together with stout, specially-made, hand-laid cable cord of Dutch flax at the joints, and there is not a nail, screw, or bolt used in the whole framework, which is lashed together by steel wire cable to tension.

The keel is 120 feet long, the deck 123 feet long, and the upper frame 127 feet long.

There are three "motor decks," in each of which will be two of the crew, one to look after the motor, the other to control a set of aeroplanes. The full complement is seven, and the captain on the center deck can communicate with the crew by means of ship telegraphs, speaking tubes, etc. The telegraphs will ring in front of each motor, and on the captain's table will be arranged the lines connected with the valves, pressure gages, etc.

The vessel will be driven through the air by three 50-horsepower Buchet gasoline motors, each of which drives two six-bladed propellers, arranged three on one side of the deck and three on the other. The motors are bolted down to strong aluminium castings, which are clipped to the large bamboo members, and they are placed longitudinally of the airship. The power is transmitted from countershafts by belts to the propeller shafts.

Large Clarkson radiators for cooling the circulating water are attached to the steel tubes forming the framework supporting the propellers. The normal speed of the engines is about 1,600 revolutions per minute, and there is a speed reduction of 8 to 1 employed between the motor and the propeller.

In conjunction with Mr. Walker, Dr. Barton has recently designed a new gasoline motor which develops 20 horse power and weighs only 90 pounds. This works out at only 4½ pounds per horse power. The present Buchet engines weigh 6 pounds to the horse power, exclusive of the flywheel, which will add another hundredweight.

Each of the six propellers is made up of three two-bladed propellers, the blades of each, which are rigid, lying behind one another. The propeller shafts are of solid steel 2 inches in diameter and 7 feet, 8 inches long. They are fitted with aluminium pulleys.

Dr. Barton points out that Count Zeppelin's balloon could be slightly inclined by the aeronaut, so that the propellers drive it upward or downward. Instead of having, like the Count, four propellers 4 feet in diameter driven by 32 horse power, Dr. Barton has a balloon less than half the size, with six propellers 12 feet in diameter, driven by 150 horse power, which by means of the aeroplanes should suffice to sustain the airship even without the help of a balloon.

The inventor calculates that 150 horse power will keep in the air a weight of 18,300 pounds to 34,650 pounds, whereas the total weight of the balloon fully loaded with crew and all accessories is under 16,000 pounds. There is no doubt that an airship using aeroplanes alone could obtain a very high rate of speed, as the resisting medium of the air is so much less than that of water or the friction of rails. It is calculated that the six propellers of the Barton airship, when revolving at their full speed, displace 1,200,000 cubic feet of air per minute, and a speed of 17 to 20 miles an hour is anticipated.

There will be no less than thirty aeroplanes for the steering of the ship in the vertical plane. They are mounted between the deck line and the top of the frame in three banks of ten, one in front of each motor, five of the aeroplanes in each bank being placed on each side of the flying deck.

Three aeroplanes in each set of five are mounted one above the other nearer to the motor than the other two, which are also above one another, but placed somewhat further forward and in such a way that they lie between those behind them. Each aeroplane is 15 feet long by 3 feet across, giving a surface of 45 square feet. The total surface is 1,350 square feet. The aeroplanes are pivoted to the frame at their forward end and the surfaces can be raised or depressed by the man in charge of them. By means of a large rudder at the stern the vessel is steered in the horizontal plane.

The ingenious system of shifting water ballast employed by Dr. Barton to keep his vessel on an even keel, when she shows a tendency to shove her nose or tail into the air, owing to the moving about of the crew or other cause, has been used by some inventors of submarine boats, notably by the late M. Claude Goubet, but has never, so far as we are aware, been adopted in aerial machines. At each end of the vessel is a 50-gallon water tank; the two are connected by a pipe, and will contain only 25 gallons each. When the longitudinal stability shows signs of being disturbed, water is automatically pumped from the forward to the aft tank, or *vice versa*. The motor-driven pump is situated on a separate deck in the fore portion of the airship.

Five hundred thousand incandescent electric lamps will be employed in the illumination of the World's Fair grounds and buildings.

REMARKABLE DISCOVERIES BY BANDELIER OF INCA CIVILIZATION IN PERU.

BY WALTER L. BEASLEY.

In recent years, one of the most interesting regions of the New World, interesting both to the historian and excavator, has been the western coast of Peru and the lofty Bolivian plateau. On the latter was situated the far-famed Inca tribe, who had developed in pre-Columbian times an advanced culture which for centuries has been the object of vain study. Mr. A. F. Bandelier and his gifted wife have carried out researches under the auspices of the American Museum of Natural History, the first two years' exploration, however, being supported by the late Henry Villard. The discovery by the Bandeliers of many relics of the ancient Indian empire of the Incas has been considered a brilliant achievement, and has won additional fame for this eminent investigator, whose discoveries now add so greatly to history and the early culture of South American civilization.

