gator. The man who will guide von Zeppelin's airship will in a measure be the plaything of natural forces which at present lie without the province of human experience. He must be cautious; for he must learn by actual practice what he does not already know.

It is evident that the loss in gas for seventeen balloons will vary. So long as this loss is equal in both halves of the airship, or so long as this loss is compensated for by throwing out ballast or shifting the sliding weight, stability will be preserved. But it is clearly necessary that in each car a man should be posted whose duty it should be to maintain the stability of the vessel by jealously watching the gas-bags. The judicious use of a horizontal rudder would correct the errors due to the inability of the two men to work in unison.

BORAX—OLD AND NEW METHODS OF PRODUCTION.

In the United States the annual consumption of borax is about 12,000 tons. Prior to 1864, consumers were dependent upon Europe for their supplies. In that year the deposits in California, which were discovered in 1856, yielded 24,304 pounds, which sold at 39 cents a pound. With the increased production prices declined somewhat, so that in 1872, the year the Nevada deposits were discovered, prices had fallen to 32 cents. The production for that year was 280,000 pounds. In 1873 supplies from Nevada and from the new San Bernardino County deposits, recently discovered, brought production up to 2,000,000 pounds, causing prices to decline to 24⅛ cents. The succeeding year the production was doubled, with prices declining to 14⅕ cents. From that year to the present, production has steadily increased, with some interruptions, until the maximum of 1899 has been reached with prices 7 cents a pound. The lowest price ever known was in 1887, when borax sold at 5¾ cents. The Dingley tariff not only cut off foreign importation, but raised the price of the native product from one to one-half cents a pound.

The high price prevailing in 1872 stimulated the search for new deposits, and, in that year, Teels borax marsh near Columbus, Nevada, together with Rhodes, Columbus, and Fish Lakes, all in the immediate neighborhood, were located and promptly developed. The supply was largely increased from these fields. In 1880 the largest deposits of all were discovered in the lowest depression of Death Valley. The Amargosa borax deposits, with the Monte Blanco borate mine of this section, are of enormous extent and fully capable of supplying the world for an indefinite time. These mines are located in a region the most forbidding, remote from the railroad and offering almost unsurmountable difficulties in the reduction and marketing of their product, but their richness and extent, compared to all other fields, soon caused them to be regarded as the principal source of supply for the future production of borax in the United States.

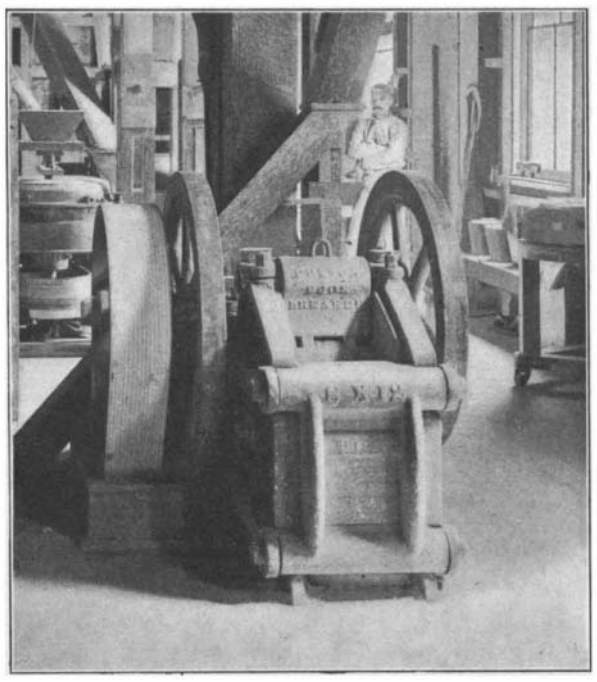
The early production of borax was by dissolving crude borate of lime and applying heat. The liquor was drawn off and the borax allowed to crystallize. Fuel was procured from the pine forests of the neighboring mountains, and, to some extent, from the roots of the mesquite.

