is adjustable so as to reduce the mixture to any thickness required. From the sizing machine the mixture, which has now been reduced to gage, is run through the cutting machine, which consists of a smooth roller at the bottom, and circular knives at the top. These knives revolve against the roller, cutting the material lengthwise. The operator then reverses the machine and the material is cut crosswise, making the familiar cubes which are known as "caramels." From the cutting machine the caramels go to the wrapping and packing room. Here the individual caramel is wrapped in wax paper and the goods are packed in boxes of from one to five pounds each. Small packages are also made up. Machines have been devised for automatically wrapping the caramels, but up to the present time hand wrapping is largely employed.

Our other illustrations are devoted to special forms of caramels, for there are many kinds, grades, and qualities. One of them shows the pulling room, where caramels are made without glucose, containing only sugar, milk and such coloring matter as enters into their composition. These are known to the trade as "pulled goods." They are light both in color and weight. Large masses of the candy are thrown over hooks secured to the wall, and the mixture is rapidly pulled until it is smooth and fibrous. In our illustrations the large trays in the foreground are filled with starch, which is used to prevent the candy from sticking to the hands. Another illustration shows the chocolate room, where certain varieties of caramels are coated with chocolate. After the caramels are cut they are placed on sheet-iron frames, each little cube in a compartment by itself. They are then lowered into a tank of liquid chocolate, and the tray and its carrier are then raised out; the excess of chocolate is removed and the drippings are allowed to go back into the tank. The coated caramels are then set aside to cool and afterward are sent to the wrapping room, where they are inspected by examiners and testers, whose duty it is to see that the weight and count of all caramels are correct and that the quality is up to the required standard.

Cocoanut enters largely into the manufacture of caramels, and in the busy season this plant consumes 5,000 cocoanuts in a single day, and has used 15,000 in two days. The shells are cracked by boys, and the cocoanut is removed and shredded by machinery. The shells make excellent fuel, and are used as well as coal under the boilers, but, strange to say, the one part of the cocoanut which goes to waste is the milk. Various experiments have been made in the hope of finding some use to which it could be put, but so far without success. The caramel company employs about 1,400 hands in this plant, and about three-quarters of this number are girls.

Latest Developments in Aerial Navigation.

Contemporaneous with M. Santos-Dumont's experiments to solve the perplexing problem of aerial flight several other inventors are designing vessels by which they hope to achieve the same object. The three most noteworthy attempts in this direction are being made by M. Henri Deutsch, the donor of the $20,000 prize, and two Englishmen named Mr. Buchanan, and Mr. T. Hugh Bastin, respectively.

In designing his vessel Mr. Deutsch has availed himself to a great extent of M. Santos-Dumont's design. The cradle is practically identical. The balloon is also very similar, only of far greater capacity than that of M. Santos-Dumont. The cradle measures 98½ feet in length, excelling the latter's machine by 38½ feet, while its weight is four times as great—440 pounds. The balloon is 197 feet in length, with a capacity of 2,000 cubic meters, as compared with 600. The motor is of 60 horse power, and weighs 880 pounds. The construction of the vessel is being pushed forward and the experimental trips will soon be undertaken.

The vessel invented by Mr. Buchanan is novel in many respects; in outward appearance it resembles an immense bird, after which it is in reality designed. It is 120 feet in length, with a beam of nearly 14 feet and weighs complete with motor attached, and all appliances, 23 hundredweight. The keel is constructed of yellow pine, and the body is entirely composed of bamboo covered with sailproof cloth made absolutely waterproof. This covering reduces the angles, gives the vessel a curved appearance, and considerably reduces the air resistance.

The engines are approximately of 14 horse power with four cylinders capable of imparting a velocity to the machine of 40 miles an hour. The most prominent characteristic of the vessel is the transverse grip propellers, placed on either side of the vessel like the wings of a bird. To insure the blades of the propellers obtaining a secure grip on the air they have been especially roughened, and by this means greater power will also be attained without increasing the power of the engines.