Chief among the curious features of the Inca people was their manner of interring the dead, and the unusually large number of objects placed in the grave as funeral accompaniments for the body on its long journey to the future world. The scattered population of the coast of Peru, for some five or six hundred miles, cultivated every available foot of good land and used the desert and barren stretch near the water as a cemetery. The people of the high plateau of the Andes used the sides of steep cliffs or stone towers, called Chulpas, as burial places. The graves of the coast were arranged in groups, being sometimes round or square-shaped pits, varying in depth from 2 to 12 feet. A matting and framework of reeds was used as a top cover to protect the contents from the pressure of the sand above. Some graves contained only one body, others three or more on the same level. The standing of a person was usually determined by the character and number of objects deposited, as well as the embellishment of the outer covering or dress of the mummy pack. The latter usually consisted of a finely woven woolen fabric, having a rich border. A typical mummy is here shown just as it was unearthed by Mrs. Bandelier. An interesting statuette found shows the Inca method of carrying the dead to the grave. An oval-shaped litter, having projecting ends resting on the shoulders of two men, was used. The right hand of each is placed over his heart as a method of expressing sorrow. Weaving was one of the industries in which the Peruvian Indians excelled. Articles associated with this occupation were the most frequent of those found in the graves. A number of reed rods, having their ends wound round with bright thread, so as to form a pattern, are placed within the folds of the outer pack. Other peculiar adornments of the outer mummy dress are small hanging pouches or bags, embroidered in rich design. These are filled with coca and various foodstuffs. As the Indian dress in life consisted of a short poncho and a loosely-worn wrap, a dangling pouch or pocket for the keeping of provisions and other necessaries which were indispensable on a journey while he was living, the same were thought necessary for comfort in death, and were therefore attached to his body. The peculiar crouched position which was given to the dead body seems to have been a long-established mortuary custom of the people. In this they simply imitated the every-day life of the inhabitants; for as the wearied Indian at the close of his daily labor seeks rest in a squatting position, he is correspondingly consigned to his eternal rest in the same attitude. The method of packing the body was to tie it in skins and matting. The whole was then bound tightly together with cords. The square form of the mummy is produced by a stuffing of the white cotton sack with seaweed and leaves. The poorest style of burial was of plain white cloth. Children in a great many instances were found wrapped and fastened full length on a bed of rushes or reed cradle surrounded with toys, domestic pets, and their favorite playthings in life. Some of the ever-recurring and characteristic objects met with in the graves of the coast were work-baskets made of plaited reed-grass used for containing the wool-spinning and sewing implements, dove-shaped wooden receptacles, combs of thongs, and other articles of daily life employed by the women. Often a complete loom having a partly completed pattern would be found. Among the most noted of the contents of such a work-basket are the beautifully finished and decorated spindles. These are looked upon as some of the most elegant and tastefully ornamented articles of Peruvian handiwork. They are of hard smooth wood, painted in showy colors. The elaborate embellishment of these spindles is somewhat surprising, as when in use the ornamented parts are hidden from view by the thread wound around them. The designs are either painted on, burnt in, or incised. Some of the textile work obtained in grave deposits is to-day fresh and magnificent in color and appearance, equaling some of the choicest Gobelin tapestries of modern times. Some contain 62 threads to the square inch. These beautiful fabrics are decorated in bird, animal, and geometrical patterns. They were woven from the wool of the alpaca and vicuna. One of the striking forms of burial was the addition of a false head. This was stitched on top of a square pack, which contained the wrapped body inside, and was stuffed with seaweeds and leaves. The eyes, mouth, and lips were generally indicated by a white thread, the nose by wood and occasionally padded white material. Frequently, though, these organs are represented by thin, cut-out pieces of copper and gold. Often the whole mask is made out of thin silver and attached to the head. The complexion of the face is often indicated with red and blue ocher painting, and the hair by a long fiber, dyed black. The false head is usually wrapped by bandages of bright cloth. The idea of this extra death-mask or head was seemingly to give a human appearance, which they wished their dead to retain even in their buried abode.

