SCIENTIFIC AMERICAN

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Vol. XCVII.—No. 10.
ESTABLISHED 1845.

NEW YORK, SEPTEMBER 7, 1907.

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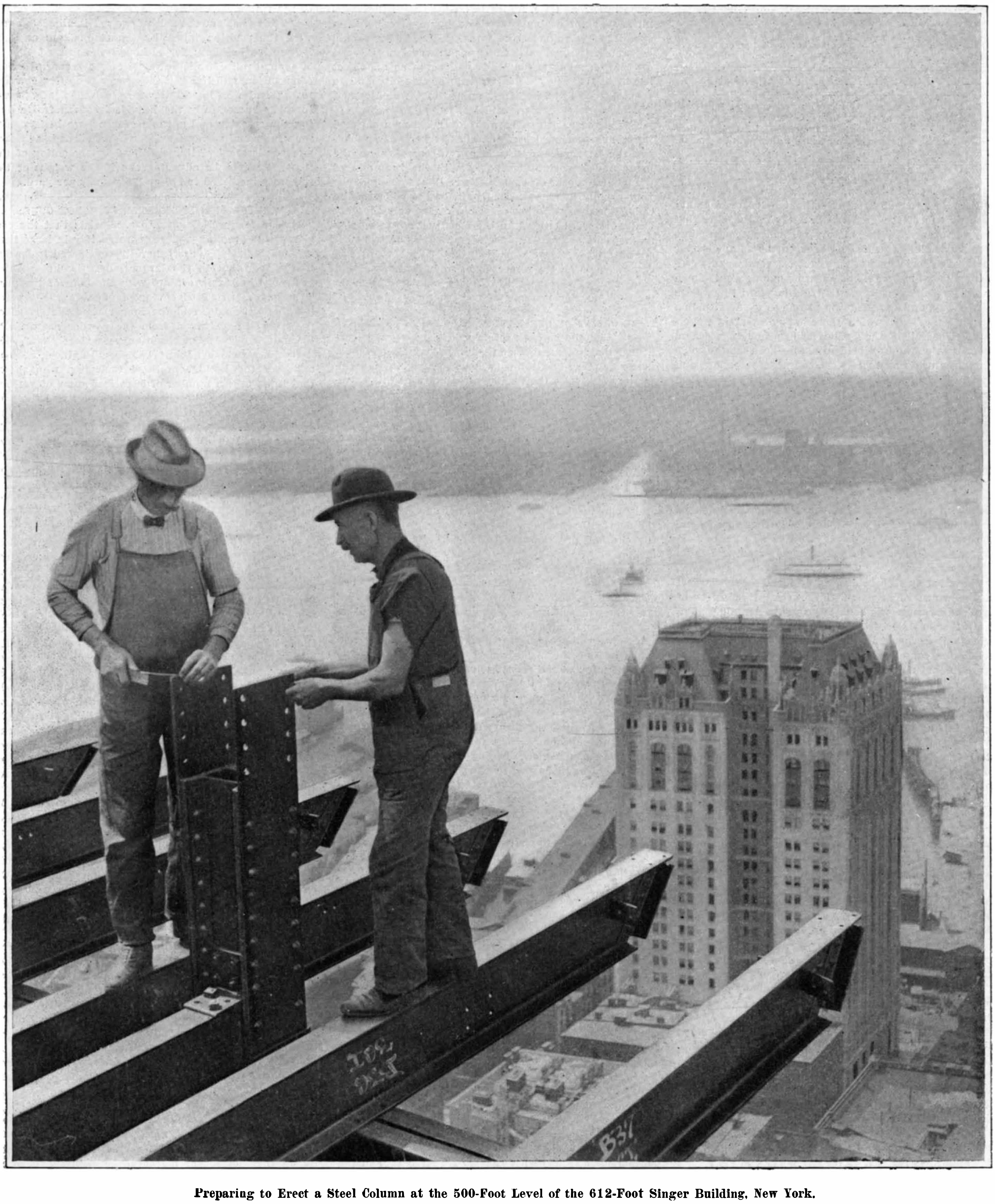

Preparing to Erect a Steel Column at the 500-Foot Level of the 612-Foot Singer Building, New York.

The building seen in the middle ground is over 300 feet in height. Beyond are the Hudson River and New Jersey.

THE SKYWARD GROWTH OF A MODERN CITY.—[See page 168.]

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ESTABLISHED 1845

MUNN & CO. - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*
361 Broadway, New York

FREDERICK CONVERSE BEACH, *Sec'y and Treas.*
361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year, for the United States or Mexico.....$3.00
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Scientific American (Established 1845).....$3.00 a year
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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, SEPTEMBER 7, 1907.

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 QUEBEC BRIDGE DISASTER.

The collapse of the great Quebec cantilever bridge, with a loss, as at present estimated, of over eighty men, is one of the greatest disasters of the kind that have happened in the history of bridge construction. For a parallel, we must go back to the fatal disaster to the Tay bridge, Scotland, when several spans, containing a whole trainload of passengers, were blown down in a fierce gale of wind, falling into the waters of the Tay, and carrying the passengers entombed in a double cage from which there was absolutely no escape. The fall of the Quebec bridge, however, differs from that of the Tay bridge in the fact that the modern structure was merely in course of erection, and the lives lost are entirely those of the workmen. At the present writing the information available is too meager to admit of any accurate statement as to the immediate cause of the disaster. Judging from the nature of the collapse, and the fact that the portion of the bridge on which it actually commenced is now probably lying in 200 feet of water, the actual facts may never be brought to light. This is the more likely, because the lives of all of the workmen who were engaged at the outermost portion of the bridge were lost, and there will therefore be no close-at-hand eyewitnesses to state where the breaking down of the structure first commenced, and from what cause.

The great Quebec bridge, as designed, is the largest of the cantilever type in the world. It consists of two shore arms of about 500 feet in length, and a central span 1,800 feet, consisting of two cantilever arms and a suspended central span. The bridge is notable as containing the longest span of any bridge yet built or under construction, the main span being 90 feet longer than the longest spans of the Forth bridge in Scotland. The bridge is being built according to the usual methods; the shore arms being erected upon false work, and the river arms built out by overhang, the material being handled by a massive steel traveler. The northern cantilever is practically completed, and, at the time of the disaster, according to the telegraphic dispatches, the southern cantilever had been built out some 850 feet over the main channel. A whistle had just sounded for the men to cease work when the collapse commenced; and, apparently, the first breakdown occurred in the outermost panel of the work. According to the statements of eyewitnesses, the collapse of the cantilever was gradual, the whole length of it failing and falling into the river panel by panel. The structure was crowded with workmen, 92 in all having been upon the work when the disaster occurred. Of these, only a few appear to have been saved. The whole of the southern cantilever, including the shore arm, or about 1,300 feet of the structure, is in the river.

If it be true that the failure commenced at the outermost panel of the bridge, it seems to us entirely possible that the bolts, which had been placed temporarily in the rivet holes of some of the riveted connections, may not have been in sufficient number to carry the load of the new work. It is possible that the heavy traveler had been moved forward on to this work, and that, preparatory for operations the next day, some of the heavy bridge members had also been brought out to the end of the cantilever. We shall hope to give fuller details in our next issue.

PROGRESS OF THE CATSKILL WATER SUPPLY.

The letting of the contract for the construction of the great Ashokan dam, which will form the principal feature of the new water supply for this city, marks an important step in the prosecution of this great enterprise. Although the lowest bid was some $2,000,000 below that of the successful bidder, or $10,000,000 as against $12,000,000, the Commissioners decided to let the contract at the higher figure. This was done under the conviction that it would be impossible for the lowest bidder to carry through this great work for the sum named, the estimates of the Commissioners' own engineers having shown that $10,000,000 was $2,000,000 less than would be necessary to build successfully a dam of this character and magnitude. Mayor McClellan, the Commissioners, and their Chief Engineer, Mr. Waldo Smith, are to be congratulated on the vigor and dispatch which they have shown in the handling of this, New York's greatest municipal undertaking. From its very inception the job has been absolutely free from the taint of political interference. It was the Mayor's wish that the work should be so handled; the Commissioners have been of the same mind; and Mr. Smith is credited with the statement that not a single politician has approached him since the beginning of the work. This is as it should be; and if the work can be carried through to the end on this clear-cut principle, it will serve as an object lesson to the various departments of this city and to the politicians of New York, as a whole, which cannot fail to be most salutary and lasting.

At the present time there are over 700 men engaged in the engineering department, in the work of completing the surveys and locations, and carrying on the many and important borings. With the inception of the actual work of construction, this force will be very rapidly increased; for it will be the policy of the Chief Engineer, who has determined that only the very best work shall enter into the construction, to employ as inspectors young engineers of the proper technical qualifications; "men who feel that their future success depends on their records in their first work, and who cannot be forced by threats or persecution to wink at inferior methods of construction."

THE CRUISE OF OUR BATTLESHIPS TO THE PACIFIC.

Now that the acting Secretary of the Navy has confirmed the statement, made by Secretary Loeb, that a fleet of sixteen battleships will start early in the winter on a cruise to the Pacific, all doubt that this extraordinary maneuver is to be carried through is removed. The acting Secretary states that the fleet will sail from Hampton Roads on December 15, and that it will consist of sixteen battleships, six torpedo boats, four supply ships, and nine colliers, making thirty-seven ships all told. According to the present itinerary, the fleet will reach Trinidad, 1,780 knots distant, on the 23d of December; Rio Janeiro on January 10; and Magdalena Bay by March 5 of next year. Here the fleet will remain one month for target practice. If the present programme is followed, San Francisco, distant 1,000 miles from Magdalena Bay, will be reached April 10. The total distance to be covered on this route is 13,772 miles, and of the whole time consumed on the voyage, the fleet will be cruising sixty-three days, and will be in port coaling and engaged in target practice fifty-two days.

Naturally, the coaling problem is a serious one, and the speed of the fleet has been determined by the necessity for strict economy of fuel. The steaming speed will be about 10 knots an hour, which is considered to be the most economical average speed for the cruise. It is estimated that if the ships start with full coal bunkers, the fleet will require for the whole cruise an additional 100,504 tons of coal, exclusive of the coal consumed on the torpedo boats. This enormous supply will have to be carried on colliers. Four of these, carrying 2,200 tons of coal each, will accompany the fleet as far as Trinidad; and five of our larger colliers, carrying 4,000 tons each, will accompany the fleet as far as Rio Janeiro. Furthermore, it will be necessary to charter twelve additional colliers, four of which will await the fleet at Sandy Point, Magellan Straits; four at Callao, Peru; and four at Magdalena Bay. In addition to the colliers, the "Panther," which is equipped with a complete machine shop, and the supply ships "Culgoa" and "Glacier," will accompany the fleet throughout the entire voyage.

BETTER RAILS FOR 1908.

We understand that the conferences already held of the joint committee of the railways and the railmakers on the subject of new rail specifications, give reason to expect that the conflicting interests will have no difficulty in framing specifications which will insure a much better quality of steel rail being provided for the forthcoming year. It is likely that the new rail will be of a more satisfactory section, with a better distribution of metal between the head, the web, and the base. On the important subject of what is known in the trade as "minimum discard," that is to say, the least amount that shall be cropped from the head of the ingot, it is likely that the percentage will be increased from 10 per cent to 25 per cent, and the cost of the rails advanced from $28 to $33 per ton. It is not likely that the maximum percentage of phosphorus, which now stands usually at about 0.10 per cent, will be materially reduced in the new specifications; but the manufacturers are so thoroughly alive to the necessity of reducing the phosphorus, that they are rapidly installing open-hearth furnaces, with a view to providing rails carrying the 0.06 per cent of phosphorus demanded by modern conditions.

The proposition of the rail-makers that the weight of even the heaviest 80 and 100-pound rails be increased to meet the higher speeds and heavier loads of modern traffic, is not meeting with much favor, the 100-pound rail, in particular, being considered amply stiff even for modern requirements. The 100-pound rail section was adopted fourteen years ago, at a time when the maximum load on the driving wheels of fast passenger engines was only 20,000 pounds per wheel. The maximum wheel load for passenger engines has gone up to 30,000 pounds, and at the same time there has been an increase both in the number of fast heavy express trains and in the speed of the trains themselves.

On this phase of the subject we are inclined to agree with the position taken by the rail-makers and the locomotive builders; for although the present 80 and 100-pound rail, if rolled of steel of the proper chemical composition, and if given the proper time for thorough mechanical working in the rolls, is sufficiently heavy to carry successfully the heaviest modern traffic during the summer and autumn seasons, we believe that for winter and spring service, when the road is thrown more or less out of line and level by the action of the frost, it would be advantageous if the weight of the rail were increased to 110 or 115 pounds per yard.

WHY EROSION IS GREATER IN LARGE GUNS.

It is a fact well known to artillerists that the erosion of the bore takes place more rapidly in large than in small guns. This is generally considered to be due to the fact that in the larger guns, the hot powder gases are longer in contact with the bore of the gun. The longer period of contact is due to the greater length of the gun, and the longer time that it takes the projectile to travel from the powder chamber to the muzzle. The case has been very clearly stated in a recent article by John F. Meigs, Engineer of Ordnance of the Bethlehem Steel Company, who shows that if we take a number of 50-caliber guns, of various diameters of bore, the charges of powder and the projectiles will vary as the cubes of the calibers, and the pressures in the powder chamber and at the muzzle will be equal in all guns of the same system. Thus in the case of a 3-inch, 50-caliber gun and a 12-inch 50-caliber gun, the velocities at the middle point of the bore and at the muzzle will be the same when the guns are similarly loaded. Consequently, it follows that the time occupied in the passage of a projectile down the bore of the gun will vary directly as the caliber. In the case of the 3-inch gun, the projectile must travel 12½ feet; in the case of the 12-inch gun, 50 feet; and, since the velocities at corresponding points down the bore are similar, the white-hot powder gases will be held within the gun four times as long, in the case of the 12-inch, as in the case of the 3-inch gun, and the surface of the bore will be subjected four times as long to the scoring rush of gas of equally high temperature moving at equal speed.

Now, at the 38,000 pounds pressure, which exists in the chamber of all 50-caliber guns having a muzzle velocity of 3,000 feet per second, the temperature of the gas is about 2,000 deg. Steel will melt at 2,800 deg. Fah., and the temperature of the welding heat of steel is about 2,000 deg. Steel at 800 or 900 deg. Fah. is distinctly softer and has less strength than at ordinary temperatures. Hence, it is reasonable to conclude that the accuracy-life of guns of similar proportion decreases faster, as they are fired, than in simple ratio of the increase of caliber. This is in agreement with the facts; for it is found that the accuracy-life of a 0.33-inch hand-rifle using pressures of 38,000 pounds is about 3,000 rounds; while the upper limit of the life of a 12-inch gun of similar proportion is only 83 rounds. Since it is known that the accuracy-life of a 0.33-inch 50-caliber gun at the pressure given above is 3,000 rounds, it is estimated that the number of rounds which the various calibers of guns will fire before they lose their accuracy is, for the 1-inch, 1,000 rounds; the 3-inch, 330 rounds; the 5-inch, 200 rounds; 6-inch, 166 rounds; the 8-inch, 125 rounds; the 10-inch, 100; and the 12-inch, 83 rounds. It should be understood that the above figures indicate merely the point at which the accuracy of the gun will probably become impaired. The muzzle velocity would not be altered at that point; but there would be a loss of accuracy that would increase steadily with successive rounds, and the projectile would be liable to tumble end over end in its flight.

To the above causes of the more rapid depreciation of the larger guns, should be added, we think, another disadvantage which is inseparably associated with large caliber, and that is, the increasing annular opening at the moment of discharge between the bore of the gun and the wall of the projectile, due to the elastic stretching of the gun under the powder pressure. This annular opening permits a certain amount of the gases to escape, at enormously increased velocity, past the base of the shell, and the cutting action of the gases at this higher speed is, of course, vastly increased. The size of the annular opening will of course increase with the increase of caliber, and in a 12-inch gun will be much greater, and allow a far larger escape of gas per unit of surface, than in a 1-inch gun. How far this fact is contributory to the more rapid erosion we do not undertake to say; but that it is a very material factor, we think can hardly be disputed.

THE SEVENTH INTERNATIONAL ZOOLOGICAL CONGRESS —BOSTON MEETING, AUGUST 19 TO 23, 1907.

BY WILLIAM H. HALE, PH.D.

The Seventh International Zoological Congress, which met at the Harvard Medical College, Boston, August 19 to 23, was the first meeting of this congress ever held in America. It was attended by over 500 members, of whom about one-quarter were from abroad, representing all parts of the world—the British Empire, including Australia and Tasmania, as well as England, Scotland, Ireland, and Canada; France, Germany, Belgium, Holland, Austria-Hungary, Switzerland, Russia, Italy, Norway, Brazil, Japan, and China. The programme included over 300 papers read before the several sections.

Prof. Alexander Agassiz presided, and opened the congress at the first general session with a presidential address on American Pioneers in Deep Sea Exploration, presenting a record beginning in 1846. During the greater part of this time Prof. Agassiz has been in charge of exploration or of work connected with it, beginning with the cruise of the "Blake." [His address will be found in full in the current SCIENTIFIC AMERICAN SUPPLEMENT.—ED.] Prof. R. Hertwig followed with an address on "Neuere Probleme der Zellforschung."

At another general session Sir John Murray, of Edinburgh, who commanded the "Challenger" on its three years' cruise, beginning in 1876, stated his conclusions as to the conditions of marine life. After expressing his preference for the term "oceanography" rather than "thalassography," proposed by Prof. Agassiz, he paid his attention to Prof. Petersson, director of the North Sea Biological Station, from several of whose conclusions he dissents. He maintains that ocean currents are mainly the effect of the sun and of winds, hence they are superficial. The ocean depths, from the poles to the equator, are of nearly uniform temperature, being not much above the freezing point of water. Hence life in them is of more uniform type than at lesser depths. Near the poles the surface temperature does not vary more than about 10 deg. F. during the year, remaining always near the freezing point. Near the equator the surface temperature is also limited to about 10 deg., but averages about 70 deg. At intermediate regions is a much wider range of temperature. Warm and cold currents meet; conditions alternately favor and interfere with the life of animals, causing at times great destruction of life because of the change to a temperature either too hot or too cold. The destruction of life at localities where warm and cold currents meet, provides a bountiful food supply, and at these localities come into play all the reason for change in form that obtains anywhere. At these points, therefore, is developed the greatest variety of living forms. The ocean surface generally is covered with algæ and other marine creatures or plants, which subsist on things about them; and on these the deep-sea animals depend for food. These surface forms are so closely related to temperatures, that he could determine the surface temperature by his microscope before the captain of the vessel could get it by his thermometer.

