufficiently rigid, hard and tough to serve all the purposes of metal in such articles. The rawhide pinions are almost noiseless, and they require little lubrication. A somewhat similar use is in the gear of friction wheels.

Mallets and mauls of rawhide are used for a variety of purposes in manufacturing. The former are entirely of hide save the handle; the latter have a wooden or metallic base with a rawhide face. Hammers with rawhide faces are also made.

The old-fashioned rawhide whips, the "cowhide" of many a social and political row, are made in several forms, as are blacksnake whips of the same material, rawhide lashes, and miners' whips. Rawhide lariats are also manufactured, though there was a time when every plainsman made his own. They cost from 15 to 20 cents a foot, according to diameter and form of pleat. They are rarely seen east of the Mississippi save in the factories.

In order to determine the density of the earth, President F. W. McNair, of the Michigan College of Mines, and Major John F. Hayford, of the U. S. Coast and Geodetic Survey, will conduct experiments at the Tamarack mine, which is particularly well fitted for this purpose, since its shaft is one of the deepest in the world, penetrating to a depth of 4,550 feet in strata of uniform density. The density of the earth is largely a matter of scientific conjecture. It has been computed by formulæ based on Newton's laws of gravitation. It is true that Sir George Biddel Airy, the British Astronomer Royal, computed the earth's density from experiments which he carried on at a Welsh colliery, but the figures which he obtained varied so much from those based on the formulæ that they have not been generally accepted.

The Rome-Paris telephone line was opened to the public in the beginning of December. The trials were most successful. The line is the longest in Europe, covering as it does 1,000 miles.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

FERTILIZER-DISTRIBUTER AND PLANTER.—J. B. CROWDER, Talucah, Ala. The object of the present invention is to provide a device for distributing and depositing fertilizer beneath cotton seed, or other seed in one and the same operation with planting and at any suitable distance from two to five inches below the seed, so that the fertilizer will be placed where it will do the most good and will not be depreciated by evaporation, or be blown away by the wind or be chopped away by the hoes.

Electrical Devices.

VENTILATED MAGNET-COIL.—W. SPENCER, Jr., Schenectady, N. Y. An improvement in magnet coils is provided in this invention, the object being to provide a coil having an inner helix, thoroughly ventilated to prevent heating, and the inner and outer helices separated by air spaces for the same purpose. The greatest possible freedom of air circulation is allowed, not only between the inner and outer helices, but likewise between adjacent convolutions of the inner helix. The inner coil terminates somewhat inward of the ends of the outer helix. By this means the danger of grounding the inner helix by contact with the ends of the outer helix is avoided.

Engineering Improvements.

BOILER.—R. B. HOBSON, Pueblo, Colo. The invention relates to water tube steam boilers in which the tubes are arranged in such a manner that the greatest possible number of tubes are exposed to the first contact of the products of combustion from the furnace, thus dividing the extreme boiler duty among as large a number of pipes as can be gotten into juxtaposition with the furnace or firebox.

ROTARY ENGINE.—F. E. WOMER, Fairhaven, Wash. The present invention provides certain improvements in rotary engines whereby the construction is at the same time very simple and most efficient. The parts are so arranged as to require but a comparatively small amount of motive agent. The engine may be made compound or triple expansion by simply increasing the number of engines connected one with the other.

Medical Apparatus.

DIAPHRAGM METER AND EXERCISER.—J. E. RUEBSAM, Washington, D. C. It is the object of this invention to provide a simple apparatus for testing the strength of the diaphragm and also for use therapeutically in exercising it. The apparatus is so constructed that the force of expiration acts to propel a small carriage resting upon a horizontal and vertically-adjustable support. This carriage is weighted to any degree required to give the desired gage or test of the strength of the diaphragm of the person using the apparatus.

WOUND-CLOSING DEVICE.—G. J. VAN SCHOTT, Passaic, N. J. An improved wound-closing device is herein provided which permits the surgeon or other person to quickly close up a superficial flesh wound without the use of plasters or resorting to sewing with needle and thread as heretofore generally practised. The device consists of a flexible U-shaped clip with its ends projecting inwardly to form pins which engage the edges of the skin and firmly clamp them together.

Mechanical Devices.

PIVOT-GRINDING ATTACHMENT FOR JEWELERS' LATHES.—J. E. JACSON, Jackson, Tenn., and W. R. JACKSON, Franklin, Ky. This lathe attachment is used for grinding watch pivots to the desired size and shape. It is so constructed and applied to the lathe that a horizontal grinder reciprocates in contact with the watch pivot which is secured to and revolves with the head stock. The working position of the grinder may be changed to accommodate pivots of different sizes and the parts have an elastic or yielding contact, so that there is no danger of breaking the pivot.

