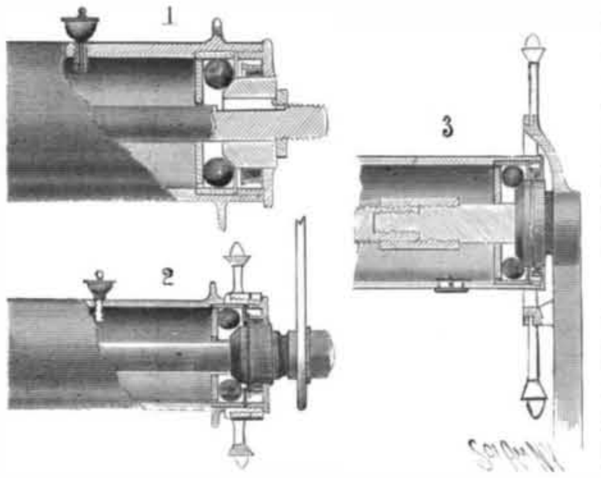
AN IMPROVED BALL-BEARING.

The ball-bearing illustrated in the accompanying engraving is designed always to run true and to permit ready access to the various parts. Means are provided for lubricating the bearing and for excluding dust.

Of our illustrations, Fig. 1 is a partial section through the hub of a bicycle-wheel showing the parts of the



HITCHCOCK'S BALL-BEARING.

bearing. Fig. 2 shows the bearing applied to the rear hub of a bicycle-wheel. Fig. 3 is a sectional view of the bearing applied to the crank-hanger of a bicycle. In all these applications the essential principle of the bearing has been retained with but few modifications.

The bearing is surrounded by a casing, in each end of which a back-plate is secured. Each back-plate has a marginal flange extending outward. To the end of the shaft passing through the casing, cones are secured, coacting with the back-plates to form raceways for the balls. Each cone is formed with a peripheral flange. Retaining-rings are provided, which bear against the flanges of the back-plates. Dust-caps are secured in the ends of the casing and are provided with flanges coacting with the cone-flanges, with the retaining-rings, and with washers on the cones, to exclude all dust. The cones are secured to the shaft, not by the ordinary method, but by means of a shouldered key placed in a groove on the shaft and threaded as far as the shoulder; when the cone and locking-nut are assembled on the axle, the nut will engage the threaded end of the key, holding it firmly in place as well as the cone itself. By providing the back-plates and retaining-rings with small apertures, the lubricating material coming from the oil-cup is permitted ready access to all the moving parts.

The bearing has been patented by the inventor, Mr. A. G. Hitchcock, of 409 Fort Street, Honolulu, Hawaiian Islands.

Luxurious Travel in Siberia.

The new Siberian train which was recently sent to St. Petersburg for the approval of M. Khilkov, Minister of Ways and Communications, returned August 3, after being personally inspected by the Czar. It left with over forty passengers, including several Englishmen, Americans, and Frenchmen. This is the second train specially built for the quick service on the great Siberian rail way. It is an improvement upon the first specially built train, which was already a marvel to Russians.

The new train consists of five coaches, two for second-class and one for first-class passengers, the others being a dining and a baggage car. The construction is of the newest design, and the train runs with great smoothness. Besides the comforts of a bathroom with gymnastic apparatus, a library in several languages, a piano and selection of music, maps, guide-books, albums of views, an ice-cellar, and an arrangement for boiling water in three minutes by means of steam, which were found in the first train, the new one is fitted with plates which indicate the next stopping station, and, if the stoppage be over five minutes, also how long the train stops.

All the windows are protected from dust and wind by external plate-glass guards; the last coach is arranged to serve as an "observation-car," showing three views of the country traversed. A stationary bicycle, with arrangements for measuring in minutes and kilometers the amount of work done, a barber, who is also qualified to give medical assistance, and a superintendent, who speaks Russian, French, German, and English, are among the other conveniences to comfort of traveling now provided. The train will be lighted inside and out by electricity, and electric cigar-lighters find a place in the dining-car. A lavatory has been fitted in the second-class car, so as to be available for the enthusiastic photographer to change plates and develop in during the journey. Electric bells and portable electric reading-lamps are in each compartment. The kitchen is intended to furnish a hot dinner for a maximum of sixty people. Paper and envelops are to be supplied gratis at the buffet, where hot and cold drinks of all kinds are to be had; there is no charge for the barber, but two rubles is the price of a bath, for which three hours' notice beforehand must be given.

From Moscow one may now get to within a few hundred miles of Irkutsk on the sixth day, and the charges for this journey under such luxurious circumstances are very moderate. The Englishman who cares to undertake the journey has only to see that his passport has been properly viséd in London before leaving; and even if he be entirely ignorant of any language but his own, he will find no difficulty in reaching the heart of Siberia by rail. In all the chief towns, as far as Irkutsk, one or two resident English or Americans are to be found, and they gladly welcome a fellow-countryman who brings the latest gossip from town. The French are already showing their appreciation of the opportunities offered for investigating the resources of Siberia. A special train from Paris is to leave Moscow for this trip in August, the whole time to be occupied being about one month.

What is Thought of it in California.

The Signs of the Times, published at Oakland, California, is an admirer of the SCIENTIFIC AMERICAN, and as it comes to us each week, says the editor, it is filled with most useful and practical matter. It keeps close watch of every field of science and industry and is a faithful recorder of the progress that is being made. It employs none but the most thoroughly competent writers, and consequently its information is always reliable.

It is a paper for men, and at the same time it is preeminently the paper for boys. Its matter has the advantage of being solid and substantial, while it is also most interesting as well. Boys will pore over its pages by the hour. And when they turn away from its study, their minds are filled with useful facts about farming, fruit-raising, carpentering, machinery, etc. For there is no field of the useful vocations of life from which this valuable paper does not bring you interesting sheaves of desirable knowledge.