The rudder, which is strongly made of aluminium and is shaped like the tail of a shark, is so constructed that it will work from any angle as the steersman may desire. The engines and cabin are situated in the lower part of the ship, the upper part being inflated to assist in the buoyancy of the vessel and to increase its ascensional power to a certain extent.

The vessel can rise or descend at any angle or vertically without losing any of its buoyancy, and is perfectly rigid in every respect. All the screws are of brass and the bottom of the vessel is cased with sheet copper and bound with hoop iron.

Mr. Bastin, in his creation, has entirely eliminated the balloon and has produced an airship pure and simple. He bases his invention upon the means utilized by Nature for aerial propulsion, viz., the wings. He has produced mechanism which is capable of reproducing the requisite movements of a bird's wings. The latter can be fixed horizontally outstretched for soaring purposes, and the plane can also be varied to render upward or downward movements possible. Also, from this fixed position, the wings can be caused to vary in a graduated manner from a simple vibration up and down to the full amplitude or beat, and this movement can be maintained under any variety of plane.

Each wing is controlled separately, so that the beat can be varied for the purpose of procuring movement in a lateral direction, left or right. The body of the vessel entirely incloses the mechanism and gives ample space for crew and passengers. It is also so arranged that the entire weight is below the wings, thus insuring perfect equilibrium. Experiments with both of the English creations will be made in the course of a few weeks, when their merits or disadvantages will be adequately realized.

New Cæsium Compounds.

M. C. Chabrié, who has been experimenting with the metal cæsium, has lately succeeded in forming a new series of compounds. Among these are the sulphite, bisulphite, hyposulphite, etc. These results are described in a paper read before the Académie des Sciences.

Breaking Cocoanuts.

THE MANUFACTURE OF CARAMELS.

The first compound is the sulphite of cæsium. It is formed by taking 14 parts by weight of pure carbonate of cæsium (obtained from the mineral pollux), and dissolving it in 400 parts of boiling ethylic alcohol at 99 degrees strength. The solution thus obtained is divided into two equal parts. One of these is saturated with dry sulphurous acid gas by allowing a stream of the gas to pass through it for 3 hours; this produces a bisulphite, which is partly precipitated as a white powder. The whole, liquid and precipitate, is mixed with the remaining half of the original solution, and heated for 3 hours in a water bath. Afterward the alcohol is distilled off and the residue dried *in vacuo*. This residue is an anhydrous sulphite of cæsium, and appears as a white and crystalline mass, soluble in its own weight of boiling water. The author points out that by using water instead of alcohol, the product, instead of being pure and anhydrous, contains 9.3 per cent of water and a large proportion of sulphate. The bisulphite is prepared by the action of sulphurous acid gas in excess upon the alcoholic solution of the carbonate, and, like the sulphite, is formed of white crystals, very soluble in water but nearly insoluble in alcohol; this compound is also anhydrous. Analysis of these two bodies shows that the sulphite of cæsium has the formula Cs_2SO_3 and the bisulphite, $CsHSO_3$. The hyposulphite is another new compound. It is formed by boiling 5 parts of the sulphite of cæsium with 5 parts of flowers of sulphur in 20 parts of water for ¾ hour, renewing the water as it evaporates. The liquid is filtered and evaporated *in vacuo*, and deposits small needle-like crystals which are extremely soluble in water. Analysis shows that the hyposulphite has the formula $Cs_2S_2O_6$. The hyposulphate is the last of the present series. To form it, a solution of sulphite of cæsium and of dithionate of barium are mixed below 60 deg. C., then filtered and crystallized. In this way very fine colorless crystals are obtained, which have the form of transparent hexagonal tables measuring about ¼ inch in diameter and 1-10th inch in thickness. This compound acts like the hyposulphates in general under the action of heat, and decomposes into sulphate and sulphite. It crystallizes in the anhydrous form, and has the composition $Cs_2S_2O_6$.

