Low temperatures when melting often result in cracked castings, the shrinkages and contractions being unequal from the segregation of the component metals.

All alloys suffer from the presence of impurities, some of them when very minute quantities are present, and by absorbing gases from the air which are prejudicial. Oxygen has an affinity for many metals, silver in particular, which will absorb twenty-two times its bulk of that gas when melting, but gives it up again upon solidifying; steel also dissolves oxygen in melting, but does not part with it again, and it is disseminated through the mass as ferrous oxide unless special means are used to dispel it. Copper acts similarly, as all who have tried to cast pure copper in sand are well aware, but there are many deoxidizing agents which can be used to prevent the difficulty mentioned. Of these charcoal is the most commonly employed; floating on the surface it acts mechanically as a shield against the introduction of air and prevents the absorption of oxygen. Manganese is another agent; in the form of cupro-manganese it combines with oxygen to form oxide of manganese, resulting in slag. Sodium carbonate and potassium nitrate are other deoxidating agents which can be used with good results, for in conjunction with charcoal they absorb most of the slag and prolong the life of the crucibles, which are greatly eroded by it. Phosphorus is a very active deoxidizing agent, and is energetic as well, so that very small quantities only must be used, 0.02 per cent being the greatest quantity allowable; the greater part of this will slag out, leaving scarcely a trace in the casting. The effect of arsenic upon copper and brass castings is very noticeable, increasing the tensile strength about 33 per cent, but bismuth is extremely prejudicial to this last quality, as it causes brittleness when present in very minute amounts.

Forestry Work in the Philippines.

BY E. A. STERLING.

The fact that the art and profession of forestry is flourishing quite as well, if not better, on the islands which constitute our new Philippine possessions than in this country is very conclusive evidence that American push and industry are actively engaged in the betterment of conditions in these islands. Especially striking is the fact that a profession, which is yet so new in the United States that it meets opposition because of the popular ignorance and misinformation as to its aims and motives, should so early become firmly established in the Philippine Archipelago.

It is of historical interest that the Spaniards had quite a complete forestry service in the Philippines for many years prior to the Spanish-American war, yet it was too poorly managed to be of any real efficiency. Some forty foresters and eighty rangers were employed, but the positions were created for the benefit of political favorites, and hence little real forestry work was done, either in caring for the forests or in securing the revenues due from the cutting and sale of timber. The result was that when the United States came into possession the forest lands near Manila and other shipping points were in a denuded condition. When the United States took military possession of Manila, the decrepit Spanish Bureau of Forestry was handed over to our care. Then came the difficult task of reorganizing the Bureau and establishing an efficient forestry service under American guidance.

The man selected for this work was Capt. George P. Ahern, of the Ninth Infantry, who was appointed director of the Forestry Bureau at Manila, and the success which has been attained shows the wise choice made in the appointment. Capt. Ahern is a graduate of West Point, and of the Yale Law School, and has for some years been an enthusiastic advocate of forestry in this country. Under his energetic management the success of the Philippine forestry service is assured.

It soon became evident that the great need of the Philippine Bureau of Forestry was a corps of young Americans, with a forestry training which would enable them to fully develop the great natural forest resources of the islands. It was with the view of obtaining these men that the Taft Philippine Commission sent Capt. Ahern to the United States in May of the present year. As a result of this visit, six professionally educated foresters sailed for Manila November 1, and another will sail early in February. This number, although small, will make quite a gap in the ranks of the small band of foresters now existing in this country. We have now, however, two fully organized schools of forestry, one at Cornell with 38 students and one at Yale with 30 students; hence we may soon hope to have a supply of professional foresters sufficient for the existing demand. The inducements and opportunities offered by the Philippine forestry service are, however, sufficiently alluring to draw a small percentage of our graduates for some time to come.

The New York State College of Forestry this year furnishes the largest quota of men for the Philippine forestry service. Its contribution consists of two members of the senior class, Messrs. Clark and Klemme, who were sufficiently advanced to pass the Civil Service examinations; Mr. Hagger, a German-trained forester who has been manager of the College Forest in the Adirondacks; and Mr. Bryant, the first student to receive a forestry degree from an American forest school, who leaves a position with the New York State Fish, Forest and Game Commission. From the United States Bureau of Forestry Capt. Ahern secured the services of Messrs. Hareford and Griffith and of Mr. S. N. Neely, a civil engineer.

The duties of these men will be of a varied nature. Briefly stated, their first work will be to learn what they have in the way of forest products, determine the possible uses of the woods, and to look up markets for the forest products. A stop, too, must be put to the illegal cutting and selling of the rich tropical woods. Under the present conditions much timber is cut on government land and no revenue paid on it. At Manila a laboratory for the study of timber physics and for wood-testing will be established, in which will be determined the values and properties of the many woods found on the islands. In addition, a botanical classification of the existing species will be carried on. There are at present 665 species classified and over 50 varieties of the rubber tree identified, but much work is yet to be done along these lines.