Of all the industries which occupied the attention of the greater part of the population, undoubtedly that of pottery was one of the most prominent. Specimens of this art are the most abundant and diversified of all the objects found in the graves. It was in the production of water vessels, jars, and vases that the inventive faculty of the Indian artisan was displayed to its fullest extent. Leaving no written language, nearly all of our knowledge of the people is due to the handicraftsman in clay, who made it a practice to represent faces, architecture, costumes, and characteristic scenes of every-day life on his creations in pottery. Thousands of these fanciful shapes were taken from coast burials and those of the upland plateaus. The material is of red, black, light colored or gray, and varies much as to ingredients and execution. The most elegant types are of fine gray and brown clay, with glazed surfaces, and show little or no granular mixture. These are considered the most beautiful form of Peruvian ceramics. In general, the bulging form prevails, although the shape varies according to the skill of the artist and the use intended. Some have a flat, others have a cone or egg-shaped bottom. The latter were set on a clay base with funnel-shaped opening. This kind of pottery, with little or no plastic decoration, but handsomely painted and of chaste form, is the true Inca pottery, made near Cuzco. The more showy results of the potter's art were displayed to the best advantage in the employment of animal and human figures.

The most satisfactory and artistic productions in clay are thought to have been when the whole vessel was treated as a human head, with the attached mouthpiece serving as a head-dress or covering. These portrait jars are especially noteworthy and highly prized, as they afford in most cases a lifelike representation of the face and features of the Peruvian coast Indians, as well as illustrating the technique. One of the types is unusually interesting, for it portrays a personage clothed in warrior's garb. Possibly here is depicted one of the chiefs, armed and equipped for battle. The striking feature of the costume is the high head-dress or conventionalized human face, with immense ear plugs. The left hand grasps a shield made of llama skin, to which are fastened short throwing-darts. The right holds a battle-ax. The other weapons used in warfare by the Incas and coast people were slings, for hurling stones, clubs four to five feet long, having five or six sharp points of metal or stone, and throwing-lances fifteen feet in length. Forest animals and maritime creatures of the period, notably the great condor with his helpless victim, were on the various forms of pottery met with. Probably one of the most extraordinary and remarkable pieces of pottery from an imaginative standpoint, at least, is one depicting a resting llama, with a sleeping child snugly clinging to its warm and fleecy back.

The great abundance of gold and silver in the time of the Incas, and their skill in soldering and fashioning these metals into striking shapes, are exhibited by the hundreds of personal ornaments, statuettes, and ceremonial objects wrested from burial places. Mosaic work on shells, supplemented by wide bands of gold, the ends terminating in a parrot's head, were evidently common household adornments, a number of such being recovered. Necklaces of golden balls, nearly the size of a twenty-five cent piece, were evidently commonly worn. Huge drinking or ceremonial cups a foot high, of silver, and more than half that length, in gold, wrought into portraits, attest the lavishness of display which flourished among the people. Long wrist-bands of solid gold and silver were worn. Instead of sacrificing the living llama, on some occasions, figures of this animal ten inches high, of solid silver, were buried as an offering. Gold was secured by washing in the mountain torrents and streams. Silver was obtained from easily fusible ores by reduction on the site where the ore cropped out, and also by fusion in small and rude ovens, placed in the open air. Copper was treated in the same manner. Silver and gold were mostly hammered.

The foregoing sketch has been intended more as a general pictorial display from the recent finds, showing

the handicraft and everyday objects used by the Incas, rather than an historic survey.

The author acknowledges indebtedness to Mr. A. F. Bandelier and to the American Museum of Natural History for the courtesy of reproducing the accompanying illustrations.

Carbon Wool.

Messrs. Constant and Henri Pelabon have recently brought out the fact that carbon is produced in the form of fine thread-like filaments in some forms of coke furnaces. These filaments when agglomerated in a mass, form a material which may be termed *carbon wool*. The carbonization of bituminous coal in the formation of coke for industrial purposes gives rise to a deposit of a thread-like character which is formed in the mass of the coke itself. The collection of such filaments gives rise to the product which the authors call carbon wool, and they have determined to some extent the structure and composition of the product. These deposits, which are never observed in recuperation furnaces where the coal is distilled in a closed chamber, are found especially in coke which comes from open furnaces, particularly of the older types. Here the air comes into the furnace through openings and the gas is allowed to burn in the apparatus. All the flames unite and are concentrated toward an opening placed in the upper wall. Near the opening is a region which is much hotter than the other parts of the furnace, and it is here that the deposits of filiform carbon are found.