Prof. Jacques Loeb presented his latest conclusions as to artificial generation in a paper entitled "The Chemical Character of the Process of Fertilization." He maintains that as all life phenomena are ultimately chemical, we can only hope to produce life by a series of definite chemical reactions. In the process of fertilization, the spermatozoon produces two kinds of effects upon the egg; it causes it to develop, and it transmits the parental qualities. His address dealt only with the former. The most obvious chemical reaction produced by the spermatozoon on the egg is an enormous synthesis or gathering of nuclear material from the material of the cell. After the entrance of the spermatozoon, the one nucleus of the egg is successively divided into two, four, eight, etc. Each nucleus is of the same size as the original one. Evidently, therefore, the chemical effect is the synthesis of nuclear matter. The nucleus consists of a salt, composed of a base of some protein substance and nucleic acid, the skeleton of which acid seems to be phosphorus. The origin of this phosphorus is obviously the egg itself, since the process goes on just as well when the egg is immersed in sea water deprived of its phosphorus as in phosphatic water.

Free oxygen is essential to the fertilized egg, because the spermatozoon causes or accelerates in the egg still other processes than oxidation. Hydrolyses are some of these processes, and in the absence of oxygen these hydrolyses set up reactions which are incompatible with the life of the egg.

Why the spermatozoon should cause development of the egg is not yet known. Its head is practically egg nucleus, and its tail is a fatty plasm. The fertilizing material, however, must be nearly the same with different eggs, otherwise it could not be understood why animals widely separated, like the crinoids and the mollusks, should be able to fertilize the eggs of the starfish.

Dr. Loeb's first method of obtaining larvæ from unfertilized eggs was by treating them with sea water whose osmotic pressure had been raised about 50 per cent. This method, however, was not successful at all places, which led to the belief that not all the processes were caused in the egg by hypertonic sea water. For example, the membrane normal to eggs naturally fertilized did not occur in the others. But by adding a small but definite amount of a monobasic fatty acid to the eggs developed by hypertonic sea water, they developed into larvæ, in part of which the formation of the membrane occurred in a perfectly normal way. This new method of double treatment has been so successful that "we are now in possession of a method which allows us to imitate more completely the effects of the spermatozoon than the previous purely osmotic method." Marine worms, starfishes, a mollusk, the giant quaker-cap of the Pacific Coast, have been thus fertilized. By adding various chemicals to the solution, Dr. Loeb reached the conclusion that the membrane formation of the egg is connected with the process of solution of a fatty layer underneath the surface film of the egg. He concludes that "the essential feature of the process of fertilization consists first in a liquefaction or hydrolysis, or both, of fatty compounds; and second, in starting the processes of oxidation in the right direction."

Dr. R. F. Scharff, of Dublin, made the opening address before the newly-formed section of zoogeography: "On the Evolution of Continents as Illustrated by the Geographical Distribution of Animals." Some of Dr. Scharff's conclusions are that the Mississippi Valley and the east coast are characterized by the possession of many curious and certainly extremely ancient forms of animal life, which are quite unknown west of the Rockies, but are related to species in Europe and eastern Asia. North America must have been connected with Europe; also with Asia, probably by a land bridge near Bering Strait; but was not connected with South America, as there was no Isthmus of Panama. The West Indian islands were connected. South America was divided east and west by the ocean. The Antilles, Venezuela, and Central America were connected with North America, and formed a bay to the west. There was a land bridge between South America and Africa and Australia. The Melanesian Islands were once part of Australia, with connections to New Guinea and portions of the archipelago. Asia was once joined to Australia by the way of Sumatra and Borneo. Lake Tanganyika was once a bay of the ocean, etc.

An improved system of classification was one of the most important problems considered by the congress. Dr. Theodore Gill read a paper on that subject, which showed that systems now in use are in many respects faulty; and he urged the classification of fishes and birds in uniformity with the methods already applied in classifying mammals.

Many entomologists were in attendance, and some important papers were presented on Economic Entomology. Dr. L. O. Howard, the government entomologist, gave an account of the work with parasites against injurious insects, particularly the gypsy moth and the brown-tail moth in New England, which is now in progress on a much larger scale than was ever before attempted. These insects were accidentally introduced in the northeasterly portion of the United States, but the percentage of parasitism from native parasites was very small, whereas the normal percentage of parasitism in their native homes was enormous. Hence they increased rapidly, till three years ago importation of parasites was begun on an enormous scale, hundreds of thousands of insects containing parasites having been brought each year from their native homes in Europe. Every effort is being made to prevent the escape in this country of the native hyper-parasites—or the parasites on parasites.

Dr. J. B. Smith, State entomologist of New Jersey, read a paper on "Ridding a State of Mosquitoes," as applied in New Jersey. Dr. Smith announces five general deductions: first, that there are an unexpectedly large number of species; second, that their life histories are very varied, and generalized statements about these are unreliable; third, only a few species are really pestiferous; fourth, that some breed only in special places, others everywhere; fifth, that some have limited distribution, others are found everywhere.

In New Jersey nearly ninety per cent of the offensive species breed in salt marshes, and many places formerly considered dangerous as breeding places are relatively safe. A survey has been made and plans adopted to drain these marshes. Work has already been done near populous centers with notable results. No oil or other killing agency is employed.

The meeting was followed by a series of receptions to the members in New York, Philadelphia, and Washington extending over a period of about ten days.

SCIENCE NOTES.

In a recently issued report of the principal chemist of the British government laboratory there is an interesting statement about the value of the eggs of the spur dogfish, a fish which has by its depredations caused much loss to the fishermen on the Devon and Cornwall coasts. The chemist states that the average weight of the egg is 3.6 ounces, the rough skin or "shell" representing 5.4 per cent. Half the egg consists of water, and the other half of protein and fatty matter in about equal proportions. As the shell of the ordinary hen's egg weighs about 11 per cent of the whole, while the contents have nearly 74 per cent of water, the comparative value of the dogfish egg, used in one way or another, becomes apparent. Dogfish have long been a pest of the fishermen on the southwest coast of England, and a few years ago an attempt was made to place them on the market as food. This effort was attended with little success, there being a prejudice against eating "little sharks." Now the fish are disposed of to those stores—common in England—which supply steaks of fried fish delivered to customers hot from the frying pan. The steaks are carried home to be eaten before they cool.

In a communication made to the Académie des Inscriptions et Belles-lettres, the Rev. P. Delattre, who is directing the excavations on the site of Carthage, mentions a recent find which has some interest as bearing upon the history of the early Christian martyrs. According to history, two of the martyrs were St. Perpetuus and St. Felicitas. This is now confirmed by a stone slab which bears their names, along with those of several of their companions who no doubt shared their fate. The slab was found on the site of the ancient basilica. Although broken in a number of fragments, it could be put together so as to read the inscription which is in five lines, each line being preceded by a Latin cross: "Hic sunt martyres Saturus, Saterninus, Ribocatus, Secundulus, Felicit. Perpet. Pas.... Maiulus." This slab was taken from the excavations made in the region known as Mcidfa, and M. Delattre is of the opinion that here was erected the great basilica known as Basilica Major, which was perhaps the oldest in Carthage. According to ancient authors, the martyrs St. Perpetuus and St. Felicitas were buried in the basilica, and it was here that St. Augustine delivered several sermons. But the present inscription is probably not the original one which was placed upon the tombs of the martyrs, as the presence of the Latin cross at the beginning of each line as well as other indications seem to show that it belongs to a later period, possibly a century after the death of the martyrs, which occurred in 203 A. D.

The difficulties that beset some branches of research are well illustrated by the skeleton of an extinct Australian marsupial (*Diprotodon australis*) just set up in South Kensington Museum. It was named about seventy years ago by Sir Richard Owen, who from a few fragments of bone thought the creature a near relation of the kangaroo. From time to time various bones were found which tended to modify this classification, but it was not until fully sixty years after its first naming that, in 1899, remains were found from which the structure of the feet and the general form of the skeleton could be realized. These remains were found by Dr. E. C. Sterling of Adelaide, and, thanks to his efforts, it has now been found possible to set up in the central hall of the Natural History Museum at South Kensington a complete restoration of the skeleton, in which a large number of bones are represented by plaster models, although many of those of the limbs and feet are original specimens. As thus restored, the diprotodon is certainly a strange beast, carrying a huge head, the jaws of which are armed with teeth approximating to the kangaroo type, and having the body very short, the front limbs longer than the hind pair, and the vertebral column much arched, and falling away toward the loins, behind which it terminates in a short tail. As regards bulk, the creature may be compared to an unusually tall and short Sumatran rhinoceros; while in the matter of relationship it appears to come nearest to the wombats.

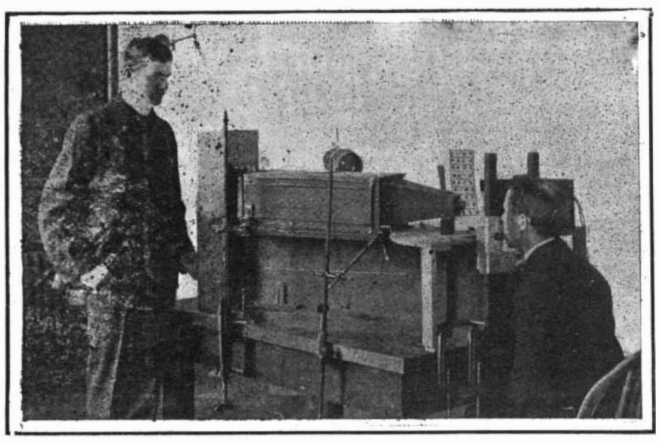
COMPLETION OF THE SCIENTIFIC AMERICAN TROPHY FOR HEAVIER-THAN-AIR FLYING MACHINES.

As we go to press we have just received word from Messrs. Reed & Barton of the completion of the beautiful silver trophy designed and executed by this firm for us in accordance with the suggestions and ideas which we advanced. An examination of the trophy reveals the fact that it is a masterpiece of the silversmith's art. We have arranged to have it on exhibition at the showrooms of the makers, corner Thirty-second Street and Fifth Avenue, for a few days, and our readers are invited to view it at their convenience. We expect to illustrate and describe the trophy in detail in our next issue. The conditions governing the first competition for the trophy (to be held at the Jamestown Exhibition on September 14) have already been published.

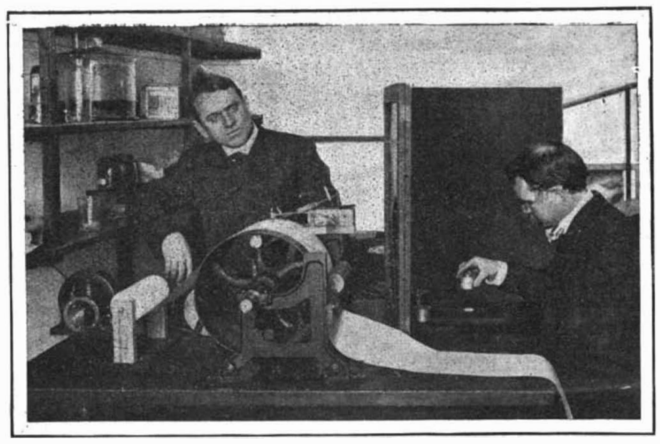
MODERN EXPERIMENTAL PSYCHOLOGY—ITS METHODS AND APPARATUS.

Modern psychology is no longer based on the vague, indefinite conclusions reached by purely philosophic thoughts, but it now bears the hall mark of a science that rings true—a science which though at present not as accurate as those of an older growth that owe their standing to experimental physics, is nevertheless destined to rank with them in good time.

In the development of the new psychology the results achieved are very largely due to the introduction of instruments of precision, which eliminate the errors of unaided observation that were characteristic of the old school, and reduce to a minimum the prejudices of the observer. As Prof. Scripture says, improvement in the method of observation may be made by the use of statistics, experiments, or measurements, or a combination of the three. That is, by taking *statistics* on *numbers* of persons, we might determine if all persons had a green-blue after-image for a red color; by taking statistics on the same person for different times of the day, for different conditions of health, etc., we could settle the question of permanency of the relation of the after-image to the original color; and finally by combining different tints and shades of red, orange, etc., it is possible to gain *experimentally* a basis for the statement that all the colors can be arranged in a closed curve in such a manner that the color of the after-image shall be found at the opposite end of the diameter drawn from the original color. By combining *statistics* with *experiment*, we may prove that the form of this curve is not the same for all persons; if now we introduce measurements with the color wheel or the spectro-photometer, we can determine the exact form of this curve and its relation to all the possible colors. By *statistical measurement* we can gather precise information concerning the mental status of mankind down to the minutest detail that our apparatus and opportunities will permit us to grasp.



Instrument for Determining the Movements of the Eye and Its Fixed Points.

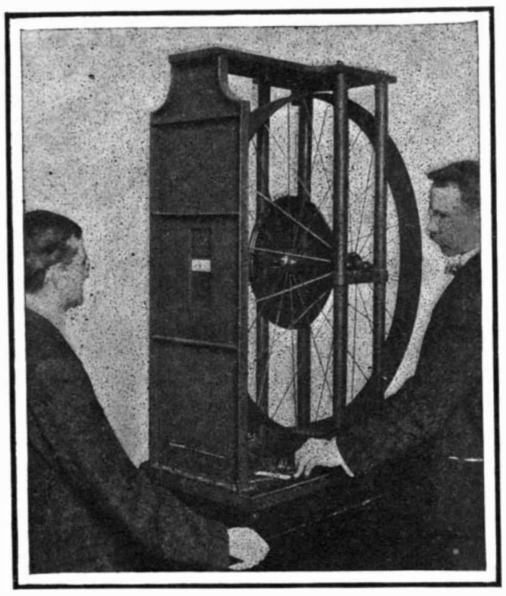


Apparatus for Studying the Factors That Enter Into the Perception of Weights.

It cannot be denied that in many and important portions of mental science the improved methods cannot be adequately applied, and that we must still rely on what has been aptly termed "descriptive psychology"; yet in the past few years advances have been made whereby the application of experimental methods to such apparently inaccessible problems as hallucinations, emotions, the thoughts of the insane, etc., is possible.

These then, namely, statistics, measurements, and experiments, are the means employed by which the ignorance that characterized the observational metaphysics of old have been thrust aside and superseded by scientific facts, which in turn have elevated experimental psychology to its present high standard.

The apparatus and instruments devised and utilized by psychologists for estimating and measuring the functions of the mind that take place in time and space and in the past and present, as well as those for determining the amount of energy expended in performing the various actions in these elements, are numerous, and some of them, as the following descriptions indicate, are exceedingly ingenious. In experimental psychology one of the most useful pieces of apparatus is the chronoscope, a clock-like arrangement. In measuring reactions requiring some degree of voluntary effort, that is, various activities commonly called voluntary acts or volitions, it is necessary that readings of as small a fraction of time as the 1-1,000 part of a second should be made, and this can be accomplished by the chronoscope. A reflex action takes place in a very much smaller period of time than the voluntary movement. Exner has made some interesting experiments in this direction. He has found, for example, that it takes three times as long to close the eye in response to a signal as it does to close it in response to reflex action when the eye is threatened.



The Cattell Color Wheel for Exhibiting a Color or a Series of Colors.

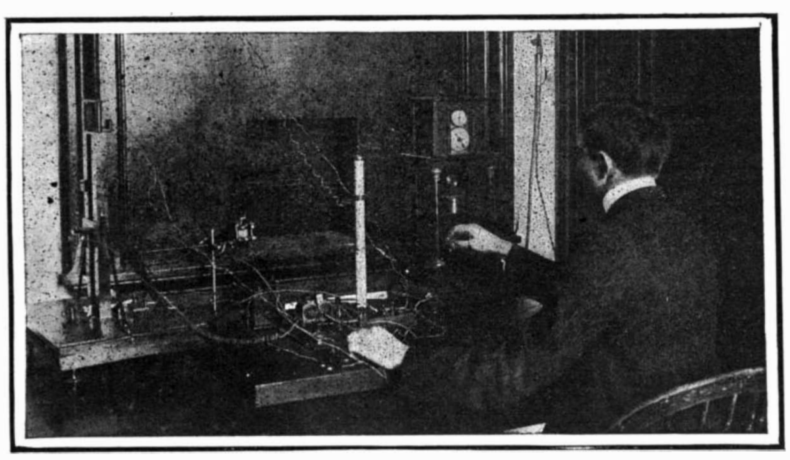
In the usual psychological chronoscope a fine clockwork is set in motion by releasing a spring, the mechanism running for about half a minute. There are two dials, the hand of one indicating tenths and the other thousandths of a second, but these do not move until a controlling lever draws them away from a train of gear wheels, by the opening or closing of an electric circuit. In this arrangement, whereby the production of the stimulus sets the hands into motion and the reaction movement brings them to a standstill, the interval of reaction time can be read off directly. The chronoscope shown on this page is an improvement over the preceding forms, in that two sets of dials are employed, one having black and the other red figures. The black corresponds with those of an ordinary clock, while the hands of the red dial are operated like those of a stop watch.

The chronoscope is useful in combination with other instruments in a large number of experiments, and among the latter may be mentioned measuring the instant the stimulus appears for sound, the noise of the key by which the current is closed being usually sufficient; for sight, when the impression to which a reaction is to be recorded is concealed behind a screen, and the removal of this screen at make and break of the electric current.

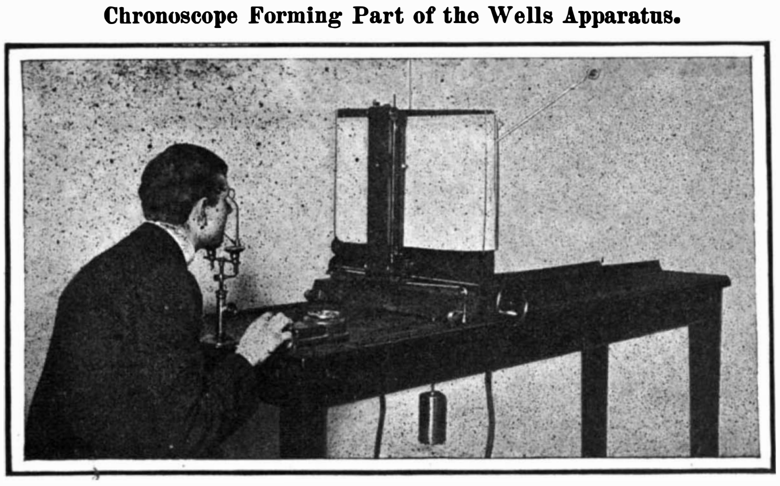
Frequently the subject sits in the dark, and the impression becomes visible only when an electric spark appears or the spark itself becomes the stimulus. For touch, temperature, and taste, a device is used in which the end of a rod touches the sensitive surface, and the pressure so exerted makes a contact with a delicate metallic blade. For smell the movement by which the odor is set free may be similarly utilized. The reacting movement is usually that of pressing an ordinary telegraphic key.

The precision conical pendulum chronoscope shown on page 165 is the invention of the late Ernest Kempton Adams. The purpose of the present apparatus besides its employment as a timekeeper, is for electrically measuring any interval of time in thousandths of a second, the indicator being instantaneously shown upon a dial. The isochronal element of the chronoscope is a large conical pendulum, which is accelerated above its knife-edge suspension by an automatically-wound train, the driving force being obtained from a weight.