From the borax marshes in Death Valley to the nearest railroad point was 165 miles. Over this distance all supplies for the camp as well as the manufactured borax had to be hauled. The wagons used for this purpose were the largest vehicles ever made and carried 20,000 pounds, taking twenty-four horses to pull them. They traveled about 17 miles a day, and were compelled to carry a tender for water as well as feed for the stock. Springs of water were wide apart, and each journey was but a repetition of hardship and adventure. Many tragical tales are told of sanguinary fights between teamsters and tramps of the road, of men dying from heat or becoming insane from thirst. This method of marketing the product was extremely expensive, and the constant decline in prices that accompanied increased production would have stifled the industry, had not the discovery of vast deposits of borate of lime in the Calico Mountains, and only about eleven miles from the railroad, opened up a new and permanent supply and in quantity sufficient for whatever demand might be made upon it.

Until the discovery of deposits of borate of lime in the Calico Mountains, borax had been a product of the marsh and of methods the simplest, admitting no improvement in mechanical appliances. An entirely new era opened with the discovery of borate of lime in stratified rock formation. Thenceforward the industry was transformed into a proposition akin to that of quartz mining and allowing an abandonment of the necessarily rough methods of the marsh system of production. Mechanical ingenuity superseded the wasteful agencies of the past and allowed the introduction of economical methods of manufacture and an adaptation of scientific principles. For hand labor was substituted mechanical appliances realizing certain results and greater purity of the product.

Borate of lime as mined at Calico is found in strata as well as in chambers sometimes as large as a house. The shafts are driven 600 feet below the surface, where the deposit is extracted in the same way as quartz.

At Calico 2,000 tons a month are produced from the mines. Here it is loaded in cars, and by means of a branch railroad, eleven miles in length and owned by



GRINDING CRUDE BORATE OF LIME.

the company, it is hauled to Daggett and thence finds its way to tidewater on San Francisco Bay.

The great wagons of the desert are things of the past, and the saving of expense of the 160 miles hauling has preserved an important industry from succumbing to the cheap labor of overcrowded Europe.

The works employ from 400 to 1,600 men. The crude borate of lime is first passed through rock breakers and is then ground to the fineness of flour by means of rolls and burr stones. It is then, with a small proportion of carbonate of soda, thrown into a digester, where under heat, pressure and agitation the existing affinities are completely divorced. The carbonic acid unites with the lime, which yields boracic acid, the latter with a small portion of soda and the result is borax in solution. The liquor is then drawn off into tanks, where the borax in crystallizing attaches itself to

PACKING BORAX FOR SHIPMENT.

small steel rods and hooks altogether like great sticks of rock candy. The sediment contained in the mixing tanks is composed largely of sand and dirt with considerable borax mixed. The deposit is passed through a filter press, which presses the dirt and allows the borax liquor to pass away to be utilized again. Repeated over and over again, the last remnant of borax is finally secured by this process.

The uses of borax are extending year by year. The meat purchasers of the country are the largest consumers, absorbing 6,000,000 pounds and over annually. For mechanical purposes the demand is constantly increasing, but it is in the domestic consumption of borax that the expectation and hope of the industry is centered. For a hundred different demands of household economy the advantages of borax as an adjunct of the kitchen, laundry, nursery, or toilet, as a sanitary agent of value and even as a medicinal quantity, has been found of such positive value as to insure a constant and increasing element in the world's necessities.

Seedless Oranges.

Twenty-five years ago there were no seedless, or navel oranges grown. A few oranges were raised in Florida, but the bulk of the supply came from the Mediterranean, and the fruit was expensive. The annual yield of California oranges was less than five carloads. Now the annual orange yield in California is upward of 15,000 carloads, and the total amount invested is now something like $43,000,000, while twenty-five years ago it was only $23,000. The introduction of the seedless, or navel orange has caused these changes. It has revolutionized the orange industry of the United States, drawing 13,000 men out of other pursuits and has transformed vast areas of sun-baked land in California into beautiful orange groves. The New York Sun recently had an interesting article on this subject, from which we derive our information.