A CURIOUS MEANS OF DEFENSE.

BY CHARLES FREDERICK HOLDER.

Ten or twelve years ago I began a collection of the so-called horned toads along the base of the Sierra Madre Mountains, in the San Gabriel Valley, California, with the view of testing their powers of mimicry. These lizards were very common here, and it was an easy matter to corral twenty or thirty. They were well protected by their power of simulating the color of their immediate surroundings, and it was often difficult to see or distinguish them from the ground upon which they rested. Those on dusty roads were dust-colored; those found among the rocks were frequently mottled, while nearly all of the specimens observed near the base of the mountains, where there was abundant verdure, were highly colored with vivid tints of yellow, red, brown and white.

These specimens were divided up into pairs and placed in enclosures 2 feet square, with a wooden fence 3 inches in height, so that there was perfect light from above. Each corral was arranged with a different colored floor; thus one had a white sand bottom; the next was green, the next brown; a fourth black and white—in all a number of changes being produced by the arrangement of pebbles, leaves and sand. In these corrals the lizards were released and changed about that their adaptation to new surroundings might be observed. But it is not to this remarkable protective faculty that attention is called, but to a protection so singular that it might well be conceived to be an effort of the imagination.

In handling the lizards, which are perfectly harmless, despite their warlike array of spines, I noticed that, although I had treated them gently, my hands were spotted with blood, and upon examining one of the animals I found that its eyes were suffused with blood, while in another specimen its eye appeared to be destroyed, or represented by a blood spot. I at first assumed that while together the animals had injured each other with their spines; but suddenly, when holding a lizard near my face, it depressed or lowered its head, and I immediately received a fine spray-like discharge, which proved to be blood. A glance at the animal showed that its eyes were bloody, as though ruptured. The volley had come so suddenly that I did not see it, but I was convinced that in some way the lizard had ruptured a blood vessel in its eye and had forced the fluid through the air a distance of at least a foot.

I immediately began to experiment with the little captives, and found that the above explanation was the case beyond question; but only a small percentage of the lizards could be induced to respond to my methods; giving them slight taps on the head seemed to exasperate them the most, and they would lower the head convulsively, the eye would be depressed, and a jet of thick blood, or blood which congealed very quickly, would be shot in a delicate stream to an extraordinary distance. Suspecting that the lizards did not consider me a dangerous enemy, and that I would have better success with some animal, I called in the aid of a fox terrier, for which the little creatures evinced the greatest fear. When the dog placed his nose near them, they crouched low and endeavored to shuffle themselves under the sand out of sight; but when the dog was urged on, and began to bark, they would draw back, hiss slightly, then depress the head, and the white face of the enemy would at once be spattered with drops of blood. Such a discharge was very effective, and, when received in the nostrils, it caused the dog no little annoyance, and he ran around excitedly for a moment vainly endeavoring to rid himself of the fluid, which evidently had some disagreeable feature.

To ascertain the distance to which the lizard could eject this stream from its eyes, I urged the dog to alarm a fresh specimen, and held a large sheet of white paper two feet in front of it, which was soon spattered with little drops of blood, which were hurled by the lizard with remarkable force, covering an area of 4 or more inches, evidently in its efforts to reach its tormentor, that was now very careful and appeared to have a wholesome dread of the peculiar secretion, which was undoubtedly an irritant. One of the lizards appeared to discharge the blood from both eyes, which immediately had the appearance of being ruptured. Another used but one eye, while still another repeated the discharge, though in less quantity and with decreased force.

