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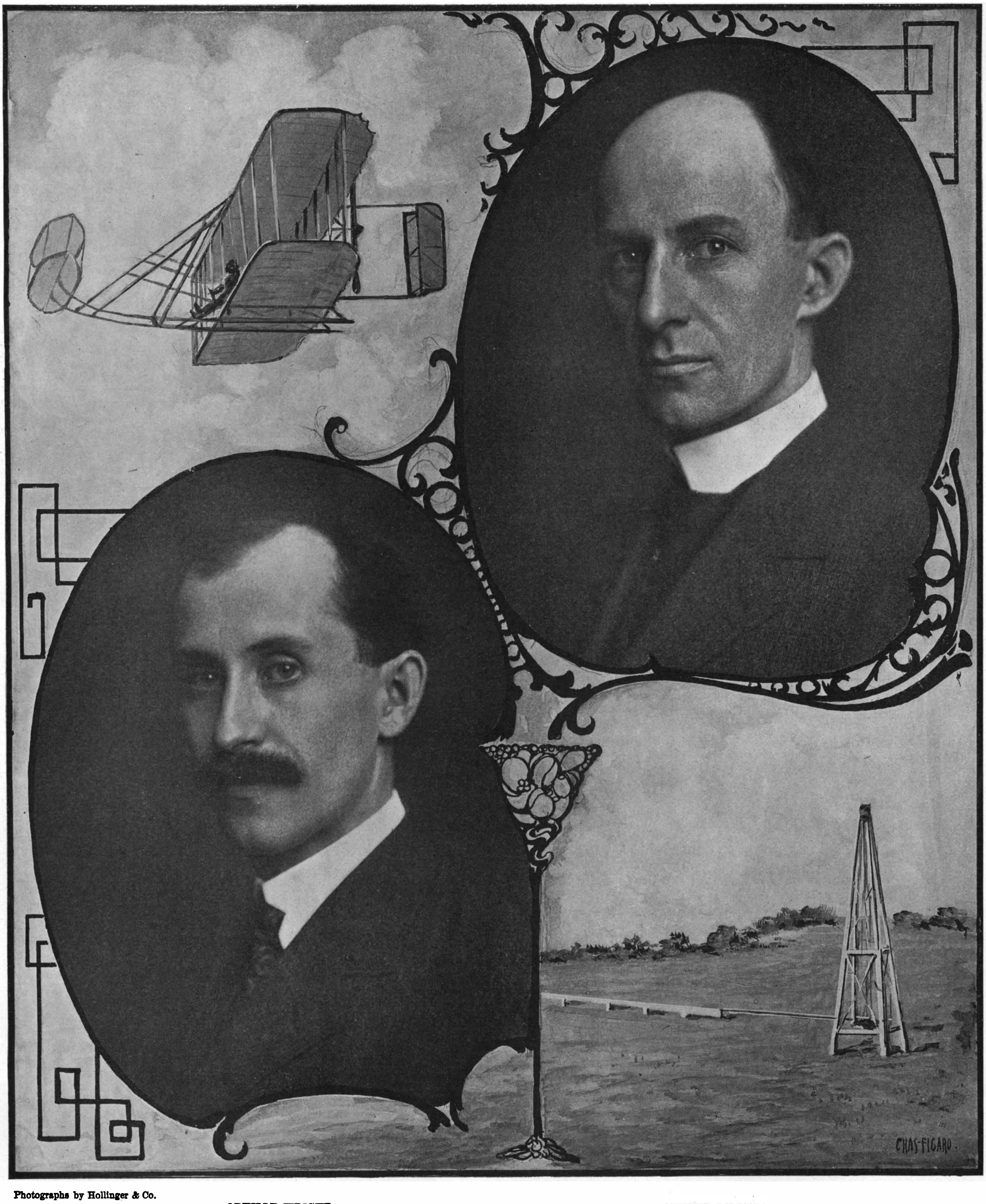

Photographs by Hollinger & Co.

ORVILLE WRIGHT. WILBUR WRIGHT.

THE WRIGHT BROTHERS, INVENTORS OF THE FIRST PRACTICAL FLYING MACHINE, AND THE LEADING AVIATORS OF THE WORLD.—[See page 448.]

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ESTABLISHED 1845

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NEW YORK, SATURDAY, JUNE 12th, 1909.

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.

THE WASTE OF OUR NATURAL RESOURCES.

The present awakening of the national conscience on the subject of the waste of our natural resources is one of the most encouraging signs of the times; but in this, as in all other great national awakenings, there is the danger that the movement may never progress beyond the stage of discussion to that of practical effort. Until the necessary legislation is secured, it is well for us to take an occasional review of the present conditions of waste, and point to the ultimate absolute depletion of our resources which must inevitably ensue unless the strong arm of the law be called in to enforce remedial and preventive measures. We have before us a succinct review of the question by Dr. George F. Swain in a paper presented at the recent annual meeting of the National Association of Cotton Manufacturers, in which the subject is treated under the four heads of Forests, Water, Lands, and Minerals.

At the present time the people of the United States use annually forty cubic feet of wood per acre, as an offset to which there is a natural growth of only twelve cubic feet per acre. In answer to the question, whether it is necessary for us to use three times what we produce, attention is invited to the fact that, while in the United States we use 262 cubic feet per capita, Germany uses only 37, France 25, and Great Britain 14 cubic feet per capita. Forest fires, most of which are entirely preventable, have consumed since 1870 an average of 50,000,000 acres of standing timber per year. There is much unnecessary waste due to careless methods of logging and sawing. For each 1,000 feet of standing timber that are cut down, only 320 feet are put to use. Tanning establishments bark the trees and leave them to die. The turpentine industry, also, results in a large annual destruction of timber. It is not to be wondered at that in the last nine years the price of yellow pine at the mill has increased 65 per cent.

Natural gas is allowed to waste in many localities without restraint, and it is estimated that a sufficient amount is lost to light all the cities of the United States having a population of over 100,000. At the present rate of use and waste all the known supplies of natural gas will be exhausted in 25 years. As for oil, it is sufficient to state that at the present rate of increase the supply will be exhausted before the year 1950. Although there has been an improvement of about 50 per cent in our methods of coal mining in recent years, the present system is uneconomical. We extract the high grade coal and allow the mine to cave in, thereby wasting a large percentage of the available supply. By the middle of the next century, the easily accessible and available coal in this country will have been exhausted.

The situation with respect to our supplies of iron ore is even more serious; for it is estimated that, if the present rate of increase of consumption continues, the known supply of high grade ore will be gone by the middle of the present century. Twenty-five years is also the limit set for the exhaustion of another important mineral—phosphate rock. Taking all our mineral products together, it is estimated that the total waste approximates $1,000,000 per day or over one-sixth of the value of the total production.

As to public lands, or lands in general, it is undeniable that we are failing to secure as large crops as we should, chiefly because we neglect some fundamental principles, such as the development of rotating crops, and so plowing on sloping grounds as to prevent washing away of the soil. Although we have some of the richest soil in the world, the average yield per acre from 1897 to 1906 was 13.8 bushels of wheat in the United States as against 28 in Germany and 32.2 in the United Kingdom.

The facts as above set forth relating to the exhaustion of our fuel supplies indicate that in the future years the value of water power as a national asset will become increasingly evident. To utilize the full hydraulic power of the rivers it will be of the greatest importance to reduce the extremes of flow so that the waste of water through floods may be made a minimum. Statistics show, moreover, that the annual damage done by floods is increasing and has risen from $45,000,000 in 1900 to $118,000,000 in 1907. The Merrimac River discharges at its period of highest flood seventy times as much water per second as it does at its lowest stage, and ten times as much as its average flow throughout the year. The regularity of the flow may be increased by the preservation of the forest, whose presence tends to retard the run-off of the rainfall, and by the construction of reservoirs, which will hold back the floods and allow the surplus waters to be drawn off as needed, thereby increasing the average flow throughout the year. Particularly necessary is it to protect the forests on steep mountain slopes, with a view to the prevention of floods and the resulting destruction of the arable lands in the lower valleys. In the Tenth Congress on International Navigation held in Milan in 1905, the engineers were unanimous upon this point. M. Lafosse, the French delegate, describes the evil effect of stripping the mountain sides as follows:

"The soil, swept bare of its forests, exhausted by the abuses of grazing, loses quickly its vegetable stratum. Washed periodically, and carried away by melting snow and summer storms, it is soon disaggregated. The waters run toward the low points, rolling before them gravel and boulders, and even tearing out loose sections of rock. A thousand rivulets cut out beds, the torrent is formed. Scours begin, the banks are broken down, and a mass of mud, stones and rocks invades the valley, destroying everything as it passes."

Most of the countries of Europe have learned the lesson and taken steps for the careful preservation of their forests; and this has been done not merely with a view to increasing the timber supply, but in the interests of navigation. Over half a century ago, the French government entered upon a policy of forest protection and reforestation, and up to the 1st of January, 1900, they had acquired no less than 620 square miles for these purposes. The efforts of our own government to solve this question on a scale commensurate with its importance should receive the hearty co-operation of every State of the Union.

FEWER BROKEN RAILS.

The alarming increase in the number of broken rails in the State of New York induced the Legislature, some three years ago, to make an investigation of the subject. The conditions were found to be so serious as fully to justify the complaints of the engineers of the railroads, that they were receiving from the manufacturers rails which were faulty both in composition and manufacture. The official investigation showed that the number of rails broken during the winter months in New York State alone ran up into the thousands. The subject was given that healthy publicity, which of late years has resulted in so many improvements affecting the welfare of the general public, and ultimately the manufacturers and the representatives of the railroads met for a thorough discussion of the subject, the outcome of which was a revision of the methods of manufacture and the adoption of specifications which were acceptable both to the rail makers and the engineers. Although it is too early as yet to judge how nearly the rails rolled under the new specifications approach the ideal standard, it is certain that there has been a great reduction in the number of breakages. Many of the recent failures have occurred, of course, in rails which had been rolled under the old system and were already in the tracks when the agitation for better material took place. As time progresses, and the place of the old rails is taken by those of a better quality, we may look for a still further decrease in the number of breakages.

With a view to determining what progress is being made, the Public Service Commission of this State has made a comparison of the returns furnished by the railroads for the four months of December, 1907, and January, February, and March, 1908, with those of the corresponding four months of the past winter. The information required for the earlier period included the rail specifications adopted since June 1st, 1907. The reports, which are practically complete, show that whereas during the winter of 1907 to 1908 there was a total number of rail failures of 3,917, the number for the winter of 1908 to 1909 was only 1,829, relatively a most satisfactory condition. Taking some of the larger roads, we find that there is a reduction on the Erie from 473 failures to 202; on the Delaware & Hudson, from 500 to 162; on the Lake Shore, from 354 to 93; on the New York Central, from 1,601 to 537; and on the Pennsylvania Railroad, from 228 to 139. Of the 54 steam roads included in the report, there is an average reduction of 50 per cent in the failures, and 22 roads report that they had no cases of broken rails. It is encouraging to learn that only four of the failures resulted in accidents, and that all of these occurred to freight trains.

A NEW FIRE-ALARM SYSTEM FOR NEW YORK.

The recent decision of the Board of Estimate and Apportionment of New York city to appropriate the sum of $100,000 for the preparation of plans for a new fire-alarm service, and the expressed willingness of these custodians of the city's funds to vote in the near future an outlay of about two millions of dollars for this purpose, will mark, it is hoped, the passing of one of the most serious dangers that menaces New York. At the very root of all fire protection lies the prompt and correct announcement of a fire by suitable mechanical and electrical devices. New York's fire department has been hampered by an obsolete and inefficient system, largely of a makeshift character and with little or no protection against damage or breakdown. Only the skill and ingenuity of the men of the telegraph bureau have made possible even a satisfactory working under normal conditions. Despite the pleas of fire commissioners and chiefs, not to mention the warnings of the insurance companies most pointedly expressed in high rates, the city authorities have for years refused to take notice of this condition and to appropriate funds for the installation of a new system to take the place of one in so scandalous a condition that it is beyond hope of repair. The Merchants' Association, the fire insurance underwriters, and large business interests have at last succeeded in driving home the needs of the fire department. The central office of the fire alarm system is at present housed in a building which in itself is not a first-class fire risk, surrounded as it is by much inflammable material used as kindling for the engines and forage for the horses of the engine company that it also shelters. Signals are sent to the fire houses throughout the borough of Manhattan along main circuits comprising cables attached in little more than temporary position to the Third and Ninth Avenue elevated railway structures in close proximity to the third rail and to high-tension feeders. Fire-alarm boxes are frequently to be found so poorly placed that two simultaneous alarms would interfere with each other and render both signals impossible of interpretation. In fact, the situation is even now considered so critical, that this winter a makeshift protection in the form of a duplicate telephone switchboard for fire department purposes was installed in a nearby telephone central exchange, so that in the event of the destruction of fire headquarters, telephone communication with the various engine and other fire houses could be maintained.

To ascertain the reasons for this sorry condition of affairs in the largest American city means a study of New York's municipal growth, for the original fire-alarm telegraph plant was installed about 1865, when the "paid system" supplanted the volunteer fire department. The plant was located in the old central station in Mercer Street until removed uptown in 1887 to fire headquarters in Sixty-seventh Street. To accommodate the growth of the city, various extensions have been made both of circuits and apparatus, but without removing it from the sixth floor of fire headquarters. Particularly objectionable is the method of leading the cables into the building. Cables, boxes, and connections are all in a hopeless state of more or less inefficiency. Instead of a non-fireproof fire headquarters containing inflammable materials, it is proposed to erect either in Central Park or some equally isolated place, a central fire-alarm telegraph station in a building absolutely fireproof and devoted to no other purpose, a building which neither fire nor flood can damage. The telegraph and telephone wires of the system are to be laid in underground ducts or subways, carefully protected throughout their course from high-tension current or from possible contact with power circuits. The distribution of circuits is to be systematically planned as regards the territory served, while the boxes themselves are to be of the non-interfering type, so that every signal will be recorded clearly, whether sent in alone or simultaneously with other alarms.

The estimated cost of this system is placed at about two millions of dollars, for which, when the plans are prepared, bonds will be issued. Large as this sum may seem, it is a small price to pay for an essential improvement so long postponed. In fact, just as the high-pressure service has proved an excellent investment for the city, and has been the means of giving vastly increased protection at reduced expense, so a modern and adequate fire-alarm telegraph system will doubtless be the means of effecting a further reduction in insurance rates.

According to the report of the Interstate Commerce Commission, many railroads are beginning to use telephony instead of telegraphy for train dispatching. During the year 1908 the telephone was adopted on 2,357 miles of railroad.

AUTOMOBILE

As the result of ten years' study and experiment, the White Company has at last perfected a kerosene burner for its steam cars, the results obtained with which are claimed to be equal in every respect to those of the gasoline burner. The new burner has the additional advantage of being adjustable for gasoline also, so that whichever fuel is most readily accessible may be used.

A demand is arising in France for road races for stock cars only. The specially constructed road-racing machines of France having been defeated, their celebrated makers came to the conclusion that they were an expensive luxury, and road racing waned in popularity. The Grand Prix of this year has only about six entries, including a "freak" single-cylinder car with a 4-inch bore, 10-inch stroke, and three each of intake and exhaust valves. This state of things is causing a demand among the smaller makers for races limited to strictly stock cars.

In England, where the road problem is somewhat different from ours, consisting of the damage to previously good roads by automobile traffic, instead of the absence of good roads suitable for the latter, it has come to be realized that the difficulty is largely one of maintaining a surface suitable for *mixed* traffic. It is pointed out that in the old coaching days those vehicles were often more numerous on the highways than motors are now, and that it is only since the railways so greatly reduced road traffic that highways came to be considered a legitimate playground for children, dogs, and chickens, so embarrassing to the automobilist. The further elimination of horses, due to the increasing use of automobiles for all purposes, will soon bring about a state of things in which highways will not be subjected to two opposed methods of wear and tear which cannot be resisted by the same means, and the problem of maintaining a durable and dustless surface will be greatly simplified.

The brake and dust trials conducted by officials of the Department of Agriculture at Newark, N. J., produced some interesting results, which should be consoling to the nervous pedestrian who considers the dangers of the street to be increased by the multiplication of automobiles. The fact, already obvious to the well-informed, that a competently driven automobile is much more controllable than the best-driven horse-drawn vehicle, was conclusively proved; and as the majority of automobile drivers are more skilled, or at least more trained, than the majority of horse drivers, the increase of automobilism should make for public safety. All kinds of motor cars, motor cycles, and pair and single horse-drawn vehicles were included in the trials, and the best stops made by the latter were in 27 and 55 feet at 10 and 18 miles per hour respectively, while automobiles stopped in 10 feet and 31 feet at 10 and 20 miles per hour, and in 53 and 74 feet at 21 and 30 miles per hour. It is thus shown that automobiles may safely proceed at twice the pace of which a horse-drawn vehicle is capable and still be pulled up in the same or less distance.

