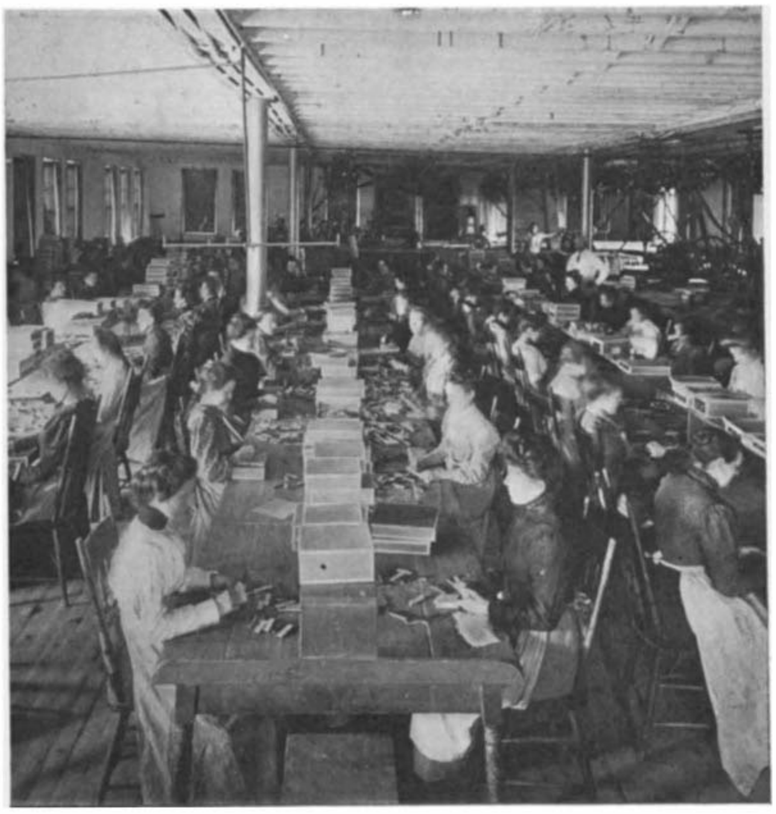
THE MANUFACTURE OF CARAMELS.

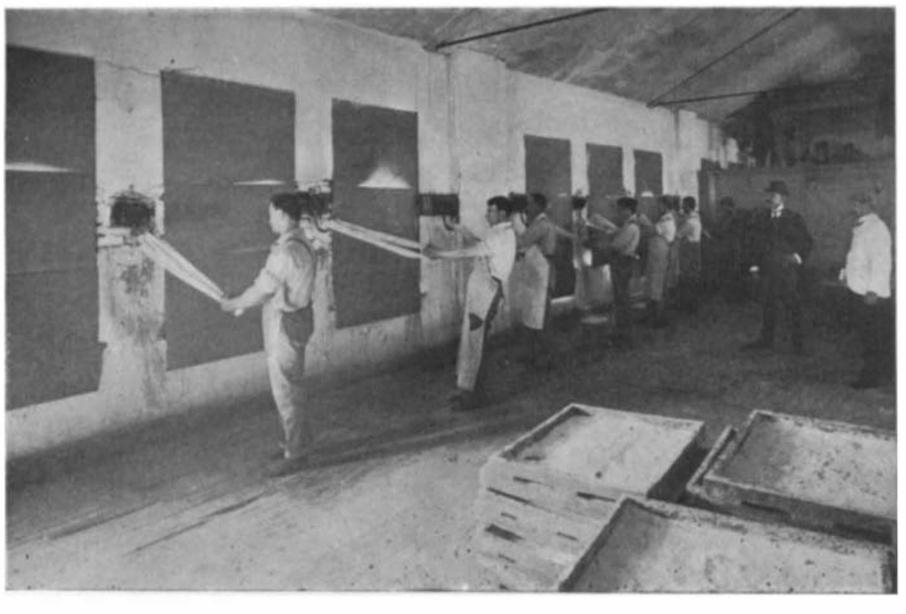
The confectionery industry in the United States is of the first magnitude, and vast quantities of all forms of this luxury are shipped abroad. Machinery now enters very extensively into the manufacture of confectionery of all kinds, and particularly in the manufacture of caramels, which are a favorite form of sweet. About 90 per cent of all the caramels made in this country come from Pennsylvania, from three factories which are operated by a single company. The books of one of these factories showed that 332,000,000 caramels were turned out last year, and it is approximately estimated that the output of the three factories amounted to 1,300,000,000 caramels. A large proportion of this amount was packed in small boxes and packages for sale on trains, etc.