It is interesting to note that this peculiarity has been observed by others. Mr. Vernon Bailey, of Kernville, Cal., wrote as follows to Dr. Stejneger, the letter

being printed in the Report of the National Museum for 1898:

"KERNVILLE, Cal., July 11, 18—

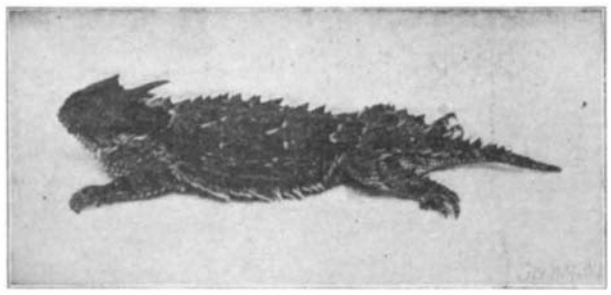
"Dear Sir: I caught a horned toad to-day that very much surprised Dr. Fisher and myself by squirting blood from its eye. It was on smooth ground, and not in brush or weeds. I caught it with my hand and just got my fingers on its tail as it ran. On taking it in my hand a little jet of blood spurted from one eye a distance of 15 inches, and spattered on my shoulder. Turning it over to examine the eye, another stream spurted from the other eye. This he did four or five times from both eyes, until my hands, clothes and gun were sprinkled over with fine drops of bright red blood. I put it in a bag and carried it to camp, where about four hours later I showed it to Dr. Fisher, when it spurted three more streams from its eyes. One of the same species, that I caught July 2, evidently did the same, as I found its head covered with blood when I caught it, but supposed it was injured in the weeds. It seems so strange that I send the horned toad to you alive.

"VERNON BAILEY."

In none of the discharges observed by me was there a large quantity of blood, but Dr. O. P. Hay states that from one he held a quarter of a teaspoonful was thrown. The lizard is *Phrynosoma blainvillei*, and the genus and its various species are found in central and southern California and in Mexico. In appearance it is disagreeable, but in reality the animal is perfectly harmless. The head is armed with spines, as, indeed, is the entire body, which, in the largest specimens, is about 5 inches in length. This lizard frequents the hot plains, as a rule, though it is also found in mountain regions. When approached, it usually depends upon its protective resemblance, crouching flat; then, when it fully realizes that it has been seen, it darts off with an absurd scrambling and waddling gait, making very good time; but it is easily caught. At first it bends its body, twists its horned head against the hand, but in a short time becomes perfectly tame. A specimen kept by me was very fond of being scratched upon the side, and would tip its body upward in response until it was virtually standing upon its side.

The lizard is the common horned toad of commerce, and constitutes one of the most popular "curiosities" of the West, hundreds being taken away alive every winter, while thousands are mounted and sent East to the various dealers in curiosities.

Since writing the above, Mr. Wakeley, a well-known collector, of Pasadena, who has probably handled more "horned toads" than anyone in the country, informed me that he has seen the blood forced from a lizard with such force that it struck the wall 6 feet away, and could be heard as it struck. He is convinced that it comes from the eyelid. Mr. Wakeley has collected and handled thousands of the lizards, and stated that the defense was often employed by them.



HORNED LIZARD WHICH EJECTS BLOOD FROM ITS EYES.

INCREASING USE OF OIL ON HIGHWAYS.