In the recent efficiency test conducted under the auspices of the New York Automobile Trade Association, known as the "one-gallon" test, the points were awarded in such a manner as to really indicate the comparative merit of design of the different cars, which can hardly be said of any previous contest on similar lines. In previous tests of distance traveled for a given quantity of fuel, distance was the only criterion of success, and, given equal ability on the part of the drivers in economic manipulation of fuel, the chances were all in favor of the lighter cars, which obviously ought to travel a greater distance per pound of fuel consumed than heavier ones. In the recent contest, however, the basis of comparison was the ton-mile transported, so that a heavy car traveling a shorter distance had a chance of beating a light car traveling a greater number of miles. The obvious advantages of this diagnostic, at least to the inexpert amateur looking for an economical car, were sufficiently borne out by the results: although the contest was won by the fifth lightest car out of twenty entered, the heaviest car on the list was first in its class and third in the entire list, and this in spite of its being of the six-cylinder type generally considered to be large consumers of fuel. The winner was an 18-H.P. 4-cylinder Franklin weighing 1,900 pounds light and 2,880 pounds with its full complement of five passengers, which it carried for 35.8 miles, making a score of 103,104 pound-miles or 51.55 ton-miles. The second was a single-cylinder 10-horse-power Cadillac, one of the cheapest cars entered, which ran the longest distance of all, 42.6 miles, making a score of 99,045 pound-miles; while the big Lozier, which was third, carried its 5,230 pounds of car and passengers 17.2 miles, making a score of 98,443. These figures are certainly rather a revelation of the possibilities of economical travel by means of automobiles, 51½ ton-miles for a gallon of gasoline, i. e., at a cost of 16 cents, representing remarkably cheap road haulage of either passengers or freight.

ELECTRICITY.

In order to permit of using tungsten lamps of low voltage in illuminated signs, a special type of transformer has been designed, which reduces the voltage in the ratio of 10 to 1. With a view to preventing loss of current in a flashing sign, these transformers are controlled through the primary circuit.

A novel galvanic cell has recently been invented, which generates an alternating current. The electrodes of this cell are thin sheets of iron, and the electrolyte is a mixture of equal volumes of a two per cent sulphuric acid solution and a saturated bichromate solution. This cell deflects the needle of the voltmeter to each side of the zero position every five or ten seconds, the voltage indicated being plus 0.4 volt and minus 0.4 volt. This action is kept up for hours.

The city of Boston is having 3,000 magnetite arc lamps installed for street illumination. The magnetite arc burns in open air like the original carbon arc, and on a direct current only. One of the electrodes is of copper, while the other, or negative electrode, is made of iron oxide and titanium. Only the latter electrode need be replaced when trimming the lamp, while the positive electrode lasts for over two years. One of the advantages of this type of arc lamp is that it can be operated on the same circuits with tungsten incandescent lamps, making a very convenient and attractive combination for street lighting.

To protect wooden electric light and telephone poles from being gnawed by horses, it is customary to wrap the wood with wire. With a view to facilitating this work, which is quite slow and consequently expensive when done by hand, a pole-wrapping machine has been devised. The machine carries a reel of wire, and is mounted on four grooved rollers which bear against the pole, being held in contact by the tension of a spiral spring. A cutter wheel is mounted on the machine, which serves to cut a spiral groove for the wire. The pitch of the groove may be varied by adjusting the cutter. With this machine it requires but fifteen or twenty minutes to wrap a pole, and the wire is laid on so tightly that it may be held with a single row of staples. The machine also serves for splicing poles.

An ingenious method of measuring the moisture in corn is to convert the kernel of the corn into a battery cell. The instrument is supplied with two pins, one of copper and the other of zinc, which are forced into the kernel of corn and serve as the electrodes of the battery, while the moist germ of the kernel is the electrolyte. A tiny current is thus generated, and its value is read by means of a galvanometer. In this manner it is possible to determine the amount of moisture in the corn. In a similar way, wheat and other grains are tested; but as it is impossible to penetrate the kernels, the grain is packed tightly in a vessel and two large plates are used for the electrodes. In some cases, a current is passed through the grain, and the moisture is determined by noting the electrical resistance with a Wheatstone bridge.

When a Wehnelt interrupter is used with an alternating current, the anode, which is ordinarily made of platinum, is very rapidly disintegrated. To overcome this defect, a German inventor has devised a type in which a carbon rod is used in place of platinum. A porcelain tube with a 3-millimeter bore is supported in the vessel, which is filled with sulphuric acid. A carbon rod covered with a thin coating of copper is arranged to fit into the bore of the porcelain tube. The porcelain arm, which bears against the bottom of the rod, may be adjusted to raise or lower the rod, thus determining the amount that projects below the end of the tube. A weight on the carbon rod presses the anode against the porcelain arm. The intensity of the current is determined by the thickness of the coating on the carbon. This construction was found to be very satisfactory on alternating-current circuits. A voltage of from 60 to 150 was required to operate the interrupter.

Investigations of the electrical state of the upper atmosphere during July and August last were made at the Glossop Observatory in England. A wire was elevated by a kite and a dead-beat galvanometer was used to measure the currents. It was found that the current was too large, at times, for the capacity of the instrument, and it was necessary to connect it in shunt. The results of the experiments were as follows, the mean current values being given:

Height above ground.	Current in amperes.
2,000 feet	5×10^{-5}
4,000 feet	13×10^{-5}
6,000 feet	23×10^{-5}

The current values varied considerably during the period of the investigations, and seemed to depend to a large extent upon the velocity of the wind. The greater the velocity, the greater was the current. Although the investigators attempted to measure the potential of the air, they were unable to obtain very satisfactory results, owing to the impossibility of insulating the apparatus perfectly against the high potentials.

SCIENCE.

A large villa was recently unearthed at Pompeii by a restaurant keeper, who obtained permission recently to excavate on a plot of land adjacent to some recently discovered tombs. It is stated that some excellently preserved frescoes were revealed.

By a process recently patented in Austria, caoutchouc is recovered from materials of every kind which contain it, by heating the finely divided material to 212 deg. F. or higher with ethers of the cyclic or acyclic series which boil at temperatures higher than 212 deg. F., and by precipitation the caoutchouc from the solution is thus obtained.

Typhoid fever vaccination has met with the approval of the army. Of the 150 men of the hospital corps on duty at the Walter Reed Hospital in the District of Columbia, 98 per cent have volunteered for antityphoid vaccination, and already over two-thirds have voluntarily returned for the second application. By this writing, probably all have returned. No opposition has been encountered, and the entire experiment has proved a success.

Auer von Welsbach, the well-known inventor of the incandescent gas mantle, has produced an alloy of iron and thorium which possesses remarkable properties. When struck lightly against a piece of iron this alloy emits exceedingly bright sparks, produced by the almost instantaneous oxidation of particles detached by the blow. Sufficient heat is developed to ignite tinder instantaneously, without the repeated efforts required by the old-fashioned flint and steel. The new thorium "flint," indeed, may be called an everlasting match. It will be very useful to explorers and tourists and should be of great value for the ignition of explosives, for military and other purposes.

Near the little Italian city of Adria excavations are being made on the site of the ancient Adria, a prosperous Etruscan seaport which gave its name to the Adriatic Sea. In the course of ages the city was buried beneath the alluvium of the Po and the Adige, and the sea receded from its site, which is now 18 miles from the coast. The project of exhuming the buried city has been discussed for many years, but until recently its accomplishment was prevented by financial difficulties. The work is in charge of a commission which includes the most celebrated archæologists of Italy, and it is expected to result in the discovery of archæological treasures of the greatest importance.

Of all the preservatives for milk, hydrogen dioxide has been regarded as the simplest and safest because of its ultimate decomposition into innocuous products. In the Moniteur Scientifique E. Feder condemns the use of this substance as dangerous and gives a method by which its presence in milk can be detected. This method, devised by Fritzmann, consists in adding to the suspected milk a small quantity of a mixture of formaldehyde and strong sulphuric acid. The presence of hydrogen dioxide is revealed by a bluish violet coloration. The same coloration is produced when formaldehyde and hydrochloric acid are added to the milk at the temperature of ebullition.

Mr. Marconi denies the statement which has recently been made that wireless telegraph waves are injurious to operators, and that they produce various diseases such as conjunctivitis, corneal ulcers, leukoma. To use his own words: "During the twelve years or so of our operations we have had to deal with no single case of compensation for any injury of this origin, nor, so far as I can ascertain, has any such injury been suffered. Speaking for myself, I may remark that my own health has never been better than during the often extended periods when I have been exposed for many hours daily to the conditions now challenged, and in the constant neighborhood of electrical discharges at our transatlantic stations, which I believe are the most powerful in the world."

The use of compressed acetylene has hitherto been prevented by the great risk of explosion incurred when this gas is confined under a pressure exceeding two atmospheres. According to Claude and Hess, this danger does not exist when the compressed acetylene is dissolved in 90 per cent acetone. In the practical application of this principle the acetone is forced into steel cylinders, filled with a porous mass composed of infusorial earth, a special wood charcoal and a suitable binder. Acetylene, also under high pressure, is then forced in and dissolves in the acetone. At ordinary temperature and atmospheric pressure acetone dissolves 24 times its volume of acetylene, but at 12 atmospheres it dissolves nearly 300 volumes of acetylene (measured before compression). In practice cylinders of about ⅛, ½, and 1 cubic foot capacity are employed, which contain respectively 12, 50 and 100 cubic feet of acetylene. They are useful for lighting railway cars, automobiles, buoys, etc., and for autogenous welding of metals.

BELIN'S IMPROVED APPARATUS FOR THE ELECTRICAL TRANSMISSION OF PICTURES.

BY JACQUES BOYER.

The Scientific American of December 21st, 1907, contained a description of the tele-photographic process invented by Edouard Belin. The object of this first tele-stereograph, as the inventor calls the apparatus, like that of the improved form now to be described, was to transmit and reproduce photographically all drawings and pictures in relief. In this first experimental apparatus, which gave some very encouraging results, the transmitting and receiving stations were mounted on one table and driven by the same motor. The fictitious distance between them was represented by a resistance equal to that of 750 miles of telephone wire. Furthermore the two stations did not possess the apparatus which is required for photographic transmission to great distances over actual telephone circuits.

The new apparatus, here illustrated, was experimentally used with success between Paris and Lyons in January of this year. The two stations, now separated, are operated simultaneously by an electrical device which insures synchronism. These stations are absolutely identical, and either may be adapted for receiving or transmitting by moving a switch.

The process of transmission is based upon the fact that a photographic print in bichromated gelatin presents, even when dry, a series of elevations and depressions, and that some other prints have the same peculiarity. The white parts of the picture are represented by the deepest depressions; and the blacks by the highest elevations, while the half tints are represented by intermediate thicknesses of gelatin, in exact accordance with their depth of tint. The photographic print is affixed to a cylinder which rotates before a tracing point carried by the short arm of lever. The long arm of this lever carries a little wheel which rolls upon a diminutive rheostat formed of plates of silver alternating with sheets of mica, the thickness of the whole being only 1/10 inch. Each silver plate is connected with the junction between two consecutive coils of a resistance box, such as is used in physical laboratories. The first coil represents the resistance of the line, and the other coils are so calculated that their successive intercalation produces a uniform decrease in current strength.

The tracing point travels over the surface of the cylinder in a spiral line, and the lines thus formed are 1/6, 1/5, or ¼ of a millimeter (1/150, 1/125, or 1/100 inch) apart, the change from one system to another being made by a simple mechanical adjustment.

The diameter and length of the cylinder are such that it is covered by a print measuring about 4 by 5½ inches.

The receiving station is composed essentially of:

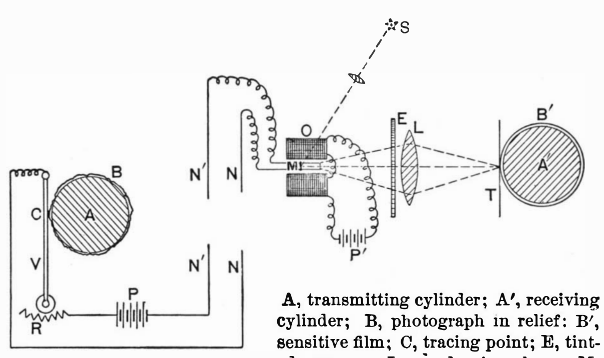
1. A Blondel oscillograph which is connected with the line wire and translates the fluctuations of the current into oscillations of a beam of light, reflected by a small mirror.

2. A rectangular box, shown in profile in one of the photographs, in which the receiving cylinder rotates. This cylinder, corresponding in dimension with the transmitting cylinder, carries the photographic film or paper upon which the transmitted picture is impressed.

Fig. 1.—A portrait transmitted from Lyons to Paris in 5⅓ minutes by the new Belin telestereograph.

In the wall of the box opposite this film is a circular opening of a diameter of 1/6, 1/5, or 1/4 millimeter, according to the scheme employed.

3. A Nernst lamp provided with a lens, which condenses its rays upon the mirror of the oscillograph.



A, transmitting cylinder; A', receiving cylinder; B, photograph in relief: B', sensitive film; C, tracing point; E, tinted screen; L, condensing lens; M, mirror; N N', line wires; O, Blondel oscillograph; P P', electric batteries; R, rheostat; S, Nernst lamp; T, aperture 1/150 inch diameter; V, lever.

Fig. 4. Diagram illustrating the operation of the Belin telestereograph.

4. An aplanatic lens which converges upon the sensitive film the rays reflected by the mirror. The mirror and the point of incidence on the film are conjugate foci of this lens.

5. A screen of graduated tints placed in front of the lens.

With the aid of this description and the accompanying diagram the operation of the system will be easily understood.

When the apparatus is started the elevations and depressions of the picture at the transmitting station impress continuous oscillatory movements upon the tracing point, and consequently upon the little wheel at the other end of the lever. When the wheel, as a result of these movements, is at one side of the rheostat, no resistance is added to that of the line and the current is a maximum. When the wheel is at the other side of the rheostat all the additional resistances are inserted and the current is a minimum. In intermediate positions the strength of the current is a function of the position and the variations thus produced are rigorously proportional to the elevations and depressions and consequently to the variations of tint of the original picture; hence, on reaching the receiving station the fluctuations of this current impress upon the mirror of the oscillograph rapid successive deviations proportional to the varying strength of the current. In consequence of these deviations the reflected pencil of light oscillates from right to left and from the center to the edge of the lens after traversing the graded screen, the function of which is to reduce the luminous intensity more or less, according to the position of the pencil. As the film and the mirror are at conjugate foci, the aperture in the box is continuously illuminated. Hence when the luminous pencil falls upon the center of the lens the absolute transparency of the screen at this point produces no diminution, and the impression is a maximum, producing a black spot in the photograph. When the luminous pencil falls on the edge of the lens the absolute opacity of the screen at this point entirely extinguishes the light and a white spot in the photograph results. In every other position of the reflected beam a partial extinction by the tinted screen produces the photographic effect desired; and the combination of all these effects produces a picture entirely similar to the original, and having all its detail, down to a fineness of 1/6, 1/5, or 1/4 of a millimeter (1/150, 1/125, or 1/100 inch) according to the system used.

It is very evident that if the tints are correctly graded and the sensitiveness of the oscillograph is properly adjusted the copy must be entirely similar to the original; but the degree of contrast of the copy can be diminished or increased by enlarging or contracting the cross section of the luminous pencil, and consequently of the spot of light and the elements of which the resulting photograph is composed.