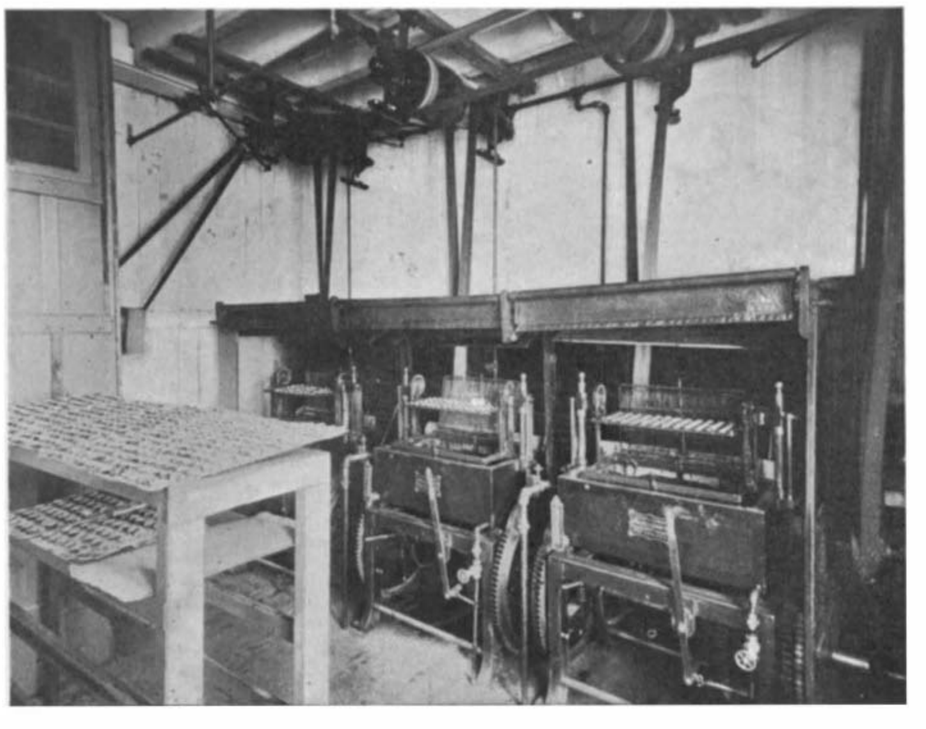
Wrapping and Packing Caramels.

The principal ingredients which enter into the manufacture of caramels are sugar, glucose, milk and cream, chocolate, and such materials as walnuts, cocoanuts, etc. Cream is used only in the higher grade goods, condensed milk being used for the low and medium grades. In brief, the various processes in the course of manufacturing caramels may be described as cooking, sizing, cutting, wrapping, and packing. The photographs from which our illustrations were made were taken in the factory at York, Pa., where one of the large plants is advantageously located between two competing railroads. There are a number of buildings, the principal one being of brick, four stories in height. The railroad tracks lead directly to the factory doors, so that the raw material and the finished product can be received and shipped direct, with the smallest amount of handling. In the basement of the building are stored large quantities of sugar and glucose, and here, also, is the cream-separating and milk-condensing plant. The milk is received directly from the farms each morning, and the cream is separated by a De Laval separator. Part of the cream is retained for use in caramel-making, but the greater part of it is sent to a creamery, where it is made into the highest grade of butter; 30,000 quarts of milk are condensed daily in the condensing plant. After the cream has been separated from the milk the latter is condensed in a condensing pan where atmospheric pressure is removed and the percentage of water is reduced by boiling.