The motion of the conical pendulum is confined in true circles by a magnetic controller, thereby eliminating the earth's rotational effect, which is the principal disturbing force that causes conical pendulums in general to travel in ellipses. The driving train is provided with four black-enameled



Chronoscope Forming Part of the Wells Apparatus.



Apparatus for Mapping the Blind Spots of the Eye.

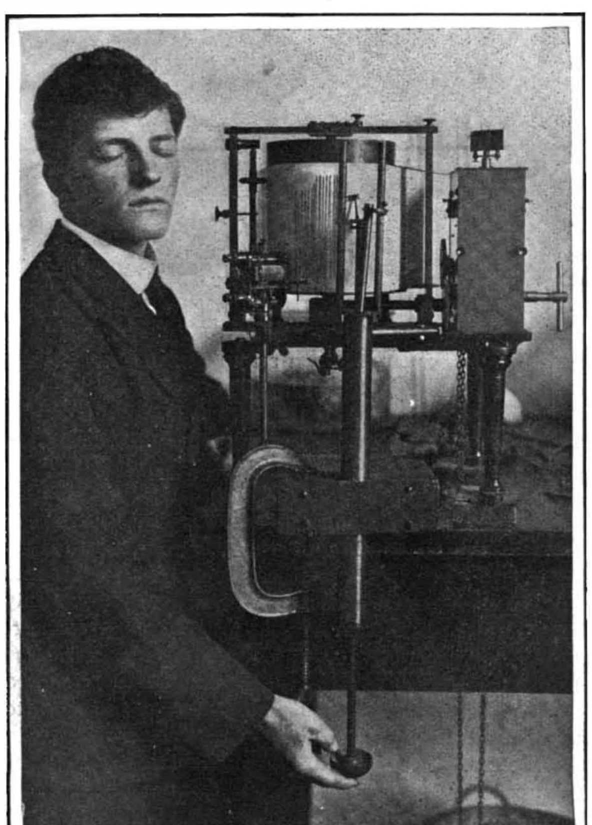
A Sonometer to Detect the Least Perceptible Difference in the Intensity of Sound.

MODERN EXPERIMENTAL PSYCHOLOGY—ITS METHODS AND APPARATUS.

indices, the first turning once per second, the second making one revolution per minute, the third revolving once per hour, and the fourth completing one rotation each mean solar or sidereal day as desired. The first and largest index travels over the periphery of the dial, which is graduated into one thousand parts, each corresponding to one-thousandth of a second. Through the medium of electro-magnetic combinations, a recording train, precisely similar to the driving one, except that the indices are enameled red, may be coupled in with the aforesaid driving train for as long a period as the measuring current lasts. The duration of the current is then registered by the recording indices upon the dial. Synchronizers and magnetic devices are provided for by setting the different indices in accordance with the methods of operation hereafter described.

The functions of the chronoscope are controlled from a small switch table, which may be located in any desired position. If necessary, the machine may be mounted in a small clock room, which would prevent the influence of air currents, dust, and in a measure, temperature variations. In this case the controlling switchboard may be located outside of the clock room, the dial of the chronoscope being observable through a glass partition.

Notwithstanding the scales say that a pound of lead and a pound of feathers are equal in weight, Scripture says that a pound of lead *is* heavier than a pound of feathers as long as you look at it. However this may be, we shall let our readers determine for themselves, and confine our remarks to the experiment of judging weights and the apparatus for recording the extent and rate of movement illustrated on page 164. The fact that the new psychology was founded very largely on Weber's and Fechner's researches in lifting weights, attaches to this class of investigation more than ordinary interest. Weber



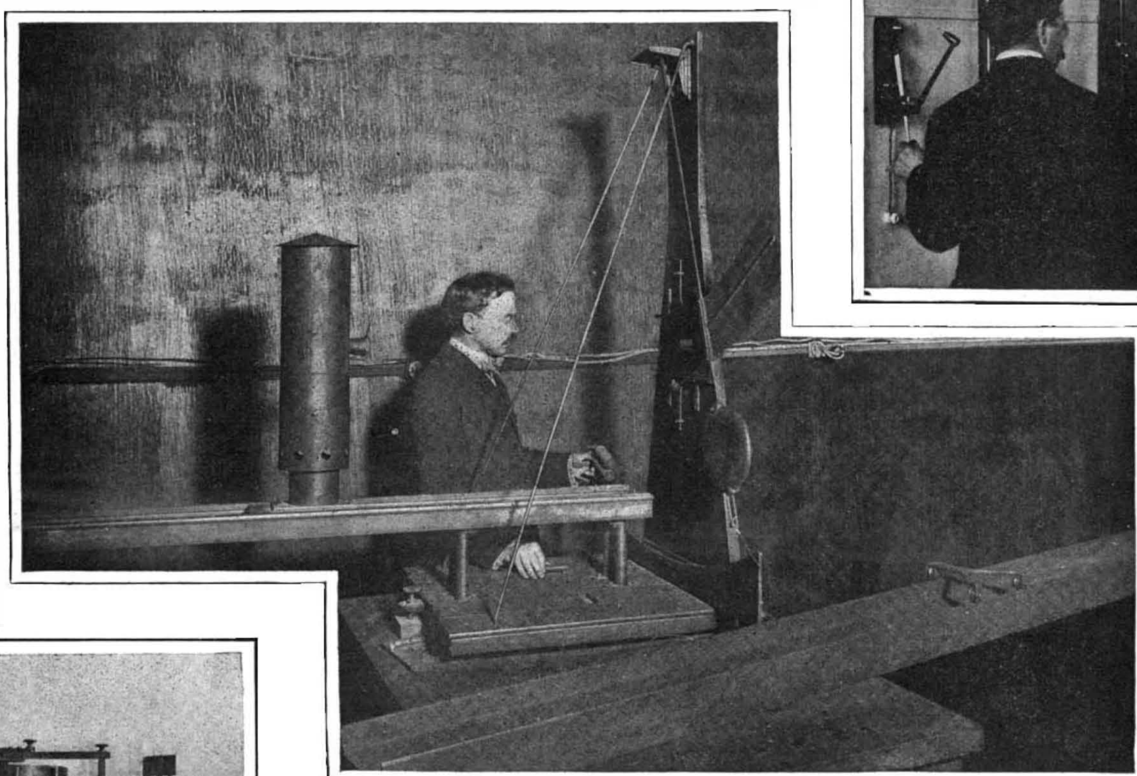
Apparatus for Measuring Preponderance of Weights.

sought to ascertain how much a weight must be decreased before a difference is noticed. He found that for a weight of 32 drachms the average difference for four persons was 3 drachms, and for a weight of 32 ounces it was 3 ounces. Thus it is obvious that the least perceptible difference for a lifted weight was not a constant fraction, but a proportional one. In testing the accuracy of this law, Fechner developed a method for measuring judgments of character, on a method of right and wrong cases as it is called, and which is really the basis of modern psychological work.

The apparatus shown for studying the factors that enter into the perception of lifted weights consists of a drum rotated by an electric motor; the drum carries a wide sheet of paper over its upper surface, while a pen, connected with a plate on which the subject places the weight, records on the moving band of paper the differences noted.

An apparatus for measuring the preponderance of weights is photographically reproduced below. In its essentials it consists of a drum carrying a sheet of paper on its periphery, and revolved by a spring motor; the latter is controlled by an electric current operating through a magnet and a make and break key. A novel form of dynamometer, comprising an upright tube, a rod sliding through it and lifting a weight to which a recording pencil is attached, is clamped to the table.

In making an experiment with this apparatus, the subject raises the weight three times, in each case with his eyes open. A stop limits the movements of the rod and weight, so that each individual movement is exactly the same in extent. Then the subject is requested to repeat the operation, this time with his eyes closed. The stop is removed in this series of trials, and it is the subject's duty to try to force the rod up to exactly the same height as that attained with the eyes open. Curiously enough, as a general rule there is a strong tendency to make larger excursions with the eyes closed than when they are open,



Apparatus of the Pendulum Type for Determining the After-Image Effect.

MODERN EXPERIMENTAL PSYCHOLOGY—ITS METHODS AND APPARATUS.

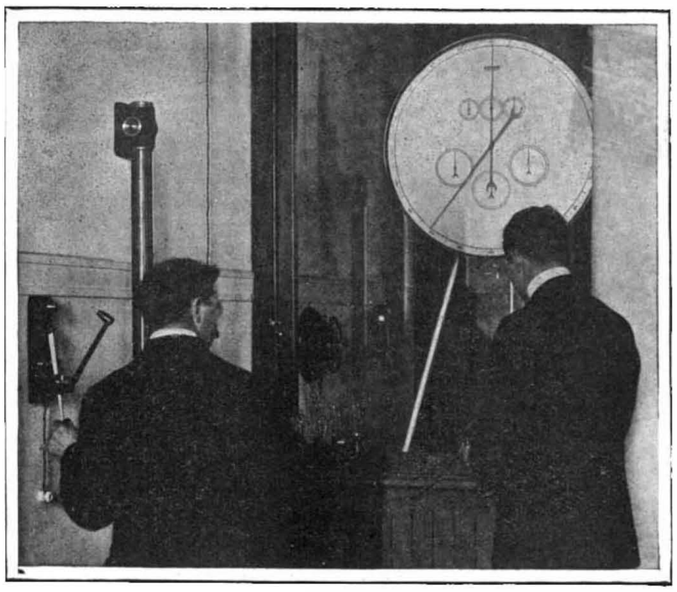
and consequently showing an under-estimation of the perception of weight under such conditions.

A very interesting as well as important branch of psychological investigation deals with the sense of sight and its relation to space. In order to record the movements of the eye, and to determine its fixed points, many arrangements have been devised and used, but the apparatus shown on page 164 is the most recent and best adapted for the purpose. In some of the earlier experiments a sensitive photographic film was made to move evenly in a vertical plane and immediately behind a narrow horizontal slit in the plate holder of a camera. The subject's eye was then brought into such a position before the lens of the camera that a horizontal plane bisected the eye through the middle of the pupil, and thence passed through the horizontal slit.

If the eye was held immovable while the sensitive film was being exposed behind the slit, the negative then presented a series of parallel lines corresponding in cross section at every point to the light and dark parts of an imaginary line drawn horizontally across the eye and bisecting the pupil. A horizontal movement of the eye while the sensitive film was moving behind the slit would be marked in the negative by oblique lines. These oblique lines were the records of the eye movements, and their time values were read off from a time record marked on a sensitive film during its progress. Owing to the untoward features of this method, satisfactory results were not obtained until the eccentric surface of the cornea was utilized as a reflector. Instead of photographing the eye directly, the movement of a bright vertical line as it was reflected from the cornea was photographed instead. Such lines give clean-cut records, which permit them to be magnified considerably, while the amount of light needed is comparatively small.

By referring to the figure, it will be seen that the subject to be tested holds his head perfectly rigid by holding between his teeth a projecting piece of hard rubber. Supported by an adjustable stand, there is an objective lens with an electric light back of it; and either between the light and the lens or in front of the lens, a blue color screen is placed. This part of the apparatus is arranged so that it will project a beam of blue light into the eye while the subject is reading letters or words on a card; the light is then reflected back to the photographic plate.

Another experiment, in which the sense of sight plays an important part in revealing the functions of the mind, is mapping the blind spot of the eye. There is one portion of the field of vision to which the eye is blind. There are many appliances for the determination of the blind spot, but the apparatus pictured in Fig. 5 is one of the most accurate yet devised. The blind spot does not usually take on a black appear-



The Adams Chronoscope.

ance, but rather that of a misty veil, so that if a black letter is printed on a white sheet of paper, where it comes within the radius of the blind spot the eye will be unable to see the letter, and that portion will remain apparently white.

The apparatus referred to consists of a rigid table, on which is mounted at the end where the observer sits an adjustable standard carrying two chin rests for securing rigidity of the head, and therefore the eyes; two rests are provided, so that the blind spot of either eye may be ascertained. On a track there is a slide rest comprising a rigid paper holder and a vertically-moving band having a white spot on it; the upright supporting the band is arranged to travel horizontally over the fixed paper surface; a movable arm having a white disk attached to its free end completes the apparatus.

The term "after-image" is used to denote the direct after-effect of the stimulation of a sense organ. While after-sensations occur in almost all the senses, those of vision are stronger and more permanent, and have consequently been given more attention by psychologists. It has been found by experiment that after the retina of the eye has been stimulated by light for one second or less, the primary image disappears quickly, but at an interval of less than two seconds it is followed by a positive after-image, that is, an after-image of the same quality as the primary image; with some observers a brief stimulus is immediately followed by a negative after-image, that is, an image which differs very greatly in brightness, and is often of a different color from the primary image. One of our illustrations shows an apparatus of the pendulum type for the determination of the after-image effect.

An apparatus illustrated on page 164 is called a sonometer, and is employed to detect the least perceptible difference in the intensity of sound. It is also the invention of the late Ernest K. Adams and is a much more accurate device for ascertaining the discriminating powers of the auditory nerves than the apparatus originally used by Stern in his preliminary observations on the subject. It consists of a heavy pair of steel rods on which reservoirs containing steel balls are carried. These reservoirs may be raised or lowered as desired. Levers permit the balls to be dropped upon a base where they are deflected into a tray.

The operation consists in the experimenter first filling the reservoirs with the steel balls and in seating the subject near the instrument with his back toward it as shown in the illustration. The operator then raises the two reservoirs to the same or different heights and clamps them upon the rods. He next throws against releasing pins when the balls will drop into the tube projecting below the reservoir. One of the arms is then moved back against the pin, thus carrying the ball around to the opening, where it will start to roll out.

As soon as the first ball has struck the base the second one in the reservoir is allowed to drop. The subject may now discriminate between the two sounds which of course will vary if the balls are dropped from different heights. The upright rods are graduated to enable the operator to vary the heights of the reservoirs by only slight differences, so as to detect the smallest degree of the auditive discriminative powers of the subject. To vary the experiment, the subject may be directed to close first one ear and then the other in order to test the nerves in each ear.

In 1795 the celebrated royal astronomer Maskelyne discharged his assistant because the latter recorded the transit of a star across the wire of the telescope half a second later than himself. Some twenty-five years later Bessel, another astronomer, had his attention called to the act, and upon investigation established the fact that no two observers recorded such transits at precisely the same time. The difference in time between any two observers was usually expressed as an *equation*, and hence the term *personal equation*, which though strictly applicable only to the differences so found, has assumed a much wider meaning.

The individual differences become greater as the process to be performed increases in complexity, and this explains in part why the personal equations as determined by the complicated eye and ear method were so large; with the simpler method of electrical record, these differences are much reduced. The object of the Wells apparatus shown on this page is to determine the differences of sensation measured by the time of preponderance of those differences in the utterance of sounds. The apparatus is divided and placed in two rooms, so that all possibility of error is excluded. The interval of speaking a particular vowel and that of raising the hand from a Morse key are measured, the chronoscope indicating differences as small as 1-1000 part of a second.

A color wheel for studying the perception of moving objects is shown on page 164. It is so arranged that the rate of motions, size of field, etc., can be accurately adjusted. It consists of a wheel 1 meter in diameter with a rim 9 centimeters wide. Cards and colors placed on the outside of the rim pass the slit, where they are seen by the observer.

It is thus possible to exhibit a color or a series of colors for an interval dependent on which the wheel moves and the size of the colored surfaces. The intensity of the light and the size of the field can also be varied, thus permitting experiments on the relations of time, area, intensity, and color in vision. Originally this wheel was used for experiments on moving objects and commingling colors, and these led to the results on perception with the moving eye, on the relations of time and space in vision, the fusion of moving objects, and the perception of moving objects.

The apparatus shown in the illustrations form part of the equipment of the Department of Philosophy and Psychology of Columbia University, New York city. The author desires to acknowledge his obligations to R. S. Woodward, at Columbia, Professor of Psychology, for much of the data in this article.

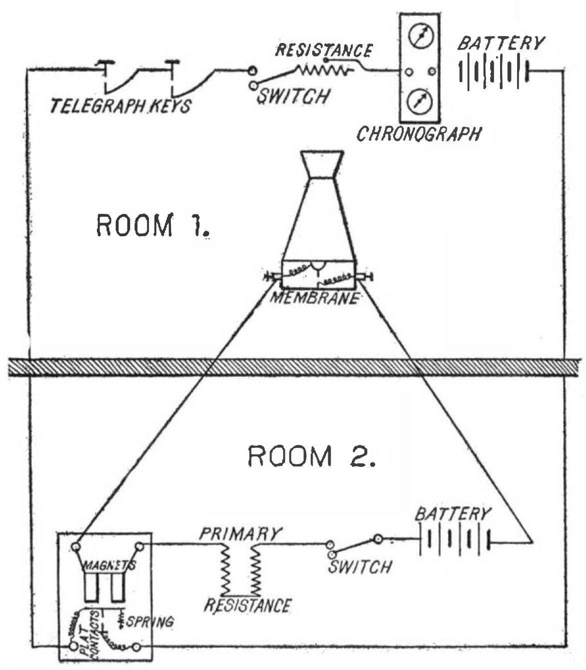
Accidental Inventions.

Gawalowski, in the Allgemeine Ingenieur Zeitung, has an interesting article on accidental inventions, in which he mentions first that the phonograph is due to an accident; Edison having related that one day when he sang in the mouthpiece of a telephone, the vibration caused the fine metal point of the diaphragm to stick in his finger, which led him to produce the talking machine. This story is probably not at all new to American readers, but perhaps the history of some other inventions, which took their rise in Europe, may be.

Natural indigo, which is among the dearest dyestuffs known, and has been used since the twelfth century, at least, has been replaced very largely by the artificial product, which is due to accident. Sapper is said to have discovered it; but Gawalowski states that the invention has been falsely ascribed to Adolf von Baeyer (not to be confounded with Alex. Bayer) and Hermann, although Von Baeyer is always considered as having been the father of this most important discovery. Eosin also owes its existence to A. von Baeyer, who was working at the time in the technical high school in München, and discovered it by accident; in this matter Caro having been of assistance. The Lauth violet and methylene blue were also products of accident; the first being produced by Lauth, and the second by Caro, mentioned above; further, benzopurpurin is due to a laboratory assistant of Duisburg. Antipyrin and saccharin are also the children of accidental discovery; while in medicinal chemistry fluorescin and acetanilid (anti-febrin) were discovered by accident by one of the employees in the Höchst works.

The Imaginative Temper in Science.