These deposits occur inside of geode-like cavities in the coke. Some parts of the carbon wool formed by the intermeshed filaments are gray and other parts quite black. By observing the separate filaments of gray wool under the microscope, they are found to have a cylindrical form in general. The surface is seen to be covered by a glaze such as is observed on the neighboring coke masses. Sometimes filaments are seen which have an alternate contracted and expanded section, as if formed of a great number of cones placed one after another. No trace of crystallization was observed, however. In the carbon wool small black masses are sometimes noticed, about the size of a pinhead. These consist of a mass or roll of very fine and closely packed filaments which are formed on some parts of a coarser filament. The black filaments have a dead color and the surface is covered with asperities which are sometimes disposed quite regularly. These filaments are seen to be formed of a series of rings. One of them had 6 rings per 1-250th inch. The thicker filaments are generally from 0.0012 to 0.0035 inch in diameter. The very fine threads which form the black masses above mentioned and seem to be attached to the thick filaments, are much finer and measure about 0.0008 inch. The length is generally about 2 inches, but may reach as high as 3 inches.

A number of experiments were carried out in order to determine the nature and composition of the threads. By burning them in oxygen, carbon dioxide is formed. Placed in a Moissan oxidizing mixture, with the addition of nitric acid and chlorate of potash, the filaments seem to be either dissolved or changed to a yellow substance. This latter is supposed to be a graphitic oxide. It deflagrates and produces quantities of sparks when heated to 300 deg. C. The carbon wool which is produced in the coke furnace is somewhat similar to that which Schutzenberger formed by passing cyanogen gas over a mixture of retort carbon and cryolite heated to redness in a porcelain tube.

Some Troubles of the Explorer.

Prof. Flinders Petrie says in the London Times:

"Unhappily, the growing lawlessness of Egypt, which Lord Cromer noticed in each of his recent reports, has affected our work, and 'a large number of offenses, not very serious in themselves, but which cumulatively become serious, have been committed, and but too often have been committed with impunity.' (Report, 1902, p. 40.) A statue was stolen from my house; and though the footprint of the thief exactly agreed with the very peculiar foot of one of the men who were notoriously accused in the village, and all the links were named by witnesses, yet no conviction could be obtained; £35 are said to have changed hands as bribes over this. Next, my workmen from Quft were subject to a general conspired assault in the market, and each robbed of his money at once. But no redress whatever could be obtained. The police officer added to the injury by taking away one man who had been beaten to see the doctor, who did nothing but detain him till he paid 10s. bribe to be let go. Last year the relations of a man who died of fever were mulcted of £6 by another doctor; and, on my complaining, the official inquiry resulted in giving an account which was absurdly false, to my personal knowledge.

"It is impossible that the present machinery can work to elicit the truth. Witnesses are examined by petty officers, who dictate the final statement of evidence at their own will; and the witnesses are summoned, through their sheikh, who is the first man to be 'squared' by the offenders, and, 'who, they think, will assuredly sooner or later endeavor to wreak his vengeance on them.' (Report, p. 36.) Such a system, dating long before the British occupation, is the most perfect for facilitating bribery and the suppression of truth. This is not the place to discuss the remedies. Happily Lord Cromer considers that 'the points which most require attention are the police, the department of justice and sanitation.' I do not touch on more personal threats to our party and being fired at, as I only wish here to refer to the failure of justice. But matters have gone so far that we must look for safety to our own resources rather than to the law, which has in each case proved to us useless."

A HARMLESS REPTILE.

BY A. R. M. SPAID.

If there is anything we need to teach more than another, it is that numerous insects and reptiles, which are held by many persons to be poisonous, are perfectly harmless. This is especially so of the pine-tree lizard, or, as it is often called, the fence lizard. It is true that the lizard has teeth, but they are almost too small to be seen, the finely serrated jaws feeling just like the rough lips of a bass. Moreover, these little saurians seldom attempt to bite, and make interesting pets.

I have a box two feet long, one foot high, and six inches wide, the sides being of glass and the bottom covered with white sand to a depth of two inches. With this on my study table I have a good opportunity for watching the five interesting inmates as they eat and sleep. Two are males and three are females, easily

TAME LIZARDS AS ORNAMENTS.

distinguished by their color. Their color seems to be influenced by the conditions of the atmosphere. After a rain or when they first come out of their hiding places in the morning, many of them are very dark. By holding them in the hand a short time, the color changes very perceptibly.

When my pets are ready to go to bed, they dive into the sand, where they remain covered up until morning. Then here and there a head bobs up, and gradually the saurians either stretch out on the sand or prop themselves up on their forelegs in a most comical manner. They soon become alert, and show how keen their appetites are if flies, crickets, grasshoppers, or katydids are thrown to them. Frequently, when one has seized a particularly fat grasshopper, another will attempt to take it away. They are also fond of roaches, but care nothing for hard-shelled beetles. They will not seize an insect unless it is moving, and one often knows when the attack is to be made, as the lizard opens its mouth just a little way before springing upon its prey. It uses its tongue with the same agility as does the frog or toad, and gorges a large insect pretty much the same way as a snake swallows a toad.