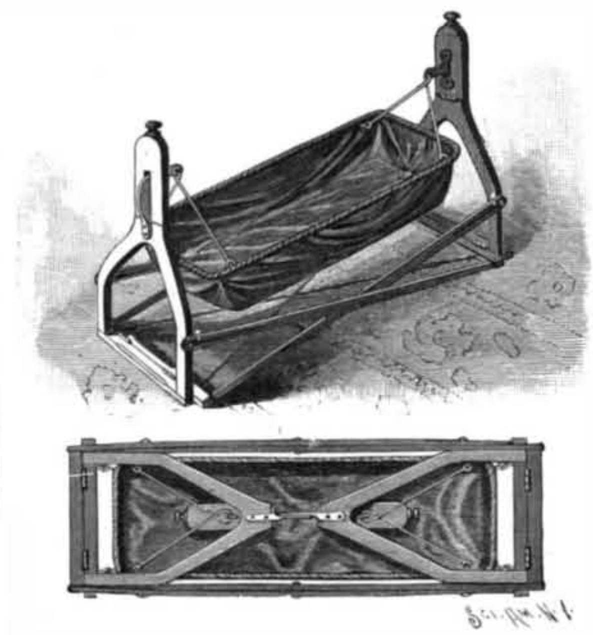
If parents will furnish themselves and their children with such papers as the SCIENTIFIC AMERICAN, instead of those that are more or less filled with stories of highway robberies, conflicts with policemen, hair-breadth escapes from bears and the like, they will see their sons grow into useful men rather than "border ruffians."

TASMANIA has one of the most wonderful tin mines in the world, called the Mount Bischoff Mine.

A FOLDING CRADLE.

An invention has recently been patented by Ralph Bird, of 307 Webster Avenue, Jersey City, N. J., which provides a novel cradle so constructed that it may be readily folded into compact form when not in use, thus permitting it to be stored and transported with great facility. The cradle, as seen from the engraving, has head and foot arches standing upon base-rails. On each base-rail a bar is hinged. Rods are connected with the bars and are provided with retractile springs by means of which proper tension is maintained. To each bar two braces are attached having slotted ends in which pins on the head and foot arches slide. Dogs are mounted in the slots and are capable of engaging the pins to hold the arches in vertical position. Each arch carries an extension-standard in which is mounted a bolt engaged by a keeper attached to the standard. By means of this arrangement the standards are held in raised position above the arches. The cradle itself is suspended by means of slings attached to the arches.

When it is desired to fold the cradle, the bolts in the standards are lifted out of engagement with their

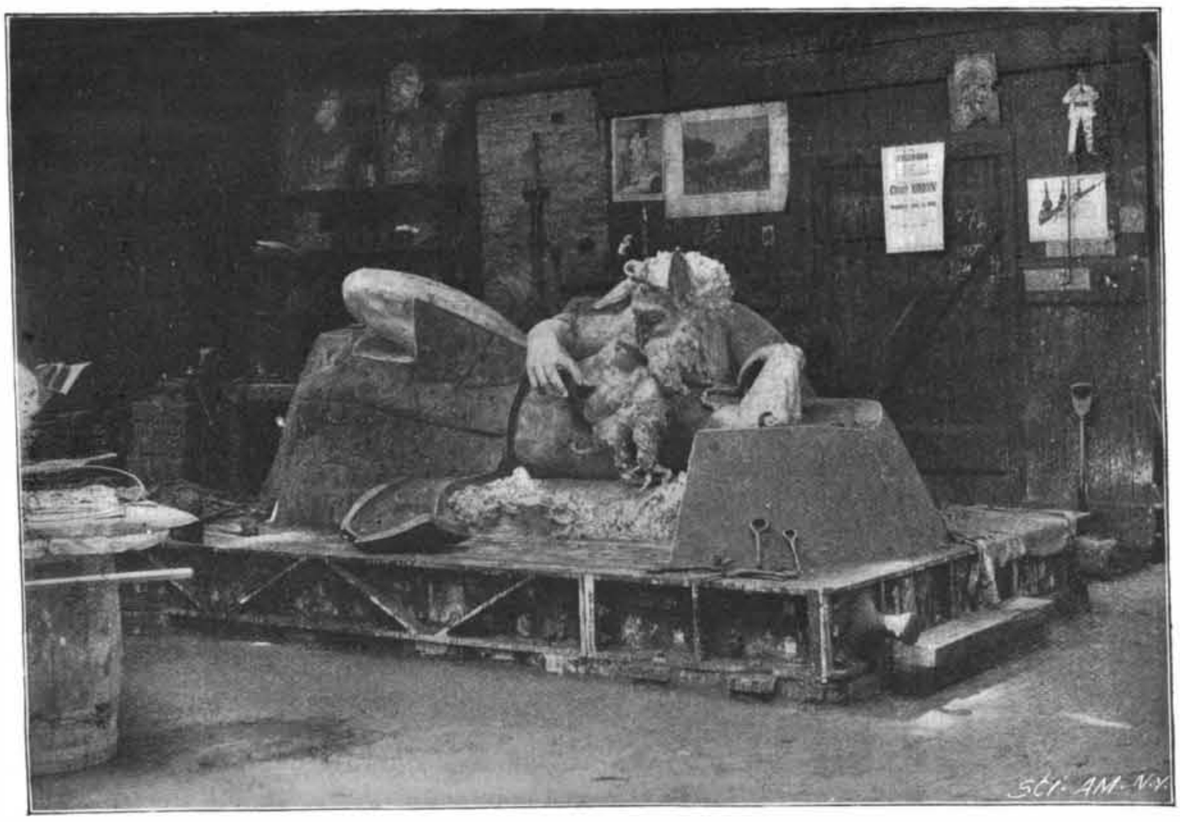


BIRD'S FOLDING CRADLE.

keepers and the standards are moved inwardly and downwardly. The dogs in the slots of the braces are then disengaged from the pins working in the slots; the arches are then folded down over the body of the cradle. The cradle itself, being made of fabric, readily collapses on the rods, and the whole device then appears as shown in the lower portion of our engraving.