The first seedless orange trees were introduced in 1872 through the efforts of William F. Judson, United States Consul of Bahia, Brazil, who heard from the natives of a few trees in the swamp on the north bank of the Amazon, some sixty miles inward, which had no seeds. It seems that even in those days there were Consuls who were interested in scientific matters, and could foresee the economic value of a discovery of this kind. He sent a native up the river to get some shoots, and bring back some of the fruit. Several of the shoots were packed in moss and clay and were shipped to the Agricultural Department at Washington. They did not excite very much attention at first, but the next year Mr. Horatio Tibbetts asked the Agricultural Department for specimens of fruit and shrubs suitable for experimental propagation in Southern California. Among other things Mr. Tibbetts obtained the four surviving orange tree shoots from Brazil. They were shipped to Riverside, California, and were immediately planted. Even here the shoots appeared to have had bad luck; one died of neglect and another was chewed up by a cow. Five years passed and the two surviving trees come into bearing, and in the winter of 1878–79 they bore sixteen oranges of the seedless variety—the first ever grown in North America. Specimens were shown to orangemen and fruit growers. At first they were sceptical as to whether the trees would bear annually such fine specimens. The second crop was awaited with great anxiety. There was about a box of oranges in the second year's crop and they were even better than those of the first crop. Mr. Tibbetts was sure that there was a fortune in the new variety of oranges. For two years he experimented with propagating trees from shoots and cutting from his two seedless trees. His attempts were a failure, but finally he hit upon a scheme of budding from the seedless navel trees upon the seedling trees. Experiments along that line were successful, and it was found that a bud taken from one of the two Tibbetts trees and grafted into the bark of a seedling tree would grow to be a limb which would grow seedless oranges. The original orange branches were then cut away and the tree thereafter bore only the new variety of fruit. Work was carried on in earnest in the winter of 1882 and in the following year the demand for buds was so large that a dozen frequently sold for $5 and $1 each was finally not considered excessive for a good bud. A fence was built around the two trees to protect them and a year or two latter the orange trees that had been propagated from the two original trees began to bear and they furnished tens of thousands of navel buds, which were as good as those from the two original trees. The industry has grown until now no one thinks of planting seedling oranges, and tens of thousands of seedling trees have been budded into navel orange trees, and there are many navel orange groves in the region which have yielded net profits of from $250 to $300 an acre a year. Riverside has grown from a hamlet of less than thirty American inhabitants to a prosperous town with 14,000 population. It is the greatest orange producing locality in the world, 16,000 acres of the land being devoted to it. The average annual shipments of the oranges from Riverside are 1,600,000 boxes. The Riverside citizens are now urging that the two trees which were the source of this prosperity, be removed to a public park and suitably protected in order that they be kept for the next generation as an object lesson. No visitor is allowed to take any flower or fruit into the orchard for fear of the scale.

In many post offices in England sealing wax is melted and kept in a liquid state by electric current.