In most cases the receiver is of the same dimensions as the transmitter; but if the essential organs, namely, the screw, the cylinder, and the aperture of the receiver,

(*Concluded on page 442.*)

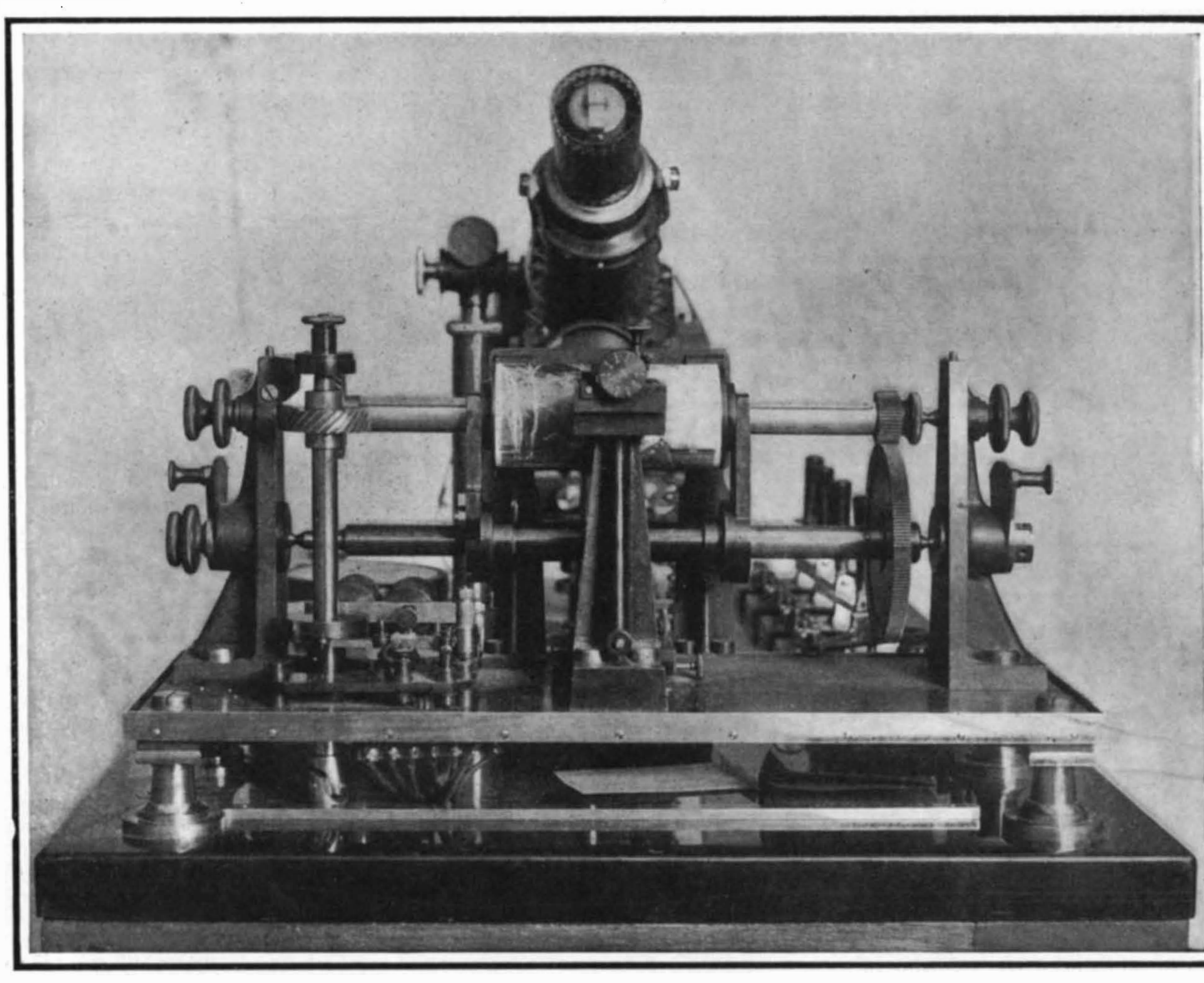


Fig. 3.—Front view of the apparatus with the cover of the cylinder removed.

Fig. 2.—The new Belin telestereograph.

BELIN'S IMPROVED APPARATUS FOR THE ELECTRICAL TRANSMISSION OF PICTURES.

IS THE EARTH'S SHAPE CHANGING?

BY J. F. SPRINGER.

We have been so accustomed to regard the earth as globular, or at most as a sphere symmetrically flattened, that it is somewhat startling to be told that there is perhaps something of a polyhedral form to it. Back in the seventies, Mr. Lowthian Green discussed at length the proposition that the contraction of the earth subsequent to its condensation into a spheroidal

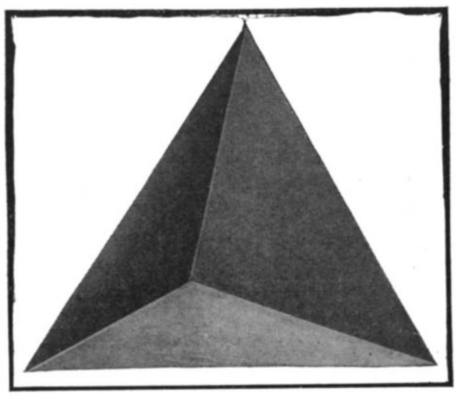


Fig. 1.—Top view of a regular tetrahedron.

form has been in the direction of a regular tetrahedron. We must not understand from this, however, that if we could station ourselves off somewhere in space, and view the earth as a whole, we should see, in accordance with this hypothesis, a geometrical tetrahedron having four perfectly flat surfaces, each an equilateral triangle. Nor are we to expect a geometrically exact tetrahedron, even if we imagine the water drawn off and nothing left but the solid earth, that is, the lithosphere. No; the hypothesis means a deformation tending in this direction. But Mr. Green's conception attracted but little solid scientific attention, being regarded perhaps as too grotesque for serious consideration. More recently, however, Mr. J. W. Gregory has recalled attention to this view in a paper read

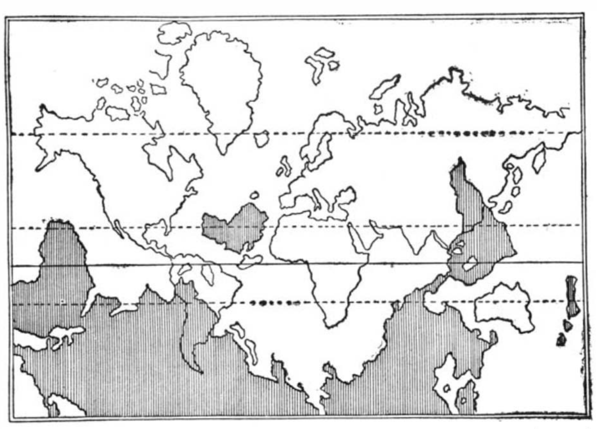


Fig. 2.—Mercator's projection showing antipodal "shadows" which would be drawn upon the globe by the opposite ends of lines passing through the center of the earth from points on the coasts of land surfaces.

before the Royal Geographical Society. The present article will, in the main, and without being exhaustive, set forth arguments there brought forward.

First, consider the regular tetrahedron of geometry. There are four equal faces, each of which is an equilateral triangle, Fig. 1. It is the regular geometrical solid which has the least number of faces, that is, four. The cube, which is the next simplest—being formed of squares—has six faces. Now, the sphere is the solid which has the smallest surface with a given volume. The regular tetrahedron, on the contrary, is

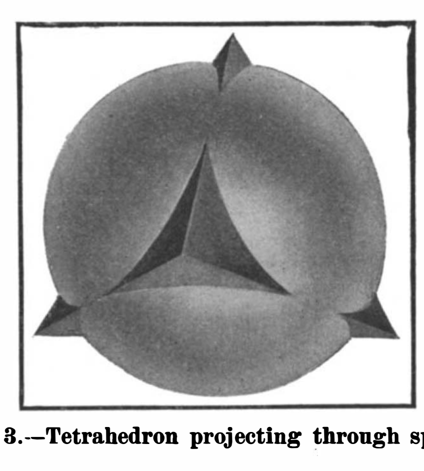


Fig. 3.—Tetrahedron projecting through sphere.

that regular solid which has the greatest surface with a given volume. By referring to the figure, it will be observed, too, that every vertex is opposite a face and *vice versa*. Further, the nearer one goes to the center of a face, the nearer he will approach the center of the entire solid.

Now, if the solid rocky mass of the earth—the lithosphere—were of such a form, gravitation would increase as one approached the center of each face, as such a course would bring him nearer the center of gravity. Consequently, water lying on such a surface would tend to collect at the center. However, the form of the exterior surface would be approximately spherical. And the deepest points of such oceans would be at the centers of the triangular faces. Now, our earth does not present precisely the aspect suggested. But, on the other hand, let us consider some of the facts.

If we refer to a geographical globe, or even to a plane map of the world, we shall see that the hemisphere north of the equator contains nearly all the land, and the hemisphere south nearly all the water. This is a tremendous fact in geography, and has probably arisen from, at most, a few causes. If we follow the northern boundaries of Asia, Europe, and North America, we shall find that there is an almost unbroken zone of land extending around the earth. Thus, North America and Asia are separated by an insignificant distance. Continuing eastward, we find land without a break until we pass from Europe to Greenland *via* Iceland. Here a moderate stretch of sea intervenes between Scotland or Norway and Iceland. But this break is only apparent. There is in reality a ridge—now submerged—connecting Iceland and Scotland. There is thus a ridge circling, almost if not entirely without breaks, the lithosphere along moderately high parallels of latitude. From this the continental land masses depend in three groups—North and South America, Europe and Africa, Asia and Australia—thus accounting for almost the entire land surface of the globe.

Consider now another great fact in geography. The continental masses are, roughly, triangular masses or combinations of triangles, the bases being toward the north. North America and South America are evidently triangles thus arranged. Europe—including Iceland and the British Isles—may be regarded as a triangle, or better perhaps as a series, with the vertices in the Mediterranean Sea. Africa needs no comment. Asia tapers off in the peninsula of India and in the Malaysian peninsula and islands, etc. Australia has its triangular vertex in the island of Tasmania. The Arabian peninsula is to be included with Europe, as will now be explained. From the Arctic Ocean to the Caspian Sea Europe is depressed. Then from the Persian Gulf there is a depression which almost enables a connection to be made with the Caspian Sea. By dividing the land mass Eurasia along the neighborhood of the meridian, 50 deg. E., the Arabian peninsula will fall to Europe, forming the vertex of a triangle having for its base Iceland and the Arctic shore of Europe. To view Asia as a single great triangle, the vertex is to be placed in the neighborhood of Java and Celebes. The Philippines would be included in this Asiatic triangle. The base of the Australian triangle is north of the continent itself, as certain of the islands in that direction belong to the continental platform, of which Australia itself is merely the largest portion extending above the sea level. Greenland is to be included with North America.

With the exception of the land lying in the Antarctic Ocean, we have thus accounted for nearly all the prominent protuberances of the lithosphere. That is to say, almost the whole of the prominences may be regarded as separable into three groups of two triangles each. Each group consists of a northern and a southern section; and all six triangles have their bases to the north and their vertices to the south.

Further, between the two triangles of each group is a marked separating depression. In the New World this depression is the basin of the Caribbean Sea. It might be thought that a consideration of the Rocky Mountain highland with that of the Andes would prohibit the idea of a severance. But it is held that these two mountain systems do not constitute in effect a single chain—what might be looked on as connecting links being short ranges running from east to west, instead of north to south. The Euro-African combination is separated by the Mediterranean and Red Seas. The remaining combination of triangles is divided by a deep channel known as Wallace's Line, which cuts in between Asia and Australia, throwing Java and Celebes and the Philippines to Asia and New Guinea to Australia.

Now, these are marked features of the lithosphere, and stand out conspicuously upon even a superficial examination. They are to be explained by some great fact of the earth's history.

But let us turn now to consider the depressions on the surface of the lithosphere. These are prominently marked out by the three great oceans. These are also triangular, but with their bases to the south and their vertices to the north. Thus, the great basin of the Pacific constitutes one immense triangle, its two sides sloping to the vertex at Bering Strait. The Atlantic forms two triangles. One has its base in the region of the Antarctic Circle, and tending to a vertex between the eastern projection of South America and the western projection of Africa; the other triangle has its vertex between Greenland and Iceland, for we must remember the ridge sloping to the northwest from Scotland to Iceland. The Indian Ocean with its base, or bases, along the Antarctic Circle tapers northward to the Arabian Sea and Bay of Bengal. All of these triangles have their bases to the south and running east and west, with their vertices to the north.

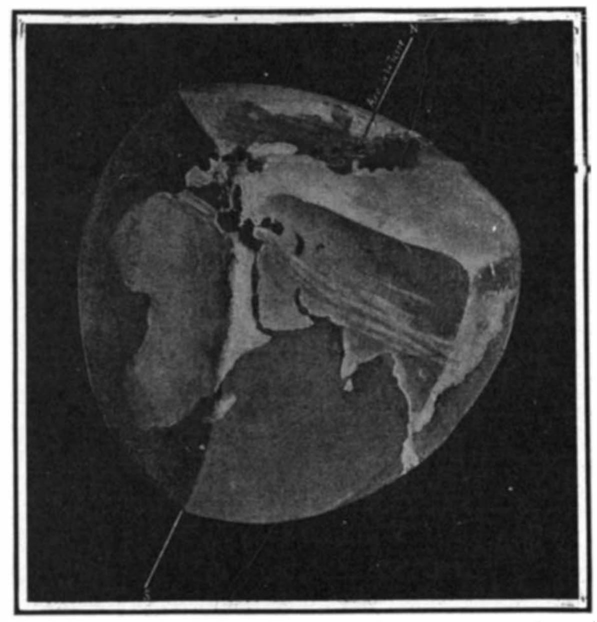


Fig. 4.—How the earth would appear as a tetrahedron.

Thus is accounted for nearly the whole of the sea. We have to add that the three oceans are connected at the south. The triangular depressions correspond then to the triangular elevations. There are three main divisions of each. The one set has its bases practically connected at the north with its extremities to the south. The other reverses these conditions.

A further fact in geography, and which is a notable one, consists in the antipodal relation of land and water. If we imagine a diameter running through the earth, one extremity being, say, at Cape Hatteras,

Fig. 5.—Europe as it is.

the other extremity will of course be the antipodal point of this cape. Suppose now that the American end of this diameter moves along, tracing out the continent of North America. The other extremity will, of course, trace out a reversed North America on the opposite side of the globe. If this process be carried out for all the land surfaces, we shall find that, with the exception of the southern part of South America (perhaps one-third of the entire area), these antipodal shadows lie in the oceans, Fig. 2. There is no other

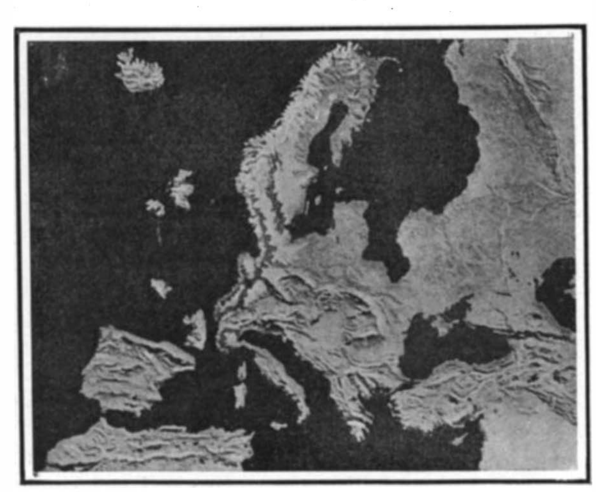


Fig. 6.—Europe as it will be.

considerable exception, unless the Arctic and Antarctic regions shall be found to furnish them. This would seem to be a remarkable fact. The correspondence is such as must be expected to arise if the causes of depression of an ocean bed on one side of the earth should react through to the opposite side and cause there an elevation—not so great, perhaps, as the depression, as some of the pressure would radiate off in other directions, and thus lack conspicuous expression.

Now, the tetrahedral hypothesis proposes to explain some, if not all, of these large facts. It is assumed that a more or less solid crust was formed, the earth being still, perhaps, in an approximately spheroidal form. If the interior goes on contracting, the external shell will be too large. But it is possible that it be maintained at the same size and with a smaller content if arranged in a form different from the spheroidal. One of the best of the forms permitting the same shell with a diminished interior is the regular tetrahedron. Perhaps this was not assumed at once, as at first the contraction would not be sufficient to demand a form having a fixed surface with a minimum interior. And perhaps the facts do not demand a consummation as yet.

Assuming that there is existent a well-advanced tendency of the lithosphere—not including the water—to take this form, we shall be able to explain some of the facts.

For the oceans would lie one on each face, with their depths in the center. They would be four in number. This would seem to agree with the requirements, if we postulate the Arctic Ocean as covering the region of the North Pole. If these did not fill their basins, the portions of the tetrahedron protruding would form the continents, each continent consisting of a corner with portions running off along the three edges meeting there. If the amount of water forming the hydrosphere were sufficient to cause each ocean to overflow the three sides of its containing triangle, but not enough to cover the corners, then we should have them all connected with each other, and each somewhat triangular in shape. The continents would be four in number and triangular in shape, Fig. 3. These would correspond to (1) North and South America, (2) Euro-Africa, (3) Asia-Australia, (4) Antarctica. To this it may be objected that North and South America constitute, not one triangle, but two. Likewise with Nos. 2 and 3. In reply to this, it may be suggested that we are not to assume that the tetrahedral tendency has reached completion. There may be at present more than four faces.

It will be observed that, since in a regular tetrahedron a corner lies opposite to a face, the continents are antipodal to the oceans, Fig. 2.

It is, perhaps, time for us to state distinctly just where on our present earth we may conceive the various corners to lie. First, we place one corner in coincidence with the South Pole. We thus account for Antarctica and the Arctic Ocean opposite. The three remaining corners we arrange thus: one on the Labrador peninsula, another in Scandinavia, and the third in Manchuria. They are thus not far from 120 deg. separated from each other. There are geologic reasons for this disposition. The rocks of these regions are of the most primitive character and of great extent, seemingly fitted to become the foundations of great land areas.