A PHENOMENAL PIECE OF BRONZE CASTING.

No substance is so well fitted for monumental use as bronze. There is a sense of dignity, weight, and value about it when used in large masses which is possessed by no other material. It successfully defies the ravages of time, and its intrinsic value has not been found great enough to make it very often the prey of the vandal; so that, if it is surpassed in some of its properties by gold, silver, and platinum, the value of these precious metals has in itself invited the destruction of beautiful works of art. We have, however, a large number of bronze statues which have descended to us from antiquity which are to-day a striking example of the difficulties with which the early sculptors had to contend and the triumphs which the bronze caster achieved. By the nature of the material, everything which is possible to the sculptor's art is possible to bronze. It can be fused and cast into moulds of the most intricate shape, and it is interesting to note that the history of this alloy has no beginning, and we only know, on the authority of Sir John Evans, that our bronze age ceased in the fourth or fifth century B. C. We also know it immeasurably antedates alike history and tradition. Bronze working as a fine art is equally lost in the remoteness of antiquity, and from that time to the present day the art of the bronze founder has never been extinct.



THE MOULDING OF "PAN"—TAKING OFF PIECES FOR MAKING PIECE MOULDS ON LARGE PIECE.

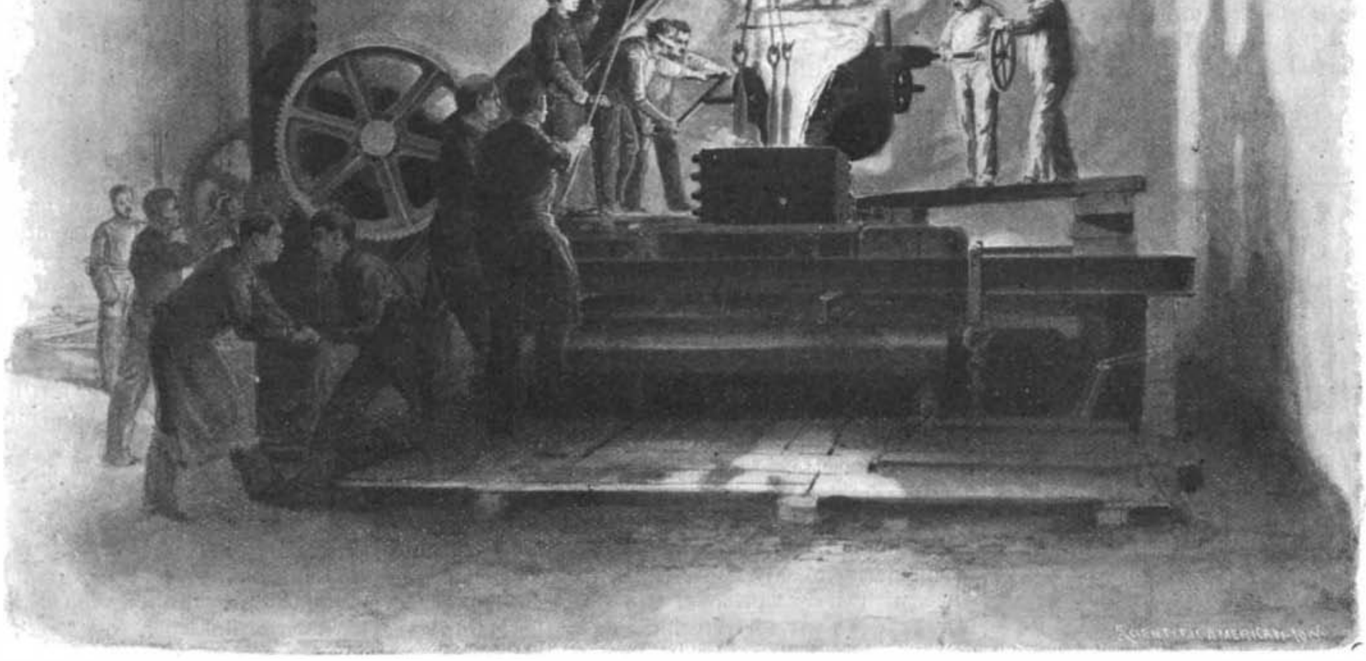
Until a few years ago, when it was necessary to cast a large statue or monument, we had to send to Munich, Berlin, Paris, or Rome to have the model executed in bronze, but it may now be said that the industry has become thoroughly naturalized in the United States. Splendid examples of the bronze founder's art are now executed here, castings in which technical skill and artistic feeling are combined with strict fidelity to the sculptor's models. Indeed, it seems as though some of our native American ingenuity has been grafted onto the magnificent technique of the foreign workman. Our illustrations present a notable triumph of this industry. They represent the moulding and casting of Mr. George Gray Barnard's statue of "Pan," intended for Central Park, where it will be placed on a natural bowlder in the lake opposite Seventy-second Street. The most interesting feature of this work is the fact that it was cast in one piece. This is the largest casting in bronze which has ever taken place in the United States, and was accomplished by the Henry-Bonnard Bronze Company, in New York city. This casting is by all odds the most difficult piece of work ever attempted in this country, and it is very doubtful if there is a bronze foundry in Europe which would care to risk the casting of such an artistic piece of work in one piece.

Before describing the casting it would be perhaps well to glance for a moment at the technique of the art. Before a work can be cast in bronze, it must, of course, exist in some other material. The sculptor usually makes a sketch of his idea, not on paper, but in wax or clay. This sketch is usually roughly modeled and is but a few inches high, so that it does not require any internal framing to support it. The general arrangement of the composition having been decided upon, the next step is the construction of a full-sized skeleton of iron, without which the statue in such plastic materials as clay or wax could not stand, but would soon yield to its own weight and sink to the floor. The iron frame or skeleton is made so substantial that the sculptor may have his work in the studio for several years without fear of its becoming injured. The model in clay is, of course, very tender, as the particles are not very tightly bonded together, and it therefore becomes necessary to have a plaster model, which is not so liable to be injured as the clay one, and it is this plaster model which is given to the bronze founder. In brief, the casting involves several operations—the construction of the mould, the preparation of the fluid alloy, the casting, the solidification in the mould and the subsequent liberation of the cast from the mould, and, finally, after all the gates are cut off, blemishes are removed and the various parts of the work are fastened together and the line of demarkation between the different pieces eliminated, the statue may be colored and then it is ready for erection.