SCIENTIFIC AMERICAN

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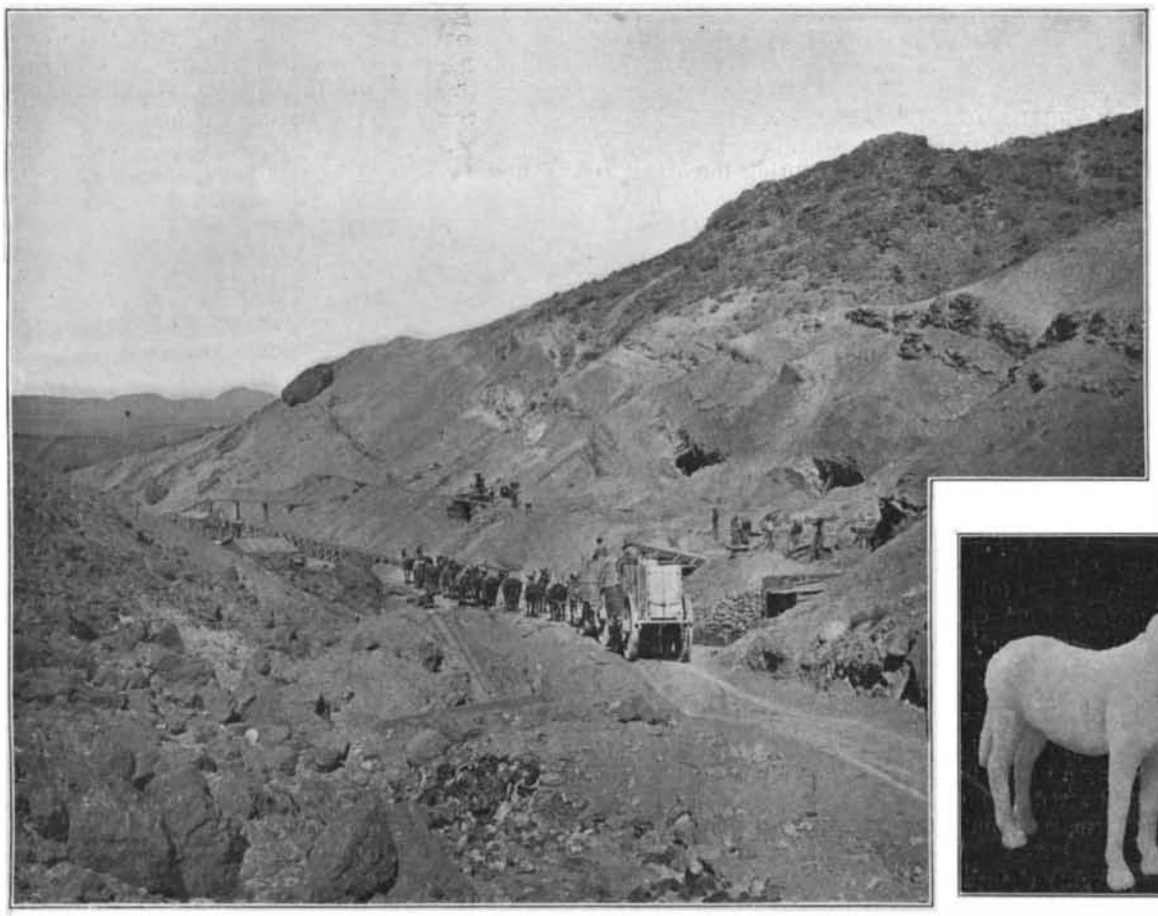
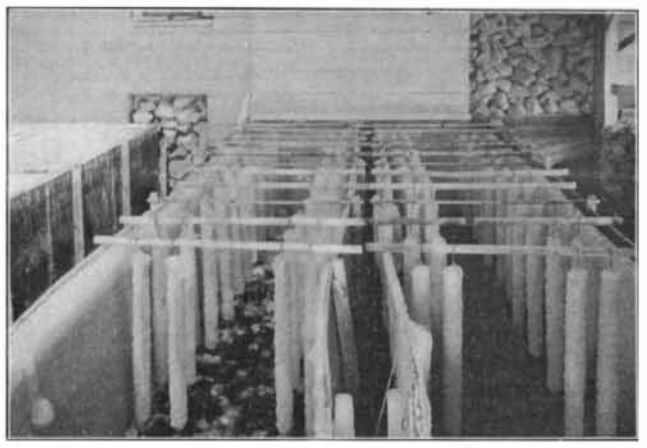
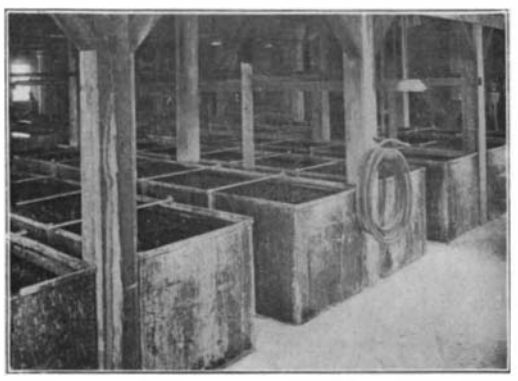


Borate Mines in San Bernardino County, Cal.