That the Bureau will be successful from a financial standpoint is evident from recently published figures: The Spanish Forestry Bureau at its best never collected over $12,500 per month (Mexican money). Under the American regime $8,000 (gold) per month was received at the very start while the total received in revenues during the first fiscal year was $199,000. At present the revenues are about $30,000 (Mexican) per month.

The Transpacific Cable.

The actual work of laying the British Government Transpacific cable connecting Australia with the home country via Canada will be begun toward the end of 1902. The manufacture of the various cables is well in hand. The Telegraph Construction and Maintenance Company, of Greenwich, London, is carrying out the contract. In order to complete the work within the specified time, the company is building a new cable-laying steamer which will be the largest cable-laying vessel afloat. The total length of the cable, including 10 per cent allowed for "slack," will be about 8,000 nautical miles. The longest span is that from Kelp Bay, on the south coast of Vancouver, to Fanning Island—about 3,561 miles. The shorter sections are from Fanning Island to Suva Fiji, 2,093 miles; from Fiji to Norfolk Island, 961 miles; from Norfolk Island to a point near Brisbane, Australia, 834 miles; and from Norfolk Island to the northern end of New Zealand, 537 miles.

The time taken by an electrical pulsation to pass through a submarine cable increases with the length of the cable, in proportion to the square of the length. That is to say, if it takes the signal one second to travel 1,000 miles, it will take four seconds to travel 2,000 miles, nine seconds to travel 3,000 miles, and so on. But the speed also depends on the dimensions of the "core" and its insulation gutta percha, or india rubber. A thicker copper wire and coating of gutta percha gives a higher speed. The Vancouver to Fanning Island section of the Imperial cable will be "fast," owing to its heavy core, which weighs about 650 pounds of copper and 400 pounds of gutta percha per mile. Such a cable will carry seven or eight paying words a minute, and as it is the longest section, this will be the speed of "through" messages. For the shorter spans of the line smaller cores will suffice. The messages will be received on the "siphon recorder" and "mirror instrument" of Lord Kelvin. The "duplex" system of Dr. A. Muirhead, by which two messages, one from each end, pass through the wire at once, will be employed on the southern sections at least. Although this system nearly doubles the capacity of a cable it is not considered so advantageous for this cable as for others, owing to the fact that only a few business hours in the day are common to Great Britain and Australasia. It is anticipated, however, that there will be a certain amount of telegraphic communication between this country and Australasia, over this cable, in which event the adoption of the system will prove very convenient. Dr. Muirhead has recently improved his system by applying a "self-induction shunt," to the receiving instruments, which has the effect of "curbing" the signals, making them easier for the clerk to read, and increasing the speed of messages. Lord Kelvin has recommended the utilization of this appliance for dispatching messages, for the same purpose. Two repairing ships will be retained to maintain the cable in working order. There is some fear of earthquakes or landslips breaking the cable in the direction of Fiji. Not long ago the Eastern Telegraph Company's cable between Sydney and Nelson was bitten by a shark, in 300 fathoms, and so injured that it had to be recovered and a splicing made.

THE DUKE OF SAXE-COBURG-GOTHA'S COLLECTION OF NEFS.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Considerable anxiety is being experienced in England regarding the destination of the late Duke of Saxe-Coburg-Gotha's remarkable and extensive collection of model silver ships, or as they are technically called "nefs." The collecting of these picturesque and rare specimens of the silversmith's craft constituted his principal hobby. At present they are resting in the special airtight glass cases he had specially designed for their accommodation at Clarence House, his London residence. His assortment contains the finest specimens of this obsolete decorative plate extant. In the middle ages, when a sovereign desired to display his or her friendship to another monarch, the gift invariably comprised a nef. Consequently the demand for these curious examples of silver workmanship was strictly limited, and it is estimated that there are no more than sixty of them in existence. Their rarity may be adequately comprehended from the fact that very few European museums contain a single specimen, and even the British Museum, London, does not contain a solitary example. The Czar of Russia has a few specimens which are jealously preserved in the Kremlin at Moscow; there is also one in the Hotel du Cluny, Paris; another is exhibited in the Galeries du Louvre; and a few are distributed throughout the world in private collections. Those represented in the late Duke's collection, however, numbered forty-one examples—some of the largest and most beautiful nefs ever made. Why the art became extinct is inexplicable, unless it was due to the fact that this form of monarchical presentation fell into desuetude.

This peculiar craft was confined almost entirely to the silversmiths of Nuremberg and Holland, though the work of the former is generally conceded to be superior to that of the latter. During his lifetime the Duke retained two of the most skilled silversmiths in London to attend to them.