The artist produces his statue without any reference at all to its capacity for "drawing" from the mould, and the bronze founder has to adapt his work to the most exacting conditions of undercutting and complicated outlines. It is nothing unusual in casting a statue to have a thousand or more pieces in the mould, and in the statue of "Pan," the moulder, Jean Leroy, spent eight months, with several assistants, in making the moulds for the huge god, and there were 1,700 pieces at least in the mould. One of our engravings shows the casting of "Pan," and another, part of the mould resting on the clay model.

When the plaster model was brought to the bronze foundry, it was laid on the bottom of a flask of great size, and loosely tamped in with a special sand used by bronze founders, which comes from Fontenay-aux-Roses, about sixteen miles from Paris. The figure being only half embedded in this sand, the surface of it was carefully pressed and smoothed all around the model, so that the latter presented somewhat the appearance of a bas-relief. The sand background was then dusted over with lycopodium, which takes the place of parting sand in the ordinary iron foundry. The object of this is to prevent one portion of the mould from adhering to another. The moulder then proceeded to work on the projecting portion of the model, making separate pieces, so that they can be withdrawn and replaced at will. The pieces were eight or nine inches thick and were generally wedge shape, in order that they might fit closely. Channels and indentations were formed in each piece in order to insure their assuming the same relative positions, and it is no easy task to remember where the small pieces go. In work of no great size, some of the pieces of the mould which is to receive the metal are no bigger than a pea. Sixteen pieces are often needed for an eye. All must be fitted with the greatest nicety. An immense amount of wire and iron clamps are embedded in the pieces of the mould to give them strength. After the various parts of the flask, each containing a large number of the pieces of the mould, were finished, they were removed and carefully dried and stored away in order to allow the moulder to work on other parts of the statue. After the entire work has been moulded, the bronze might be poured into it; but this would give a solid statue of enormous weight which would be heavy, expensive, and no better than a hollow statue, in fact, not as good, as the shrinkage would be increased, therefore the mould is "cored." The parts are assembled, and the core is made by filling the cavity of the mould with the same sand as before, only a softer variety is used, so that the figure is again reproduced. As, however, this sand figure occupies the entire cavity of the mould, it must be cut down, so that a space may remain between its surface and the interior of the mould, and this space will be filled by the metal. Our engraving shows the appearance of the core and the part of the mould, and also shows by a dark line the space which the metal was to occupy. Of course, such a core must be supported by an internal iron carcass, the ends of which project through various openings in the mould, serving to keep it in place. Without this it would fall, and thus prevent either the flow of the metal or would reduce the metal to a dangerous thinness. When the statue has been entirely moulded, the pieces of the mould are separated and dried in special ovens or furnaces. This operation takes place before the core is formed. The core itself must also be baked. The mould must be provided with openings for the admission of the metal and for the escape of the air and gas, and this result is obtained by the use of many gates and channels. After the core was put in position and all the pieces of the mould adjusted with care and accuracy, they were secured in place by a most elaborate system of clamps and iron rods. The mould in the bronze foundry weighed 54,650 pounds or about 27 tons. Some

PART OF MOULD AND CORE SHOWING SPACE OCCUPIED BY THE METAL.



CASTING THE STATUE OF "PAN" IN ONE PIECE—POURING THE BRONZE IN THE RESERVOIR.

idea of the great weight which had to be supported by artificial means will be gained when it is stated that the mould comprised some pieces which weighed from 4 to 5 tons each, and the core comprised 28 detached parts, besides the main core, which alone weighed 6 tons. The figure of "Pan" is 11 feet 4 inches long and 5 feet 3 inches wide. If the figure should rise, it would be 13 feet 6 inches high.

At this point it might be well to mention some of the difficulties which deter sculptors and bronze founders from casting large works in one piece. A bronze casting, unless it be of very small size, is always cast hollow, and in order that it may be so cast it is necessary that it should have a core inside as well as a mould outside. Now it is clear that if an object like a horse is to be cast with a core inside, and if it is to be cast all in one piece, the core will have to be left inside, since there would be no opening whereby it can be removed. Now the great weight of the core inside is a marked disadvantage in erecting or moving a statue, besides it puts an unnecessary strain on the legs of the horse. In addition, the material of which the core is composed is excessively porous, taking up moisture from the air, so there is a source of danger to the bronze statue, which is very likely not to be absolutely air and damp proof. There will be here and there some tiny flaw through which core will absorb air and will become so moist that a severe frost might swell it almost to bursting. But if the horse is cast without its head or neck, the core is usually removed and these dangers are avoided. To avoid these dangers, the ancients cast very large works in pieces, and modern founders find it advisable to cast their works in comparatively small pieces. There is another point which is an important one. If there should be any flaw in the mould or in the casting, the entire work of the moulders for months would be vitiated and they would have to begin anew. For this reason it is very rare to cast large works in one piece, and the great success which attended the casting of "Pan" at the Henry-Bonnard foundry is a triumph for art metal work in America.

After the various clamps and stays which held the model together were in place, the interstices were filled with sand, for cooling must be rapid to prevent the separation of the tin and copper which sometimes occurs, owing to the difference in their melting points. The sand was then tamped hard and the top and sides of the flask are applied.