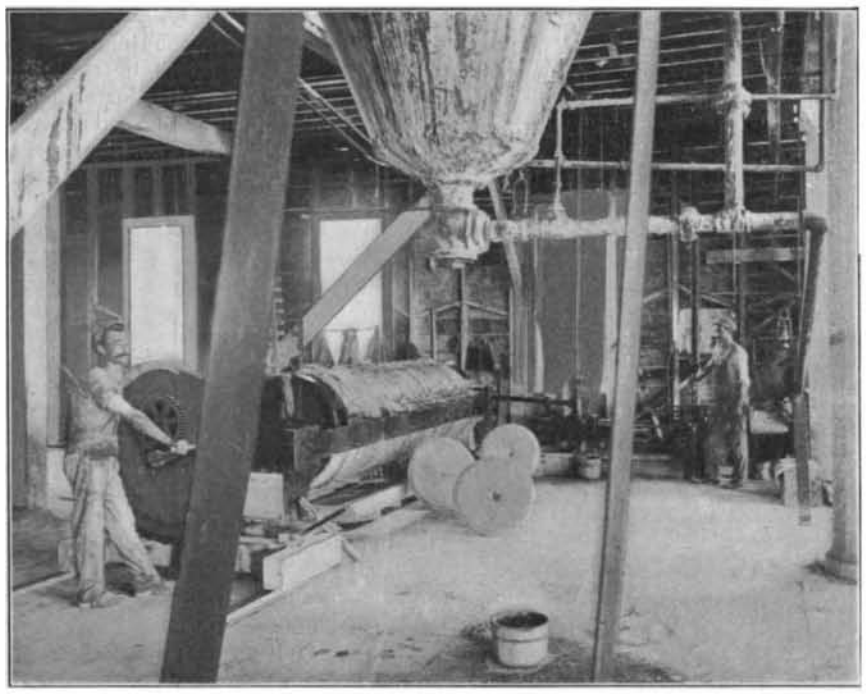


The Crystallized Borax on the Rods.

A Borax Mule.

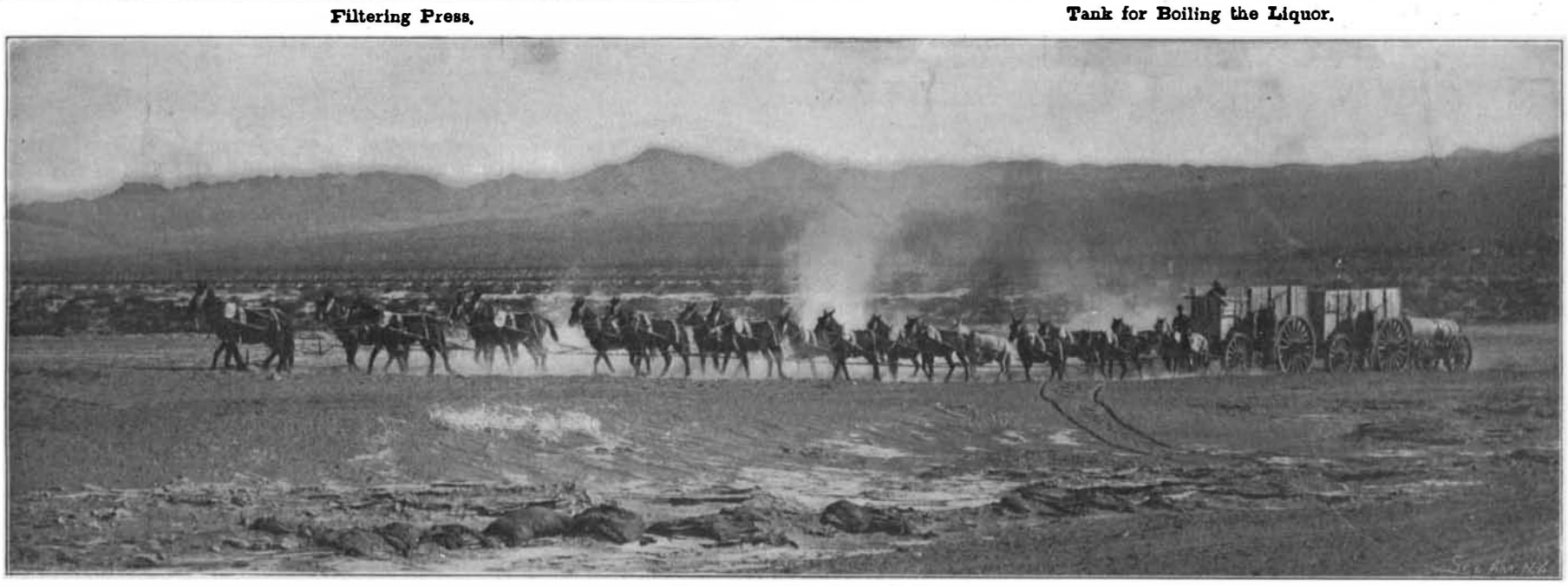


Tanks Dissolving the Borate of Lime



Filtering Press.