Mr. Rider Haggard, speaking at a recent distribution of prizes to the students of the Medical Schools of St. Thomas's Hospital, London, exhorted his hearers to fit themselves for their profession by cultivating, among other things, their imagination. Speaking of this, the Lancet (London) says: "We consider that Mr. Haggard was giving a remarkably good piece of advice, provided always that those who follow it allow their pursuit of science to be not dominated by imagination, but tempered with it. The importance of this faculty in relation to science may not be clear to all. Some certainly will tell us that imagination is for the poet, but they confuse imagination with fancy. Imagination has more affinity to science, to true constructive science, which transcends the bare collection of facts. Indeed, it may almost be said of the great masters of science who revolutionized their own domains that they were endowed with an imaginative grasp of their subject that gave them a well-nigh prophetic insight to its deepest mysteries; and this insight has served them for an ever-strengthening faith that the minute researches to which they have devoted their lives would one day result in the introduction to the world of thought of a grand and glowing truth the faint image of which had been revealed to them, though darkly, in the glass of their imagination many years before. But herein they showed themselves to



The Wells Apparatus.

be men of science and not dreamers, that before they presented their great gifts to the world they had searchingly and patiently applied to them the touchstone of experiment and ofttimes modified them again and again from their original crude forms; in a word, their imagination was their servant and not their master. For illustration, many great names occur. Even though the story of Newton's apple be apocryphal, yet it serves to remind us that he was endowed with an imagination which could conceive of a law of cosmic unity of stupendous import and which had power to urge him to direct the light of his vast intellect upon its elucidation. Will any deny imagination to the scientific faith that in later years confidently announced the existence of an unknown planet with an importunity that met with a triumphant justification? Or if we turn to the sphere of biology, the temper of imagination enters so prominently into the life work of Darwin and Pasteur that we are almost tempted to believe that it was this one faculty which lifted them so high above the many great investigators of their century. In the case of the father of bacteriology, the insight which led him on from the study of the crystallography of tartaric acid to that of fermentation in plants and thence to the bacterial conception of disease is a pure example of what we mean by the imaginative temper in science."

Many other illustrations might be cited, showing the value of imaginative science. Unfortunately, there is another side to the question. Much harm has been done by people who do not control their imaginations by the one safe method of laborious and impartial experiment. It is too easy to enunciate a general principle from some particular example; and this has often been done with most unfortunate results.

It is stated that the tunnel through the main range of the Tauern Mountains, in the Tyrol, begun six years ago, was pierced on July 21. The tunnel is 5½ miles long. It is situated a few miles south of Gastein, and its opening is at Wallnitz, where it passes under the Villach range.

The Spontaneous Production of Bromine from Radium Bromide.

On opening a glass tube containing a milligramme of radium bromide which had been hermetically sealed for almost exactly twelve months, there was a very strong smell of bromine. Now, according to the calculations of Rutherford, the amount of the bromide decomposed in this period would be about 5.4×10^{-7} grammes; the amount of bromine corresponding to this would be about 2×10^{-7} grammes. It might be thought that this exceedingly minute quantity would have been beyond detection by its odor. From some measurements made by Mr. A. C. G. Egerton, it appears that the minimum quantity so detectable is between 10^{-8} and 10^{-10} grammes per cubic centimeter. Experiments are in progress with the object of determining this limit more definitely; but in the meanwhile, the evidence is quite in accordance with the assumption that the bromine detected was produced directly by the spontaneous decomposition of the bromide, and was not the result of secondary actions. As far as we know this is the first application of the olfactory sense to the detection of radioactive changes. It should be observed that the ability to apply it here arose from the cumulative character of the chemical change produced. Of course, from the ebonite cells in which radium is usually stored, the bromine can escape easily enough to prevent its being detected.—Knowledge and Scientific News.

Radium Emanation and Its Products.—According to a letter in Nature, another important discovery has been made in connection with radio-active products. Sir William Ramsay and Mr. F. Soddy showed in 1903 that helium is formed as the result of the spontaneous change of radium emanation. Sir William now finds that if the emanation is in contact with and dissolved in water, neon is produced instead of helium. But, further, if a saturated solution of copper sulphate is substituted for water, argon is produced, with only a trace of neon. The importance of this discovery consists in that this is the first successful attempt to change in some way the products of disintegration. Hitherto, the mode of transformation has appeared to be an inexorable one, yielding in no way to efforts made with the hope of modifying it. How far the above modifications are attended by others has not yet been ascertained. It is possible that the emanation breaks up successively into radium A B C D E, as in the genealogical table of Rutherford. Indeed, it is probable that this is the case, for the helium or other non-valent gas is probably formed out of the Alpha particles shot off in the successive stages of decay. Besides the above direct actions, important secondary actions occur in the surrounding medium. The copper (in the copper sulphate) seems to be partly transformed into lithium, for the red lithium line was observed after treatment, though it was very faint.

The Railroad Commission of Indiana has issued the following circular to railroads: "The general assembly has provided (chapter 205, Acts 1907, page 353) that your railroad, where its gross annual income from operation is $7,500 or more per mile, shall be equipped with an approved block system by the 1st day of July, 1909. This act resulted from an investigation made by the railroad commission, by direction of the assembly, of railroad accidents which had taken place, and of present conditions of railway service and operation in the State. Its purpose was to remedy existing conditions and dangers, and not to postpone the institution of the block system to the time limit made in the statute. You are advised and directed to commence as early as possible to comply with this act of the assembly in its spirit and purpose. Our chief inspector will confer with you at any time at your request as to the kind of system best adapted to your line, having regard first to safety and then to the amount of business and your ability to put in this system. Your attention to this circular will be evidenced by prompt response from your general officers to the commission showing what you have done, and intend to do, to carry out the will of the general assembly, so expressed in this act."

The start of the Wellman airship "America" for the pole has been delayed by adverse winds. The start was set for August 20, but at the time a fresh breeze was blowing from the northeast, and the balloon, ready inflated, was kept in her shed. Later reports show that the wind has continued unfavorable, but the balloon is kept inflated, awaiting a favorable moment. Mr. Wellman has stated that unless he can leave by September 6, the start must be postponed until next year. If the start is made, the steamer "Express" will wait ten days to see if the balloon returns, while the steamer "Frithjof" will cruise off the coast for a month. If the pole is successfully reached and crossed, Mr. Wellman may be heard from in eight or nine days from the start.

Do We Eat Too Much?

BY JOHN B. HUBER, A.M., M.D.

The traveler who visits us is amazed at the variety and plenitude of our fare; our dinner tables groan quite as they did in the good old Elizabethan days. The Englishman especially comes to us from his inn at home, where at breakfast the traditional mutton chop, eggs, marmalade, and one or two other eatables (no more than half a dozen and all excellently prepared) are offered for his choice. In most of our hotels, whether urban or rural, his bewildered eyes will see a hundred things upon the breakfast card, many of them very badly cooked indeed. And he will find the contrast at lunch and dinner even greater. The sturdy steerage immigrant has at home subsisted very well indeed upon his plain bread, his cup of wine, his fresh vegetables, and his stews—a diet into which meats enter at most but several times a week. Here he finds his fellow-laborers indulging generously in meats daily, and often more than once a day.

The dietetic vice of a century ago—the time of the three-bottle men—was alcoholic; now, we Americans at least, eat too much, especially too much meat. It is the concomitant of our prosperity. And to this effect Prof. Chittenden submits a most valuable and scientific work (the second upon the subject) in which are detailed exhaustive experiments done through six years by him and his colleagues at Yale.* This book is well worthy the layman's perusal. In terms easily comprehended, one finds here much light thrown upon the many perplexing problems of nutrition; and much besides that is very interesting and instructive upon the larger subject of physiology.

Human food is composed mainly of organic living tissue, both vegetable and animal; and it has an admixture of inorganic mineral salts which help to make up bone, to enrich the blood, and otherwise to keep the body in good order. For scientific purposes Chittenden, as do all physiologists, divides our foodstuffs into proteids, carbohydrates, and fats. All things which we eat, of whatever nature or origin, are made up simply of representatives of these three classes. Some foods contain all three, others but one or two.

The proteids (or the albuminoids) are the most important. In addition to carbon, hydrogen, and oxygen, they contain also nitrogen, sulphur, and phosphorus. We sometimes call them the nitrogenous foodstuffs; for they contain the nitrogen which is absolutely essential to build our cells, tissues, and organs, and to repair the constant waste which is attendant upon the vital processes. We cannot maintain life without the proteids; besides, if heat and energy are lacking from other sources, they can supply them, temporarily at least. They enter variously into the composition of all foods. They are most in cheese and then in diminishing order in pulses (peas and beans), nuts, meat, eggs, and grain. There is a fair amount in bread and other grain products, and very little in fruit and many of the vegetables. The carbohydrates and the fats are made up of carbon, hydrogen, and oxygen; they contain no nitrogen. The carbohydrates comprise the sugars and the starches, and they yield energy for heat and work; as do also the fats. These two elements ordinarily furnish the fuel which is consumed in the body. They may replace each other; but they cannot be substituted for the proteids.

There has of recent years been much experimental work upon nutrition; and among the standards which have found pretty general acceptance are those of Voit and Atwater. Voit found that a dietary providing 118 grammes of proteid and 3.055 calories are required daily by the average man weighing 70 kilogrammes, if he is to do moderate work. Atwater's standard calls for 125 grammes of proteid and 4.150 calories. Chittenden submits the following as a specimen dietary for one day: Breakfast, one shredded wheat biscuit, one teacup of cream, one German water roll, two one-inch cubes of butter, three-fourths cup of coffee with the remainder cream, and one lump of sugar; lunch, one teacup home-made chicken soup, one Parker House roll, two one-inch cubes of butter, one slice lean bacon, one small baked potato, one rice croquette, two ounces maple syrup, one cup of tea with a slice of lemon and one lump of sugar; dinner, one teacup cream of corn soup, one Parker House roll, one-inch cube of butter, one small lamb chop broiled, one teacup of mashed potato, apple-celery-lettuce salad with mayonnaise dressing, one Boston cracker, split, one half-inch cube American cheese, one-half teacup of bread pudding, one demi-tasse coffee, one lump of sugar.

Such a dietary as this would furnish 60 grammes of proteid and 2.800 calories, which Chittenden holds is ample to maintain the body in health and strength, both mental and physical; and this with the least expenditure of time, attention, and energy. He counsels us to cut down especially the proteids in our food; and it is the meats which should be reduced, since they are our chief nitrogenous foodstuff. He concludes that the dietary standards which now obtain are much too high; and that better health, increased efficiency, and greater chances of longevity would certainly follow upon our reducing our proteids at least fifty per cent. In his opinion we consume altogether too much above what the body needs for its building up and to keep it in repair. Physiologists declare that proteids are the one substance in food which the body cannot burn up thoroughly when they are eaten in excessive quantities. Thus such organs as the liver, the stomach, and the kidneys become overtaxed in the undue efforts they have to make to dispose of them; and when this overtaxing becomes long continued, these organs are bound to develop chronic diseases, and too often to break down quite disastrously. Chittenden indeed found his interest in the subject upon which he was working to increase enormously when he found that at the end of a short period after he had himself begun to go without breakfast and otherwise to cut down his own food consumption, his general health had decidedly improved; he had rid himself of a rheumatism which had before been quite rebellious to treatment, and he also was free from bilious attacks and sick headaches.

Prof. Curtis has well likened the body to a furnace. The combustion of proteid within it yields a solid ash which must be raked down by the liver and thrown out by the kidneys. "Now, when this task gets to be over-laborious, the laborers are likely to go on strike. The grate, then, is not properly raked; clinkers form, and slowly the smothered fire grows dull and dies."

Chittenden's work is all the more valuable by reason that he is no faddist. The mixed diet is the normal for human beings. He would not have us vegetarians, though many people would do very well indeed upon an exclusive vegetable dietary. "Complete vegetarianism is entirely successful in many cases, and disastrous in others." In the latter an occasional use of meat is needed "for some reason not perfectly clear," probably because meat is "peptogenic," in that it stimulates the secretion of the gastric juice, which is essential to digestion. Many among those who abstain from meat during a number of months find a meat hunger asserting itself for a few days only, after which a long period elapses before another such craving occurs. Some who abstain from meat for years find themselves declining in health, which, however, becomes immediately restored by again including meat in the dietary. It seems that many popular vegetarian food preparations imitate very strikingly the meat flavors, thus satisfying an instinctive and quite normal craving.

Nor would he have us altogether Fletcherites, although that wise man has advised much which is salutary. Fletcher when nearly fifty years of age was literally obese, he suffered from several diseases, he was rejected by all life-insurance companies; yet he regained complete health and vigor to the degree "that he could tire out young athletes at their own work and carry a severe mental labor at the same time." This result he obtained through complete mastication of all food, both solid and liquid, and yet at the same time eating far less than the ordinary sedentary person. He declared: "If you eat only when you have an earned appetite, masticate your food thoroughly, and take great care to eat only what appetite approves, the rest will take care of itself."

Yet a faithful adherence to Fletcherism in all cases would not be healthful. For instance, Dr. F. G. Shattuck, of Boston, has observed that Fletcher's son-in-law, Dr. Van Someren, who used to be a rather stout and good-natured gentleman, has become cadaveric, although he is quite satisfied that his father-in-law's system is enabling him to maintain his metabolic equilibrium. While in Cairo Dr. Shattuck met Dr. Sansmith, who practises in that region; and the latter told him that he not infrequently had the opportunity of seeing patients who had been under the Fletcher system; and the main thing he had to do with them was to encourage them to eat more, and so build them up to their normal condition of health. Besides, as I intimated in a paper contributed to these columns on June 8, it is not well for the body to take in only enough food for its maintenance. We must ingest a little more, in order to provide and support our "factors of safety." We would hold a railway company criminal which would provide, for the passage of its trains, bridges of just sufficient strength to bear them and no more; such bridges should be and generally are made capable of enduring several times the strain ordinarily put upon them.

* The Nutrition of Man. Russell H. Chittenden. F. A. Stokes Company, New York.

The new German military dirigible balloon and the Parseval airship have just made successful test trips in Berlin. The Parseval airship's test included a journey of over two hours against a strong head wind. The motor worked splendidly, and the ship made good progress, answering her helm with the greatest facility. The military balloon made a number of short voyages, and executed a series of complicated maneuvers. After being in the air for some hours, the two balloons landed at the same moment on the exact spot whence they had ascended. They sailed side by side in the air for a short distance before alighting.

Analysis of Hens' Eggs.

M. Barbieri, of Paris, recently carefully analyzed the yolks of hens' eggs, and separated a certain number of compounds. The first body is the oil of the yolk, and when this is purified by animal charcoal it is found to be quite free from nitrogen, phosphorus, sulphur, or ash. Analysis of the oil shows it to be made up of carbon 76.5, hydrogen 11.7, oxygen 11.8 parts. Its composition is therefore very near that of trioleine. The second compound is a solid substance which is soluble in hot alcohol, but upon cooling it is separated in the form of a jelly-like mass. After purifying, it yields a white crystalline body which melts at about 140 deg. F. Its composition is carbon 76.2, hydrogen 12.2, oxygen 11.6. This body is identified with tri-stearine, and the latter has the same melting point From the two bodies can be separated stearic acid, oleine, and stearine. Another body found in minute quantity is a white crystalline substance. It is soluble in an excess of alcohol and the solution is neutral. It melts at 356 deg. F., having the composition: carbon 64.8, hydrogen 11.3, nitrogen 3.66, phosphorus 1.35, sulphur 0.40, oxygen 18.49, ash 0. This body, mixed with tri-stearine, was observed by other experimenters, and known as cerebrine. By its composition it seems to be related to the cerebric acid of Fremy. M. Barbieri proposes to call it *ovine*. He also obtains a white mass from the yolk which divides into two layers, a lower oily portion and an upper layer. Treating the latter he finds a substance which swells up when placed in wood-spirit, but did not continue to observe it at present. From the yolk he then separated a body known as *ovo-cholesterine*. When purified, it appears as a crystalline compound, and has the composition: carbon 83.44, hydrogen 11.84, oxygen 4.72. Another body is an oil which has an intense yellow color, known as *chromatine*. When treated by ether or chloroform it yields small octahedral crystals whose melting point is found to be 239 deg. F. What is remarkable is that these crystals are nearly pure sulphur.

Sulphur exists in various forms, which may be classified into amorphous and crystalline, the former being insoluble, and the latter soluble in carbon bisulphide. Of the crystallne modifications, the most stable is that in the form of minute rhombic octahedra, and the small prismatic crystals which form when melted sulphur solidifies gradually change into octahedra, heat being evolved in the process. Amorphous sulphur also undergoes a gradual change into the rhombic crystalline condition, but, as Mr. Rankin has recently shown, the converse change of the crystalline into the amorphous form can be brought about by the agency of light. Thus, if a solution of rhombic sulphur in a suitable solvent be exposed to daylight, a precipitate of amorphous sulphur is produced. The intensity of illumination needed to effect the change decreases with the increase in the concentration of the solution, but more light is required when the solution is heated. Only the violet and ultra-violet rays of light are concerned in the precipitation, and the nature of the solvent does not have any influence. The precipitation is prevented by adding ammonia or sulphureted hydrogen to the solution, and strong sunlight has then no effect. In Mr. Rankin's opinion, there is a state of equilibrium between the two forms of sulphur, one being more stable in the light and the other in the dark.—Knowledge and Scientific News.

The Current Supplement.

The SCIENTIFIC AMERICAN SUPPLEMENT, No. 1653, contains an unusual number of varied and interesting articles. Of zoological value are an article on the Okapi and a paper by Prof. Alexander Agassiz on the "Progress of Zoology." Dr. Allerton S. Cushman's brilliant investigation of the corrosion of iron, which resulted in his discovery that electrolytical action is the real cause of iron rust, is concluded. J. H. Morrison's excellent treatise on the development of the armored war vessel is continued. "The Rise of Man" is the title of an interesting book review which gives not a little information on the descent of man. I. M. Angell writes on some curious hybrid tomatoes that imitate fruits. Henry Clay Weeks reviews mosquito extermination work in Massachusetts. To the roll of long and important tunnels the Karawanken was added last year. Although its construction was based upon what is known as the English system of tunnel building, yet it presents many features of novelty and interest, especially with regard to rapidity of execution. Paul T. Warner writes on the modern locomotive and discusses the various types at present in use.

The railroad ticket tax imposed a year ago by the German Empire was estimated to produce about 24,000,000 marks the first year. The Secretary of the Treasury recently announced that the prospect is that only about 12,000,000 marks will be realized by it. The diversion of travel from the higher to the lower classes has been greater than was estimated.

THE ERECTION OF THE 612-FOOT SINGER BUILDING.

Now that the Singer office building, or to speak more descriptively, the Singer tower, has been carried up beyond the 500-foot level, its really stupendous proportions assert themselves with far more dramatic effect than was possible in the many illustrations which have been made of the structure. It is at once a simple and a complicated task to erect on a foundation only 65 feet square, a building which shall lift its head more than 600 feet heavenward, and maintain itself, free from tremor and absolutely secure, against the fiercest hurricanes that can blow upon it. It is a simple matter so far as the erection of a 600-foot office tower consists merely in the addition of story to story; but it becomes complicated when we bear in mind that each successive story calls for a proportionate thickening and stiffening of the supporting columns below to support the ever-growing weight, and by adding to the enormous wind strains calls for yet more additional metal to resist them.

The tower itself forms the most striking feature of an elaborate reconstruction of the old Singer building, which is located at the corner of Liberty Street and Broadway. An addition, with a frontage of 76 feet on Broadway, has been built on the northern side of the old building, and the great tower rises above this addition, with its front standing about 15 feet back from the Broadway building line. The original building is being raised five stories, so as to match the fourteen-story height of the new addition. The completed tower will extend twenty-eight stories above this, and will contain forty-two stories in all.