Now, it might be thought that if this hypothesis of a tetrahedral earth be true, we should find some evidence of a ridge running from corner to corner. By examining a map of North America, it will be found that there is such a ridge extending from east to west in the neighborhood of 50 deg. N. latitude, the rivers on each side flowing in different directions. In Asia extending across from east to west is a divide sending the rivers to the north of it to the Arctic Ocean. It may be that the Telegraphic Plateau in the North Atlantic is to be regarded as evidence of such a ridge connecting Scandinavia and Labrador.

As to the ridges extending from the northern corners toward the South Pole, the three double continents themselves supply evidence. Now, it might reasonably be thought that the divergence of the three ridges from each of the northern corners would give rise to a confusion of river flow. And the facts are in fair agreement with this. Also, it might just as reasonably be supposed that farther south—since the ridges are separate and extend north and south—there would be water flow to east and west. In South America this is the case. Likewise, Africa corresponds well to this requirement. Australia exhibits, perhaps, no very clear evidence.

Consider now the triangle formed by the three northern corners and their connecting ridges. With certain exceptions to be mentioned later, the principal mountain ranges in the north are parallel to these ridges. Thus, in Asia we have the Himalayas extending roughly from east to west. In Europe the same may be said of the Carpathians, the Alps, and the Pyrenees. The Ural Mountains, the Rockies, and the Appalachians are apparent exceptions. But these are said to belong to a different era of mountain formation.

There is another line of evidence which may be thought to have some bearing. This is in reference to polar flattening of the earth. This flattening was suspected because in 1672 a clock which was known to be a correct time-keeper in Paris was observed to lag two minutes per day in French Guiana. If a terrestrial radius in the latter locality were longer than one at Paris, this loss might be accounted for, since in the one case the strength of gravity would be feebler than in the other, thus causing the clock to run more slowly. By actually measuring a degree of latitude in a far northern country and again near the equator, certain French astronomers were able to show, from the fact that the former was longer, that the earth was flattened at the North Pole. By carrying out the same process at the Cape of Good Hope, it was shown that there was flattening at the South Pole also. Now, these facts can be explained—and adequately, perhaps—by the oblateness induced by rotation when the earth was in liquid and plastic stages. But it has been shown that the southern flattening is not so great as the northern. Here is where the tetrahedral hypothesis enters with its Arctic depression and Antarctic elevation.

Now, it is quite possible, perhaps, that this hypothesis can not be made—in its present form—to explain everything, and can even be made to appear inconsistent with facts. But that would not necessarily mean that it is not a step in the right direction, containing a germ of real truth. Perhaps it may need modification. However, until the logic of inescapable facts intervenes, this may be looked on as a tenable and possible, though perhaps not complete, explanation.

BELIN'S IMPROVED APPARATUS FOR THE ELECTRICAL TRANSMISSION OF PICTURES.

(Concluded from page 440.)

are made *n* times larger or smaller than the corresponding parts of the transmitter, the copy will be correspondingly enlarged or reduced, but it will always remain as sharp as the original because the aperture is in contact with the film.

It was necessary to make some other additions to the primitive apparatus in order to allow the operators to exchange signals. For this purpose a system of bell signals is employed, operated by the synchronizing relay and a switch which connects the line either with a call or with the photographic apparatus, like the switch moved by the hook of the telephone.

In the recent experiments between Paris and Lyons the sender called up the receiving station by a prolonged ringing and the receiving operator replied with three short rings, and then waited until the sending operator had started his apparatus. The movement of the apparatus was indicated at the receiving station by a series of rings, the frequency of which increased with the speed of the motor, and gave to the operator an idea of the speed to be employed, while his commutator enabled him to obtain perfect synchronism. Then the photograph was transmitted in the manner above described.

M. Belin sent a portrait from Lyons to Paris in 5 minutes and 20 seconds, and a landscape photograph was then sent from Paris to Lyons in 9 minutes and 15 seconds. At the end of each transmission the circuit was broken and both operators were informed of this fact by the return to zero of the needles of their amperemeters.

It is not, however, necessary for the operator to observe the needle, as the motor simply goes on and when the cylinders have arrived at the end of their course they continue to rotate without advancing.

Lightning arresters and fusible plugs are added to each station.

M. Belin expects soon to repeat his experiment between Paris and London, Vienna and Rome. The object of the tele-stereograph is to reproduce not only photographs and half-tone pictures, but also all designs in black and white, including writing, printing, engraving, and process engraving. For this purpose the apparatus can be simplified.

At the transmitting station the lever, the wheel, the rheostat, and the resistance coils are omitted. Their place is taken by a simple and quick acting interrupter. The apparatus becomes, in fact, a Morse key worked automatically. At the receiver the graded screen is replaced by a narrow slit in a diaphragm placed before the lens. The transmitter is so arranged as to close the circuit when the tracing point enters the depressions, and to break it when the point passes over the raised lines. In this method, which is necessary for line drawings, the result is independent of the height of the relief. At the receiving station the luminous pencil may be arranged to fall upon the slit when the current is closed and to move away from it when the circuit is broken, or by a simple adjustment of the oscillograph, the rays may be thrown upon the slit when the circuit is broken and away from it when the circuit is closed. In the former case the lines of the original picture are represented in the copy by white lines on a black background; in the latter case they appear as black lines on a white ground. Either method may be used according to the object in view and also according to the direction of rotation of the cylinder, by which the direction of the lines may be reversed.

It is evident that when the apparatus is thus used for transmitting writing and line drawings by simply opening and closing the circuit, its operation is entirely analogous to that of an ordinary telegraph. It may, if desired, be operated by a relay and even by wireless impulses.

As various systems derived from the inventions of Caselli and Meyer have recently been proposed, it is proper to insist upon the fact that Belin's method is entirely new and original. It is not necessary to execute the drawing or writing with insulating ink or with metal foil. A special, rapidly-drying ink may be used on any paper which can be easily stretched over the transmitting cylinder. Hence the new apparatus is a universal telegraphic instrument, since it transmits equally well writing, drawings, and photographs.

Official Meteorological Summary, New York, N. Y., May, 1909.

Atmospheric pressure: Highest, 30.26; lowest, 29.63; mean, 29.93. Temperature: Highest, 83; date, 14th; lowest, 40; date, 2nd; mean of warmest day, 74; date, 15th; coolest day, 46; date, 2nd; mean of maximum for the month, 68.0; mean of minimum, 52.8; absolute mean, 60.4; normal, 59.8; excess compared with mean of 39 years, 0.6. Warmest mean temperature, of May, 65 in 1880; coldest mean, 54 in 1882. Absolute maximum and minimum of May for 39 years, 95, and 34. Average daily excess since January 1, 2.2. Precipitation: 1.72; greatest in 24 hours, 1.22; date, 21st and 22nd; average of May for 39 years, 3.29. Accumulated excess since January 1, 0.23. Greatest precipitation, 9.10, in 1908; least, 0.33, in 1903. Wind: Prevailing direction, northeast; total movement, 9,169 miles; average hourly velocity, 12.3; maximum velocity, 48 miles per hour. Weather: Clear days, 7; partly cloudy, 11; cloudy, 13; on which 0.01 inch or more of precipitation occurred, 11. Thunderstorms: 1st, 6th, 14th, 28th. Dense fog: 1st, 9th. Mean temperature of the spring, 49.40; normal, 48.73. Total precipitation of the spring, 10.84; normal, 10.69.

Ozonizing a City's Water Supply.

The water supplied to Nice (105,000 inhabitants) and several smaller French cities is now purified by ozone, in addition to filtration. The following method has been adopted by the city of Chartres (24,000 inhabitants). The water is pumped from the river Eure into sedimentation basins which are contained in a building of ferro-concrete, with a double roof which keeps the water fairly cool in summer and prevents it from freezing in winter. The building has windows of yellow glass, yellow light being unfavorable to the development of bacteria. In these basins about 1,600,000 gallons of water are clarified in 24 hours. The water flows thence through coarse coke filters and fine sand filters to the ozonizing apparatus. The coke filter beds are cleaned, when they become choked, by exposing them to the air and washing away the oxidized impurities with a current of water. The sand filters are cleaned by powerful jets of compressed air and water, directed upward.

The ozonizing plant is constructed in duplicate, so that one section is always ready for use. The water trickles down through four beds of pebbles which have an aggregate thickness of 14 feet and are supported by perforated floors in a tower, at the bottom of which ozonized air enters under pressure. The ozone generator is a cell of glass 6 feet long, 3 feet wide and 6 feet high. It contains five elements, each composed of three cast iron plates. The middle plate is connected with a transformer which furnishes an alternating current of 20,000 volts; the outside plates are connected to earth. Between the iron plates are glass plates covered with tinfoil. Ozone is produced by the alternating electric discharges between the plates. The outer iron plates are perforated to allow the ozone to escape, and the middle plate is cooled by a current of water from a tank insulated by triple bells of porcelain. Air is forced into the generator under a pressure sufficient to carry it, laden with ozone, through the water tower. One grain of ozone is used for 8½ gallons of water. The primary circuit of the transformer is connected with an alternator which produces a monophase current of 250 volts and 500 cycles. It is of interest to note that the price charged for water, about one cent for 44 gallons, has not been increased since the installation of the ozonizing plant.

British Patent Law Opposed.

The Lord Chief Justice, Baron Alverstone, delivered an address on May 28th before the section of the International Chemistry Congress which is dealing with legislation affecting chemical industry. He spoke strongly against the revoking clause of the new British patent law, saying he considered it a backward step which would result in people keeping their inventions secret. The scientists present were unmistakably hostile to the British patent law, and a resolution was unanimously adopted recommending that committees of the various countries adhering to international conventions agitate in favor of a general understanding providing that manufacture in one country belonging to the union protects the patentee against the revocation of his patent in other countries of the union.

Correspondence.

THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN:

Your correspondent who figures out that each of us had 1,424 ancestors ten generations ago must be an only child. It is so naive a statement to make that each person living has two parents and each parent had two, etc.

He forgets that the figuring is more apt to be the other way. Ten generations ago a couple got married. They had four married children, and each child had two children that married, etc. Thus in the present generation there will be living 1,424 descendants of the original pair. When speaking of human beings, it is polite to say couple, and not pair, of course.

According to his way of thinking, the world at some time in the past must have been densely populated. History does not show this. On the contrary, history tends to show that the increase in population is such that it very nearly doubles in each generation. The ancient wise men who considered that the population of the world started with one couple were simply men who observed and applied facts. Your correspondent runs away with himself, and a little sober thought would show how absurd some of his ideas are.

Chicago, Ill. ERNEST MCCULLOUGH.

IMPRESSIONS OF AMERICAN INVENTORS.—II.

THE WRIGHT BROTHERS AND THEIR ACHIEVEMENTS.

It must indeed have been a proud moment for Orville and Wilbur Wright when they received from President Taft—a native of their own State—the gold medals of the Aero Club of America and the thanks of this great nation for having solved the problem of all ages—flight. With the presentation of these medals on June 10th, and with that of the Smithsonian and Congressional medals a week later, has come to them at last the recognition that is seldom accorded a prophet in his own country, and that was several years late in being given in this instance. As a result of this tardiness, France has thus far witnessed the greatest flights yet made by either of the two "birdmen"—those of Wilbur Wright—although Orville Wright's flights at Fort Myer, near Washington, last September, were excellent in every particular, and will doubtless be duplicated and surpassed by the younger brother in the coming tests to occur at the same place within a few days. The longest flight made here last year was 1 hour and 15 minutes on September 12th last; while Wilbur Wright's record is 2 hours, 20 minutes, and 23 seconds at Le Mans, France, on December 21st, 1908. Besides this Wilbur Wright holds the record for height, having flown over a line suspended at a height of 360 feet above ground. As far as speed is concerned, the Wright aeroplane has flown in an official test at the rate of 38 miles an hour. Several French monoplanes have surpassed this figure slightly, the fastest speed so far attained being about 45 miles an hour. But when the matter of stability is considered—especially in a transverse direction—the Wrights have so far beaten all other experimenters. By warping the two main planes of their machine, they can vary the angle of incidence, obtaining a greater lift on the low side and a diminished lift on the high, and thus quickly bringing the aeroplane back to a level keel. The fore-and-aft stability is maintained by means of a double-surface horizontal rudder mounted well out in front. The equilibrium in both directions is maintained manually; but it is probable that in the near future the brothers will find a way of accomplishing this important function by some automatic means.

The two modest Americans whose portraits appear on our frontispiece have probably received more attention from royalty during the past six months than any other of their countrymen who have been abroad of late. While at Pau, France, last spring they were visited by King Alphonso XIII. of Spain and by King Edward VII. of England. They also made flights at Rome in the presence of King Victor Emmanuel, while in August they expect to go to Germany and fly before the Kaiser.

Both brothers are as modest and unassuming as their photographs indicate. Wilbur, the elder, is rather quicker and more positive than Orville, and generally speaks in short, quick sentences, giving his opinion in a few words. At first sight he strikes one as a typical Yankee inventor, and this idea of him is strengthened when one sees him working upon his machine with his pockets bulging with balls of twine for use in making a quick repair. Both men are extremely careful in making their experiments, and both have a great amount of patience. They always delve to the bottom of any problem they have to solve, and argue with each other at length *pro* and *con*. As their only sister, Miss Katharine, so aptly puts it, "To hear them argue around and knock the bottom out of each other's ideas till, at the end of three hours, you find Orv where Wil started off and Wil where Orv began, is just the killingest thing imaginable, and makes them both burst out laughing—but it saved them no end of useless experiment." And according to the testimony of a man who studied them while they were at work at Pau, hardly a flight was made but what some new problem was presented or solved, so that they are still making improvements.

The story of how the two brothers conceived and perfected their aeroplane has been told often; but perhaps a brief retelling of it would not be out of place here. Receiving their first interest from a toy flyer of the Frenchman Penaud, which their father brought home one time when they were boys, they some years later were stirred by the tragic death of Lilienthal (who was killed by a fall with his glider in Germany) and they determined to take up the problem of flight where he laid it down. They read all of Lilienthal's writings, and became acquainted with Mr. Octave Chanute, a mechanical engineer of Chicago, who had carried on some experiments in gliding flight. They built a glider of their own, and experimented with it during a few weeks each summer on the huge sand dunes of the North Carolina coast. They developed a method of gliding by lying flat upon the lower plane, and controlling the glider in an up and down direction by means of a horizontal rudder rigged out in front. Later they solved the problem of lateral stability by a method of warping the planes which they devised and patented. They attained great skill in gliding flight, and consequently were not much surprised when, on December 19th, 1903, they were able to fly half a mile at the fourth attempt, after fitting a specially-built aeroplane with a gasoline motor. There were many problems to be solved, however, after this first power flight, and with the inadequate facilities offered by their small bicycle shop in Dayton, as well as the lack of funds with which to experiment, nearly two years more were spent before they felt that they had really solved the problem. But they were too early at that, for the U. S. government refused to have anything to do with aeroplanes and the French people had not yet become enthusiastic. Two years more elapsed before our War Department finally gave out specifications for an army aeroplane, and owing to the unfortunate accident to Orville Wright's machine when in flight on September 17th last at Fort Myer, the fulfillment of the tests required is only now about to take place. Orville Wright will conduct the machine, and will make the first cross-country flights the brothers have ever attempted.

When one considers that the two brothers not only built a successful aeroplane, but that they constructed several gasoline motors—in which art they were quite inexperienced—as well, one can partially realize what great credit is due them; for six years ago the best automobile gasoline motors were weighty and cumbersome, while such a motor for an aeroplane had hardly been thought of. That they were able to build a sufficiently powerful and light motor to make their aeroplane fly at this time is another side light on their genius. Not only did they make several fairly light motors, but they also developed a propeller for testing these, and a device whereby they could read the horse-power while the motor was running. Owing to the degree of perfection to which they had brought their aeroplane surfaces—which was reached only after numerous experiments with models—the two brothers were enabled to fly with about half the horse-power required by other foreign experimenters, a 25 to 30-horse-power motor being sufficiently powerful for their needs. Nevertheless, their first motors weighed about twice as much per horse-power as those they are using to-day.

The making of such long flights as 2 hours and 20 minutes, and the carrying of a heavy passenger at other times, augurs well for the eventual commercial use of aeroplanes, though the Wrights themselves do not believe they will ever be largely used in this way. Their aeroplane is ordinarily started by being shot from a catapult, but once in Rome it rose in the air with its own power, after sliding on its runners over the grass. If mounted upon wheels, it could readily do this upon suitable ground. Probably a combination of wheels and runners will eventually be used.

Dirigible Balloon Progress.

The recent partial success of the "Zeppelin II," of the moral of which we shall have more to say next week, renders timely the article presented in the current issue of the SUPPLEMENT describing the practically identical "Zeppelin I." The "Zeppelin II" is so called because, if accepted by the German military authorities, it will be the second war dirigible; but it is actually the fifth large dirigible balloon built by Count Ferdinand von Zeppelin on similar lines, his experience resulting only in modification of detail.