AMALGAMATOR.—W. F. BEDELL, Kaslo, Can. The improved amalgamator provided by this invention has a simple and durable construction and is very effective in operation. It is so arranged as to utilize the head of material and water to actuate the machine and to insure proper action of the mercury on the heavy valuable material, including flour gold, so that all the valuable material in the charge is completely saved and ready disposal is had of the tailings.

GAS-METER.—J. R. DUPOY, 36 Rue Guersant, Paris, France. In this improved meter an oscillating bell is divided into compartments of spiral form extending from the center at which the gas to be measured is admitted toward the periphery where the gas is delivered after measuring. The compartments are bound laterally by partitions having a spirally-curved surface, all the vertical sections of which form arcs of circles having for their center the point of oscillation of the bell. The arrangements of parts is such as to cause an oscillation of the bell when the gas enters the compartment, which oscillation operates the recording instrument.

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

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**
MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 3622.—For makers of tierces, hogsheads or barrels holding about 45 gallons.

For mining engines. J. S. Mundy, Newark, N. J.

Inquiry No. 3623.—For manufacturers of automatic egg boilers.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 3624.—For machinery for pressing straw into blocks for fuel purposes.

Coin-operated machines. Willard, 284 Clarkson St., Brooklyn.

Inquiry No. 3625.—For manufacturers of wood-sawing machinery.

Dies, stampings, specialties. L. B. Baker Mfg. Co., Racine, Wis.

Inquiry No. 3626.—For makers of brass tubes.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 3627.—For manufacturers of smoke consumers or fuel economizers.

Patented articles, principally of cast iron, made and introduced. Atlantic Foundry, Philipsburg, N. J.

Inquiry No. 3628.—For makers of rope-transmission apparatus.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 3629.—For manufacturers of copper and iron tanks.

Inventions developed and perfected. Designing and machine work. Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 3630.—For a machine for engraving name plates on caskets, etc.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 3631.—For manufacturers of family sewing machines as sold in department stores.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 3632.—For manufacturers of "Zylonite."

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 3633.—For manufacturers of wooden napkin rings in large quantities.

Inventors wishing to sell their patents or to have them manufactured on royalty will find it to their interest to correspond with me.
J. C, Christen,
Main and Dock Sts., St. Louis, Mo.

Inquiry No. 3634.—For manufacturers of photographic mounts of different sizes.

REPRESENTATIVES WANTED.—For "Good Roads Magazine," "Teller" and electrical periodicals. Powers Co., 150 Nassau Street, New York.

Inquiry No. 3635.—For parties to manufacture a flat, endless coil spring.

DR. A. ISBERT, technical office, Frankfurt-on-Main, Germany, established 1888, undertakes the sole sale of profitable special articles and novelties in the technical and chemical line for Germany; also the use of patents in the same line and the purchase of chemical and technical products.

Inquiry No. 3636.—For parties to make bicycle rims and tires to order.

Inventors and parties desiring to have patented articles manufactured please take notice:—An old established New England concern, with large experience in manufacturing and marketing specialties of different kinds, desires to obtain control of patented inventions of merit, and would either purchase same outright or manufacture on royalty. All communications will be considered strictly confidential, and we reserve the right to reject any or all inventions submitted.
Address P. O. Box No. 316,
Bridgeport, Conn.

Inquiry No. 3637.—For makers of celluloid, white rubber and waterproof paper collers and cuffs.

WANTED.—To manufacture some simple tool or machine, the work of which can be done chiefly on an engine lathe. Geo. W. McKenzie, Wilmington, Mass.

Inquiry No. 3638.—For manufacturers of carpet-cleaning devices, compressed air preferred.

Inquiry No. 3639.—For dealers in hydraulic rams.

Inquiry No. 3640.—For makers of water wheels getting a great amount of power from low head of water.

Inquiry No. 3641.—For machinery for pressing briquettes.

Inquiry No. 3642.—For manufacturers of short-hand typewriters.

Inquiry No. 3643.—For the manufacturers of the "Arlington" rubber collar.

Inquiry No. 3644.—For makers of finished castings to build a small model locomotive.

Inquiry No. 3645.—For dealers in second-hand surveying instruments.

Inquiry No. 3646.—For manufacturers of glass ink bottles.

Inquiry No. 3647.—For parties to make small steam boilers for engines 1-16 to 1-2 h. p. from brass or copper.

Inquiry No. 3648.—For machinery for boring 3 and 4 inch holes in logs to depth of 16 feet.

Inquiry No. 3649.—For the manufacturers of the "Prize Holly Scroll Saw."