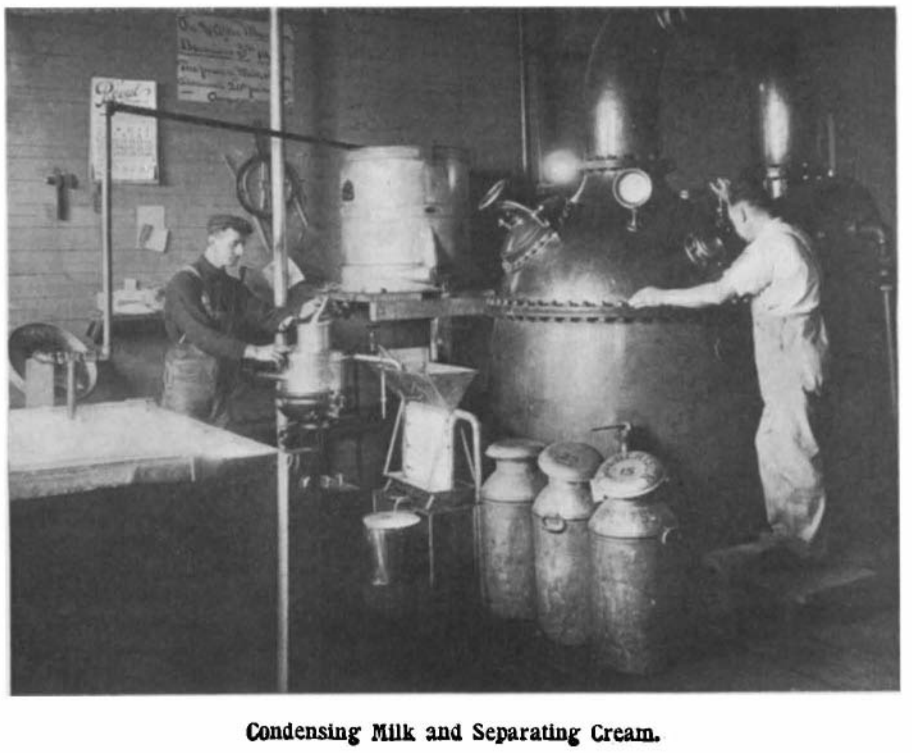
The glucose, sugar, syrup and condensed milk are forced through pipes to the top of the building, in order to reach the cooking room. When the glucose reaches its destination it is stored in a tank provided with a steam jacket to keep the contents thin. From this tank the glucose is distributed through the medium of other tanks to the cooking kettles, which we illustrate. There are twenty of these copper cooking kettles, provided with steam jackets. They hold from 75 to 200 pounds of the material. The other ingredients are mixed in the basement of the building, and when reduced to a liquid state they are forced to the cooking-room in the same manner as the glucose. The cooking process, which usually lasts about 30 minutes, varies in time according to the nature of the goods being produced. The contents of the kettles are stirred constantly by mechanical means, and they are nearly all of the tilting pattern. When the ingredients have become thoroughly mixed and cooked they form what is known as "caramel paste." The kettles are then tilted and their contents turned out into iron pans, shown at the rear of the kettles. The pans with their contents are then slid into the cooling room and the doors of the compartments are shut. The cooling room is connected with a refrigerating plant so that the caramel mixture in the shallow pans hardens in a very few minutes, when ordinarily one or two hours would be required if exposed to the air. Where large quantities of caramel-mixture are to be handled it will readily be seen that it is very necessary to have all the operations conducted so as to occupy a minimum of time. From the cooling room, the mixture, still in the pans, is taken to a cutting room, where the sizing and cutting operations are performed by machinery. The pans are adjusted so as to fit these machines. The sizing machine, which reduces the mixture to any thickness required, consists of rollers which act in the same way as the rolls in a mill. Each has two steel rollers, one smooth and the other grooved. The machine



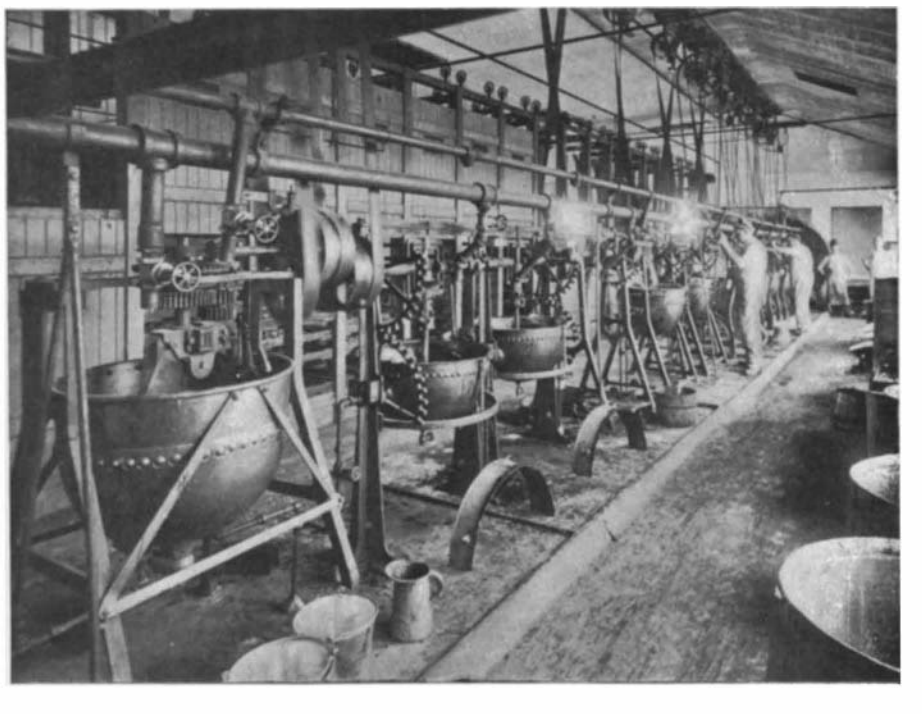
Pulling Room.



Chocolate Caramel Dipping Machine.



Condensing Milk and Separating Cream.



Cooking Room.

THE MANUFACTURE OF CARAMELS.

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