The "Zeppelin II" left its floating shed on Lake Constance late on Saturday night, May 29th, with the supposed object of sailing to Berlin, which, however, Count Zeppelin has since disclaimed. Berlin lies a little east of north from Friedrichshafen, the home of the balloon, and its course as far as it went was straight in that direction, and apparently quite independent of the wind. It passed over Treuchtlingen early on Sunday morning and Nuremberg two hours later, reaching Bayreuth at 10:30 A. M., Zwickau at 2 o'clock, and Leipzig at 5:20 P. M. At Bitterfeld, a few miles farther and 465 miles from its starting point, the Count decided to return, as he had lost some gas, and estimated that the return journey would take fifteen or twenty hours. The balloon was next reported at Schweinfurt at 3:30 A. M. on Monday, over Wurzburg at 5 A. M., and Heilbron at 8:10. At Goppingen, half an hour after passing Stuttgart, a descent was made to replenish the supply of fuel, which was nearly exhausted. The motors had already stopped, and the airship was nearing the ground in an open field, when a gust of wind carried it against a tree with considerable force. The prow of the balloon was crushed in for a considerable distance, nearly to the front end of the "gondola" below, and the aluminium stays were entangled in the branches.

It is most regrettable that so remarkable a voyage should have been marred by an accident, serious in its results to the balloon but so trifling in its cause, the weather conditions being in no way worse than the airship had successfully negotiated for the previous thirty-six hours. A cruise of 850 miles in that time, however, is alone sufficiently remarkable.

Temporary repairs were made in twenty-four hours, which enabled the balloon to return to Friedrichshafen under its own power, this fact alone testifying to the merits of Count Zeppelin's "compartment" system, without which the damage done to the prow would have been sufficient to entirely incapacitate the airship. Permanent repairs will take probably six weeks.

We present in the current issue of the SUPPLEMENT a complete diagram and description of the first German government Zeppelin airship, known as "Zeppelin I," together with a critical consideration by a prominent aeronautic authority of the merits and demerits of the rigid type of construction as compared with the semi-rigid and non-rigid systems.

Airship Budgets of the Great Powers.

A note addressed to Parliament by the British War Office contains a comparative statement of the sums expended in 1908 by the governments of the principal nations of Europe in the construction of airships and the prosecution of experiments in aerial navigation. The approximate amounts, in American money, are: Germany, $1,900,000; France, $225,000; Austria-Hungary, $26,000; Great Britain, $25,000.

The German government contributed $1,250,000 to the Zeppelin fund, expended $510,000 in the purchase of Zeppelin airships, and $125,000 for the pay and maintenance of the balloon corps. France spent $34,000 on aeronautical schools, pay, and experiments, $57,000 for material and construction, and $135,000 for the maintenance of existing airships. Austria-Hungary spent $14,000 for schools, pay, etc., and $12,000 for airships. Great Britain spent $9,500 for dirigible balloons and $2,500 for aeroplanes. These figures are official and therefore not open to question. London newspapers comment bitterly on the fact that Germany spends nearly eighty times as much as Great Britain for the creation of an aerial navy.

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1745, discusses the subject of the Comparative Practical Efficiency of Various Types of Gas Lamps. The author, Mr. R. C. Ware, is a well-known authority on the subject. A detailed description of the Bellini-Tosi System of Wireless Telegraphy is given, together with an account of the radio-goniometer, which is the basis of the system. For some time past the German government has been practically testing a new system of issuing railway tickets, which dispenses with the necessity of retaining large stocks of printed tickets for each of the stations served from that center. Instead, the ticket is printed upon demand by means of a machine which is described in the current SUPPLEMENT. An Automatic Gate for Grade Crossings is described and illustrated. Jacques Boyer writes on Watercress Culture in France. The Coal-Tar Dye Industry and Its Importance is reviewed. A complete detailed description of the Zeppelin airship also appears.

A Prize Competition.

The eighth regular prize competition of the Austrian Engineers' and Architects' Society has been announced. A solution is asked for the following question:

"How is it possible to avoid the injurious effects of the so-called higher harmonics of current and voltage waves which permanently or temporarily enter the alternating circuit; or how may their production be generally prevented?"

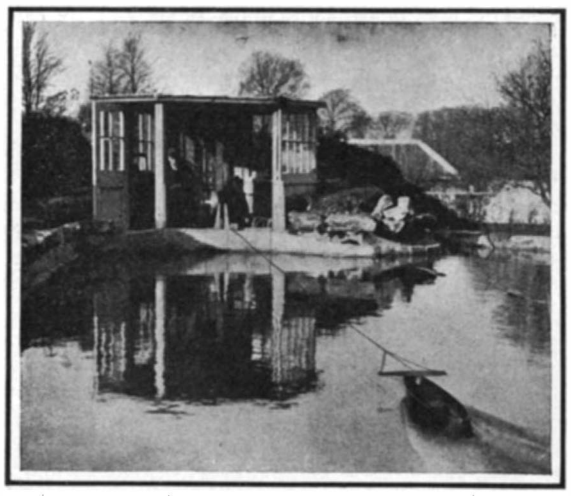
Three prizes are offered, the amounts being $600, $200, and $100. Persons who desire to obtain further particulars and to ascertain whether they are eligible to enter the competition, should address: "Oesterreichischer Ingenieur und Architekten-Verein," Eschenbachgasse 9, Vienna, Austria.

EXPERIMENTS WITH HYDROPLANES OR SKIMMERS.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

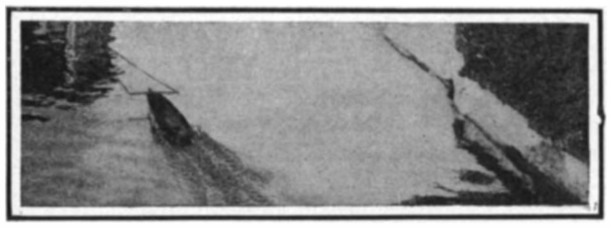
The results of a careful series of experiments with models of this class have been published by Sir John I. Thornycroft, F.R.S., the well-known British naval architect. Special arrangements were adopted in the carrying out of these investigations. A small pond served as the towing tank, with requisite equipment in a small laboratory at one end for towing the models at varying speeds. Through the courtesy of the experimenter we are enabled to publish herewith a series of photographs showing the tests in progress. The results of the investigations were communicated by Sir John Thornycroft to the Motor Yacht Club.

Though the generic term "hydroplane" is adopted to individualize those vessels which greatly reduce their displacement when traveling at high speeds, Sir John Thornycroft points out that this use of the word is not correct, inasmuch as the surfaces on which they glide are not always planes. He prefers the designation "skimmers." The skimmer is no modern evolution of marine handicraft. As a matter of fact, it is very ancient, and is still in use among many of the islanders of the Pacific, among whom it performs useful service. These skimmers are extremely crude, representing as they do the hydroplane in its simplest form. They comprise a single slab of wood rounded at the extreme ends. In the manipulation of these "surf-boards," as they are sometimes called, the natives are extremely adept. Standing upright or lying prone on the primitive support, they can dexterously "coast" down the waves at high speed.

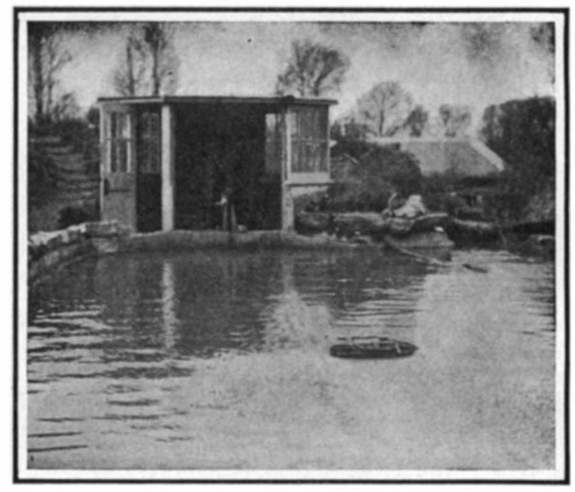


"Gyrinus" model at moderate speed.

Ramus model at rest.

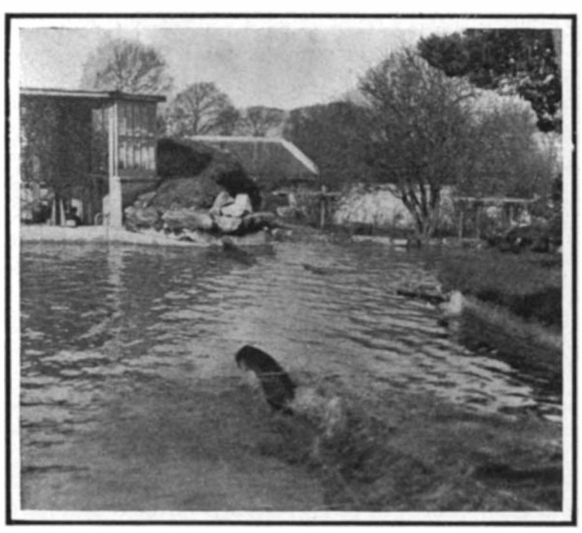


"Gyrinus" model moving at corresponding speed to about 19 knots.

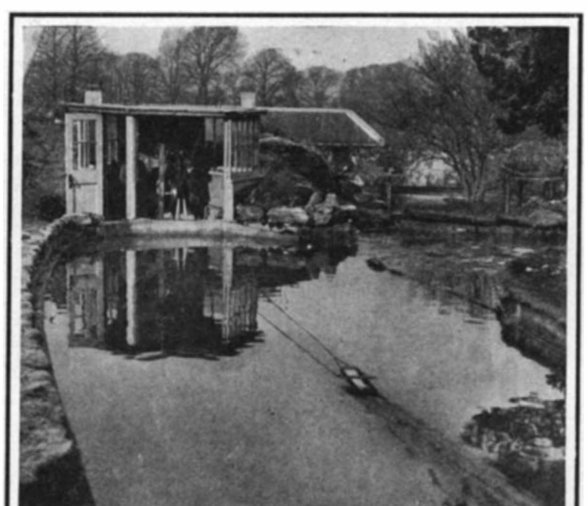


A very beamy Thornycroft model at high speed showing very small surface disturbance.

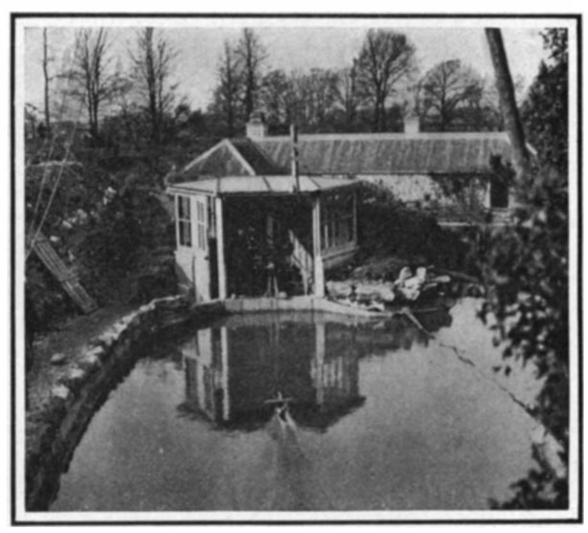
But to make a boat glide steadily along the surface of the water is by no means so easy. Steadiness can be attained probably by using a number of planes, but this is likely to increase the frictional resistance. When a number of planes are used to support a given load, each must be of less length than when only one is used. The friction per unit of surface being greater for small surfaces, it is improbable that a smaller total surface will be sufficient, and the necessary power required for a given speed must be more.



"Gyrinus" model towed backward to illustrate loss of pressure on cruiser stem and stern at high speed.



Ramus model jumping.



Ramus model; steady motion at high speed.

EXPERIMENTS WITH HYDROPLANES OR SKIMMERS.

Mr. Froude, who carried out elaborate experiments in the same field, advanced the opinion that the best results could be obtained from a single plane, held at a particular angle to the water surface. He built a model on which three surfaces were attached to a frame, and towed in such a position that the wake of either of the three did not interfere with the water on which any one of them had afterward to run. He also proved by theory that the angle made by the plane with the line of motion should be such, that the resistance due to surface friction should be equal to the resistance due to gravity, or the horizontal component necessary to balance the weight of the vessel on the incline of the supporting surface.

This inclination he found to be about 1 in 14, so that the total resistance amounts to about one-seventh of the weight of the displacement of the vessel. This friction, however, depends on the value to be attached to the surface friction, which again varies with the character of the surface and the length of the rubbing surface. Mr. Froude ascertained in the course of his experiments with the Ramus model that the front plane lifted entirely above the water surface as the speed was increased, the center of gravity apparently overhanging all natural support. It is evident that this effect can be produced only by having the pressure on part of the surface less than the atmospheric pressure. Sir John Thornycroft carried out some experiments to illustrate this effect by means of a model, the bottom of which for the most part was a simple plane, but the after surface of which could be turned at right angles. The result of this design was clearly shown by the model's jumping clear of the water surface.

When the bottom surface of the model was left flat throughout its length, it glided smoothly over the water, but when the tail part was bent down, it very promptly dived. From the result of these experiments it appears that the endwise vertical section of the bottom of a skimmer or hydroplane should be a straight line, although, as Sir John Thornycroft points out, a hollow curve would seem to promise a more even distribution of pressure on the bottom.

A number of factors must be considered in the evolution of a boat intended for skimming or sliding along the surface of water with the least possible disturbance, and the problem is rendered more complex from the fact that these do not all lead to the same proportions in design. The lifting force depends on the amount of surface and speed, while the friction for a certain amount of surface will decrease with greater length; but the speed at which skimming will take place must increase with length. Below a certain velocity the performance of a skimmer model is very bad, owing to the formation of large waves, which allow the stern to fall and greatly increase the angle of the planes, thereby rendering it more difficult for the vessel to mount to the surface and to skim.

This difficulty he found to be capable of being lessened, either by extending the amount of the supporting surface or by reducing the weight of the vessel, the surface remaining the same. The reduction of weight, however, is a difficult matter, because of the degree of strength necessary to withstand the shocks to which this type of boat is subjected. The speed at which skimming commences, however, should be kept as low as possible. If the boat is short and wide it leads to excessive air resistance, which becomes quite important at speeds of about 30 miles per hour. Consequently, one must not resort to too great a width.

When a skimmer is moving below the skimming phase, the wave formation resembles that of an ordinary vessel, but the waves are larger in proportion to the size of the vessel and diverge at a wide angle. The contrast is strikingly shown when the same model is made to travel fast, since then the volume of the waves is much less and the angle divergence is small. An important point in order to achieve the best result is the position of the center of gravity. In the course of his experiments Sir John Thornycroft found with his models that improvement appeared to take place as this was moved aft, until skipping or flapping commenced. Though this dancing motion may become dangerous, still the best results seem to coincide with its commencement.

Some months ago the Thornycroft Company built a motorboat, the "Gyrinus," which has proved very successful in races, and which differs radically in design from the majority of craft of her class. The vessel has an over-all length of 22½ feet, with a breadth of 5 feet 4 inches and a draft amidships of 8 inches. At the bow the water lines are comparatively full, while the stern is quite flat, finishing in a sharp angle, so that all drag from the water, as mentioned above, is eliminated. This boat has proved most successful in speed contests, and last season carried off the international race for 8-meter vessels. The lines of this craft have provoked considerable discussion, and it has been suggested that they lifted and reduced its displacement to some extent like a skimmer. Photographic records carefully made while she is under full speed refute this contention, since the bow is nearly at the same level at rest or speed, while when moving fast the stern is much lower. The forepart of the boat appears to plow a channel into which the stern falls, and with increase of speed the resistance rises very rapidly, although the form of stem would seem well adapted to avoid this result. Because the lines of this motor boat rise very gently and terminate in a sharp angle, there is no surface which can suck up the water, and by so doing reduce the pressure below that of the atmosphere.

The increase of resistance in a skimmer differs markedly from that in an ordinary boat. It rises very rapidly at first with increase of speed, but once the phase of skimming is established, it may fall temporarily and afterward rise only very slowly, so that the power required increases but little faster than the elocity. This was conclusively shown by experiments iade with a model of the above motor boat and a amus skimmer model of the same weight. The lotted records showed that the resistance curves rossed at approximately 17 knots. For lower speeds ıe boat form is much superior, but above the point here the resistances between the two models are equal, ıe skimming model possesses decidedly greater ad- antages.

Thornycroft also carried out a series of experiments ith the model of the "Gyrinus" motor boat towed ackward, in order to illustrate the clinging of the ater around the rounded form of stern, which the ow then represented; and although this gave no ouble at ordinary speed, the effect at extreme speeds as found to be surprising. The real stern lifted, hile the bow was depressed until the model made a ırge angle with the line of motion, as was found to e the case by Mr. Froude with his Ramus model.