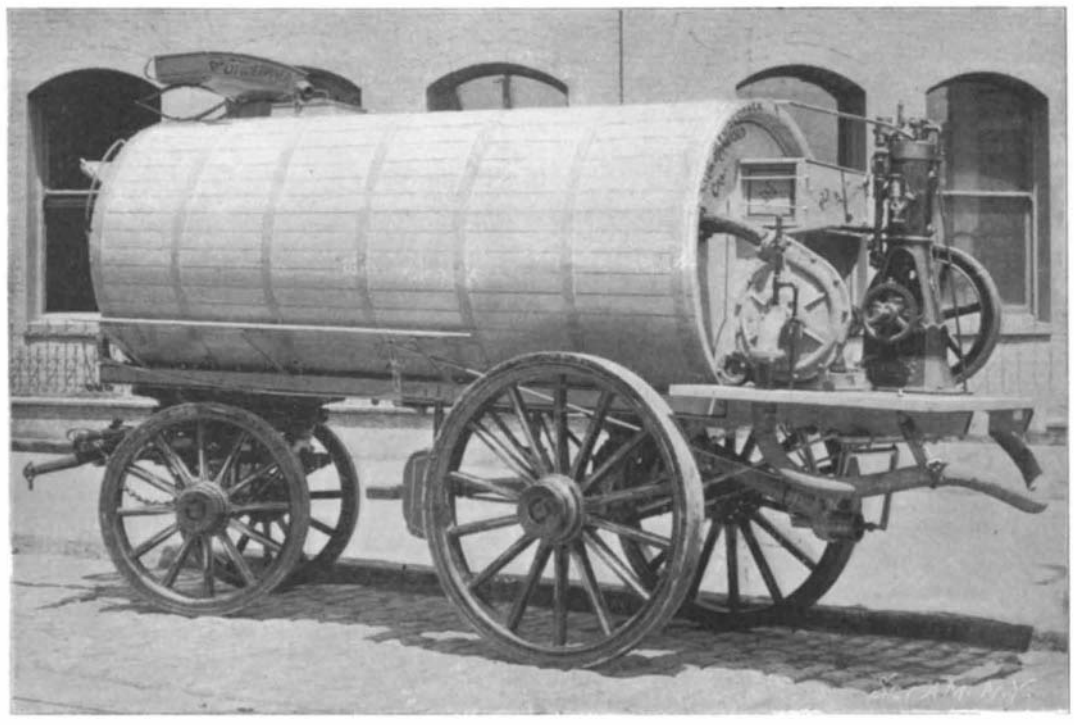
The use of oil upon the streets and highways in California is becoming more and more general, and the number of communities adopting the innovation is constantly enlarging. The system meets with favor as affording an outlet for a great portion of the oil now produced in large quantities, and at the same time as possessing real merit, inasmuch as by its use the condition of the roads is much improved and the comfort of the traveler greatly increased.

The city and county of Sacramento have, after conclusive experiments, adopted the plan, and the results have proved most satisfactory. The oil was applied hot and cold, the first giving the best results. Heated to a temperature of 180 deg. in a boiler adapted for the purpose the oil was pumped into the sprinkler and then sprayed over the roads. The tanks, boilers, pumps and injector cost about $1,000. The experiment proved the decided economy over the water system, besides lessening the cost of the maintenance of the roads, giving a hard, smooth surface and allowing increased loads with a decreased strain upon horses. Sprinkled with oil the roads are practically dustless, while the injury to rubber tires was found to be practically nothing. The first application requires one-third more oil than subsequent ones; two, in some cases one, applications a year is all that is ever required.

The city of Catton, in Southern California, computes that the expense of sprinkling its streets with oil has reduced the expense from $1,200 a year to $745, a saving of 45 per cent.

In the County of Kern 100 barrels of oil to the mile on roadways 12 feet wide sufficed for the first application, and 60 barrels for the second, six months later, secured permanently good results with generally improved condition of the highways. A contract was let to one oil company by which a road was first harrowed superficially and heated oil applied, with a result that confirmed the success of the process. The entire cost was covered by the payment of $1 a barrel for the oil. In Los Angeles, a large producer of mineral oil, the custom is fixed and all its delightful drives are sprayed with oil. The cleanliness and perfection of condition of the streets of that city is remarked by Eastern tourists as a most enticing feature of the place. In San Francisco, where the streets are mostly paved with basalt blocks or asphalt, sprinkling with oil has not been tried as a civic measure, but the commissioners of Golden Gate Park, in defiance of public opposition, concluded to make an experiment on an extensive scale on the main driveway of the park. This thoroughfare is 4½ miles long, and extends from one extremity of the park to the other, with an average width of 35 feet. Thousands of vehicles and a multitude of individuals pass over it every week. The roadway is scientifically constructed, and is as perfect an example of a dirt road as it is possible to make. The first application consumed 6,000 barrels of oil, costing about $1 a barrel, and the surface was thoroughly saturated. In soft spots the process was repeated. For a time the odor was objectionable, but this soon disappeared through the action of wind and sun. There was no damage to clothing, as anticipated, and for a time the driveway was avoided by persons with wheels, but whatever inconvenience was temporarily caused by its means soon vanished as the marked improvement in the drives became perceptible. Time has demonstrated the efficiency of the application of oil to the roads. The surface is impacted and firm, giving the same character to the drive as if covered by asphalt, and at the same time the visual appearance of the park has greatly improved. For eight months of the year, during which there is no rain, the clouds of dust arising from the dirt roads settled upon the foliage, turning it into a hue of dirty red marring one of the exceptional beauties of the park. Since the application of oil the dust no longer flies and the verdancy of the trees and plants is no longer obscured. The economy of oil over water for sprinkling is demonstrated. The commissioners estimate a saving of $500 a month on the one driveway alone, besides saving 70,000 gallons of water in each day. Two applications a year is all that is requisite. The cost of oil is now 87½ cents a barrel.