Tank for Boiling the Liquor.



Teaming Through Death Valley.

THE CALIFORNIA BORAX INDUSTRY.—[See page 326.]

Science Notes.

The bust of the late Prof. Egleston and a bronze tablet will be given to Columbia University by the students of the School of Applied Sciences.

A book industry exhibition will be held at Gothenburg from July 15 to September, 1, 1900. It is expected that the exhibition will be of great interest, not only to printers, but also to the public at large. Rare and unique books, prints, etc., which are of value especially to printers will be shown. The exhibition will be the first of its kind ever held in Sweden and contributions from foreign countries are expected. There will be a printing office in operation and if possible, it is intended to illustrate the progress of art by exhibiting a printer's shop of the middle ages and a paper factory producing hand-made paper.

The eclipse of the sun of May 28 will be visible in Europe about 4 o'clock P. M. in Spain and Algeria, but the time of the eclipse will be very short, only 2 minures 14 seconds in the most favorable localities. It will be only partial at Paris and throughout the rest of France. The astronomers who are to observe the eclipse have taken all the necessary measures to obtain good results. The Astronomical Society of France has sent two expeditions to the regions of total eclipse; one of these will be installed near Alicante and the other in Algeria. Besides the American expedition under Messrs. Percival Lowell and Todd, several English expeditions will be installed in Spain and Algeria.

We have already discussed the excavations of the Roman Forum. Signor Giacomo Boni describes a most interesting scientific discovery. This is that the sacrarium of Mars was an actual and genuine sacred seismic observatory, the shocks of earthquakes being registered by the oscillations of spears. The spears kept in the Regia were venerated as the weapons of the mythical father of the first king and founder of Rome. The spears were wooden rods with metal points, and they were in themselves objects of worship. It is not known whether the spears were suspended so as to register the smallest oscillation, but it is certain that their vibration was considered as a forerunner of disaster. The oscillations of the spears were registered in classical writings as in Livy: "Hastæ Martis motæ," the date is 570 A.U.C. Similar instances occur for 635, 650, 654 and 657. In the small group of the Regia, the temple of Vesta, the sacred well in the intervening way were assembled, and not all of them by chance. All connected with those natural phenomena which most impressed primitive man, earthquake, fire and lightning. Professor Boni's most interesting paper is published in the current SUPPLEMENT.

The International Conference for the protection of wild animals in Africa recently began in London and was opened by delegates from many countries. Concerted action is necessary in order to obtain an international agreement to restrain the extermination of many of the mammals, birds and fishes in Africa. It is useless to preserve wild animals in one part of Africa, while they are killed off in neighboring districts by persons claiming to be citizens of other European States, so that an international agreement is sought for. It is needless to dwell upon the unnecessary slaughter of elephants, rhinoceroses, hippopotami, the larger kind of antelopes, etc., since the Cape Colony, the Boer States, and the Rhodesian territories have been opened up to colonization. The establishment of large reserves like Yellowstone Park in the United States is advocated, where wild animals can be allowed to lead their natural life. The experiment has been tried on a small scale with considerable success. In a narrow strip of forest country on the south coast, the Government of Cape Colony preserves some herds of elephants. Ten or twelve of these large reserves will keep alive, for a time at least, the striking types of animal life in which Africa is so extraordinarily fertile.

Switzerland has not many feathered songsters, but those that do exist are carefully protected, not only by law, but by the fostering character of the people, particularly the German-speaking people of Switzerland. In northern Italy bird killing is an epidemic and this spirit has spread over the Swiss-Italian canton of Ticino. As the seasons come and go the Swiss birds make their pilgrimages south and in going and returning cross the land of northern Italy, and the Swiss canton of Ticino, and they are mercilessly pursued by hunters of all ages and all classes. On the Lake of Maggiore it is estimated that at least 60,000 feathered songsters are trapped and killed every year, and in the regions around Bergamo and Brescia many millions are slaughtered to satisfy the demands of tables and of the millinery establishments of the world. One of the schemes is to cover the limbs of trees with bird lime so that they become helpless captives if they stop in their flight for rest or for food; hundreds are often captured by this simple means. During the past year the border police of Ticino captured and destroyed 13,000 bird traps set to imprison the weary little flyers. Now, however, excellent laws are being enforced and the song birds of Switzerland may yet survive the attempt to exterminate them.