Sir John Thornycroft also studied the passage of ir underneath skimmers. It is generally supposed hat air does pass beneath them when traveling at igh speed, but he contends that this is only likely to ccur when the water surface is broken, as it is well nown that a jet of water impinging on a surface ven at an acute angle does not all pass under in the irection of the jet. A small part near the surface as its motion reversed, and renders the passage of ny air between the jet and the surface impossible. f, however, the surface of the moving water is broken or churned into foam, then that mixture of air and water will pass along the surface. What will be the effect of this seems uncertain, but the late Lord Kelvin was thoroughly of the opinion that the friction of this mixture would be greater than that of solid water. The form used by M. Fauber is adapted to eject any air from under his vessel, and Sir John Thornycroft thinks it possible that he obtains from this advantages which balance what would appear to be a loss due to the many short skimming surfaces.

In the opinion of Sir John Thornycroft, hydroplanes are closely related to aeroplanes. Although smooth water would seem to form a definite plane on which to travel, a boat of this kind when moving at high speed is not content to be limited to motion in two dimensions, but tends to oscillate vertically and to jump from the water surface, and under some conditions to dive.

ARTIFICIAL RUBIES.

BY VICTOR BARTON.

Diamonds are composed of pure carbon, but most other precious stones consist of alumina, colored by various oxides. Hydrated silicates of alumina are known as clays and are found in vast quantities everywhere, but all varieties of crystallized alumina, or corundum, are comparatively rare. Some corundums are colorless, while others derive various tints from the presence of metallic oxides. Red, blue, green, and yellow corundums are used as gems and are known, respectively, as rubies, sapphires, oriental emeralds, and oriental topazes. Rubies and sapphires are by far the rarest and most valuable of these gems.

Many attempts have been made to produce rubies and sapphires synthetically by fusing alumina with coloring oxides and crystallizing the mass by cooling. The first partial success in the synthesis of colored corundum was obtained in 1837 by Gaudin.

In 1852 Ebelmen, director of the national porcelain works at Sèvres, produced rubies of microscopic size by heating a mixture of alumina, borax, and oxide of chromium in a porcelain kiln. St. Claire Deville and Caron succeeded in producing rubies, in the form of very thin crystalline laminæ, by means of the reaction between vaporized anhydrous boric acid and aluminium fluoride. In the course of their experiments they occasionally obtained crystals of sapphire, the formation of which they could not explain, but which were doubtless due to the presence of particles of oxide of iron.

In 1865 Debray and Hautefeuille attacked the problem, but it was reserved for Frémy and his assistants, Feil and Verneuil, to solve it in a series of remarkable researches distributed over the period 1877-1890.

In the method first employed by Frémy and Feil, an aluminate of lead was formed, and this salt was then decomposed by the action of silica, the result being to set free the alumina and to cause it to crystallize. The crystals of corundum thus produced were colorless, but rubies were obtained by adding 2 or 3 per cent of potassium bichromate, while the

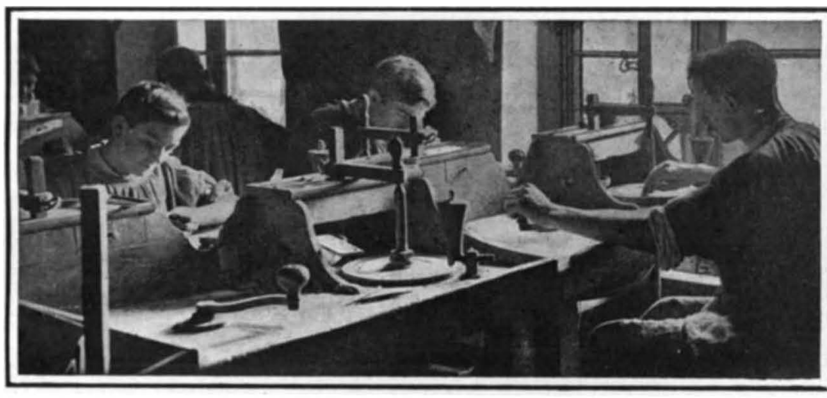


Fig. 3.—Cutting "scientific" rubies.

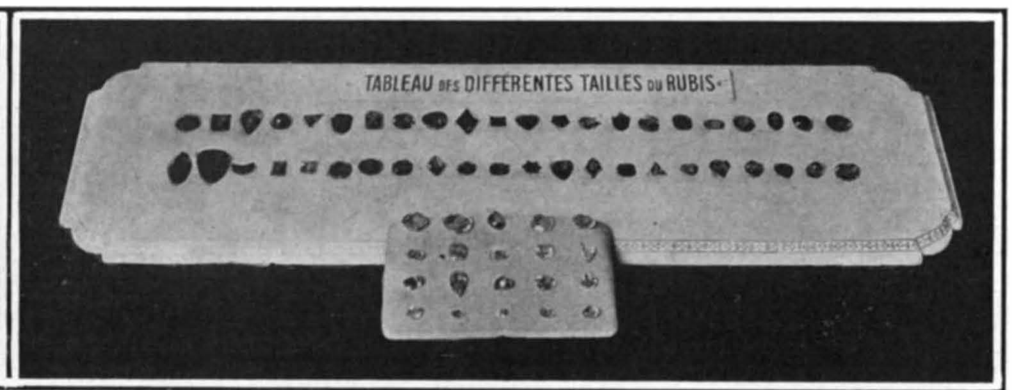


Fig. 5.—Rubies of various shapes.

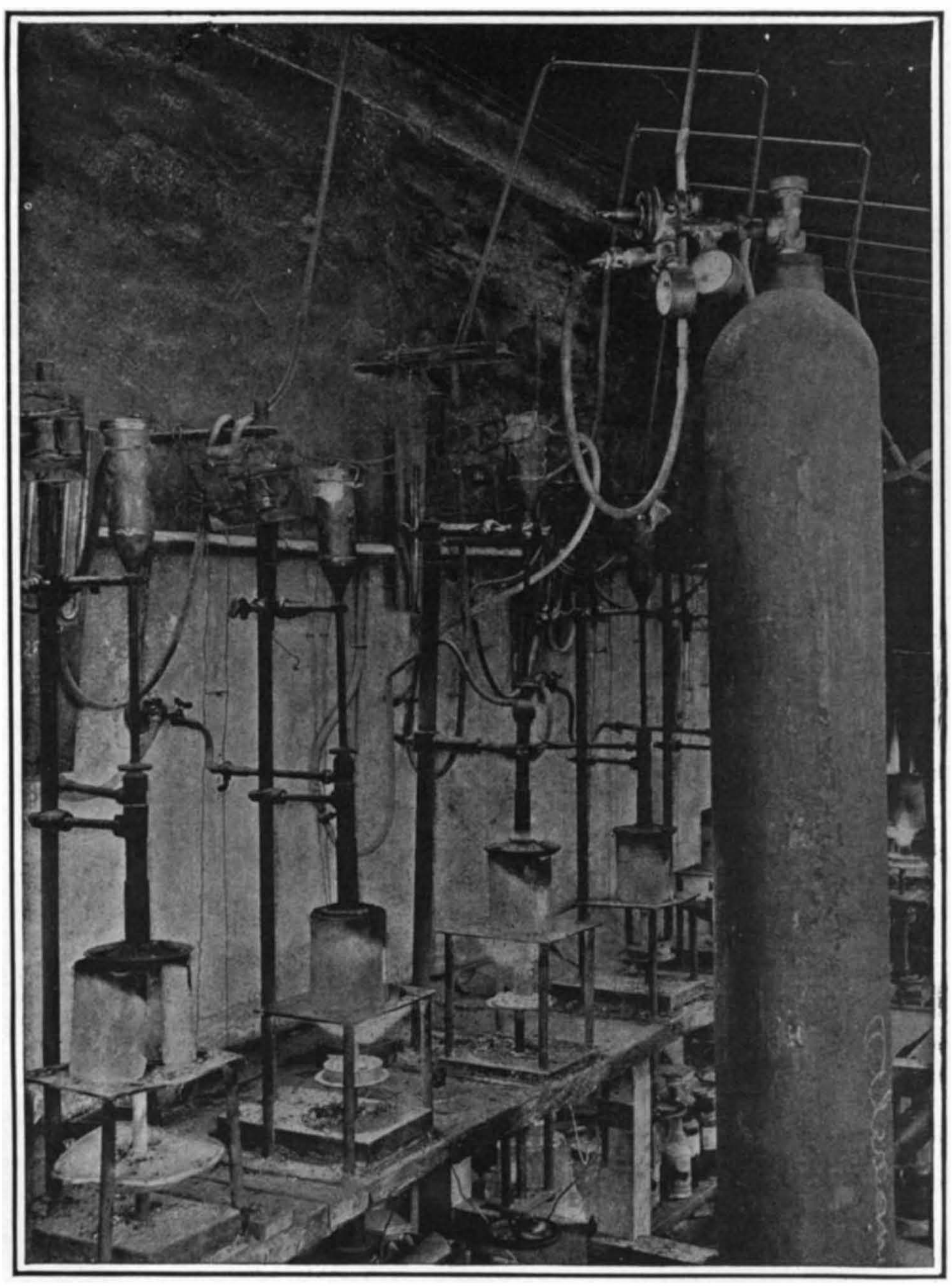


Fig. 2.—Blowpipes and oxygen cylinder in Paquier's ruby factory.

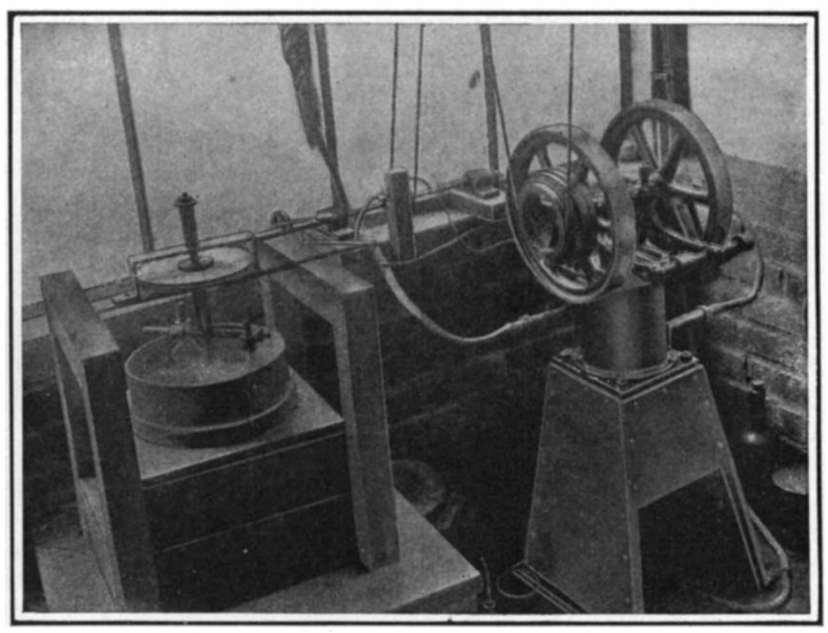


Fig. 1.—Sifting the mixture of alumina and oxide of chromium.

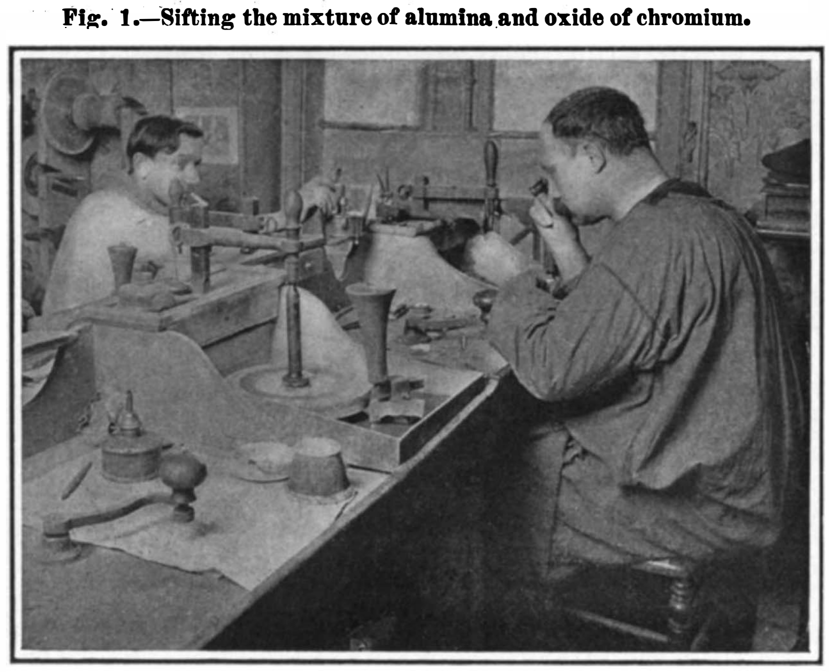


Fig. 4.—Examining artificial rubies, and mounting them on rods for cutting.

ARTIFICIAL RUBIES.

further addition of a little oxide of cobalt produced the blue color of the sapphire. These artificial gems, however, were laminated, friable, and of little value as jewels.

In a second series of researches Frémy and Verneuil crystallized alumina at a very high temperature by a process in which potash and barium fluoride were employed. By skillful manipulation and by maintaining a circulation of air in the crucible, they succeeded in producing magnificent rhombohedral crystals, as transparent and brilliant as natural rubies and thick enough to be cut in the rose form. But these crystals were still too small to be employed to advantage in jewelry.

Several chemists conceived the idea of increasing the size of Frémy's rubies by a process of "feeding" analogous to Leblanc's process of increasing the size of soluble crystals by keeping them in the mother liquor, from which additional matter is slowly deposited on them. With rubies the process was conducted, necessarily, in the dry way, the matter being in the fused state and the temperature between 2,700 and 3,300 deg. F. But the operation proved less simple in practice than in theory.

The first "reconstructed" rubies appeared on the market in the early eighties. They were made by fusing ruby chips together, and their artificial character was easily detected by experts. Yet they had a brilliant appearance and sold for $20 or $30 per carat, although they crumbled when they were cut. Large rubies of a cloudy and unsalable character were obtained soon afterward by the chemist Maiche. Meanwhile the inventor of the "reconstructed" rubies, a Swiss engineer named Michaud,* had been compelled by lack of money to sell his secret to a foreign resident of Paris, who sold it in turn to a number of other persons, several of whom formed a company which soon failed. Then some men who had been employed in the work undertook to carry on the manufacture of rubies by the process, which had become public property and which was conducted substantially as follows:

The first small ruby, or nucleus, was placed in a platinum crucible, which was fixed at the center of a rotating disk and exposed to the flame of an oxy-hydrogen blowpipe, producing a temperature of 3,300 deg. F. Minute ruby chips were then brought, one by one, with pincers, into contact with the incandescent nucleus, and the process was continued until the mass had attained the desired size. The chips became welded together and formed a mass sufficiently compact and homogeneous to allow of cutting. The work required great skill and the partially amalgamated crystals often cracked in cooling. At first the reconstituted rubies, uncut, sold for $2.40 per carat. About a thousand carats daily were manufactured in Paris and exported to Germany and America, and even to India, whence they sometimes returned, mixed with natural rubies. Competition gradually lowered the price to 6 cents per carat.

The "scientific" rubies have suffered a similar depreciation. These gems first appeared in commerce in 1901. They were made, and are still made by Paquier, Disclyn, and others, by the improved Verneuil process described below.

In the first place, calcined alum is mixed with a small quantity of a salt of chromium, the function of which is to produce the red color of the ruby. The mixture is rubbed through a very fine sieve by means of two stirrer blades driven by a small motor (Fig. 1). The sifted powder is then melted by blowpipes consuming illuminating gas (Fig. 2).

Verneuil found that three conditions must be satisfied in order to produce transparent rubies; the mixture must be exposed to that part of the flame which is richest in hydrogen and in carbon, in which it not only melts but boils and becomes purified; the ruby must be built up gradually from the bottom, and the operations of fusion and solidification must be so conducted that the area of contact between the first layer and the support is extremely small, in order to reduce the danger of fracture to a minimum. These conditions are satisfied in the construction and operation of Paquier's apparatus, which is shown in the accompanying diagram (Fig. 6). The calcined powder, consisting of alumina with a little oxide of chromium, is placed in a little sheet-brass hopper (*A*), the bottom of which is made of wire gauze of sufficiently fine mesh to retain all particles large enough to obstruct the orifice of the blowpipe beneath. This hopper is suspended by a rod in a chamber (*B*), which is really an enlargement of the oxygen tube. The lower part of the chamber is drawn out into a slender tube, which ends in a fine jet. Oxygen is admitted at *C*. The oxygen tube is surrounded by the coal gas tube, to which gas is admitted at *E*. The flow of gas is regulated to produce a temperature of from 3,300 to 3,600 deg. F. A little hammer, operated by an electromagnet, falls at regular intervals on the top of the rod which supports the hopper, and each blow causes a little of the powder to sift through the gauze bottom.