Both the main building and the tower are finished in red brick with light buff stone facings, and it must be admitted that the treatment of this difficult architectural problem has been most successfully carried through by the architect, Mr. Ernest Flagg. The design of the structural steel work was worked out by Mr. O. F. Simsch as chief engineer, to whom we are indebted for courtesies in the preparation of the present article.

The leading particulars of the building are as follows: The tower is 65 feet square, and extends in height 612 feet from the sidewalk to the base of the flagstaff. The distance from the basement to the top of the flagstaff is 742 feet. There are forty-two office floors, and including the cupola and lookout there are forty-nine distinct stories. The weight of the tower alone is 18,365 tons. In the entire building there are 9½ acres of floor space, a large proportion of which is in the tower itself, which will contain sixteen offices on each floor, all of them lighted from the outside. It is estimated that when the building is fully occupied, it will accommodate about 6,000 people. For a structure of this size, it is necessary to provide quite an extensive engineering plant. In the present case this includes seven steam engines, five dynamos, thirty-three electric motors, twenty-eight steam pumps, besides air compressors, electric pumps, and other elements. The lighting of the building alone calls for 15,000 incandescent lamps. There will be sixteen elevators in the main building, and four in the tower.

From the viewpoint of the engineer, the most interesting feature is the means adopted for resisting the great wind pressure. During the summer thunder storms which burst over Manhattan with cyclonic fury from New Jersey, and during the equinoctial and winter gales, the wind will sometimes reach a velocity of from 50 to 70 miles an hour; and, of course, it became necessary to give particular attention to the question of the stability of a tower over 600 feet in height when exposed to the shock and thrust of such winds. Not only does the wind pressure tend to overturn such a tower bodily upon its base, but it induces enormous bending stresses within the framing of the building. It was realized that the most desirable method of stiffening the tower was to run a continuous system of diagonal bracing from top to bottom, giving to it the true triangulated truss form. From an engineering standpoint, the best way to do this would have been to run the diagonal ties and struts continuously from side to side of the building; but this would have interfered seriously with the proper size and spacing of the windows. The problem was solved in a way which gives ample strength to the tower, and at the same time affords opportunity for excellent architectural treatment. As will be seen from our large photograph, in each side of the tower there are six lines of columns, forming five panels. It was decided to run continuous bracing throughout the whole height of the corner panels, and to extend this bracing inwardly at the corners for the depth of one panel. Also continuous bracing was run throughout the full height of the tower around the center elevator well. The whole tower, as far as its wind bracing is concerned, may be considered as made up of four corner towers, each 12 feet square in plan, and a central tower inclosing the elevator well. As will be seen by reference to our engravings, this arrangement provides an open space 36 feet in width down the center of each face of the building which is entirely free from diagonal bracing. These spaces are occupied by large bays filled in with glass, while the corner towers are lighted by single windows, which are so disposed that they are evenly spaced in a vertical direction, and are not in any way interfered with by the wind bracing.

Now, although this elaborate system of bracing, coupled with the resistance afforded by the masonry walls of the tower, is sufficient to resist all bending stresses, so great is the height and so large the area of the building, that precautions had to be taken to prevent the windward columns of the wind trusses from lifting from their foundations. The total uplift on certain columns amounts, under the most severe conditions, to as high as 470 tons. To provide against this, the columns are anchored down to the caissons, the margin of safety against lifting being never less than 50 tons on a column. The

The Top of the Projecting Columns is 500 Feet Above Street Level. Note the Wind Bracing in the Side Panels.

THE ERECTION OF A 612-FOOT BUILDING IN NEW YORK.

figures for the loading on a single one of the columns will be of decided interest. The total dead load at the foot, when the tower is fully occupied, will be 289.2 tons, this amount representing the weight of the steelwork and masonry. To this is added 60 per cent of the maximum live load, which reaches at the foot of the column in question a total of 131.6 tons, thus making a total dead and live load of 420.8 tons. The downward pressure on the foot of the leeward column due to the wind pressure is 758.8 tons, which added to 420.8 tons gives a total load on the column of 1,179.6 tons. In the whole tower the greatest combined load on a single column, when the building is completed and fully loaded and subject to heavy wind pressure, will be 1,585 tons.

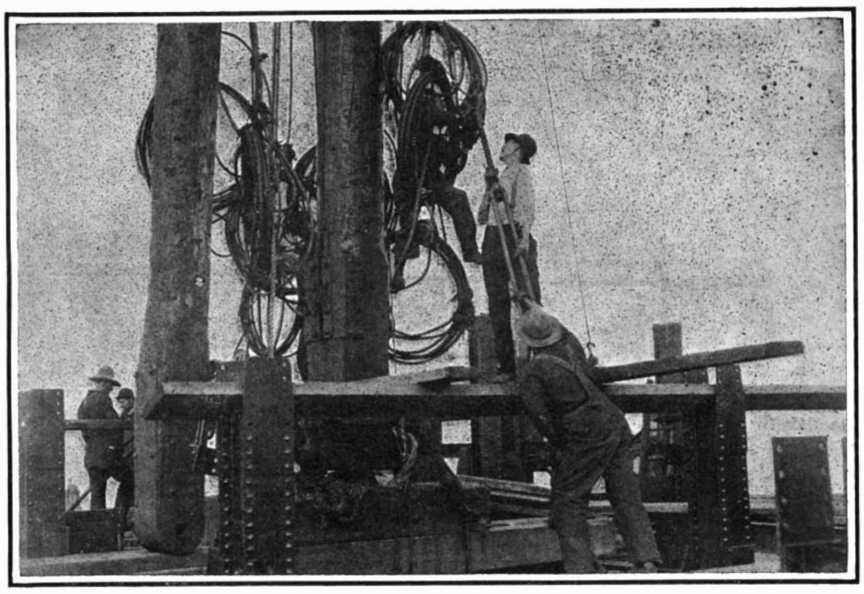
When once the steelwork of the tower was clear of the roof of the main building, the structure began to go up with great rapidity. The lifting of the steel columns and girders is done by means of a large derrick, the mast of which is placed centrally upon the topmost floor of the building, and guyed down with steel ropes to the tops of the outside posts. The swinging boom has sufficient reach to extend well clear of the sides of the tower and pick up the structural steel, either direct from the trucks on Broadway, 500 feet below, or from one of the intermediate platforms, to which it has already been lifted. After a sufficient amount of steel has been taken up for the erection of another two or three stories, the derrick picks up the various members, and swings them into position, where they are first bolted by the erection gangs, and then riveted by the riveting gangs. Our front-page engraving, taken at the 500-foot level, shows a couple of the erecting gang making preparations at the top of one of the columns to receive the next length above it, which will be lowered between the two cover plates and temporarily bolted to them. After the columns are erected the beams are swung into place and bolted up, and then the riveting gangs rapidly rivet up the work, being followed by other gangs, who put in the terra-cotta flooring. In the present case, one of the chief difficulties is to find storage room for the vast amount of material which must be on hand in order to keep the work steadily progressing. The material is stored on the various floors as fast as they have been filled in with terra cotta, and is subsequently built in position as required.

The view from the 500-foot level is superbly beautiful and full of varied interest. Certainly, it could not be matched in any city of the world. Lower New York, flanked by the East and Hudson Rivers, appears blocked out with the distinctness and regularity of a map, and the foreshortening of the nearer office buildings is so pronounced, that even the 300-foot structures look insignificant as viewed from a point 200 feet above their own roof line. The great altitude enables the eye to trace the outlying suburbs of New York in surprising detail.

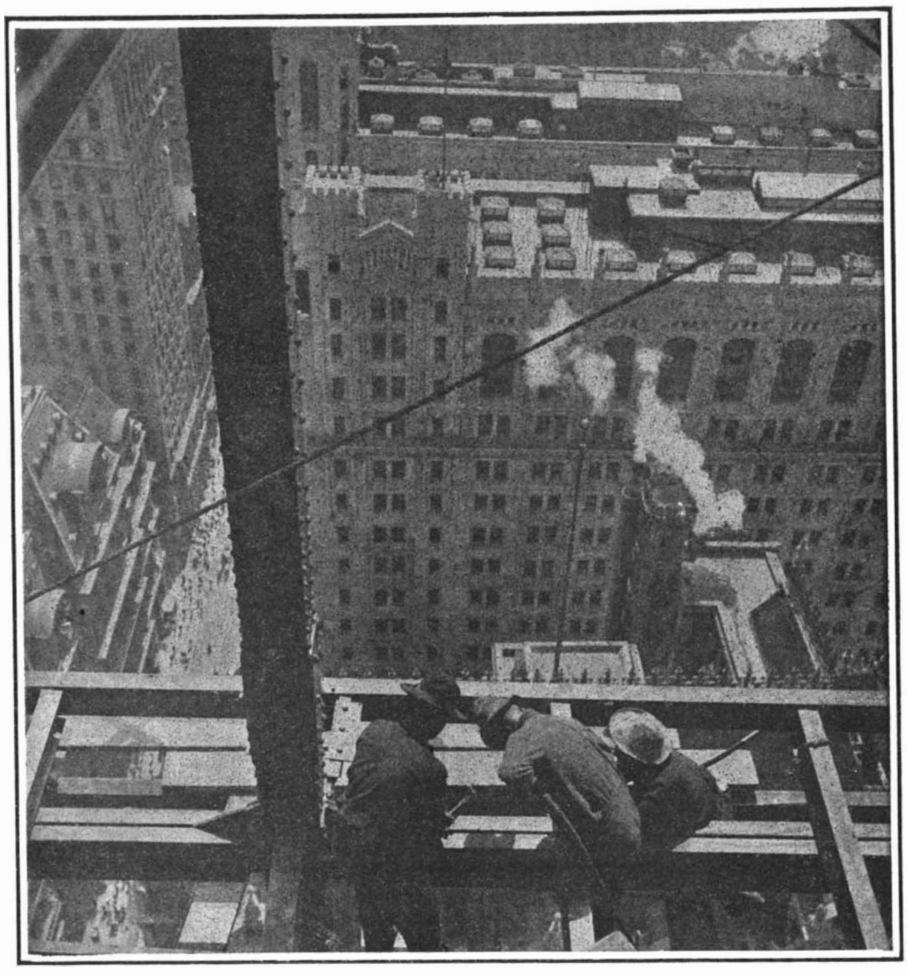
When the building has been carried to its full height, and the topmost observation platform is available, the horizon will be even more extended, and the map-like detail of New York, as spread out below, even more pronounced.

The first railroad in Morocco was opened some months ago. It was built by a German company to haul stone from a quarry to tide water, and is only about one and one-quarter miles long.

Working on a Corner Post of the Tower at the 450-Foot Level.



Adjusting the Derrick at Topmost Floor for Hoisting New Steelwork.



View Looking Down Upon the Realty Building (380 Feet High) with Broadway Showing to the Left.

THE ERECTION OF A 612-FOOT BUILDING IN NEW YORK.

New Railway in Asia Minor.

A railroad project of great interest is the proposed Bagdad railway which Germany expects to carry out. The promoters of the scheme desire to give direct connection between Hamburg and Berlin, by way of Budapest and Constantinople, with Konieh, Bagdad, and Basra, thus reaching the western end of the Persian Gulf. The Kaiser is backing up the scheme, and the Sultan Abdul Hamid is warmly in favor of the new railroad, as naturally it will do much to develop the resources of Asia Minor. Germany has already secured a concession from the Turkish government which will secure her immense advantages, for the railroad running through Asia Minor is no less than 1,700 miles long, and the concession includes a tract of land twelve miles in width on each side of the railroad line, including mineral rights. The construction of the road has been already commenced, and the section from Konieh to Eregli in the Taurus region is now constructed. This section is 120 miles long, and it is proposed to build several other sections in the same region, probably three, of the same length. Where the line passes across the Taurus mountains it will be difficult to build, and will require a considerable amount of engineering work.

It is stated that the German engineer Siegesmund Schneider has worked out the plans for a bridge over the Bosphorus which have the Kaiser's approval. The Turkish government is doing everything possible to have the project carried out, and there will be practically an alliance between the two countries which may be far-reaching. Germany by this means will extend and confirm the commercial supremacy which she has been gradually acquiring in Turkey. What is desired especially is to develop the great mineral and agricultural resources of this wide region. Considering the future of the cotton supply of Mesopotamia alone, this would give Germany a vast advantage in securing an independent source and thus being free from the obligation to take supply from America. There are immense mineral riches to be developed, and one of the most important is the petroleum fields in the region of Babylon and the Tigris and Euphrates valley. It is said that their value is many times that of the Baku oil fields. As regards the raising of wheat, this can be carried out on a vast scale in Syria, Anatolia, and Mesopotamia, and in the future these regions can be counted on for a supply which may equal that of Russia. Experts are now investigating the coal seams at Eregli, the present limit of the road, and the results are encouraging. An important point is the rights which are given by the concession for making use of water power along the present tract, and electric plants can be operated in this way so as to provide current for different localities on the railroad line. Privileges are also granted for navigation on the Tigris and the Euphrates, and this may lead to the construction of quays at Bagdad and Basra and also at various points on the Persian Gulf. Germany will also be able to make connection with British India and establish commercial relations on a large scale with that country.

According to Power, gas generated in a producer, without the use of steam, has a thermal value of about 70 British thermal units per cubic foot. By using steam with the air admitted to the fire, the producer gas generated will have a thermal value of from 135 to 140 British thermal units per cubic foot.

ELECTRIC LOCOMOTIVES OF THE PENNSYLVANIA RAILROAD.

With a view to determining the type best adapted to pull its heavy passenger trains through the New York tunnels, the Pennsylvania Railroad has in progress a series of experiments upon electric locomotives. On its West Jersey and Seashore Division and on the Long Island Railroad, two direct-current, heavy-type locomotives have been put in service. In general appearance they are quite similar, and resemble a short two-truck passenger coach, with few windows and large wheels. One of the locomotives weighs 174,100 pounds, and is equipped with four motors, aggregating 1,400 horse-power, which drive the wheels through single reduction gears. The other locomotive weighs 195,200 pounds, and is equipped with motors aggregating 1,240 horse-power, which drive the wheels directly without gearing.

By comparing the performance of the two locomotives, it will be possible to determine the relative merits of the two systems of driving. Another important question, relating to the method of supporting motors, will be settled by observing the performance of one of the locomotives. One of its trucks has motors fastened to the truck frame, and the other truck has motors which rest on springs supported by the main journals, and which are independent of the truck frame. The couplers and buffers are carried by the trucks instead of on the underframe of the car body. By this arrangement, strains of buffing and pulling are transmitted directly through the trucks, and do not enter the body of the cab at all.

Over all, the locomotives measure 37 feet 10½ inches in length, 10 feet 1¼ inches in breadth, and they are 13 feet 4 inches high. The driving wheels, which are 4 feet 8 inches in diameter, are supported by axles 8 inches in diameter at the center. The cab is of steel, and the electrical apparatus which it contains is arranged along the sides, allowing a passage through the center. Electrical connections are so arranged that if two or more locomotives are coupled together and pulling the same train, they can be controlled by the engineer of the first locomotive.

A Widespread Scientific Hoax.

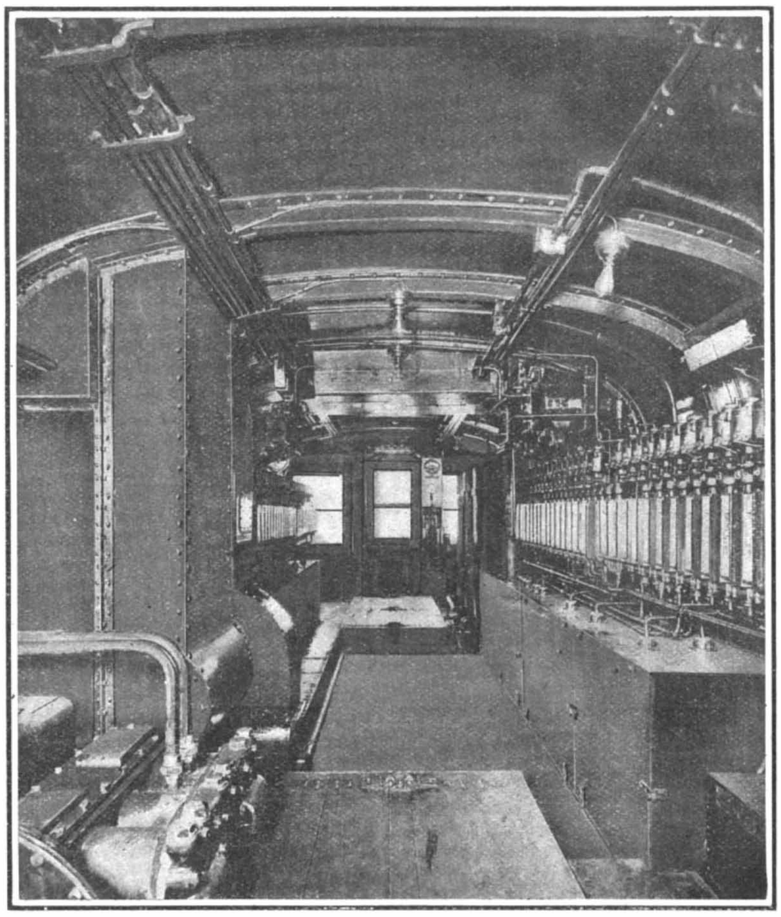
BY FELIX J. KOCH.

While scientific hoaxes of every sort are heard of and overthrown from time to time, there is one "fake," at least, which has managed to survive well on to a quarter century, and having crept universally into the histories, ethnologies, and anthropologies, will doubtless require many years for its complete overthrow in the minds of the public. This hoax was the plot of a simple miner in Calaveras County, California, a good many years ago, and it has been perpetuated by the most careful scientists as the famous "Calaveras skull."

Almost unknown to fame, there now lives in Los Angeles as assistant rector of the Episcopal Pro-cathedral, the Rev. Mr. Dyer, to whom belongs the credit of exposing the Calaveras imposition.

Mr. Dyer, who is now a man quite well along in years, tells his story as follows:

"I was stopping in the eighties with John C. Scribner, the Wells-Fargo agent, druggist, and keeper of the country store at Angels Camp, Calaveras County, about five hundred miles from here. This Angels Camp was a mining camp then of about three hundred population; and at the time the trick was played the population was slightly greater. I was talking with Mr. Scribner in his store, and also with an old friend of his who happened to be present, and whose name I have forgotten. Conversation led to old times, and among other incidents coming up, was the story of how they fooled everybody about the famous skull. They, however, assumed that I and every one else now knew that it was all a trick, and no longer attempted to disguise the facts, as they were glad they had had a little laugh over the effect of it. What they had said convinced me that the trick was as stated. On my return to Los Angeles, therefore, I called on an old gentleman they had mentioned as having had a hand in it, and by recalling certain incidents to him, got him to recount the hoax.