In burrowing in the sand they make several strokes with the right or left forefoot, changing from one to the other; but when this dirt is to be worked out of the way, they use their hind feet with alternate strokes with great rapidity. The female in this way evidently digs into the ground, where she deposits a dozen or more white eggs, which she leaves for the warm earth to hatch.

I know of nothing else so easily tamed. When caught in the hand they seldom attempt to escape. Placed on one's clothing, they often sit in the same position for a long time. Knowing this peculiarity, I decorated my little son with nineteen lizards, just to prove to some skeptical people that I was willing to back up my assertions with a demonstration. Yet one observer who witnessed it declared that it was risky, and that he knew a man who had lost a finger from the venomous bite of a fence lizard. A teamster who was not afraid to handle a snake could not be persuaded to touch a lizard, although they both saw a finger thrust into a little saurian's mouth. Ignorance is hard to banish, but it easily drives away the truth.

They are not only harmless, but beneficial. Lying on the fences which surround the field of growing crops, they devour many insects as these attempt to enter the fields, thus benefiting the farmers, who have no appreciation of their value.

A Strange Use for Skimmed Milk.

BY GUY E. MITCHELL.

A use to which skim milk, sour milk, buttermilk, or even whole sweet milk is not often put is paint-making, yet this product of the diary makes possibly one of the most enduring, preservative, respectable, and inexpensive paints for barns and outbuildings. It costs little more than whitewash, provided no great value is attached to the milk, and it is a question whether for all kinds of rough work it does not serve all the purposes and more of the ready-mixed paint, or even prime lead and paint mixed in the best linseed oil. It is made as follows, and no more should be mixed than is to be used that day: Stir into a gallon of milk about three pounds of Portland cement and add sufficient Venetian red paint powder (costing three cents per pound) to impart a good color. Any other colored paint powder may be as well used. The milk will hold the paint in suspension, but the cement, being very heavy, will sink to the bottom, so that it becomes necessary to keep the mixture well stirred with a paddle. This feature of the stirring is the only drawback to the paint, and as its efficiency depends upon administering a good coating of cement, it is not safe to leave its application to untrustworthy or careless help. Six hours after painting this paint will be as immovable and unaffected by water as month-old oil paint. I have heard of buildings twenty years old painted in this manner in which the wood was well preserved. My own experience dates back nine years, when I painted a small barn with this mixture, and the wood to-day—second growth Virginia yellow pine—shows no sign whatever of decay or dry-rot. The effect of such a coating seems to be to petrify the surface of the wood. Whole milk is better than buttermilk or skim milk, as it contains more oil, and this is the constituent which sets the cement. If mixed with water instead of milk, the wash rubs and soaks off readily. This mixture, with a little extra of the cement from the bottom of the bucket daubed on, makes the best possible paint for trees where large limbs have been pruned or sawed off.

The Current Supplement.

The current SUPPLEMENT, No. 1463, opens with an illustrated account of the Stewart-Eaton steam-operated cinder pot. Mr. Stephen de Zombory presents an excellent discussion of aerial tramways as economical means of transportation. His paper is illustrated with engravings of historical interest, among them one showing a Roman wire cable dug up in Pompeii, another a historical German rope tramway reproduced from an old print. Commissioner Lindenthal's proposed improvement of the Brooklyn Bridge, whereby the carrying capacity of the structure will be materially increased, is described. Mr. Albert P. Sy's account of the nitrocellulose stability tests is concluded. Prof. W. M. Davis' paper on the geography of the United States, read before the American Association for the Advancement of Science, is also printed.

The Scientific American at the South Pole.

A subscriber, who is at the head of one of the large transatlantic steamship companies, informs us that through his instrumentality the SCIENTIFIC AMERICAN is about to take a southerly journey which will certainly carry it further toward the South Pole than it has ever traveled before, and probably as far, if not farther, south than any printed matter has yet made its way. He tells us that in packing a box with articles, which he was sending out to a friend by the relief ship which will shortly sail from Tasmania in search of the "Discovery," he included a year's file of the SCIENTIFIC AMERICAN. With the papers was sent a strict injunction that one copy at least was to be nailed to the South Pole! While we must confess that we are scarcely as confident in the near discovery of the pole as our subscriber, we must confess that among the remote corners of the earth to which the SCIENTIFIC AMERICAN has penetrated, this last is decidedly the most unlooked-for and interesting.