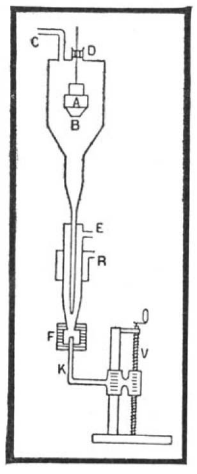


Fig. 6.—Diagram of apparatus for making rubies.

Thus the powder is thrown, a little at a time, into the current of oxygen which comes into the flame, where it is transformed into liquid drops. Some of these drops fall on a little platinum dish attached to the top of a rod (*K*) and inclosed in a box of fire-clay (*F*) to prevent too rapid loss of heat. The box is provided with an opening through which the formation of the ruby on the platinum dish can be observed. The dish can be moved in any direction by three screws, at right angles to each other, of which only the vertical screw (*V*) is shown in the diagram.

Each drop, as it falls on the dish, unites with the solid mass formed by preceding drops, and thus the ruby increases in size and assumes the form of a pear resting on its stem.

Each blowpipe produces about 10 carats per hour, and one operator can attend to ten or twelve blowpipes. Pear-shaped rubies weighing 80 carats can be obtained.

After the rubies have cooled they are split lengthwise, so that each furnishes two cut rubies. The loss in cutting amounts to three-quarters of the original weight, or three times the weight of the cut stones. The crude pear-shaped rubies are worth about 2½ cents per carat, the cut gems about 40 cents per carat.

The cutting, so called, and the polishing are performed by cementing the stone to a rod and pressing it on a revolving wheel of copper or bronze covered with abrasive powder of various degrees of fineness, the final polishing being done with tripoli and water.

Paquier's "scientific rubies" are physically, chemically, and optically identical with natural rubies. Both frequently contain microscopic air bubbles, which are called "frogs" by jewelers and "inclusions" by mineralogists, and which are spherical in the artificial rubies, but of various shapes in the natural gems. Moreover, the planes of crystallization characteristic of the natural ruby are not always discernible in the "scientific" ruby. But these slight differences are sometimes lacking. The eminent geologist Lacroix has expressed the opinion that it is impossible to decide with absolute certainty whether a ruby of fine color and free from inclusions is of natural or of artificial origin. On the other hand, Pinier, one of the leading gem experts of Paris, asserts that an artificial ruby can always be distinguished from a natural ruby.

Artificial sapphires are made by M. Louis Paris, by a process which was described in the Scientific American of December 17th, 1908, and which differs from the ruby process chiefly in the substitution of cobalt for chromium and the addition of lime in order to prevent the separation of the cobalt. These sapphires are not as perfect copies of nature as the rubies here described. Even in chemical composition, density, and hardness they are not quite identical with natural sapphires, and in physical and optical characters they differ unmistakably from the latter. In short, they consist of colored alumina, melted and solidified, but not crystallized, and their artificial origin can be detected very easily.

* The best reconstructed rubies were made by fusing minute rubies of inferior quality together with quartz crystal. The secret of the process was lost on the death of the inventor, a Swiss priest, who delivered the uncut rubies to a lapidary of Geneva. These rubies reached America in 1886. Some were very inferior, but others sold as high as $100 per carat and were—and are—as brilliant as the finest Burmese rubies. A few of them are still to be found in the possession of dealers and connoisseurs.

AN AUTOMOBILE TROLLEY-REPAIR TRUCK.

BY DR. ALFRED GRADENWITZ.

The ability of the automobile to travel quickly naturally led to its use by the fire departments of the more prominent cities of the world. Its success in this field has further led to its adoption by some street railway companies as a repair vehicle. Inasmuch as most of the street railways of the world are now operated by electricity, it was but natural that the electric automobile should have been selected. The cost of charging the batteries involves no great outlay on the part of the company with an elaborate power plant at its disposal, and the vehicles themselves are so simple in construction that they can be operated by any of the mechanically trained employees of a railway company.

The conditions which require immediate repair of a live wire are not unlike those which demand speed on the part of the fire automobile. Until the damage is repaired the cars are often stalled.

In the accompanying illustrations we present views of the electric trucks designed by the Siemens-Schuckert Company for street railway repair. In Fig. 1 an electrically propelled power car is illustrated which consists of a substantial frame which can be moved up and down by a crank. The frame is mounted on a base so stable that even when rounding curves there is no tendency to side swaying. On the frame a platform is mounted on a turn table of considerable radius. The lowermost level of the platform is eleven feet and the uppermost fifteen feet from the ground. The platform is reached by means of a ladder. Within the frame, spare parts and wrecking tools can be carried. The seating capacity is two men besides the driver.

The electrically propelled truck pictured in Figs. 2 and 3 differs from that just described. Instead of a tower, a large collapsible ladder is carried, which, when extended, rises sixteen feet above the ground. This ladder is readily set up and folded.


Fig. 1.—Electrically operated trolley-repairing automobile in service.


Fig 2.—The trolley-repairing truck ready to start.

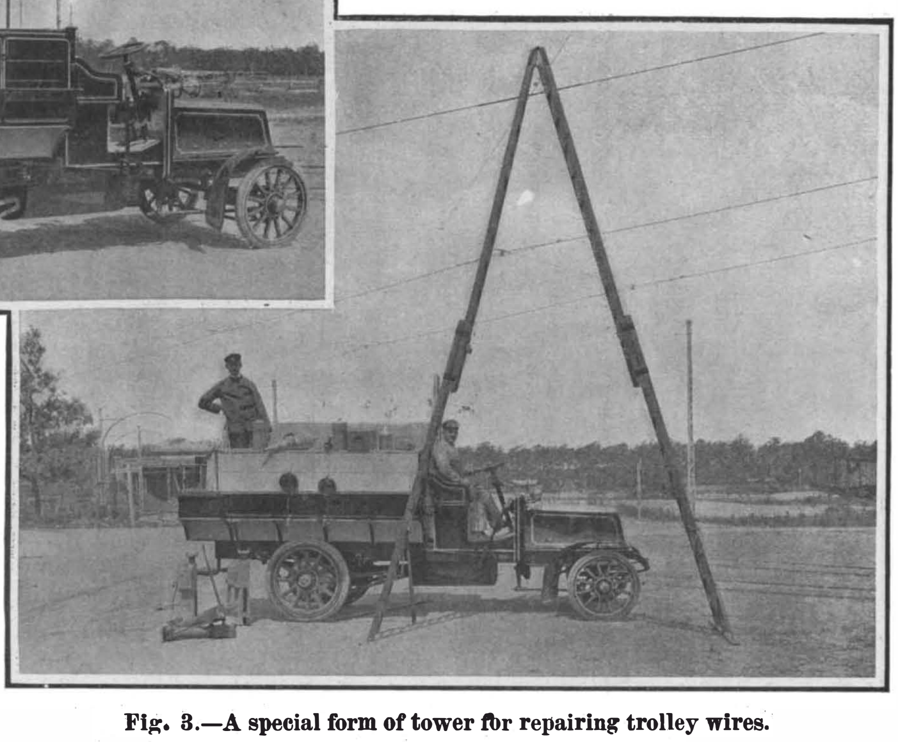


Fig. 3.—A special form of tower for repairing trolley wires.

AN AUTOMOBILE TROLLEY-REPAIR TRUCK.

HOW TO MAKE CONCRETE POTTERY.—I.

BY RALPH C. DAVISON.

Few people realize that anything of an artistic nature can be made from Portland cement. Most of us are used to looking upon this material as fit only for heavy construction work, such as foundations for buildings, bridge abutments, piers, etc. It is not remarkable, then, that the layman does not know that cement if used properly can be made to compare more than favorably with ornaments made from other and much more expensive materials; for even those who are in the trade, and working with it every day, know nothing of the wonderful and endless variety of artistic effects which can be produced with Portland cement.

The author for seven years has followed the Portland-cement concrete industry more or less closely, and for the past two years has devoted his entire attention to it. Some time ago he started experimenting with concrete pottery, and the experiments conducted along this line have developed some very interesting and practical results.

The method of making cement pottery is simple when understood; and if the craftsman follows the directions as will be given in this series of articles, he will find it easy to produce results which are fully worth while. Each step in the operation from the raw materials to the finished product will be explained in detail, including the incorporation of color effects, waterproofing, various surface effects, etc.

Portland - cement mortar has peculiar characteristics of its own. It is unlike clay. Therefore in modeling it has to be worked differently. In modeling clay one can form it into almost any shape, and it will remain there, for the reason that it is more or less sticky, and the various particles of which it is made up cling or adhere to one another, and thus hold the entire mass together. Portland-cement mortar, of which cement pottery is made, is composed of a mixture of sand or marble dust and pure Portland cement mixed together in various proportions. This mixture is wet down with water, and then by turning over and troweling, is made into a plastic mass called cement mortar. It is next to impossible to model in this material, for the reason that unless it is placed in a mold or a form is used to hold it in shape, while in its plastic state, it will fall down. The first step then in cement pottery work is to make the form.

There are several methods of making forms. One is to make wire frames on which to build up the cement mortar, and another is to make wooden or plaster molds. In the latter method the cement is handled in an entirely different manner from that used for the former. The use of wire forms is the simpler when there are but one or two of the same shape of articles to be made. When a quantity of one kind is to be made, it pays well to spend some time in making a wooden or plaster piece mold, as it can be used over and over again, whereas when wire forms are used a new form has to be made for each article, whether of the same shape or not.

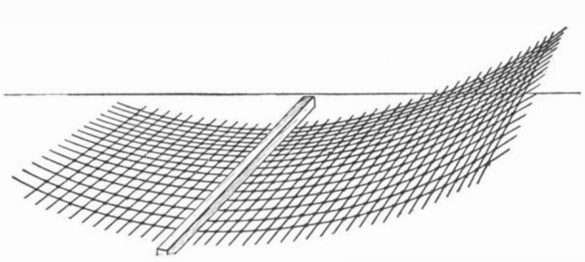
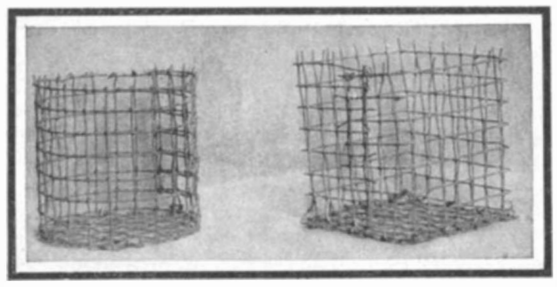


Fig. 2.—BENDING SIDE PIECE INTO CIRCULAR FORM.

The best material for making wire forms is No. 20 Clinton wire lath having about a half-inch mesh. This can be procured at almost any hardware store. When buying it ask for galvanized wire lath, as this is better and easier to work with than the ungalvanized. If not familiar with this material, the accompanying illustrations will give a good idea of what is to be used. The only tool necessary is a good strong pair of tinners' shears for cutting the wire, or better still, a combination wire cutter and nippers, as this will answer for two purposes. In the accompanying half-tone illustration are shown two completed frames, one for a square and the other for a round piece of pottery. The latter



ROUND AND SQUARE FRAMES FOR A PIECE OF CONCRETE POTTERY.

form is composed of a round piece for the bottom and a long narrow piece for the sides. (See Fig. 1.)

To make a wire form 5 inches in diameter by 4 inches high.—First cut a piece of the wire lath large enough on which to lay out a 5-inch circle. Hammer it out until it is perfectly flat, and then place the point of the dividers in the intersection of the wires near the middle of the piece. Set the dividers to a 2½-inch radius, and scribe the circle. A piece of red or black chalk is best for this purpose, as it will make

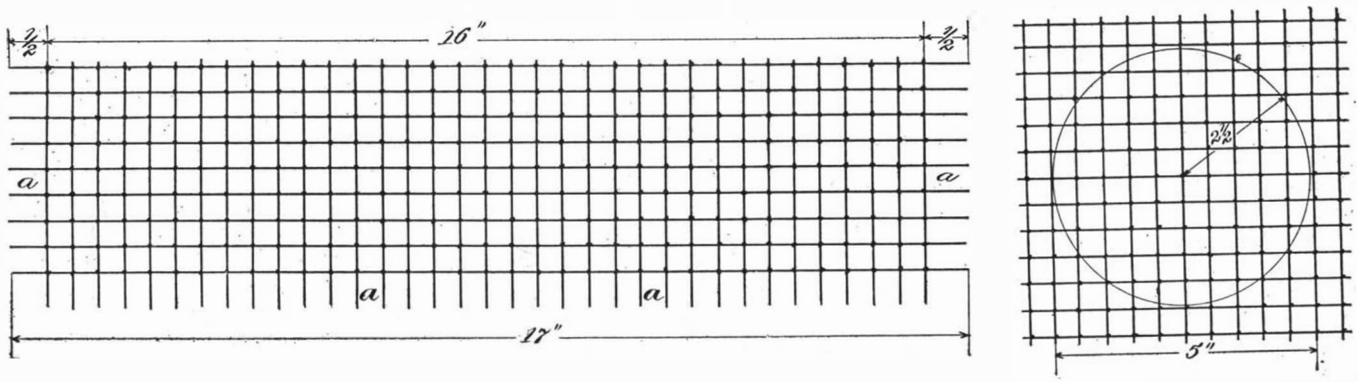


Fig. 1.—SIDE AND BOTTOM PIECE OF WIRE LATH FOR FRAME OF ROUND JAR.

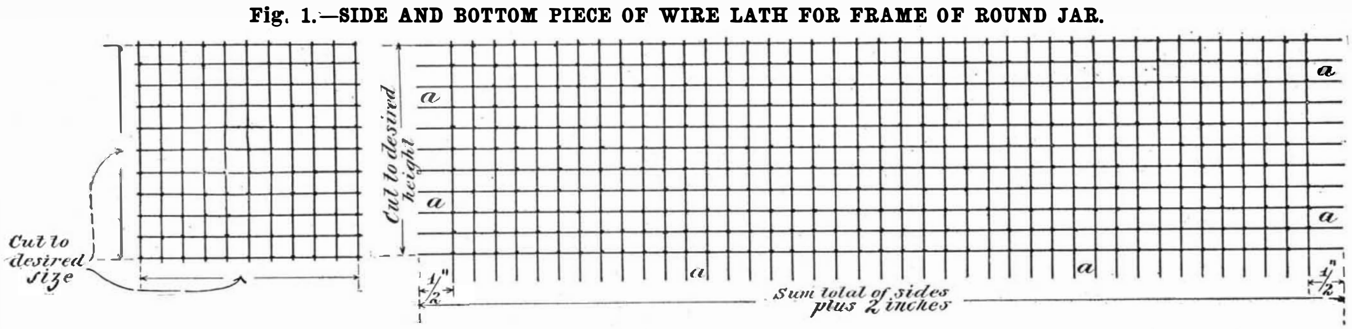


Fig. 3.—SIDE AND BOTTOM PIECES FOR RECTANGULAR JAR.

more distinct marks. Now take the wire cutters and cut the wire directly at the marks, and you will have the bottom of the frame complete.

The diameter of the bottom being 5 inches, the piece necessary for the sides of the frame will have to be three times this length, or 15 inches. Make it 17 inches long, thus allowing 1 inch for lap, and ½ inch of surplus wire on each end, as indicated at *a—a*. The height of the finished form is to be four inches. Cut the wire lath to 4½ inches, leaving a series of wire strands half an inch long at the bottom as indicated. Now take this piece which has been prepared for the sides and coax it into a circle by placing a straight edge (a piece of wood or metal having straight edges) successively along each of the meshes and pulling up on the free end of the wire lath as indicated in Fig. 2. After the piece is fairly well formed, lap the ends over, thus forming the circle, and secure them firmly to the main body of the sides by turning the free ends of the wire around the strands of the wire mesh, using the nippers to clinch them tightly. After having completed the side the bottom is placed in position, and the half-inch lengths of wire left at the bottom of the sides are used to wrap around the bottom and secure it in place. It is not essential to have this frame absolutely round or true, as it is used merely as a surface on which to build up the cement. The cement when once in place can be trued up by methods which will be explained in future articles. The square frame which is also illustrated is made in a similar manner. Care must be taken, however, to get the corner lines perpendicular to the base, for if this is not done it will cause trouble later on when truing up the sides.

In cutting the wire lath for the sides, do not forget to make it at least two inches longer than the sum total of the four sides. This will allow plenty for the lap and for the wire strands which are to be used for securing the ends in place. Of course, one need not confine himself to round and square forms, as innumerable sizes and shapes of frames can be made up, such as octagons, hexagons, etc., as well as forms for vases with gracefully curved outlines.

The next article in this series will treat of the method of applying the cement mortar and the forming of the finished pottery.

(*To be continued.*)

A SIMPLE MEDICAL COIL.

BY FREDERICK E. WARD.