Inquiry No. 3650.—For makers of the very lightest engines possible, of 2 or 3 h. p., such as for aerial machines.

Inquiry No. 3651.—For wholesale dealers in unground infusorial earth.

Inquiry No. 3652.—For machinery for filtering new and old cider.

Inquiry No. 3653.—For makers of machines for making fish nets.

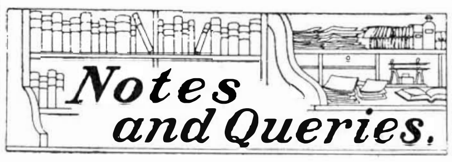
Inquiry No. 3654.—For machines for making ferrules used on wooden handles.

Inquiry No. 3655.—For parties to make small castings.

Inquiry No. 3656.—For makers of phosphorescent paint or ink.

Inquiry No. 3657.—For non-breakable glass milk bottles.

Inquiry No. 3658.—For manufacturers of laundry machinery and supplies.



HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled

(8780) W. R. asks: What the different gases are which, if introduced into an inclosed arc lamp, will turn the color red, green, yellow, blue, etc. A. Colored electric lights are ordinarily produced by coating the globe with an aniline dye, made in alcoholic solution, and mixed with a little varnish. We do not know any gas which could withstand the heat of the arc for any time and which could color the arc. Some color can be imparted to the arc by soaking the carbons in solutions of sodium chloride, strontium chloride, or lithium chloride, and drying them thoroughly before using. The light of the arc itself is so intense that it is very difficult to overcome it with any other colored light.

(8781) L. R. B. writes: Last evening our cook set a dish of raw steak in the pantry near an open window; the steak was salted lightly with fine salt. Near morning, while it was still dark, I chanced to look into the pantry and saw a faint silver glow near the window, and upon investigation found it to be the dish of steak giving off a soft silvery light; but when I lighted a match the meat looked natural and all right. I then took the dish of meat to show to others of the household, and it continued to show its soft, silvery light. The steak was cooked for breakfast in the morning, and we all ate of it and could find nothing wrong with it. Can you explain the chemical or scientific reason for it? A. The beefsteak of which you write had become phosphorescent. Incipient decay had set in, and at a certain stage phosphorescence is frequently seen, both in vegetable and animal substances. It had not in this case advanced far enough to produce an odor of decay, and when the meat was cooked the bacteria were killed, and no harm resulted from eating the meat.

(8782) W. E. F. writes: Do you know of any cheap and safe process for breaking up very heavy castings, such as heavy cylinders with 8 to 12 inch thickness of metal? Would be glad to have you advise me if there is any other process than dynamite or nitro-glycerine? A. The dynamite or nitro-glycerine for breaking large castings is entirely too expensive and dangerous for practical use. The old large naval guns are broken by a heavy weight falling about 30 feet in most of the large foundries. This seems to be the cheapest method available.

(8783) E. M. B. asks how shellac and aniline black are mixed together, such as pattern makers use? A. Aniline black is entirely insoluble. The only way, therefore, to prepare such a mixture would be to dissolve the shellac in the usual manner for a shellac varnish, and then stir in thoroughly the very finely powdered aniline black.

(8784) W. D. L. asks for a recipe for the petrifaction of wood. A. The term petrifaction as applied to artificial treatment of wood is a misnomer. The natural process of petrifaction takes many centuries; the final product is completely mineral, every portion of the original wood having been replaced by mineral deposit, preserving however the form and structure of the primal wood. Artificial petrifaction consists in depositing some form of mineral matter in the pores of the wood, without removing any of the woody material itself; its object is to render the wood very dense, and resistant to both fire and decay. Paragraphs 1, 3, 4 and 5 under article "Preservation of Wood." in the "SCIENTIFIC AMERICAN Cyclopedia of Receipts," are processes of petrifaction. Besides the chemicals therein mentioned, wood is often treated with silicate of soda solution, followed by treatment with alum: this gives very good results.

(8785) M. W. asks: How large would an electro motor have to be to drive a ten-foot propeller making twelve hundred revolutions per minute and pumping as much air upward as possible? Also, how large would storage battery have to be to furnish the electricity, and how much would the motor and battery weigh? A. We can give only an approximate answer to your inquiry. That it will require a five-kilowatt motor, weighing about 800 pounds. The storage battery of about 40 cells of large size would weigh about 1,600 pounds.

NEW BOOKS, ETC.

A POPULAR HISTORY OF ASTRONOMY DURING THE NINETEENTH CENTURY. By Agnes M. Clerke. London: Adam & Charles Black. 1902. Pp. xv, 489. Price $4.

The book which lies before us, and which has now passed to its fourth edition, is one of the most scholarly works on astronomical history which has appeared in England. The author presents her information attractively and scientifically. The illustrations have been carefully selected and do much to elucidate the text.