Engineering Notes.

Acetylene gas seems destined to play an important rôle in the illuminating world in Spain. Large numbers of generators are already in use.

Venice has been selected as the spot for a modern shipbuilding plant. The works will be erected on the island of Sant'Elena at the eastern end of the city.

A railway is to be constructed from Damascus to Mecca in order that pilgrims may be saved from a sea voyage. It is proposed that the line shall be built by soldiers.

Irrigation is of the utmost importance in Persia, as cultivation depends upon it, and water is extremely dear. It has been suggested that artesian well manufacturers might find an excellent opening once that the success of these wells was assured.

It is suggested that it will be profitable to try the experiment of using gas engines for driving ships, the gas being generated on the vessel itself. Coal will be roasted in retorts aboard the ship in order to drive off the gas for the engines. The coke thus produced, says The Electrical World would furnish the fuel needed to roast the coal. The purpose of the experiment which is to take place is to ascertain whether the saving of weight of the gas-producing plant and gas-consuming engines over the ordinary plant of steam boilers and engines, and the saving of space are sufficient to warrant the adoption of a new system.

According to an English Consular Report, oil engines are rapidly advancing in favor in Palestine, for the purposes of drawing water from the deep wells to irrigate the orange gardens. Hitherto the water was pumped by animal power. There was a large water wheel, and from four to eight mules were required to revolve it, according to the size of the wheel. Not only was this a very slow and laborious method, but it was very expensive costing about two dollars a day. It has been found that with an oil engine of six horse power it is possible to pump double the quantity of water that was previously raised by eight mules while the average expense is about the same, since the engines consume about nine gallons of oil a day. Under these circumstances it has been found far more economical to use an oil engine upon the large plantations than to employ animal power.

The arrival last week at the port of New York of the twin-screw steamship "Grosser Kurfurst," after her maiden trip across the Atlantic, is the latest evidence of the remarkable activity which is being shown by the North-German Lloyd Steamship Company. This vessel is a representative of that rapidly increasing class of transatlantic steamers which combines large freight-carrying capacity with an extensive accommodation for passengers. The rapid growth in the size of modern steamships is shown by the fact that had this vessel come to New York some half dozen years earlier than she did, she would have been the largest steamship afloat. She is 560 feet long and 63 feet in beam, with a gross measurement of 13,000 tons and a displacement of 20,000 tons. Before being placed on the Atlantic route she was given an extensive trial by being sent on the round trip to Australia.

The Chemiker Zeitung examines the question of preserving the hulls of vessels from corrosion. The essential conditions of the preservative coat to be applied are that it should protect against all corrosion, the surface should be smooth, to avoid friction, and it should dry rapidly, so as to allow two coats per day. In the case of new steel cruisers, the black scale must be taken off by acid before applying the paint, as otherwise this will fall off with the scale and leave the metal bare. The best process is that of Rahtjen, using a solution of shellac in alcohol, with which is incorporated a little oxide of iron and a small quantity of linseed oil to give elasticity. The first coat serves to protect the metal, and a second is given of the same composition, to which arsenic and mercury are added. This is designed to prevent the adhesion of marine vegetation, owing to the formation of chloride of mercury under the action of the sea-water upon the mercury. This paint dries rapidly and several coats may be applied per day. The disadvantage consists in the fact that only a small quantity of mercury can be incorporated without attacking the shellac, and that the latter is slightly soluble, so that the preservative value is diminished in the course of time. The author points out the conditions under which the preservative action is exercised, and shows that the toxic substance added to the paint has the effect of killing the germs of crustacea which float freely during the first period of their development in search of a place to fix themselves, such as the side of a vessel. When the ship is displaced through the water the layer of paint is constantly affected by the friction, and the sea-water exercises a chemical action, causing the formation of antiseptic compounds at the surface of the hull, and thus destroying the organisms which come into contact with them. As long as the ship is in movement the successive layers of paint continue the action, and this only ceases when the toxic substance has been entirely used; the paint still continues to preserve the hull against corrosion.