The alloy used was 90 per cent copper, 8 per cent tin, 2 per cent zinc. The total amount of bronze melted was 6,450 pounds. It was melted in 15 crucibles, in 7 crucibles of 750 pounds and 8 crucibles of 150 pounds each. The fires were started at 1 A. M. August 22, and the casting took place at 5 P. M. the same day in the presence of a number of invited guests. The large ladle was heated, and when the bronze was at the proper condition of fluidity, the covers of the furnace were removed, the crucibles loosened, and they were drawn out with the aid of a tackle. They were carried to the ladle and emptied. When the ladle was full, it was hoisted by the crane and swung around in position over the flask, which rested in the casting pit. The scene was a magnificent one. The metal was not poured directly from the ladle into the mould, but was received in a reservoir at the top of the flask. At the bottom of the reservoir were holes, which were closed by iron plugs. When these plugs were closed, all connection with the gates was shut off. It was now a moment of great excitement, for the success of the whole undertaking depends upon the exact condition of the metal when it is allowed to flow through the gates into the space between the mould and the core. Every one waited with bated breath until, in the judgment of the foreman, the bronze was at the exact temperature to insure a perfect flow; too high or too low a temperature would ruin the casting. The men took the keenest interest and pride in their work, and waited like soldiers to receive and implicitly obey the orders given them. At the proper moment the foreman, Eugene Veillard, gave the word, and the plugs were removed from the reservoir and the metal flowed to all parts of the mould. Flames burst from all sides of it for a moment, and the foreman waved the American flag over this great triumph of metallurgical art in America.

The work of taking down the flask was soon begun, and the greatest possible care was taken to avoid injuring the statue, in removing the carcass which sustained the mould and the core. The cast was found to be smooth and perfect.

Artistically, "Pan" will be very interesting when placed on the big bowlder in the lake. The statue was offered to the city a year ago by the Clark estate and the model was approved by the National Sculpture Society. The measurements of the huge figure have already been given. The god is reclining on a ledge; one knee is raised, and one arm serves as a support. The repose is a lazy, careless one and he is blowing the "Pan" pipes. His long beard falls over his breast; his hair tumbles carelessly over his head. The head differs somewhat from the Greek conception of the god, but it is thoroughly artistic and will prove an excellent addition to the sculpture of Central Park which is already too much burdened with solemn rows of bronze statues of the departed great.

Prof. Haeckel on Evolution.

At the Cambridge Congress of Zoology Prof. Haeckel read a fascinating paper on the descent of man. He does not hesitate to say that science has now definitely established the certainty that man has descended through various stages of evolution from the lowest form of animal life, during a period of a thousand million years. The New York Sun with commendable enterprise cabled over quite a full account of the paper, and goes on to say: Lamarck, Darwin, and finally scores of other investigators won the knowledge which must now be accepted as the crowning achievement of science during the nineteenth century.

Recent discoveries of fossil remains in Java, Madagascar, and Australia have made still more complete the evidence, available proof, and discoveries wherewith Darwin's name is most commonly associated. Prof. Haeckel thus summarized the steps in evolution:

"The monophyletic origin of all mammalia—that is to say, their origin from one common parent form, from monotremata upward to man—is no longer a vague hypothesis, but an established fact. All the living and extinct mammalia which we know are descended from a single common ancestral form which lived in the Triassic or Permian period, and this form must be derived from some Permian or perhaps Carboniferous reptile allied to the Progonosauria and Theriodontia, which was derived from a Carboniferous amphibian of the group Stegocephala. These amphibians in turn descend from Devonian fishes, and these again from lower vertebrates. The most important fact is that man is a primate, and that all primates—lemurs, monkeys, anthropoid apes, and man—descended from one common stem. Looking forward to the twentieth century, I am convinced it will universally accept our theory of descent. I have no doubt that the strong influence of anthropogeny upon other branches of science will be most fruitful."

A member of the congress said that Prof. Haeckel had spoken of one thousand million years as necessary for his evolution tree, while Lord Kelvin supposed himself to have proved that this world as the scene of life could not be more than twenty-five million years old. It seemed unwise to complicate Prof. Haeckel's theory by assuming that a thousand million years would be required for proof.

Prof. Haeckel replied that the computation was not his own. He took the time from one of the most eminent geologists. For himself he confessed that he had no intuition as to the length of time required for the evolution.

The congress received and discussed Prof. Haeckel's paper with the greatest enthusiasm.

The Oldest American Journal.

Another piece of bric-a-brac which Mr. Cyrus Curtis has coveted for many years, but was not able to purchase until recently, is The Saturday Evening Post, the oldest newspaper in America, which has been issued regularly in the city of Philadelphia since December 24, 1728, and was edited by Benjamin Franklin from 1729 to 1765. It was originally known as The Universal Instructor in All Arts and Sciences, and was projected by Franklin, but that usually discreet person disclosed his plans to George Webb, a fellow-apprentice in Samuel Kiemer's printing office, and the latter started the paper under that preposterous title. It was a small folio, six and a quarter by ten inches in size, and the first number contained two columns of reprint from "Chambers' Dictionary of Arts and Sciences," which had recently appeared in London, three advertisements, and a grandiloquent address from the publishers, who promised that "each person who preserves their papers will possess the richest mine of knowledge (of the kind ever before discovered, except of late in Europe)."

Franklin was naturally indignant at having his ideas stolen, but, after thirty-nine numbers had been published, Kiemer was glad to unload the enterprise, and the paper was purchased by Franklin and Hugh Meredith for a trifling sum. Kiemer claimed a circulation of 250 copies, but Franklin asserted that it had but ninety paying subscribers. The new proprietors dropped the absurd title and called it The Pennsylvania Gazette. At that time there were only five newspapers in America, all weeklies. A year later Franklin made it a semi-weekly, the first in America, but it did not pay, and, after two brief experiments, resumed the weekly issue, which has continued ever since, with the exception of two weeks in 1765, when it was suppressed for refusing to pay the stamp tax, and large handbills headed "Remarkable Occurrences" were published instead, and during the occupation of Philadelphia by the British from November 27, 1776, to February 5, 1777, and from September 10, 1777, to January 5, 1779. In these periods a few straggling numbers were printed at York. When the regular publication was resumed upon the evacuation of the city, the title was changed to The Pennsylvania Gazette and Weekly Advertiser. David Hall purchased the property in 1776 and his sons ran the paper, with the assistance of several partners, until 1821, when it passed into the hands of one Atkinson, who changed the name to The Saturday Evening Post, as it has since been known.