IN CITY TENTS. By Christine Terhune Herrick. New York and London: G. P. Putnam's Sons. 1902. 16mo. Pp. vii, 229. Price $1.

The author has written an entertaining little book on the economy of a city household. She tells what she has to tell in a racy way that lends not a little interest to her work.

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AND EACH BEARING THAT DATE.

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RUBBER STAMP MAKING. — THIS article describes a simple method of making rubber stamps with inexpensive apparatus. A thoroughly practical article written by an amateur who has had experience in rubber stamp making. One illustration. Contained in SUPPLEMENT **1110**. Price 10 cents. For sale by Munn & Co. and all newsdealers.

Glass, lear for annealing plate, J. W. Cruikshank 717,172
Glasses, tumblers, etc., device for rinsing and washing, E. Witte 717,061
Golf ball, L. M. Selzer 716,945
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Governor, pressure, A. Roesch 717,122
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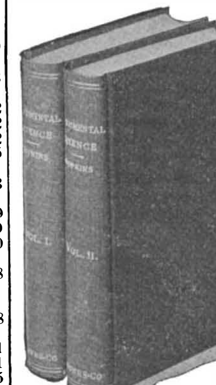

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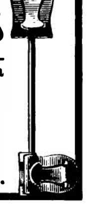

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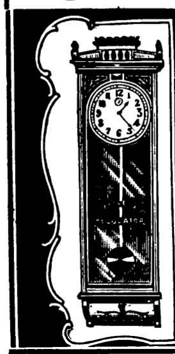

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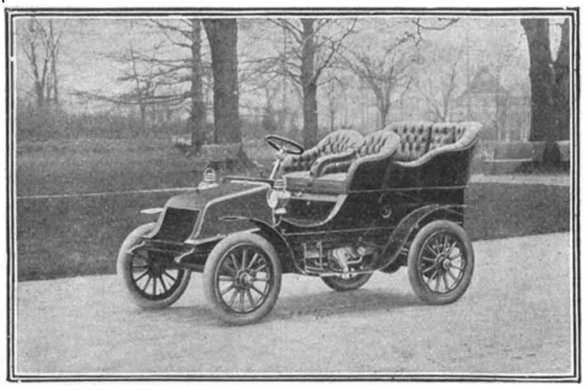

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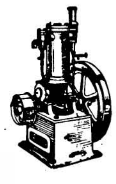

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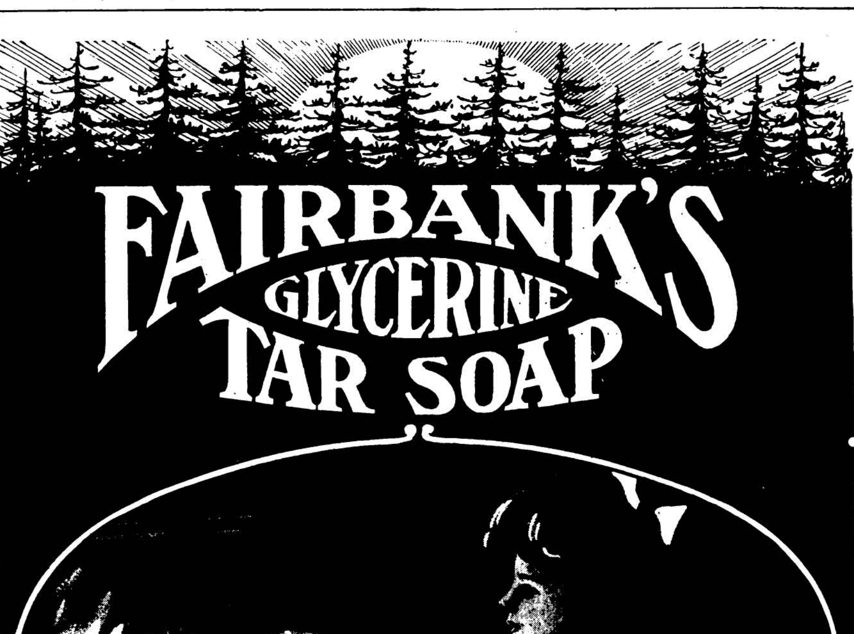

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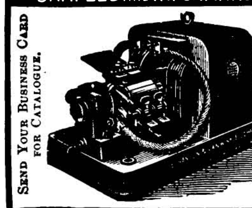

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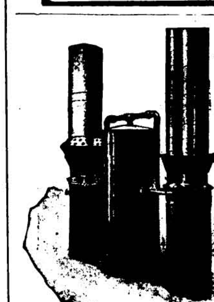

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