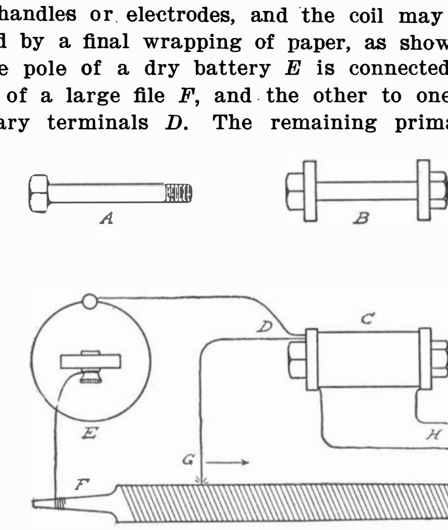
Doubtless there are many persons who would like to make an induction coil for medical use, but are deterred from so doing by the belief that the work is too difficult for any one but a skilled mechanic to undertake. This is a great mistake, however, as it is quite possible for almost anybody to make a coil that will give good results at a cost of but a few cents, and with the use of only the most ordinary tools.

For the core there may be used an iron bolt about three inches long and three-eighths of an inch in diameter, as shown at *A* in the accompanying drawing. It is a good plan to soften the bolt by heating it red hot in a fire and allowing it to cool slowly. Make two thin wooden washers about an inch and a quarter in diameter, and glue them on the bolt to form a spool as shown at *B*, and cover the iron between the heads with a wrapping of two layers of paper glued on. The nut shown is not necessary, but makes a neat finish.

The first part of the winding, or primary coil, requires about half an ounce of No. 20 or No. 22 double cotton-covered magnet wire. Pass the end of the wire through a small hole in one of the heads, and wind on a smooth layer of the wire like thread on a spool. When the opposite head is reached wind a second layer of wire over the first one back to the place of beginning. Cut off the wire and pass the end through a second hole in the head near the first one, as shown at *D*. The excess of wire will be useful for connections.

The next part of the winding, or secondary coil, requires an ounce or two of No. 32 single cotton-covered magnet wire. Finer wire gives more powerful results because of the greater number of turns for a given weight, but it is rather delicate to handle. Before winding on any of this wire, glue on a wrapping of two or three layers of paper over the primary coil, to keep the two coils entirely separate. The secondary wire need not be wound in layers, though care is required to avoid injuring the insulation or breaking the wire by pulling it too tight. The two ends may be left projecting, as shown at *H*, for connection to two handles or electrodes, and the coil may be protected by a final wrapping of paper, as shown at *C*.

One pole of a dry battery *E* is connected to the tang of a large file *F*, and the other to one of the primary terminals *D*. The remaining primary terminal *G* is then lightly dragged along the surface of the file, thus making and breaking the circuit in rapid succession as the wire passes over the teeth. If the shocks received from the handles are too strong, use a longer piece of wire at *G*; if too weak, add another dry battery in series, or put more wire on the secondary.



A SIMPLE MEDICAL COIL.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

GARMENT-RACK. — Fannie Wood, New York, N. Y. More particularly the invention relates to means for supporting a plurality of garment hangers in spaced relationship. The rack is also adapted for use in supporting skirts, the skirts and garments on the hangers being rotated about the central standard of the hanger. Features of the present patent are modified forms of a prior application filed by F. Wood.

SHOE.—J. E. Shawhan, Nevada, Mo. The improvement is in shoes and particularly in the fastening devices of the shoe. The construction will avoid the necessity of lacing the shoe down entirely to the base of the front opening, and provides for preventing the gapping of the opening below the laces by means secured in the shoes and held from twisting or other displacement.

Electrical Devices.

ALARM SYSTEM.—L. Giese, Fort Worth, Texas. The invention refers more particularly to a circuit breaker adapted to operate upon a predetermined increase in temperature or upon being mechanically bent or broken. The minimum quantity of fusible material need be employed, and so supported that upon being broken or fused, it becomes entirely displaced and the circuit broken.

Of Interest to Farmers.

STOCK-WATERING DEVICE.—G. E. Odell, Bowen, Ill. The object of the inventor is to provide a device more particularly of the class with means for automatically controlling the supply of water thereto, and having an arrangement of means for intercepting trash and filth, whereby clogging or interference with the water supply is avoided and cleansing of the device is facilitated.

BROADCAST ATTACHMENT FOR PLANTERS AND FERTILIZER DISTRIBUTERS.—B. F. Cranwell, Henderson; C. F. F. Allan and J. H. Trudgeon, Auckland, New Zealand. The invention provides an attachment to planters, seed drills, fertilizer distributers, and like machines. It will act to automatically spread seed or fertilizing material as it passes through its tubular body from a source of supply, and which will further spread and scatter material at its discharge end and distribute it in a broadcast manner and so that the discharged material will be largely protected from the action of the wind.

COMBINATION-PLANTER. — C. Linder, Converse, S. C. An object of the invention is to provide a plow beam for use with the planter held in such a manner that the machine is self guiding. Further, to provide a novel form of hopper for the grain and for the fertilizer and means for feeding the fertilizer and the grain simultaneously.

Of General Interest.

PRINTER'S HOOK.—F. C. Leethem, Middletown, N. Y. The object in this case is to produce an adjustable printing hook which can be adjusted by an ordinary pin wrench, or by other interchangeable means. From this arrangement a printer purchasing the hooks may select the particular means desired for adjusting the hooks, but if at any time he desires to adjust the hooks in a different manner, or by different means, this may be done.

METHOD OF COATING LEATHER WITH FABRIC.—F. J. Gleason, Walpole, Mass. Generally speaking this invention relates to the manufacture of articles in which a cement containing rubber or rubber compounds is employed to secure fabric to leather. The object is to provide a process by means of which such cement may be rendered highly adhesive after it has once become dry and substantially non-adhesive, and a cement-coated fabric may be caused to adhere firmly to a surface of leather.

SIGHT.—J. T. Peddie, Caxton House, Westminster, London, England. This sight is for use upon firearms, and more particularly when it is desirable to attai.. a fine vertical adjustment of the cross bar by aid of a screw. Generally speaking, in this type of sight, a long screw is employed, and ordinarily it is impossible because of the slow movement of this screw and all parts actuated thereby, to obtain a coarse and rapid adjustment of the cross bar as, for instance, by sliding it quickly by a direct movement of the hand.

Heating and Lighting.

SMOKE-CONSUMING FURNACE. — P. J. Flanagan, New Orleans, La. The inventor provides a furnace which is simple and durable in construction, and arranged to insure a complete burning of the smoke and gas arising from the burning fuel in the firebox, utilizing the burning fuel to the fullest advantage for heating purposes and providing a complete consumption of the fuel.

MINER'S CANDLESTICK.—C. J. Ramstead and P. J. Johnson, Ouray, Colo. More particularly the invention relates to candlesticks such as are adapted for use in mines or similar places, and each of which in general consists of an elongated body member adapted to have one end driven into the wall of a mine, a folding hanger pivotally secured on the body member and a bracket for holding a candle in place.

LENS FOR BUILDING-LIGHTS. — P. Schwickart, New York, N. Y. In the present patent the invention has reference to building-lights used in walls, skylights, floors and other parts of buildings, and its object is to provide a new and improved lens for building lights, arranged to insure a proper and uniform distribution of the rays of light over a large area.

Household Utilities.

POST-HINGE.—W. S. Emery, New York, N. Y. The object of the inventor is the provision of certain new and useful improvements in post hinges for water-closet seats, covers and like articles, whereby the spring pressure is graduated and a stop is provided for limiting the upward swinging motion of the seat, cover, or like article.

WATER-CLOSET SEAT.—W. S. Emery, New York, N. Y. In this instance the object of the invention is to provide a new and improved water closet seat, built up from a number of pieces of wood, formed and joined in such a manner that the greatest amount of strength is had at the sides, that is, at the points most needed.

Machines and Mechanical Devices.

MOUNTING FOR GANG-SAWS.—A. Jones, Oolitic, Ind. The invention has reference to mountings for gang saws, the more particular object being to produce certain improvements in hanger arms for supporting the saw and in parts associated with this hanger arm, in order to improve the general efficiency and safety of the gang saw while in action.

MECHANICAL SCRAPER.—F. R. Abbel, Tacoma, Wash. This invention pertains to dirt scrapers. A shovel is operated by a cable which passes through an anchored pulley and causes the scraper to travel up an inclined plane leading to a hopper where the load is dumped. The shovel is provided with a novel arrangement of gates and controlling device for ready loading and unloading.

Railways and Their Accessories.

CAR-SEAL.—J. W. Bowers, Seymour, Ind. The improvement refers to metallic seals for preventing the unwarranted opening of freight car doors without exposure, and has for its object to provide novel details of construction for a car door seal which afford a conveniently applied seal that cannot be detached unless broken.

CAR-DOOR LOCK.—C. H. Lewis, Chillicothe, Ohio. By means of this device a car door may be securely fastened when either open or closed, or at any intermediate position. It is adapted for employment upon the doors of box cars which are employed in carrying perishable goods, it being desirable in such cases to permit the door to stand open slightly for the purpose of ventilation.

PASSENGER CONTROL.—E. Linhardt, New York, N. Y. The object in this instance is to provide a control for conveniently and quickly handling passengers in the stations of underground and elevated railways with a view to facilitate the loading and unloading of the cars without discomfort to the passengers entering or leaving the cars.

Pertaining to Recreation.

AMUSEMENT DEVICE.—A. P. Lauster, Paterson, N. J. More specifically this device is of the type which employs a car moving along a guide or track, and the object of the inventor is to provide a construction which will operate to give the cars a peculiar movement so that the occupants will have a novel experience.

MECHANICAL TOY.—C. W. Clark, New York, N. Y. In the present patent the object of the improvement is to provide means for giving one portion of the animal, for instance, the head, one movement, and giving a portion of the head, for instance, the ears, a separate movement independent of the movement of the head.

Pertaining to Vehicles.

WHEEL.—J. S. Strawn and R. W. Davies, Avonmore, Pa. The invention comprises a wheel hub having the inner end counterbored and the outer formed with a lubricating chamber having a hole for the introduction of the lubricant, an annular lubricating chamber near the inner end of the hub contiguous to the bore and connected with the first named chamber by a passage contiguous to said bore, and a hardened bushing wholly arranged in the bore of the hub between the annular chamber and counterbore, the hub being formed as a single piece.

WHIFFLETREE-HOOK.—T. Morcom, Norwood, Ohio. This invention relates to whiffletree hooks, and more particularly such as are provided with resilient retaining means for securing the end of a trace in position on a whiffletree, swinging-tree or the like. It constitutes an improvement on the device shown and described in the U. S. Patent formerly granted to Mr. Morcom.

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.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12093) C. D. C. says: In a recent issue you answered an inquiry in regard to the peculiar rusting of galvanized fence wire. Permit me to add, from an experience of ten years with barb-wire, ribbon-wire, and chicken-wire netting, that ribbon wire outlasts barbed wire twice over, ordinary 18-gage chicken-wire netting lasts in the vicinity of New York city not over three years, and always rusts out completely along the upper one-third or one-half of its width, while the remaining portion of its width will still be perfect. The same condition may be observed to a degree with barb or ribbon wire strung parallel in a fence. The bottom wire remains in good condition, while the others are more and more corroded from the bottom upward. The persistency of these peculiar conditions would indicate that it is not due to local or chance conditions. Remembering that all masses of metal show opposite polarity at top and bottom, it would be logical to attribute this peculiarity of rusting largely to galvanic influence. Now in turn I would ask whether it is a common and recognized fact that a tin roof coated in the best manner with graphite paint is sure to corrode in rather minute points and form holes as though fine shot had been fired through it, the body of the sheets remaining uncorroded? Having had sufficient (dear) experience to be sure of my ground, I do not hesitate to assert that graphite paint is solely responsible for such condition. My explanation (which correlates this inquiry with the previous question) would point also to galvanic action as the fundamental cause, probably due to incompatible polarities of graphite and steel. A. We thank you for the particulars of your interesting experience, which seems to confirm the substance of our reply to the question to which you refer.

(12094) O. H. T. writes: I have just noted in your is·ue of the 15th of May your answer to the "coiled watch spring" question, in query No. 12083. I have speculated a good deal on the problem, and wish to give what I think is the explanation, though experimental proof would probably be difficult. In winding up the spring work would disappear and, I believe, an equivalent amount of heat would be produced, which would be dissipated; then when the spring was allowed to unwind, the reverse would take place. Thus, if the wound-up spring were destroyed, its energy would nevertheless not be lost. In the same way, if compressed air were crowded into other substances, and so rendered incapable of giving back the energy expended in compression, that energy is still in existence. Many other problems along the same lines as these, but much more difficult of solution, present themselves on a little thought. A. Your comments upon the dissolving a coiled spring in acid are quite correct. It would be foolish to maintain that the potential energy of the coiled spring would produce more heat of solution than the same weight of steel in any other mechanical condition. As well maintain that the spring would produce more heat if dissolved on a hilltop than in the valley below because its potential energy is greater on the hilltop. Potential energy is not thus convertible. As you say, there are many other problems which involve the same thing.

(12095) W. B. B. asks: To give information that will immensely benefit the public at large, I will be pleased to have you give me, as soon as you can look into the matter thoroughly, the best means and best way to lay sewer pipe, and especially the making of cement joints. We have sanitary sewers here, and they are filled with roots that creep into the crevices and joints of the pipe. The pipes laid in this vicinity are placed in position, a little cement placed on the lower half of the bell or socket end of the pipe, and then the next pipe with a string of oakum on it is inserted into the pipe; the balance of the joint is mortared up with cement. The principal information I am seeking is whether the hemp or oakum string is necessary or of any value, or whether a good Portland cement joint is or is not the better way to make the joint. A. Provided the sewer pipe is laid upon a perfectly solid bed, so that the joints are unlikely to be distorted at all (by the filling in of material above the sewer, subsequent traffic over it, or otherwise) we should say that as far as the prevention of the entrance of roots into the joints is concerned, the oakum might better be omitted and a joint of neat Portland cement substituted. It is of course essential that any flow of water through the sewer should be prevented until the cement has had time to set, otherwise a very small quantity trickling through the joints will wash out a small part of the cement and leave interstices in it. The object of oakum or similar fibrous packing is to provide a small amount of "give" or "spring," so that any slight distortion or settlement of the pipe will be compensated by expansion of the packing, and will not leave openings or break the pipe or flanges; but such roots as you describe are quite capable of growing through the oakum, even when the latter apparently tightly fills the joints.

NEW BOOKS, ETC.

Hütte. Des Ingenieurs Taschenbuch. III. Berlin: Verlag von Wilhelm Ernst & Sohn. 20te Auflage. 12mo.; pp. 830.

We have already had occasion to review the first two volumes of this excellent standard work of engineering reference. This, the third volume, has occupied not a little time in its preparation, largely because entirely new subject matter has been introduced. Among the new subjects may be mentioned "Reinforced Concrete," "Rack and Pinion Roads," "Dam Construction" and "Factory Plants." The subject matter of the volume is divided into Mensuration, Structural Iron Work, Heating and Ventilation, Road Engineering, Water Supply, City Draining, Statistics of Building, Reinforced Concrete, Bridge Building, Railway Construction, Rope Tramways, Rack and Pinion Roads, Water Works, Gas Engineering, Factory Plants. The work contains not only the information which is to be found in such American reference books as Trautwine and Haswell, but much mathematical discussion which will simplify engineering calculation.

An Octaval Instead of a Decimal System. An Essay to Show the Advantages of Eight-Figure, and the Disadvantages of a Ten-Figure Notation for Money, Weights, and Measures. By S. S. Buckman, F.G.S., Honorary Member of the Yorkshire Philosophical Society; of the Cheltenham Natural Science Society; late Hon. Secretary of the Cotteswold Naturalists' Field Club. Oxford: Parker & Son, 27 Broad Street. London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd.

Artificial Waterways and Commercial Development. By A. Barton Hepburn. 12mo.; pp. 115. Price, $1 net.

This book may be considered a concise statement of the functions of canals in their relation to the economics of this country. After discussing the world's canals in general, the author passes to a fairly detailed account of the canal system of New York, and shows how the failure of New York State to develop and maintain her canal system found yearly expression in loss of commerce to the city of New York. The Panama Canal is rather briefly dismissed in nine pages—an allotment of space which it seems to us is somewhat inadequate for so important a subject. A good chapter is that on "The Waterways Question and Conservation of Our Resources."

Our Insect Friends and Enemies. By John B. Smith, Sc.D. Philadelphia: J. B. Lippincott Company, 1908. 12mo.; 314 pp. Price, $1.50 net.

This book deals with the relation of insects to man, to one another, and to plants, and it has a chapter on the war against insects. The author is Professor of Entomology in Rutgers College, and is a member of many learned societies. The book is well illustrated, and there is a welcome absence of the time-honored cuts which we are wont to expect in books on entomology. The book is one which will prove of value to the general reader as well as to the specialist.

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June 1, 1909,

AND EACH BEARING THAT DATE

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