The most conspicuous specimen in the collection is that which was presented to the Duke of Edinburgh by the Elder Brethren of Trinity House, to commemorate the twenty-fifth anniversary of his holding the post of Master of this corporation. This nef measures 28 inches in length and was made in Nuremberg about 1650. It is a trading ship with two masts, and has a large figure of Neptune seated in the stern, and a draped female figure forming the prow. The most salient characteristic of this work is the remarkable fidelity with which it is executed. The ropes and rigging, together with the sails and various appliances on the deck, and even the crew itself, are reproduced delicately in the solid metal. In this particular model the rigging is crowded with sailors furling the sails. One curious feature of this nef, and which may also be noticed in several others is that the captain is represented twice the size of a member of his crew, as if to assert his authority.

These pieces of plate were designed for utility. For the most part they were used as vessels for containing wine, the deck being either removable to allow the insertion of the bottle or else the hull is hollow to permit the wine being poured therein, while in the bow is a small orifice through which the liquid can be withdrawn. Some were intended for containing sweetmeats or other table delicacies. Owing to their immense size and corresponding weight, they were mounted on small silver wheels, richly pierced and chased to facilitate their movements upon the table.

The hull was invariably heavily embossed with an appropriate design, nautical in subject, and at times further embellished in gilt. The nef presented to the Duke of Edinburgh bears no such picture, however, but is beautifully engraved with a scroll design. The sails are made from thin sheets of silver and are bellied as if with the wind. This specimen was evidently intended purely as a table decoration, since it contains no provision for holding wine or other delicacy, the deck being quite open.

Another prominent nef represents a three-masted vessel in full sail. The crew may be seen replete in their military uniforms; from the portholes project miniature guns, exact facsimiles of their prototypes, while small cannon are distributed about the deck with the gunners standing beside them. This specimen is of Dutch origin, dating from the year 1600. The arms of England are emblazoned upon the sails, and also heavily embossed upon the body of the ship itself.

The fighting merchant vessel is also represented, and in this instance the sailors manning the deck can be recognized as of English nationality. Although not so large as the two previous models, it is a far more artistic piece of work. The hull in this instance bears a pretty representation of the figure of Neptune accompanied by tritons and dolphins. It is dated Nuremberg, 1700. This vessel was intended for holding sweetmeats. On the bridge may be seen the captain shouting his commands. Two conspicuous features of this example are the real compass with which it is fitted in front of the wheel—which was

probably added at a later date—and the airshafts upon the deck. This is the only vessel in the whole collection containing the latter fittings.

A third war vessel shows the ship cleared for action. It has four masts, and the diminutive crew on the deck are carrying baskets of ammunition to the guns, while the gunners are standing with the sponges in their hands to clean the muzzles after the discharge. The captain is provided with a telescope with which he is scanning the horizon, and in the crow's nest are the sharpshooters or lookout men. The design on the hull depicts Venus rising from the sea with a host of Cupids. This example is Dutch, as may be determined from the bizarre horned mask with a protruding tongue from which the wine could be poured, constituting the figurehead. The model contains no hallmark, however, so that it is impossible to locate the date of its manufacture.

Although the majority of these nefs are mounted upon four wheels, some of them were treated much more fancifully. One is a single-masted ship with the deck merging into a huge shell. This specimen, which closely resembles our present-day bonbon dish, is mounted by means of a slim stem, comprising sea horses attended by boys, upon a tall stand, and measures twenty-four inches in total height. The sails are emblazoned with the arms of the Scottish lion and the French *fleur-de-lis*, respectively, interwoven. From the peculiarity of the figures on the deck it is surmised that they are supposed to represent Ferdinand, Alonzo, and Sebastian, while the winged figure on the mast is Ariel raising a storm.

The most modern example in the collection is inscribed with the year 1746, and was made at the town of Maestricht. It is not till one has closely examined the workmanship of the models that one can realize the immense amount of time and labor that must have been expended upon them. Without a doubt they are the finest specimens of silver carving and chasing in existence. The Nuremberg and Dutch silversmiths of the sixteenth and seventeenth centuries, to which period these nefs belong, were unrivaled in their skill and artistic taste, as this work abundantly testifies. It is mooted that the present Duchess intends bestowing them to the British Museum as a gift to the English nation. At any rate, it would be a matter of regret if such a unique collection should be permitted to be broken up and distributed in various directions.

THE DUKE OF SAXE-COBURG-GOTHA'S COLLECTION OF NEFS.

THE SANDS OF CAPE COD.

BY L. P. GRATACAP. NATURAL HISTORY MUSEUM, NEW YORK CITY.

Cape Cod, the long forearm with clenched fist that holds back the surges of the Atlantic from Boston Harbor, is a sand ridge covering tertiary clays, mingled with alluvial material and vegetable débris, and sparsely covered with woods. Its surface is irregular, made up of groups of low hills separated by depressions, inundated swamp country, and broad long plains supporting a thin herbage. There is enough nutriment in the sands assisted by the rainfall to bring to maturity the more common fruits, and vegetables flourish, in some places perhaps precariously, upon a soil ninety per cent of which is pure silica.