For half a century it has been published in the same old-fashioned way, for the benefit of the same old-fashioned, conservative patrons and their children and grandchildren, with a highly moral serial story, a column or two of antique and shelf-worn anecdotes, selected poetry, conservative comments upon current events, crochet patterns, charades and rebuses, a column of "wit and humor" and a page of Sunday reading. With the aid of a pair of scissors and a pastepot one man has been able to do all the editorial work, and another has attended to the business department.

Bids for Three Eighteen-Knot Battleships.

The bids which have been put in for the construction of the three new battleships which are authorized for the navy make it certain that the vessels will be of at least 18 knots speed, as against the 15 knots speed which was the minimum that had been previously imposed by the government.

The successful bidders are the three well known firms, William Cramp & Sons, of Philadelphia, the Newport News Company, of Norfolk, Va., and the Union Iron Works, of San Francisco, the builder of the "Oregon."

The bids were as follows: Newport News Company, one ship, class 1, in 31 months, for $2,581,000; one ship, class 2, in 32 months, for $2,680,000, minimum speed, 17 knots; one ship, class 2, in 32 months, of 12,500 tons, 18 knots minimum speed, for $2,850,000.

William Cramp & Sons, Philadelphia, one ship, class 1, in 29 months, for $2,650,000; two ships for $2,625,000 each. One ship, class 2, of 11,500 tons, 17 knots, in 32 months, for $2,725,000; two such vessels for $2,700,000 each. One ship, class 2, of 12,150 tons, 18 knots, in 32 months, for $2,885,000, and two such ships for $2,870,000 each.

Union Iron Works, San Francisco, one ship, class 1, for $2,674,000, in 31 months; class 2, one ship for $2,725,000, 17 knots; class 2, one ship in 33 months, 12,200 tons, 18 knots, for $2,899,000.

It is expected that the Cramps will build a practical duplicate of the Russian battleship which they have in hand. This vessel is to be 376 feet long, 72 feet wide, 26 feet draught, and of 12,700 tons displacement, with a coal capacity of 2,000 tons. She is to maintain an average speed of 18 knots for 12 hours. This is 8 hours longer than the term required by the United States.

The 18-knot vessel proposed by the Newport News Company is based upon the department plan, the increased displacement being secured by lengthening the ship by 15 or 20 feet and putting in more powerful engines and boilers.

The Union Iron Works also propose to lengthen the hull and put in additional boilers of the water tube type.

There is cause for great satisfaction in the change that has thus been made in the designs of these vessels. As originally proposed, they would have been so slow as to be almost obsolete for their purpose; but the new vessels, if a similar improvement is made in the velocity and energy of their armament, will be thoroughly up to date.

Yale's Physical Statistics.

Dr. J. W. Seaver, associate director of the Yale gymnasium, gives the following physical measurements of the Yale freshman class, whose compulsory gymnastic work was begun this year, says The New York Evening Post. The average age of the class at the time of measurement was found to be nineteen years one-half month. The oldest man in this class was thirty-three years and youngest fifteen years nine months. Average height, 5 feet 7·5 inches. Tallest member of the class, 6 feet 3¼ inches, shortest 5 feet $\frac{1}{10}$ inches. The average weight, 134·2 pounds, the heaviest man being 215 pounds and the lightest 101½ pounds; girth of chest, normal, 34·4 inches; girth of chest, inflated, 35·8 inches; girth of biceps, 11·5 inches; girth of neck 13·8 inches; girth of head, 22·4 inches; girth of waist, 28·1 inches; girth of thigh, 19·9 inches, and girth of calf, 13·7 inches; capacity of lungs, 4 cubic liters, or 240 cubic inches.

Comparing these measurements with those of the freshman class at Yale fifteen years ago, Dr. Seaver finds the average freshman strong physically at almost every point, his lung capacity having risen from 225 to 240 cubic inches. This is attributed to athletic training in the preparatory schools, where Dr. Seaver says ten men train where one trained fifteen years ago. There are but ninety-seven men, or 38 per cent, of the freshman class who have normal eyes. Seventeen others have one normal eye, the other eye being abnormal to the extent of at least twenty-thirtieths. Thirty-eight men, or about 13 per cent, used glasses before entering college. No figures are obtainable for discovering whether there are fewer men with normal eyes now than ten years ago, but it is believed that this is the case.

Miscellaneous Notes and Receipts.

Glossy Blacking for Shoes consists of the following ingredients, according to Neueste Erfindungen und Erfahrungen: Spirit, 126 parts; camphor, 11 parts; Venetian turpentine, 16 parts; shellac, 36 parts. Color with 32 parts of a mixture composed of aniline blue, 15 parts; Bismarck brown (phenylene brown), 15 parts; and spirit, 800 parts.

To Give Zithers a Soft, Full Tone.—The purpose of an invention which has lately been patented in England is to impart a soft, full tone to zithers, which is purported to be attained by the use of glass rods as frets for these musical instruments. These glass rods may possess any desired thickness, and the strings are stretched over them in the usual manner. The musical effect attained with such a zither is said to be quite astonishing.—Neueste Erfindungen und Erfahrungen.

Artificial and Natural Indigoes.--Leon Lefévre reports the experiments of a dyeing establishment in France which tested the artificial indigo alongside of the natural product, in exact comparison, on hank. According to the results obtained, artificial indigo would be about 5 per cent cheaper, on the basis of the 1897 indigo prices, while with the present low price of the natural product the same comes 5 per cent higher. As regards the quality of fastness, both are equal.—Revue Générale des Matières Colorantes, 1898, 226.