INTERIOR OF THE NEW TEST ELECTRIC LOCOMOTIVE OF THE PENNSYLVANIA RAILROAD.

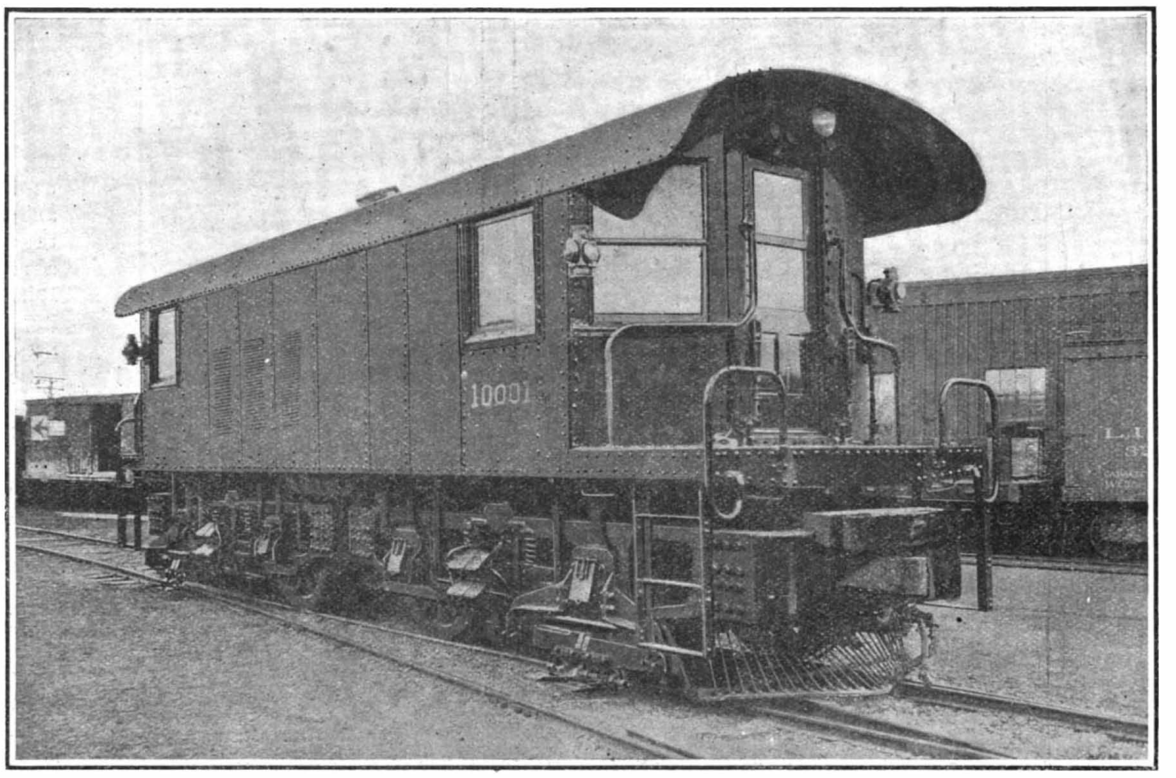
"His story was a typical one of the old mining camps. The skull, he said, had been placed by Scribner in Matson's mine at Angels Camp, to fool Matson. This man Matson was a blacksmith, who, when work was dull, would dig a bit deeper down in his shaft. Scribner, therefore, dug into the *debris* at the bottom of the mine, and hid the skull where Matson's pick must strike it. Matson, as per the plotter's plan, went down the shaft very shortly after, struck into the earth, and the first thing his pick brought up was the skull.

"Of course Matson was astonished. The skull, he saw at once, could not have grown there, nor could it have fallen there. Matson, by the way, was really an intelligent man, one of a great number of men who had come out here to make their 'pile,' and then quit the country as soon as possible. He recognized the possible value to science of the skull, and took it to Scribner's partner, who took it to Scribner, telling him of the find. The joker kept his secret, and the fame of the skull spread. Gradually both the story and the cranium came into the possession of a certain Dr. Jones, of Murphy's Camp. When State Geologist Whitney came through that part of the State, he was made acquainted with the find, and secured the valued treasure. He, after investigation of the place of finding and the nature of rock, gave credence to the tale, and proclaimed the finding of the skull of a man of the Pliocene period.

"It remained for a poet, Bret Harte, to hit at the truth—in a humorous poem suggesting that the skull was that of a Digger Indian. Scientists the world over, however, felt assured that the oldest human remain now known was that of this creature of the Pliocene era. Only Prof. Le Conte, of the State University, was dubious, and his scruples were based on a feeling that there never had been definite proof that the skull had been found where stated. He, however, described what facts were known to him, and let the question remain open. Meanwhile the Smithsonian Institution sent men to take samples of the earth from the surface at Angels Camp, and at different depths in that shaft. The wiseacres also inspected the skull, and found some earth inside it. This they took away to analyze, but no one knows what their tests proved. Possibly they learned that there was a stratum of the earth of to-day down in the bowels of the Pliocene strata, a statement so ponderous that they felt it would not do to make it public. But whatever was found, the tests were not made known.

"From time to time one has heard doubts expressed about the skull. The old men of the camp locality have long known the truth, and told it to anyone who would ask and listen. It is one thing, however, to proclaim a discovery, and have it taken up by the press, and quite another to get a denial as widely spread. When I discovered the facts, Scribner had been dead several years, and at rest back in New York State. At the time of his funeral, I was told, they pronounced quite an oration upon his career at Angels Camp, when again the story was told, and his sister has written me that she too for a long time knew the truth about the skull. I first told the *facts* to a reporter of the Los Angeles Times, but history seems to stick to the delusion. I visited Angels Camp for the last time in the eighties. Near the foot of the camp there was then still an Indian burial place (there having been an Indian village nearby), and skulls could readily be obtained.

"As to the skull, there are pictures of it in the reports of the Smithsonian Institution, and from these it is evident that the Indian was a Digger, and that he had died of violence, having been crashed on the head by a heavy bludgeon, in such wise as to cause him to throw the head far back, so that it is on a level with the spine, a bit of the backbone still remaining."



ONE OF THE NEW 1,400-HORSE-POWER DIRECT-CURRENT ELECTRIC LOCOMOTIVES INTENDED FOR USE IN THE EAST AND NORTH RIVER TUNNEL SERVICE.

The movement of crude and refinery products from Port Arthur and Sabine amounted to 10,744,710 barrels in 1906, compared with 10,482,797 barrels in 1905, indicating an increase of 261,913 barrels. Crude constituted 6,223,628 barrels of the total, refinery products 4,521,082 barrels. Of the crude 3,481,940 barrels went from Port Arthur and 1,118,513 barrels from Sabine. Of other grades 3,402,569 barrels went from Port Arthur and 4,521,082 barrels from Sabine. The total port movement of crude as compared with 1905 shows a decrease of 372,078 barrels in 1906. The movement of other grades in 1906, compared with 1905, shows an increase of 633.991 barrels.

The radium mines at Joachimsthal, in Austria, recently supplied the Vienna Academy of Science with ten tons of uranium ore, and this has yielded $250,000 worth of radium.

MOVING THE MONTAUK THEATER.

A task of "house moving" on a colossal scale is just now being carried on, with every appearance of success, in the neighborhood of De Kalb and Flatbush Avenues, Brooklyn. When it is stated that the weight of the building is several thousand tons, and that it has to be moved back some 50 feet from one street, slewed around, and moved another 65 feet to another street, and this without causing any settlement or the slightest crack in the massive brick walls, it will be understood just how formidable and delicate a job this is. The old Montauk Theater, which is 153 feet in length by 45 feet across its greatest width, has stood for many years with its façade on Fulton Street. Recently the city decided to construct an extension of Flatbush Avenue; and since the new street line cut diagonally through the center of the building, the theater was purchased by the city, who subsequently sold it to private purchasers, who decided that there were yet many years of useful life in this fine old theater, and made arrangements to shift it bodily to a new site, on that portion of the block which would be left after the Flatbush Avenue extension had been cut through.

The theater is built entirely of brick. The walls are 2 feet 6 inches in thickness at the base, and 65 feet in height around the auditorium, and 95 feet high around the stage. The building is rendered particularly heavy by the fact that it is of fireproof construction, with a brick arch roof and galleries, and other details of construction of unusual weight. By reference to the accompanying diagram, the old and new positions of the theater will be made plain. Briefly stated, the task consisted in moving the theater bodily 47 feet back from De Kalb Avenue, slewing it around through an angle of 85 degrees, and then moving it forward between 60 and 70 feet until it fronted on Hudson Avenue.

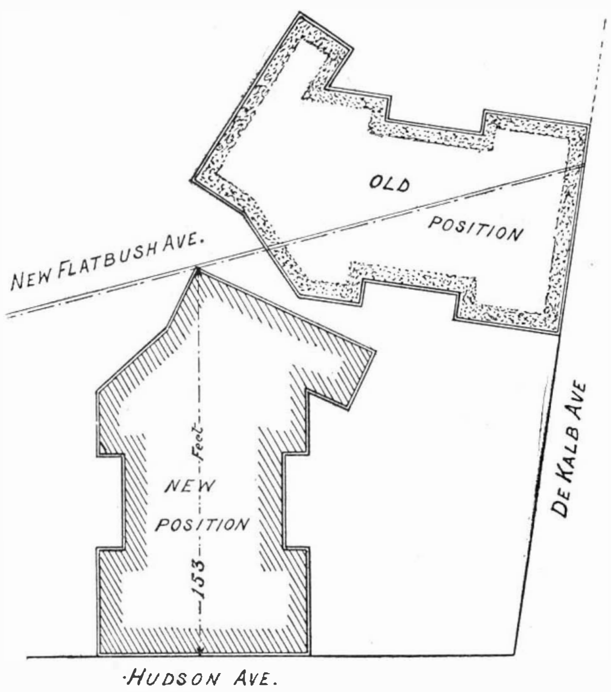
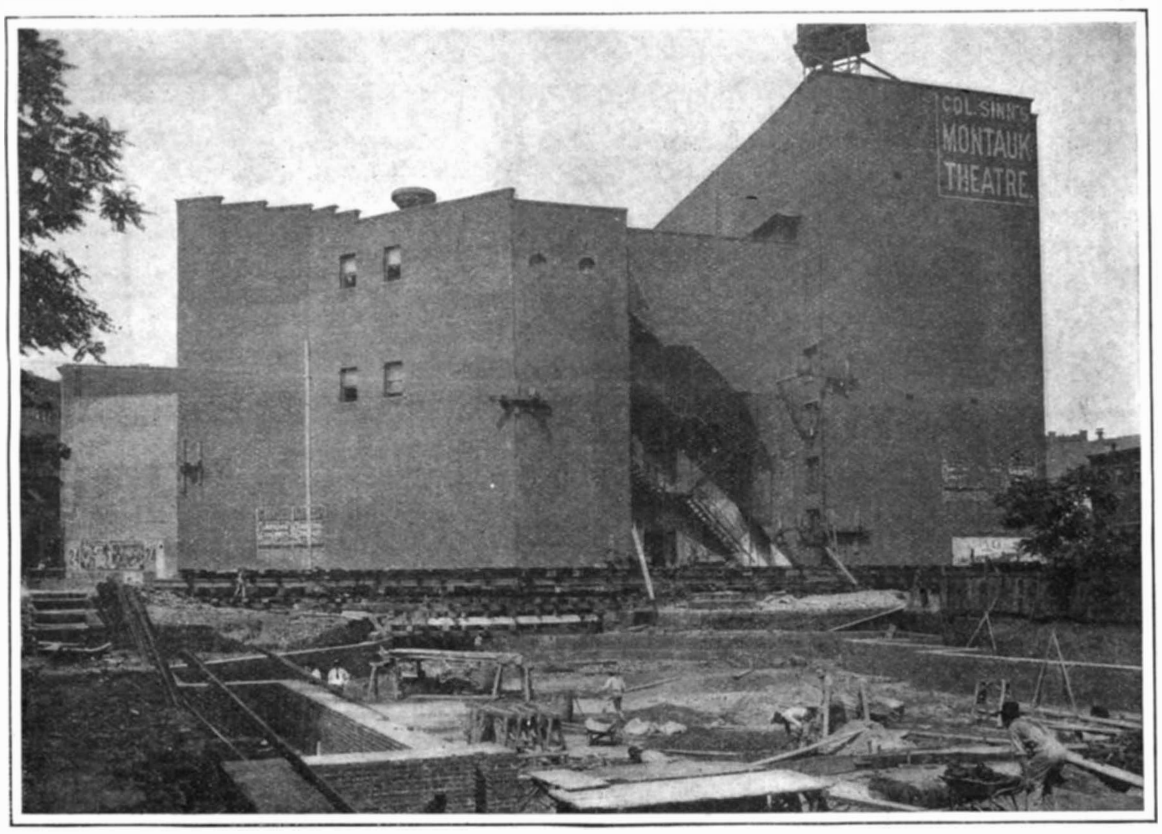


Diagram Showing the Old and New Positions of the Montauk Theater.



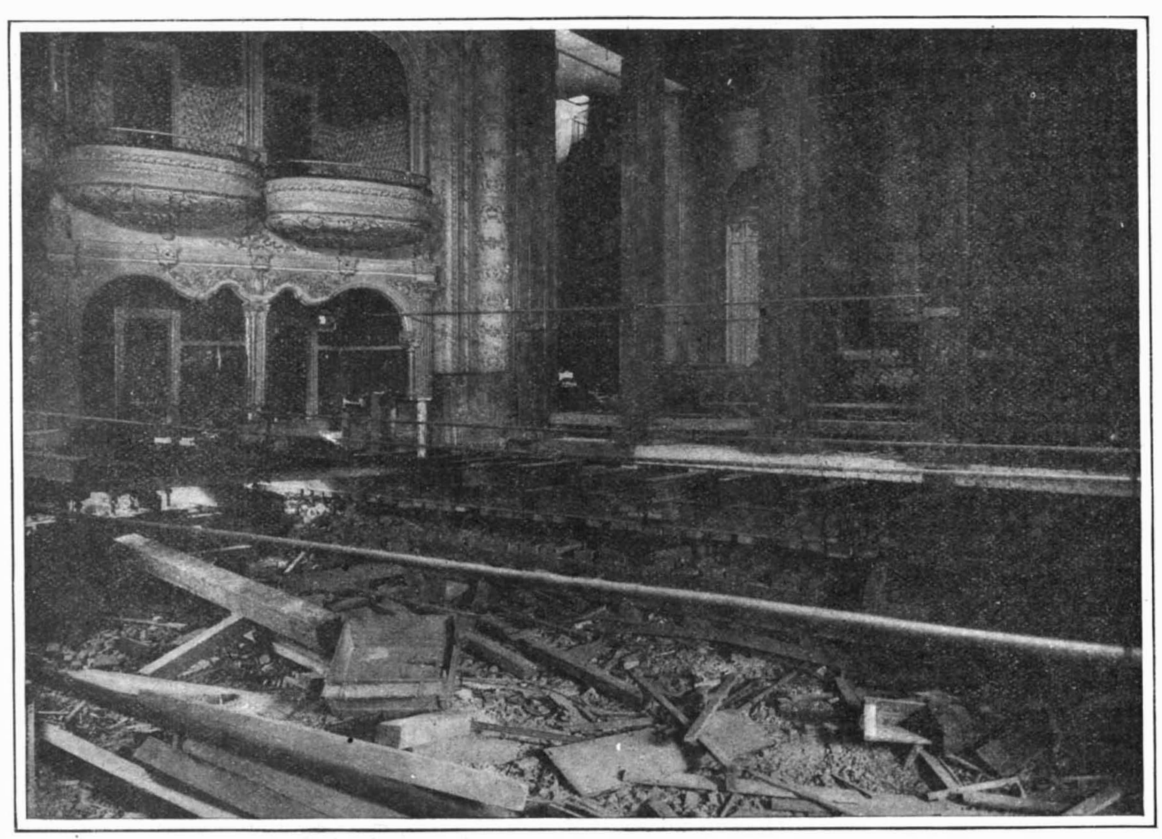
Montauk Theater Cut From its Foundations, and Being Moved on Steel Rollers to Its New Foundations.

The first step taken by the contractors, Iversen & Gustavsen, in moving this vast shell of a building, which has no interior division walls to bind the outer walls together, was to provide a system of struts and tie-rods which would serve to keep the whole structure in true vertical position and prevent distortion of any kind, either in a vertical or horizontal plane. Therefore, the floor of the auditorium was cut away, and horizontal lines of 12-inch by 12-inch timber struts were run across the building at the level of the floor, and heavy 1½-inch tie-rods provided with turnbuckles were carried through the walls, in the line of the timber struts, and attached to large wooden beams on the outside of the walls. By driving wedges between the abutting ends of the 12-inch by 12-inch struts and screwing up the turnbuckles on the tie-rods, the walls were securely held in their exact relation at the plane of the auditorium floor. Other sets of tie-rods were run across the building at the level of the balcony. Particular attention was paid to the proscenium arch, which is of 35 feet opening and spanned by a steel girder. The load of the wall above this girder is carried upon two brick piers, formed by thickening the walls on either side of the arch. In order to relieve these piers of their concentrated load and distribute the weight more evenly upon the supporting crib work below, ten 12-inch by 12-inch vertical timber posts were placed across the opening, extending from the under side of the arch to a bearing upon 12-inch by 14-inch timbers laid upon the crib work beneath it. By wedging these vertical supports, the arch load was transferred largely from the piers to these timbers, and so distributed to the crib work.

The first task was to cut a series of holes through the base of the theater walls, spaced 3 feet center to center, and introduce through each hole two 15-inch I-beams. At their ends these I-beams rested upon two parallel lines of crib work, one on each side of each wall. The crib work was built up as follows: Upon the ground were first laid 12-inch by 12-inch timbers in courses of varying depth to compensate for the irregularity of the ground, and upon these were laid parallel lines of 60-pound steel rail, the rails being laid in groups of four, there being one such group directly below each point at which the wall of the building was pierced for the supporting I-beams. Immediately below the I-beams which supported the walls, longitudinal lines of 15-inch I-beams were laid in pairs parallel with the walls, and between the bottom of these last-named beams and the top of the steel rails, were introduced the nests of 2-inch turned-steel rollers, upon which the building was to make its journey. The next step was to provide an abutment for the horizontal jacks to bed against, when the actual moving of the building took place. For this purpose, 12-inch by 12-inch timbers were laid parallel with the De Kalb Avenue wall of the building, and anchored by chains to the supporting crib work below the building. Twenty-five jacks manned by twenty-five men were then placed at regular intervals between the 12-inch abutment timbers and the longitudinal 15-inch I-beams—twenty on the outer wall and five on the inner wall. The wall of the building between the needle-beam supports having been cut away, and the building slightly raised on 1,200 jacks, everything was now ready for the horizontal moving. The screwing up of the jacks was done by signal, each man taking a half turn when the whistle sounded. The work proceeded without any hitch, and in the course of a week the huge mass had been moved back 47 feet from De Kalb Avenue.