The sprinkler commonly used differs in no respect from that in which water was distributed excepting in respect to a regulator being attached which produces a fine spray of oil. An engine is sometimes attached to the tank where the oil is not supplied by gravity or when the tank is filled from the heating boiler.



OIL-SPRINKLING WAGON FOR USE ON HIGHWAYS.

Capacity, 1,500 gallons; width of spread, 28 feet.

Novel Use of an Electric Automobile.

We have heard of the application of an automobile storage battery to an X-ray apparatus where a physician was in hurry to complete an X-ray examination; but recently a use of a novel and more general character was made with very satisfactory results.

In Stratford, Conn., there has lately been installed a system of electric lights in the Congregational Church, current being supplied only at night from the neighboring city of Bridgeport. One of the proprietors of the SCIENTIFIC AMERICAN resides in this town and operates an electric surrey.

It happened that one Sunday morning was dark and cloudy, and as no current was furnished during daylight, there was no way to illuminate the dark interior portions of the church except by the use of a few oil lamps.

The owner and his family rode to church in the electric vehicle, then ran it under a window in the rear of the church, near where the switchbox is located, and, after throwing off the main supply switch, connected the feed wires to the storage battery in the carriage. As the several switches in the panel-box were turned on the church was well lighted up, and remained so through the service. At its conclusion the wires were disconnected and the family and minister taken home in the automobile.

Many in the congregation took it for granted that the lighting occurred from the regular source, and were much surprised upon learning of the method of supplying the electric current that was actually used.

Another practical use of storage batteries in boats has come to our notice. A gentleman in Connecticut has a small launch operated by a storage battery; this is charged in the daytime, and when not in use the boat is tied to the dock from which feed wires run (connected with the storage battery in the boat) to his house a short distance away. In the evening he thus uses the battery in the boat to light the house, and finds it a very satisfactory arrangement.

The British government is considering the advisability of sending an engineer to both American and continental cities to inquire into the subway systems and to report on their advantages over the London tubular system.

The Current Supplement.

The current SUPPLEMENT, No. 1342, is of unusual interest. The first-page article is devoted to "Canaigre-Growing in Southwest United States," by John E. Bennett, and is fully illustrated. This new industry is referred to elsewhere in this issue. "Geology and Geography at the Denver Meeting of the American Association for the Advancement of Science," is a report prepared especially for the SCIENTIFIC AMERICAN SUPPLEMENT by E. O. Hovey. "The Food of Nestling Birds" is accompanied by a complete list of all the food gathered for a brood of house wrens in a period of six hours. It is a long and interesting list. "The Mycenæan Question" is illustrated. "Stage Bridges at the Covent Garden Opera House, London, England," describes the latest phase in stage construction. "The Cultural Value of Engineering Education," is by Prof. Frank O. Marvin.

Contents.

(Illustrated articles are marked with an asterisk.)