Varnish and Linseed Oil.—At the occasion of a dispute, O. Bach has conducted experiments to determine the non-saponifiable parts in a number of differently produced linseed oils of authentic purity. He found in cold-drawn linseed oil 0·42 per cent; warm-drawn oil, 0·32 to 0·92 per cent; extract oil, 0·61 to 0·90 per cent; Baltic oil (nine years old), 0·88 per cent; boiled varnish, 0·43 to 0·74 per cent; varnish prepared in the cold, 0·95 to 1·71 per cent; "stand" oil, 1·0 per cent. From this he forms the conclusion that in varnish (even that prepared in the cold, i. e., by adding resinates) the percentage of unsaponifiable substance should never be higher than 2 per cent at most.—Zeitschrift oeffentl. Chemie, 1898, 167.

"Colored Colors."—The denomination of "colored colors" may sound paradoxical, but as a matter of fact mineral colors are frequently met with of late whose dull and little productive character is rendered more fiery and richer by an addition of coal-tar colors. In general, no objection can be made to such a procedure, if colors sufficiently fast to light are chosen, as is well possible nowadays. But very often this is not done. Thus the eosines used for carminette are very fugitive; likewise coloring with fuchsine and aniline blue fades in the light. If one wants to employ artificial organic coloring matters for fining, faster ones should be employed. According to M. Bottler, the rather fast rhodamines, next methylene blue and meldola blue, which are very fast, deserve a preference. Against the use of ponceau, coccines, and scarlets, which for the most part are not inferior as regards fastness, to the cochineals, whose place they have taken, less objection can be raised. Since it has been established by the above mentioned observations that for coloring various varieties of carminette, velvet red, purple, cinnabar red (vermilion), and chrome red such artificial organic coloring matters are also employed as are liable to fade quickly, this fact should be given sufficient attention in practice. Carminette is frequently used, prepared with turpentine and English varnish, as a carriage color; likewise vermilion and chrome red.—Maler Zeitung.

Varnish for Photographs.—Varnishes for photographic negatives have to meet very special requirements. They must be colorless, hard, impervious, but at the same time elastic and exceedingly adhesive. If they are not hard enough, the plate is injured in printing the positive copies; if the elasticity is lacking, the negative will easily tear and crack. Another important requirement is exacted from the photograph lacquer: with hardness, elasticity, and viscosity, it must dry so quickly that the plate can be retouched immediately after varnishing. Following are some recipes for photograph varnishes (by weight throughout): 1. Sandarac, 16; lavender oil, 12; chloroform, 2; rectified alcohol, 90. Filter off all insoluble parts. 2. Place shellac in a concentrated solution of ammonium carbonate, extract the latter, and substitute pure water (shellac, 1 part; water, 8 parts), whereupon the shellac dissolves. 3. Take shellac, 2; sandarac, 12; mastic, 12; ether, 150. Dissolve entirely and add benzole, 9. 4. Digest dammar, 2, with acetone, 9, in a well-closed flask for two weeks in a warm place, shaking from time to time. Then pour off from the insoluble residue. Several coatings are required of this lacquer, which is also adapted for paper. 5. Gum lac, 75; sandarac, 10; alcohol (95 per cent), 915. 6. Amber, 2; copal, 2; benzole, 4; rectified alcohol, 30. 7. Amber, 4; copal, 4; mastic, 2; petroleum ether, 20; rectified spirit of wine, 40. 8. Sandarac, 40; turpentine, 4; lavender oil, 5; ether, 5; absolute alcohol, 100. 9. Mastic, 2; turpentine, 2; bleached shellac, 10; rectified spirit, 60. Care should be taken to use only the purest ingredients obtainable.—Färben Zeitung.

Spiders and Pitcher Plants.

In the insectivorous plants of the genus Nepenthes, a form represented by a number of species and widely distributed over the Indian and Australian regions, as well as in Madagascar, the pitchers or insect-traps, which are usually regarded as expansions of the leaf-stalk, are suspended, mouth upward, at the ends of long tendrils proceeding from the tips of the leaves. The gaping orifice, frequently strengthened and kept open by a thickening of the rim, is protected by a lid, which, while preventing the infall of rain, offers no obstruction to the free entrance of insects. To attract the attention of these animals the pitchers are frequently conspicuously colored in their upper parts, and honey is secreted from glands scattered around the margin of the aperture and on the under-face of the lid. This gaudy and sweetened portion, designed as it is to catch the eye and act as a bait, constitutes the "attractive" area. A short distance within the cavity and below the attractive area just described, the walls of the pitcher are smooth and of a waxy consistency, so that no foothold is afforded to insects, which are consequently precipitated to the bottom of the pitfall if luckless or incautious enough to venture on this "conductive" area. The lower part of the receptacle is filled to a greater or less extent with a fluid, containing among other substances potassium chloride, malic and citric acids, as well as soda lime and magnesia in smaller quantities, and an enzyme which, in the presence of the acids, has the power of digesting organic matter. This fluid, poured out as a secretion from a large number of glands developed in the adjacent walls of the pitcher, is usually crowded with the indigestible remains of insects, commingled with those of which the nutritious tissues are in process of decomposition under the action of the alimentary juice of the plants and of the bacteria which infest it.

The spiders of the family Thomisidæ belong to that artificial section of the order sometimes spoken of comprehensively as the wandering or hunting species as opposed to those of sedentary habit, which spin snares for the capture of prey. Some of the Thomisidæ live on the ground among vegetable débris or beneath stones; others on the trunks or leaves of trees; others, again--and those are the species that have attracted the greatest amount of attention—frequent flowers, and lurk among the petals on the watch for visiting insects. To this last category belongs the spider (Misumena nepenthicola) now under discussion, a species which invariably takes up its abode in the pitcher of a North Bornean (Labuan) Nepenthes, perhaps referable to the species described as N. phyllamphora; in any case, whatever the name of the plant may be, the Misumena appears to inhabit exclusively the one species, for although several other kinds were found growing in the vicinity, they were never observed to be tenanted by spiders.