In slewing the building around, a center will be taken within the building, and the turned-steel rollers will be laid radially from this center. The jacks will be applied tangentially at the corners of the supporting framework, and the huge mass will rotate exactly as does a bridge on its turntable. When it has been turned through 85 degrees, it will be pushed forward until the wall which fronted on De Kalb Avenue is fronting on Hudson Avenue. Here it will be lowered upon a new foundation which has been already built in place.

In the history books in use in English grammar schools about a quarter of a century ago, the pupils were led down centuries of kings or of wars—normal English history in those days took cognizance of little else—until in due course they reached the reign of George III., of happy memory, and the "South Sea Bubble." This curious name is given to a period when England went speculation mad, and people ruined themselves by financing the most hare-brained schemes. To return to the history book: As an example of the fantastic ideas to which people were willing to subscribe two are quoted—a plan "for importing live jackasses from Spain to improve the quality of the domestic breed," and one for "casting sawdust into perfect boards without knots or flaws." More than a century ago these ideas commanded capital, and thirty years ago they were quoted as wildly fantastic. But many Spanish asses have been imported to the United States—though not exactly to "improve the local breed"—and the idea of using sawdust has long been turned to practical use.



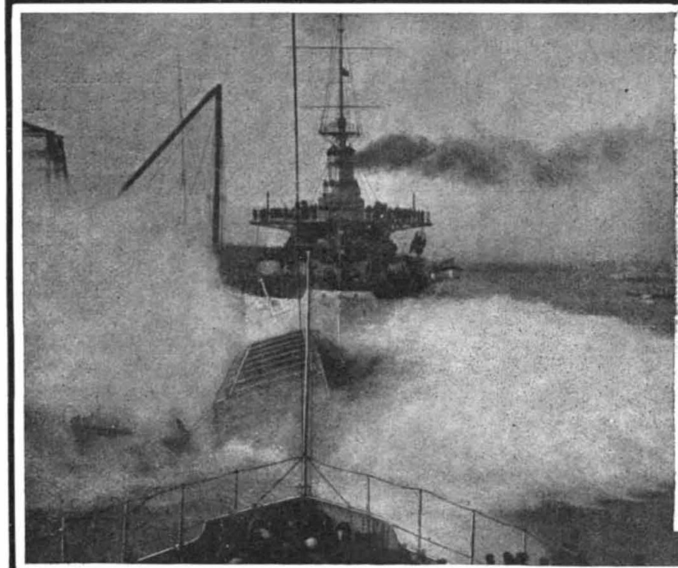
View Inside Theater, Showing the Crib Work, the Tie Rods, and the Vertical Posts for Bracing the Proscenium Arch.

MOVING THE MONTAUK THEATER.

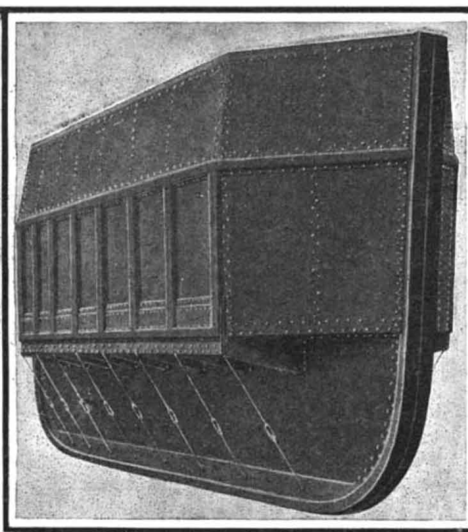
THE LAUNCH OF THE CAISSONS RECENTLY BUILT AT THE NORFOLK NAVY YARD.

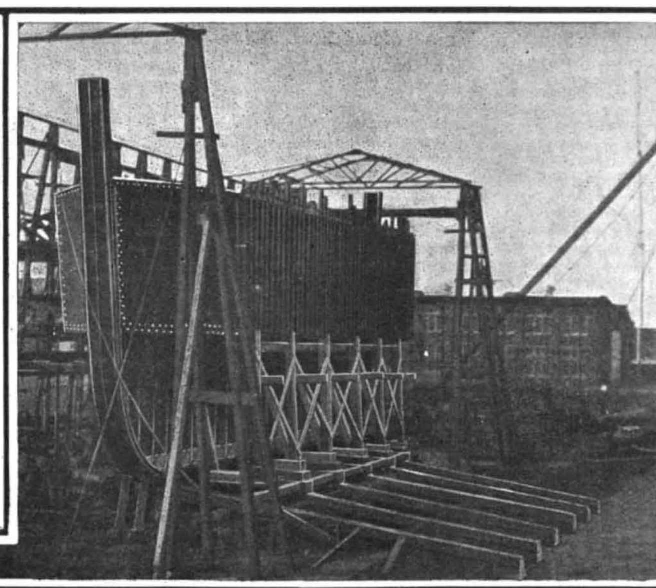
BY E. C. HAMNER, JR., ASSISTANT NAVAL CONSTRUCTOR, U. S. N.

The caissons recently completed for the drydocks at Charleston, S. C., and Norfolk, Va., differ from the old ship-shaped caissons in several particulars.

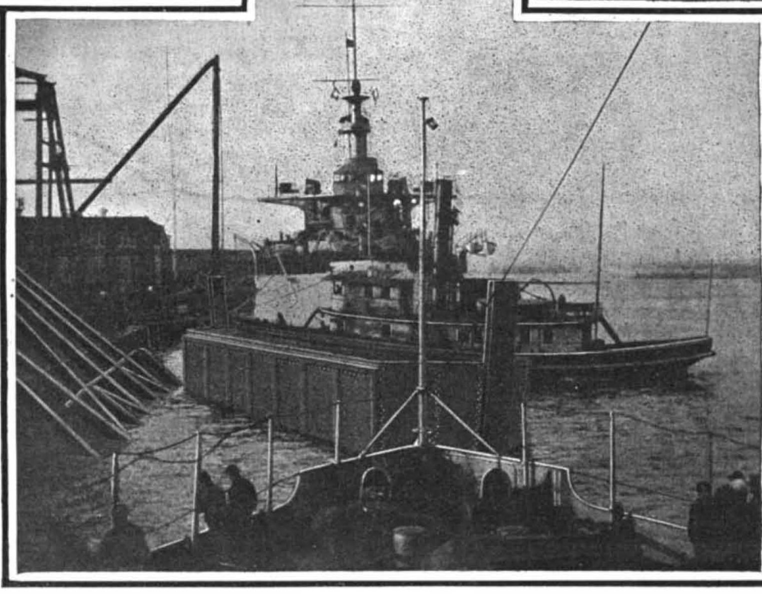


The Launch.





On the Ways.



After the Launch.

THE LAUNCH OF THE CAISSONS RECENTLY BUILT AT THE NORFOLK NAVY YARD.

A section of the caisson built in 1892 for the stone dock at the Norfolk navy yard, which is the general type of caisson now in use in nearly all docks, is essentially boat-shaped, and built up from the keel, with frames and plates leaving tanks inside for flooding.

The new caisson, as shown by section, consists of a box with parallel sides tapering toward the ends, and a flat bottom, under which projects a deep fin keel, which is stiffened on each side by I beams, and also by tie rods fitted with turnbuckles which connect the bottom of the keel to the outer edge of the overhang of the box. The plating of the keel is 30 and 40 pound plate, and of the upper body 20 and 17½ pound plate; the material throughout being of mild steel.

One caisson is provided with ten 24-inch gate valves, and the other with twelve 22-inch gate valves, for flooding the dock; these valves are both hand and electrically operated, each valve being operated by a small induction motor, the induction motors being operated from a common starting panel. For pumping out the ballast tanks a centrifugal pump with 15-inch suction is provided; this pump is also driven by an induction motor.

The dimensions of these caissons are approximately: Length, 114 feet; beam, 20 feet; depth at center, 42 feet; draft, light, 26 feet; draft with ballast tanks filled, 36 feet; displacement, 1,050 tons.

Besides the departure from the conventional ship form of floating caisson, the most interesting feature was the peculiar means of launching. There was available at the Norfolk navy yard the old launching slip used for the "Texas" and "Raleigh." In order to use this, however, it would have been necessary to extend the ground ways to a great distance into the stream, on account of the great draft of the caissons in the launching condition, which was 23 feet 7 inches. This was objectionable, not only on account of the cost involved, but because it would have interfered with navigation in the narrow channel opposite the yard. It was consequently determined to launch the caisson broadside on. This method is regularly employed on the Great Lakes, but there the ground ways are carried out far enough for the ship to become water-borne before leaving the ways. To have built such ways would have been as difficult as to build ways for an end-on launching.

The ground ways, which were temporary, were carried out over the sea wall for a distance of about 13 feet, and the height of the sea wall above the level of the water was about 7 feet. The ground ways were not secured to the ground, and when the caisson reached the edge of the wall, the inner end of the ground ways rose, tilting the caisson. The caisson itself was carried on a cradle resting on six sliding ways; this cradle was weighted so as to sink clear of the caisson, as were also the outboard ends of the ground ways.

From tests made on a model in the tank, it was expected that the caisson would strike the water at an angle of nearly 90 deg., i. e., that the side of the caisson would strike almost flat. To protect the side plating, which was 20-pound plating, there were nailed along the side white oak planks 6 inches by 12 inches, spaced about one foot apart. The accompanying pictures show the caisson before, during, and after launching; the one showing her taking the water gives a good idea of the tilting effect of the ground ways.

THE COLD STORAGE OF FURS.

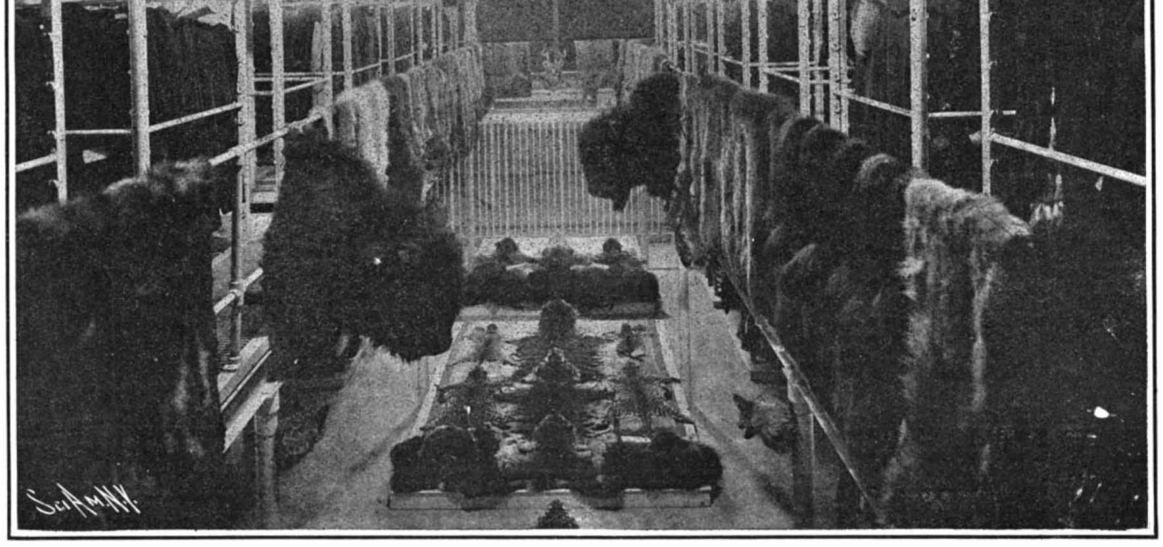
It is reasonable to suppose that any set of conditions under which furs naturally thrive, would if successfully reproduced offer the best means for preserving them. That is the principle adopted for the modern storage of furs as exemplified by the dry-air cold storage method.

Furs are finest, glossiest, thickest, and best in the coldest climates. The most valuable pelts come from the Arctic or sub-Arctic regions, and hence, to retain their natural brilliance, they should be kept, as far as possible, during their summer period of rest, in a temperature equivalent to that of their native land. Where such conditions prevail, the natural oils of the skins are preserved, instead of drying out in the summer heat of the average storehouse. Again, in cold storage damage by moths is absolutely prevented. Freezing benumbs the larvæ and renders them harmless for the time being. Preliminary precautions are of course taken thoroughly to clean the furs before storing them. It was with these facts in view that the new fur storage plant was planned. Existing plants were carefully studied and the shortcomings they developed were avoided.

The plant occupies a space 80 x 120 feet, extending from the eleventh to the thirteenth floors of the Wanamaker building. The walls, which are 24 inches thick, are composed of cork and fireproof materials and absolutely exclude the heat of the outside air. Entering the storage vault through a series of air-locks which are protected by doors built on the principle of those used on refrigerators, the observer is struck by its whiteness, airiness and lightness.

No wood is used in the floors, walls, or ceilings, concrete and steel being the only materials. The floors of the upper tiers of the vault are formed of iron gratings, like those in the engine room of an ocean liner. All the iron cross-pieces from which the hangers for the garments are attached are removable and can be arranged to suit the number and length of the articles to be stored.

The ground floor of the vault is equipped with about 4,000 spindles projecting horizontally from uprights, giving storage



SCENE IN A COLD STORAGE ROOM FOR THE PRESERVATION OF FURS.

room to nearly 8,000 muffs or the various pieces composing fur sets. On the floor of the open court in the center are platforms for the storing of mounted animal rugs—and a remarkably fine collection of wild beasts are now convened there. The three upper tiers have provisions for storing upward of 50,000 fur coats, wraps, lap-robes, etc. Sprinklers arranged on the dry-pipe system afford protection in case of fire.

The system of refrigeration represents the very latest in the art. No brine pipes enter the vault, thus avoiding the danger of damp, mildew, or a downright soaking with salt water, all fatal to a fine garment. A powerful ice machine, producing in cold the equivalent of 100 tons of ice daily, is located in the sub-basement of the building. This cools the brine to a temperature of 8 deg. above zero, and after the brine is pumped to the thirteenth floor it passes through a coil containing several thousand feet of iron pipe, where a powerful blower drives a steady current of fresh air over it. The extreme cold freezes all the dampness out of the air, which then enters the cold storage vault through openings in the roof, whence it circulates slowly through the whole room and is drawn off by outlets through the floor of the vault.

The air thus deprived of much of its cold is led back to the cold-pipe chamber, where it is again reduced to the proper temperature and starts on its journey once more. This constant circulation of cold, dustless, dry air maintains a temperature of 20 to 30 deg. above zero in the storage vault. Of equal interest to the customer is the manner in which the articles are identified and withdrawn when wanted. When furs are brought in for storage all pieces in each lot are tagged with the same number. A receipt is filled out in triplicate with the owner's name and address, date, valuation and description of the articles. One copy is sent to the customer and the other two are filed.

Insects That Destroy Metal.

The astonishing fact that in the Vienna mint the leaden walls of a reservoir containing sulphuric acid, although 43 millimeters, or about 1.7 inches thick, were eaten through by an insect; that the leaden gas pipe in a café was also damaged in like manner, and that also in the sulphuric acid factory in Nussdorf the wall of the lead chamber was found to contain defects from the same cause, has recently attracted attention to the damages done by insects both to wood and to metal. Such damages are due to a sort of wood wasp, of which there are many sorts in central Europe. The largest of these, the black and yellow giant wood wasp, resembles the true wasp, which is so feared by reason of its sting; but close observation shows it to be very different. Its breast and belly are joined by a wide connecting piece, whereas in the case of the real wasp the "waist" is proverbially small. On the under side of the elongated belly, the female has a very hard boring device, about 19 millimeters (¾ inch) long, black and fluted, and which lies in its sheath. Ordinarily this borer is directed backward; but when in use it is turned about its base, so as to make a considerable angle with the axis of the body, and is used like a rat-tail file until it makes a hole about 18 millimeters (0.7 inch) deep in the wood which it usually chooses to perforate. The egg which the female lays in the wood develops into a caterpillar-like creature with six short legs, and without eyes. (What would it do with eyes? About two years—during almost its entire life—it lives in the wood, in perfect darkness!) With its sharp, hard jaws it bites in the trunk of the tree tubular channels, which increase in diameter as it grows larger. It swallows the wood which it gnaws off, digesting the nutritious portions and discharging the rest in a meal-like form. For two years it eats its way forward in this manner. In the third year the insect creeps out, biting with its jaws through the thin wall which separates it from the outer world, leaving the home of its childhood to enter upon a short life in freedom.

Should a tree trunk that has been perforated by such a wasp, and in which an egg has been laid, be employed when insufficiently seasoned for building purposes, it may happen that some day the insect, which has been two years working its way through the piece, will suddenly appear in the building.

If a piece of such timber which contains a larva is surrounded by a leaden plate, the insect will not stop at this, but will bite its way through just as though it were of wood.

Almost more wonderful are the performances of the boring cricket. Although this is a dwarf compared with the wasp, it has been able in Rochelle to gnaw through the leaden roof of a building and to make holes 14 mm. (0.55 in.) deep and 4 mm. (0.16 in.) in diameter in printers' stereotype plates, despite the fact that by reason of the antimony in such plates they are much harder than lead.

There are more coke ovens being erected in the Connellsville, Pa., and neighboring regions than have ever been known before in the history of the coke trade. The number in hand and projected is 7,950, and the work on them is only restricted to some extent by the difficulty in obtaining labor.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

GARMENT-HANGER.—A. M. Taylor, Port Ewen, N. Y. The object of the inventor is to provide a hanger more especially designed for the use of ladies, and arranged to conveniently and properly support a coat, a skirt, a plurality of shirt waists and a hat in a very compact form and without danger of crushing or injuring any of the garments, and allowing convenient removal or replacing of any of the articles.

EYEGLASS ATTACHMENT FOR CAPS AND HATS.—J. A. Blackiston, Piedmont, W. Va. The inventor has devised an attachment by which the glasses may be secured to a cap vizor or hat brim, and out of the way when not in use, or they may be lowered and held in normal vertical position in front of the eyes without touching the nose. The glasses proper may be easily and quickly detached when it is desired to use them independently.

Electrical Devices.

TROLLEY-WHEEL.—W. H. Bradt, Schenectady, N. Y. The invention has reference to certain improvements in trolley construction, whereby there are provided two wheels revolving parallel on the same shaft, the object being to improve the contact of the wheels with the trolley wire to prevent sparking, and to increase the life and efficiency of the apparatus.

Of Interest to Farmers.

IMPLEMENT.—T. M. Walker, Brister, Ark. This is an improved tool of a construction adapting it as a convenient device for many purposes, such for example, as a grubber, cant-hook, fence-jack, and post-hole-digger. It is particularly useful to the farmers and others who have constant need of such a device.

BRUSH FOR COTTON-GINS.—W. W. Robinson, Alexander City, Ala. The brush is intended for use in gins or other machines requiring a revoluble brush of simple construction. The invention resides in a drum or cylinder, on which devices or sticks carrying the bristles of the brush are fixed. The cylinder is composed principally of sheet metal, providing a strong, light and well-balanced structure.

Of General Interest.