Paris Exposition Notes.

In the Electrical Palace, the collection of historic apparatus shown by the United States will be of considerable importance. It will be contained in a pavilion which has been erected on the second floor, covering large space. The pavillion takes the form of a series of colonnades of white staff, enclosing the different spaces for exhibition rooms; as it extends nearly across the building, two passage-ways have been provided, besides which a central passage gives access to the central room, from which branch four side spaces. The colonnade is in the classic style and gives a pleasing effect. Over each of the doors is represented an eagle upon a shield, and along the upper part are a series of figures in white staff, upholding incandescent lamps. The pavillion is well provided with flags, and a large American flag hangs over the whole in a conspicuous place. The historic collection will include early apparatus used by the principal American scientists and inventors.

A novel form of electric fountain is to be seen in the attraction known as "Spain in the time of the Moors," its peculiarity consisting in the fact that no water is used. It was at first proposed to erect a fountain in the center of one of the large halls, having a jet about 6 or 7 meters high, but when the consumption of water was estimated it was found that the cost would be too great. M. Trouvé, the engineer in charge, found an ingenious solution of the difficulty. Below the large basin, whose sides are inclined toward the center, is installed a powerful electric ventilator, and above is the tube for the jet. An arc lamp sends reflected rays through the tube in the usual way, and instead of water, a certain quantity of rice grains mixed with mica and metal foil are used; this is blown up by the ventilator and falls from the tube into the basin, from whence it is taken again by the current of air. A disk of colored glasses turns below the tube and varies the light upon the jet.

One of the most novel, and interesting, exhibits at the Paris Exposition is a complete set of bed hangings manufactured in Madagascar from the silk of the halabe. The halabe is a huge, indigenous, female spider of great ferocity. It eats the males which venture near it, and will even devour the weaker members of its own sex. M. Nogue, the head of the Antananarivo Technical School has been studying the instincts and life of this insect for many years and after much perseverance has now perfected a neat arrangement for winding off the thread with which the spider spins its web. Each spider yields from three to four hundred yards of this silk which is somewhat finer than that spun by the silkworm, but, nevertheless, it possesses extraordinary strength and is of a light golden color. There is no doubt but that by M. Nogue's process the product of the halabe, like that of the silkworm, can be widely utilized for commercial purposes. The bed hangings exhibited this year at Paris are the first results of M. Nogue's invention and cannot fail to excite unusual interest.

At the Vincennes Annex have been erected several large buildings and pavillions to accommodate the various exhibits. The Transportation building will contain a number of locomotives, cars, trucks and automobiles. A Forestry building has also been erected, with a large pavillion. The United States has a large machinery building, in which will be installed various types of machines and dynamos; it contains a Shaw electric traveling crane, and to operate this, as well as to obtain the necessary lighting current during the construction, it was intended to erect an American engine and dynamo, but as these were sent over on the "Pauillac" nothing has as yet been heard from them; to supply the deficiency an English dynamo and engine were brought over and rapidly set up. In front of the building is a race track for bicycles, and in the interior will be a second track for foot races. Tiers of stone seats have been built along each side of the track. Around the lake a wide track has been constructed for automobile races. An aerostatic park has been laid out and a number of balloon ascensions will be made.

The representation of a naval combat in miniature with all the details is to be seen in Paris. This attraction is situated just outside the fortifications, where a large basin has been constructed, containing 10,000 cubic meters of water, around which have been arranged suitable decorations representing the port of a large city. The miniature boats attempt to reach the city, but are repulsed by the fleet situated in the port, giving rise to a naval combat in which the cuirassiers and torpedo boats go through their evolutions, with bombardment of the city or ports. The spectacle is viewed from a stand 80 meters long extending along one side. The small boats are an exact representation of the latest types of battleships; they are from 4 to 5 meters long, and are directed by a battery of accumulators and electric motors. Each boat contains one or more persons concealed in the interior, who direct the boat and carry out the necessary maneuvers; to represent the discharge of the guns, blank cartridges are fired from a small gun or pistol. The signals or lights are represented by incandescent lamps distributed around the boat.