According to that skilled collector and trustworthy observer, Mr. A. Everett, who kindly furnished me with the notes forming the basis of the account here given, the pitchers in question are somewhat elongate in shape, and constricted a short distance below the rim, broadening out again as the bottom is approached, and narrowing ultimately to a vanishing point where they join the supporting stalk. Just below the upper constriction the spider spins a slight web, adherent to the wall of the pitcher. This web is not of the nature of a snare or net designed to intercept insects, but extends as a thin carpet over a small portion of the conductive area, and enables the spider to maintain a secure hold on its slippery surface. Here it lives and rears its young, no doubt feeding upon the insects which the Nepenthes attracts for its own use, capturing them either as they enter the pitcher, or perhaps after they have fallen in the digestive fluid below.

So far as procuring food is concerned, this spider would seem to be no better off than those of its allies which live in flowers and capture the honey-seeking insects that visit them, except in so far as it is not dependent upon seasonal inflorescence for a place wherein to lurk. But in one very important respect it must presumably score heavily in the struggle for existence —that is to say, in its means of escaping from enemies.

It is a well known fact that almost all spiders, especially those that occur in tropical and subtropical countries, suffer immense mortality from the relentless persecution of the solitary mason wasps, which at their breeding season scour the country and explore every nook and cranny in the eager search for spiders wherewith to lay up a sufficient store of food for the voracious young wasps during the days of their larval existence. From these enemies the flower-frequenting species have no means of escape, except such as is afforded by quiescence, in conjunction with the protective nature of their colors, attitudes, and form. The slightest movement on their part will attract the notice of the quick-sighted wasp, and bring swift destruction upon them.

Whether or not the mason wasps have the temerity to invade the pitchers of Nepenthes in their quest for victims, there is no evidence to show. Possibly long-billed birds thrust their beaks into the insect-trap to extract any living things or organic débris they may contain. At any rate, the account given by Mr. Everett of the behavior of this spider when threatened with danger points forcibly to the conclusion that the species is subject to persecution from enemies of some kind or other. This collector found that when an attempt was made to capture them by tearing open the pitcher, the spiders, although very active, never attempted to escape from the mouth of the vessel, but ran down its inner surface, and plunged boldly into the liquid at the bottom, ultimately, if still pursued, retreating to its very base, and burying themselves among the remains of ants, moths, beetles, etc., with which the pitcher was more or less choked.

Although many spiders of semi-aquatic habits, such as Dolomedes, Thalassius, and some species of Lycosidæ, plunge beneath the surface of water when threatened with danger, and escape along the stems of the subaqueous weeds; and although an example of Araneus (Epeira) cornutus, a terrestrial species, which, however, frequents the banks of streams and marshy country, has been noticed, when disturbed, to drop to the ground, run into the water, hide beneath a tuft of weed, and there remain for a minute or so before venturing to climb back to its web, I am not aware that the adoption of water as a city of refuge has ever been recorded of any member of the family Thomisidæ. These spiders, in fact, as already explained, depend for safety upon protective assimilation to their surroundings. Consequently, the habit of plunging into the fluid in the pitcher of Nepenthes, adopted by Misumena nepenthicola, must be regarded, it appears, as a new instinct acquired by the species in connection with the exceptional nature of its habitat; and its behavior carries with it the conviction that the species is constantly subject to persecution from some enemy other than man, whether it be bird or wasp.

Possibly the spiders, when once they have taken up their abode in the pitcher are, like the insects that venture in, unable to get out again on account of the opposition to exit offered by the slipperiness of the walls of the conductive area. If this be so, they would be compelled, in case of attack, to seek safety in the lower parts of the pitcher; and while those too timid to take the plunge, or too weak to withstand the immersion, would be captured or destroyed, their instinctively bolder or physically hardier companions would be saved to transmit their characteristics; and so by a process of elimination and selection the instinct would be gradually brought to the state of perfection Mr. Everett has described.

Lastly, if it be wondered by what means the spider is able to resist the action of the fluid, and to regain its position of security in the upper part of the pitcher, it must be remembered, in the first place, that a great many spiders, as well as many insects, can be immersed in water and other liquids and withdrawn in a perfectly dry state; and in the second place, that almost all spiders, when dropping from their webs or leaping after prey, insure a safe return to the spot they have left by letting out a drag-line of silk, which passes from the spinning mammillæ to the point of departure. A silken thread of this description would enable M. nepenthicola to climb out of the digestive fluid which retains the captured insects; while the nature of the integument and of its hairy clothing would prevent the penetration of the fluid during the short time that the spider remains beneath it.—R. I. Pocock, in Nature.

A Pygmy Locomotive.

What is claimed to be the smallest locomotive for drawing passenger cars has been built by T. E. McGarigle, of Niagara Falls, and the small steam road is to be operated at the Trans-Mississippi Exposition, in Omaha. In all, six locomotives are to be built. It is possible that they will be used also at summer resorts, such as Coney Island, Atlantic City, and other places. The road in Omaha is about 1,100 feet long. The locomotive from the point of the pilot to the rear of the tender is 7 feet 3 inches long, and it weighs about 600 pounds and can draw ten cars, each containing two persons, or a weight of about 4,000 pounds. From the top of the stack to the rail is 25 inches and the gage is 12½ inches. The steel boiler is tested to 300 pounds pressure and works at 125 pounds. The boiler is of 1½ horse power and it will hold 24 gallons of water. The feed water is supplied by two injectors and there is a steam brake between the drivers. The cylinders are 2 × 4 inches. The wheels of the forward truck are 5 inches in diameter. The tank in the tender holds 30 gallons of water, and the operator sits on the seat in the tender. The scale is about one-seventh of a full sized locomotive, and the type selected is one of the latest engines on the New York Central road.

RUSSIA is going to abolish the difficulties of navigation at the mouth of the Volga by cutting a canal directly from the river to the Caspian Sea. Work on it will begin this summer.