RAZOR.—J. F. Bailey, Valdosta, Ga. In practice, the implement blade will be made very thin and sharp, and can be used either in the right or left hand, and reversed, and the blade when pushed into the body portion will interlock, having the spring wings or tongue which may spread laterally when adjusting into and out of engagement with the projecting portion of the body. It is especially an improvement in what are called safety razors.

HAME-FASTENER.—S. T. Marlette, Buffalo, N. Y. This fastener comprises a slotted body having a hame hook at one end, a slidable hame hook projecting from the other end of the body, and having a downwardly curved shank, a lever provided near its free end with a lateral stud and a plate spring secured at one end to the shank of the slidable hook and provided with a hole to receive the stud, its free end projecting beyond a lever in position for manual access so that it may be pressed laterally for unlocking the lever.

BOTTLE-SEAL.—L. E. Hendrickson, Osage City, Kan. This device for use in sealing bottles is designed to prevent the opening of the bottle and dispensing of its contents without first breaking the sealing device. The invention includes under the term bottle, jugs, demijohns, and other containers having necks provided with downwardly facing lip or shoulder for engagement by the tongues of the locks.

PIPE-CLOSURE.—A. A. Fisk, Pomona, Cal. This improvement pertains to irrigation pipes, stand pipes, and the like, and its object is to provide a closure arranged to permit of conveniently, quickly, and securely closing the end of a pipe, and to allow of opening the same for making connection with another pipe whenever it is desired to do so.

BLOCK.—P. J. Macdonald, Bangor, Me. The aim is the provision of a light and easily constructed block which will relieve a load of sudden jerks and shocks as are incident in hoisting, drawing, and landing loads with the usual hoisting block. This is accomplished by forming a yielding connection between the block and the means for suspending or holding it in fixed position.

FIRE SHIELD AND EXTINGUISHER.—S. German, Monkton, Md. This invention is an improvement in apparatus designed especially for the protection of buildings from fire and for use in extinguishing the fire. In carrying it out the inventor provides in connection with uprights, shield sections extending between the same and preferably made of fireproof material and adapted to protect the structure, upon which it may be used, from fire when an adjacent building is burning.

ENVELOP.—H. C. Murphy, Marengo, Ind. Envelops of the safety type are improved by this invention. The object is to provide an envelop for the transmission of valuable matter through the mails by express or otherwise and having a novel means of sealing without employing adhesive, and which cannot be fraudulently opened or tampered with without detection.

CYCAS-LEAF HOLDER.—W. N. Reed, New York, N. Y. The improvement pertains to means for holding leaves, flowers, and the like, and more particularly for holding cycas leaves in definite position suitable for ornamentation. It admits of general use, but is used especially for the decoration and adornment of caskets, coffins, graves, and the like.

HORSE-BOOT.—M. Weiss, New York, N. Y. One purpose of the invention is to provide a metal boot adapted to be worn over the shoe, and means whereby the boot can be quickly and conveniently applied when needed and as expeditiously and readily removed when not needed. It will prevent slipping when traveling over exceedingly slippery roads, and will not be cumbersome, nor interfere in any manner with the motion of the horse.

SIGHT FOR FIREARMS.—G. B. Crandall, Cherry Valley, Ontario, Canada. Loose and inaccurate adjustment has been the result of attempts to secure a rear tang-sight having a wind-gage base. This inventor obtains a rear wind-gage by use of a sight stem having a wind-gage top no more likely to become loose and shaky than an ordinary tang-sight. An ordinary sight can be immediately converted into a very satisfactory rear wind-gage by the simple use of the extra wind-gage stem. It does away with the high and cumbersome front wind-gage sight and places a wind-gage at the rear, which all who use an arm, prefer.

Hardware.

CAN-OPENER.—J. Codville, Bella Bella, British Columbia, Canada. A shank member has rigidly fixed to it at its outer end a steel plate having means to puncture the can center with a slidable blade on the member adapted to co-operate with the puncturing means in cutting out the top of a round can. In connection with the blade is a guiding means to keep the blade at proper distance from the center. The plate at the end of the shank, in addition to the puncturing means, carries a cutting blade for opening square or irregular cans and a slot for engaging a removable strip as placed on some cans to provide means for their opening.

Railways and Their Accessories.

RAILWAY-TIE.—M. A. Glynn, Habana, Cuba. In this case the invention pertains to metallic railway ties, and is designed to provide means adapted to be readily connected with railway ties and to hold said rails firmly in position. It is also designed to provide means for cushioning the rails and enabling them to be readily detached from the ties and be replaced when desired.

CAR-FENDER.—F. J. McDonnell, New Bedford, Mass. The invention refers to car fenders such as are adapted to be carried at the front of a car to prevent persons from being run over. The object is to produce a fender of simple construction which will operate efficiently to catch the body on the track and move the same rearwardly, at the same time tipping downwardly so as to hold the body in a place of safety.

Pertaining to Recreation.

AMUSEMENT DEVICE.—G. E. Williams, Jersey City, N. J. The device comprises a square board having a flange at its outer edge, and a disk with a slightly concave upper face at its center. From its center the disk is provided with two concentric rows of pins, those of one row being staggered in relation to those of the other and surrounded by divisions alternating in color and of different numerical values. The disk has a rail surrounding its circumference and a bell in its center, the latter having a path leading to it through the pins and adapted to be rung by a marble or other sphere discharged in a novel manner.

BASE-BALL-GAME APPARATUS.—A. H. Heitmann, Columbus, Ohio. By means of the apparatus an indoor game of ball is played by small dummy players placed upon a board representing a baseball diamond. The object of the invention is to provide means whereby the game may be played with all the rules of an ordinary outdoor game of baseball, and all the realistic effects produced.

PITCHER FOR BASE-BALL-GAME APPARATUS.—A. H. Heitmann, Columbus, Ohio. This invention relates to improvements in toy base-ball game apparatus, and more particularly to means employed for throwing or pitching the ball; this application being a division of a prior one, filed by Mr. Heitmann. The object is to provide means whereby the direction, speed, and distance to which the ball is thrown may be readily controlled, and whereby the greatest possible velocity is secured.

BATTER FOR BASE-BALL-GAME APPARATUS.—A. H. Heitmann, Columbus, Ohio. The invention refers to improvement in apparatus for playing an indoor game similar to an ordinary game of baseball, and in which small dummy players are manipulated upon a baseball diamond board. This application is a division of a prior application filed by Mr. Heitmann, its object being to provide a batter so constructed that the bat may be swung in any direction, and in the direction in which the ball is batted may be more perfectly controlled.

AMUSEMENT DEVICE.—F. W. Thompson, New York, N. Y. The invention relates to improvements in amusement devices formerly granted to Mr. Thompson. The object of the present invention is to provide a construction involving a plurality of downwardly inclined slide-ways discharging into a common slide-way, the slide-ways being preferably contiguous except at a point intermediate their length, where they diverge and again converge before passing to the common slide-way.

Pertaining to Vehicles.

TRACE-CLIP.—C. A. Gunzelmon, Abilene, Kan. The invention refers to trace retaining devices and its object is to provide a clip which is arranged to securely hold the trace in place on the end of the whiffle-tree. To unlatch the trace, the operator presses certain members of the clip to disengage the hooks from the whiffle-tree, and swings the clip upwardly and inwardly to disengage it from the trace and to allow of slipping the latter off of the now free and unobstructed end of the tree.

VEHICLE-WHEEL.—M. G. Babio, New York, N. Y. The invention refers to improvements in vehicle wheels, or wheels which are particularly adapted for use in connection with automobiles and the like, and primarily to provide such wheels with a novel principle of twin pneumatic tubes. Mr. Babio improves in the present invention upon the construction shown in the patent formerly granted to him, on a wheel for light and for heavy service.

VEHICLE.—M. L. Johnson, Galena, Ill. The invention is an improvement in vehicles and particularly in the class of two-wheeled vehicles. The invention gives the horse a mechanical advantage by compounding the leverage of the shaft in making the draft direct from the spring gear and elastic to relieve the vehicle from the horse motion.

Designs.

DESIGN FOR A PLATE.—M. J. Mullins, New York, N. Y. This ornamental design is for a round plate in the center of which a milkmaid is milking a cow standing in a pasture amid farm scenery.

DESIGN FOR A TEAPOT OR SIMILAR ARTICLE.—L. Rouquart, New York, N. Y. In this ornamental design the pot stands in graceful proportions, swelling from the top and then gradually sloping to a short flanged base. The body rim on which the lid rests is sex-angled. The handle and spout are plain and tasteful in thin lines.

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.

HINTS TO CORRESPONDENTS.

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

(10603) C. S. says: Kindly let me know what substance or combination of chemicals will change its appearance or color under the action of a current of electricity. A. There are many solutions that will do this. Make a solution of potassium iodide and immerse two platinum poles connected to source of direct current. The positive pole will turn brown.

(10604) J. O. G. says: Are our battleships equipped with lightning rods? If so, in what way are they so equipped? I have heard that they were, but plead ignorant for my part, and any information you will publish will I think benefit more than one of your readers. Would a dynamo, direct-current, 4 amperes, 110 volts, run an arc light such as used in a moving picture machine? Said dynamo will run 12 lights 16 candle power. A. The whole battleship is a lightning rod. What better could you want than steel stacks and masts with a ground connection always moist? A dynamo 4 amperes is hardly large enough for a very bright arc lamp. These lamps take from 15 to 50 amperes at 50 volts when used for projection.

(10605) K. H. says: I have an iron-clad fan motor, formerly 220 volts. When I got the motor the armature windings were completely burned out. I have rewound the armature with No. 26 magnet wire. I find that this wire is so coarse that the motor will not run on account of the field magnets becoming so strong with this large wire on the armature that they hold the armature still regardless of the windings which tend to make it revolve. Before the present windings were on the armature I had it wound with wire the same size as the wire which was on it originally, about 34. With this wire on it the motor ran very nicely, but it took such a large voltage to run it that it was not of much use to me. What I want to know is what size wire to put on the fields and how much of it to make my motor run on a voltage somewhere between 50 and 120, the exact voltage I am not particular about. I desire it to run at a high enough speed to be a good fan motor. The motor is series wound. A. Wind your armature with No. 31 wire if the original size was 34. Put on one-half as many turns as there were before. For the field use a wire that has an area twice as large as the one originally used, and put on one-half as many turns. This ought to make the motor run at its original speed on 110 volts. Since you have given us so little information, we cannot help you further.

(10606) L. M. C. asks for a formula for ox-gall soap for cleansing silk stuffs. A. To wash fine silk stuffs, such as piece goods, ribbons, etc., one cannot do better than employ a soap containing a certain amount of ox-gall, a product that is not surpassed, if indeed it have an equal, for the purpose. In making this soap the following directions will be found of advantage: Heat 1 pound of cocoanut oil to 30 deg. R. (100 deg. F.) in a copper kettle. While stirring vigorously add ½ pound of caustic soda lye of 30 deg. Bé. In a separate vessel heat ½ pound of white Venice turpentine, and stir this in the soap in the copper kettle. Cover the kettle well, and let it stand mildly warmed for four hours, when the temperature can be again raised until the mass is right hot and flows clear; then add the pound of ox-gall to it. Now pulverize some good, perfectly dry grain soap, and stir in as much of it as will make the contents of the copper kettle so hard that it will give little to the pressure of the fingers. From one to two pounds is all the grain soap required for the above quantity of gall soap. When cooled cut out the soap and shape into bars. This is an indispensable adjunct to the dyer and cleaner, as it will not injure the most delicate color.

(10607) J. W. asks for a varnish for tin boxes. A. In 75 parts of alcohol dissolve 15 parts of shellac, 2 parts of Venice turpentine, and 8 of sandarac.

(10608) P. J. D. asks for a formula for bookbinders' varnish. A. In 90 parts by weight of alcohol dissolve 12 parts of Venice turpentine and 30 parts, also by weight, of shellac of light yellowish shade.

NEW BOOKS, ETC.

Engineering in the United States. A Report to the Electors to the Gartside Scholarships on the Results of a Tour in the United States in 1904-05. By Frank Foster. Manchester, England: The University Press. 8vo.; cloth; 114 pages.

A report on American engineering methods written from the English standpoint by a "Gartside Scholar" of the University of Manchester.

Sanitary Construction in Building. Edited by Paul N. Hasluck. With numerous engravings and diagrams. Philadelphia: David McKay. 16mo.; cloth; 160 pages. Price, $1.

A comprehensive, clearly written treatise on Sanitary Construction as applied to building. It contains instruction in various questions that have to be met by those who are doing construction work.

Modern Milling Machines. Their Design, Construction, and Working. A handbook for practical men and engineering students. By Joseph G. Horner. With 269 illustrations. New York: The Norman W. Henley Publishing Company. 8vo.; cloth; 304 pages. Price, $4.

Milling machines have become highly specialized and the work of milling is now subdivided between different groups of workmen, according to its difficulty, so that no apology is necessary for work which treats of but this single department of machine-shop practice. The sections which offer no special difficulties have been lightly dealt with, while special space is devoted to the manufacture of cutters and to the work of the machines that call for the exercise of special skill. A number of typical methods of holding work, as well as some fixtures and jigs, are shown, as a general guide to the machine attendant. Some of the latest improved machines are illustrated in detail, and special attention has been given to the question of speeds, and of feeds.

Tools for Machinists and Woodworkers. Including Modern Instruments of Measurement. By Joseph G. Horner. Illustrated with 456 engravings. New York: The Norman W. Henley Publishing Company. 8vo.; cloth; 340 pages. Price, $3.50.

An account of the tools commonly used by engineers and woodworkers, written chiefly from the standpoint of the men who use them, and who wish to understand the principles underlying the forms in which these tools are found. Practical instructions for their employment have been added. The work is more comprehensive in its scope than any which has preceded it, the subject of instruments of measurement being treated in a very full manner and freely illustrated.

Mortars, Plasters, Stuccos, Artificial Marbles, Concretes, Portland Cements and Compositions. Prepared, compiled, and edited by Fred. T. Hodgson. Profusely illustrated. Chicago: F. J. Drake & Co. 12mo.; cloth; 520 pages. Price, $1.50.

A practical treatise on the various kinds of cements, taking up their use from the period of mixing through all the various stages to the production of the finished building. The department devoted to more elaborate decorative construction should prove very serviceable to all who use this material.

Stray Currents from Electric Railways. By Dr. Carl Michalke. Translated and edited by Otis Allen Kenyon. New York: The McGraw Publishing Company. 12mo.; cloth; 101 pages. Price, $1.50.

The electrolysis of pipes and other metallic objects due to leakage of electric currents is a serious problem. A great deal has been written about it in different technical periodicals, but never before has information on the subject been placed in such form so as to be readily accessible. This volume does not give any method for preventing the disturbances, since too many factors depending upon local conditions enter into the problem. It describes, though, all the principles upon which leakage depends, and it should enable any one to solve his own difficulty by merely adapting the knowledge gained to the local conditions.

Cyclopedia of American Agriculture. A Popular Survey of Agricultural Conditions, Practices, and Ideals in the United States and Canada. Edited by L. H. Bailey. In four volumes. Vol. I., Farms. With 100 full-page plates and more than 2,000 illustrations in the text. New York: The Macmillan Company. Quarto; cloth; 618 pages. Price, $5.

The "Cyclopedia of American Agriculture" was announced several years ago, but unavoidable delays kept back its publication until this year. It collects and presents the most significant facts and opinions now current with respect to agriculture, rather than pointing out new, and perhaps untried, ways. The subjects chosen are general in their character, mingling the scientific and the exact with the practical and the empirical. The work is divided into four headings—"Regions," "Soils," "Farm Plans," and "Atmosphere."

Cassell's Carpentry and Joinery. Comprising Notes on Materials, Processes, Principles and Practice. Including about 1,800 engravings and 12 plates. Edited by Paul N. Hasluck. Philadelphia: David McKay. 8vo.; cloth; 567 pages. Price, $3.

An exhaustive practical work on handicrafts, from which theory has been excluded, except where it was necessary for the explanation of some method or process. Although the work is written mainly to meet the needs of those actually practising carpentry and joinery, students preparing for examinations will find this a textbook of great importance, covering minutely the subjects of timber, joints, timber roofs, doors and door frames, skirtings, dadoes, panelwork, linings, and a number of related subjects.

Telegraph Secondary Cell Installations. A Practical Work on the Charging and Management of Accumulators. By Arthur Crotch. London: Guilbert Pitman. 12mo.; cloth; 178 pages; 100 illustrations. Price, $1.

The installation and maintenance of secondary cells require the knowledge of many principles far beyond those of telegraphy. This volume contains directions on generators, measuring apparatus, charging arrangements, care of secondary cells, and the use of the gas engine, so that the ordinary operator could easily fit himself in the details of battery management by studying its pages.

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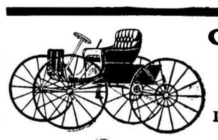

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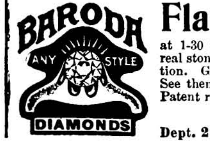

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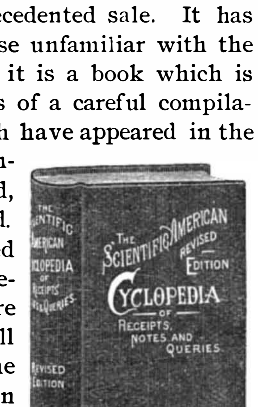

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Thread, spool cotton, and sewing silk, American Thread Co. ... 64,827, 64,830 to 64,833
Tires, rubber vehicle, Shawmut Tire Co. ... 64,839
Tobacco, chewing and smoking, D. Dunlop ... 64,847
Tobacco, smoking and chewing, Penn Tobacco Co. ... 64,860
Washing powder and scouring soap, N. K. Fairbank Co. ... 64,856
Whisky, Daniel Crawford & Son ... 64,846
Whisky, J. B. J. Nienaber ... 64,857
Whisky, Pickel & Hand ... 64,880
Wine, Wetmore-Bowen Co. ... 64,842
Wines, G. W. Steiger-Busch ... 64,840
Wood buckets or pails, W. Heyser ... 64,937

LABELS.

"American Dehydro Vegetable," for dehydrated foods American Dehydrating Co. ... 13,766
"Amidina," for ointment, D. Delfino ... 13,767
"Green Turtle," for cigars, cheroots, and tobacco, Gordon Cigar and Cheroot Co., Inc. ... 13,762
"Joe Cannon," for cigars, R. Kline ... 13,761
"Red-Moon," for an eye tonic, J. S. Patton ... 13,768
"Sweetheart Brand," for canned syrups, Louisiana Molasses Co. ... 13,765
"Tastes like Ice Cream in the Summertime," for prepared fruit, Stedman Fruit Co. ... 13,764
"The Star," for insecticide, Sachs & Co. ... 13,769
"Tro Tro Chocolate Krunch," for confectionery, Trowbridge Chocolate Chip Co. ... 13,763

PRINTS.

"Artgum The Dry Cleaner and Massager," for a cleaning composition, A. Sommer ... 2,097
"Men's and Boys' Apparel," for men's and boys' apparel, H. C. Lytton ... 2,096

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

C nadi n patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.