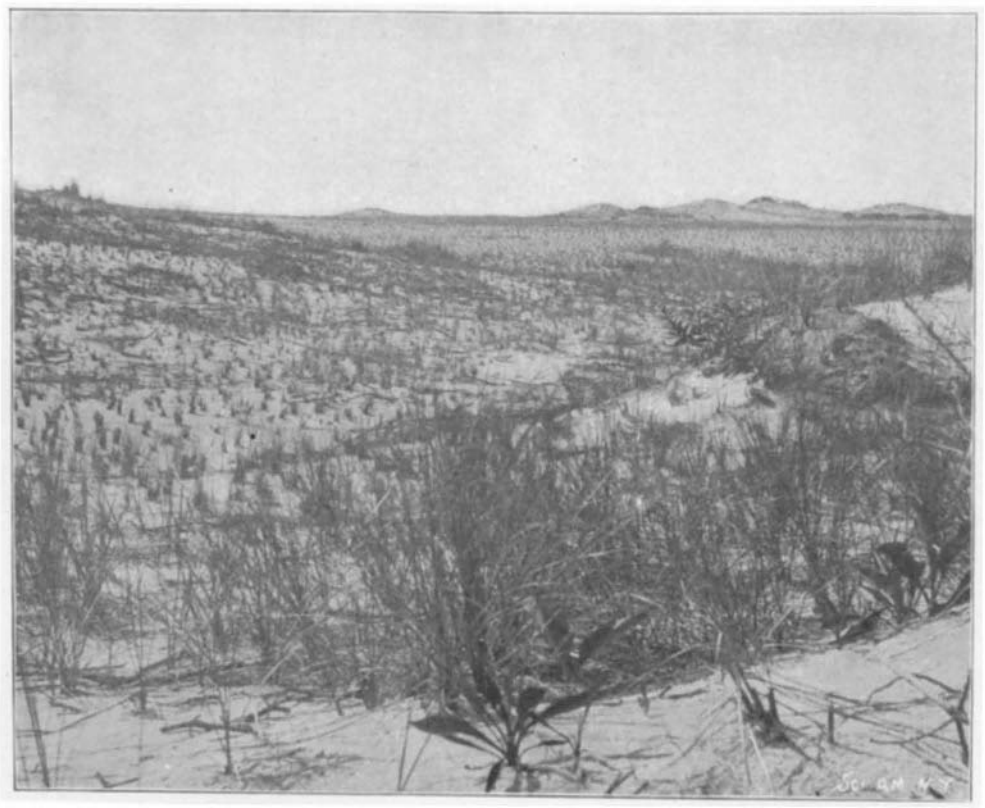
It is an interesting region geologically, and, apart from its pictorial interest, furnishes the tourist with abundant opportunities of observing the shifting nature of sandbeds, and the topographical features their movements create or destroy.

The rounded extremity pushed eastward by the winds, or driven northward, forms a wide two-horned head or spit behind which a sea of little hills recedes from the shore line, surrounding Provincetown and blending into the "peaked hill" district, and the rolling plateau of North Truro. Dr. Julien has recently laid before the New York Academy of Sciences the results of his study of this capricious landscape, and the sands that give rise to its protean character. He remarks upon the obvious contrast between the sands of the Cape and those of the Atlantic coast southward. The former are almost pure silica, while in the latter there is a greater prevalence of garnet iron oxides, and in the sands of Staten Island, as the writer has noticed, of serpentine feldspar and even mica. The Cape Cod sands have been longer exposed to the separative action of wind and water, have undergone far more violent intervals of translation, and are less immediately subject to replenishment from continental drainage.

Dr. Julien notes the preponderant recession of the tops of the bluffs, observing that "a very large part of the damage has been done by the violence of the wind, reinforced by vast quantities of sand and spray lifted up and hurled continuously for hours against all opposing objects." At the Highland Light, North Truro, this is evident, but it can be in a measure also accounted for by the firmer barrier presented to the sea in the basal beds of more or less consolidated clays. The writer has noticed a process of detachment along the planes of contact between the sands and the underlying clays. Water penetrating the sand layers oozes out on the face of the cliff at the junction of the clay and sand, and, if the clay has a seaward dip, the superincumbent sands slip, by levigation, over the clays and spill outward on the beach, to be later carried away by wind and water.

The rapid movement of the sand, its constant volatility, under the influence of strong winds, is a menace to the harbor of Provincetown, where broad shoals and bars have been formed by its recurrent deposition. The Cape Cod Railroad also suffers from its mobility. The national government has, in recent years, attempted a systematic repression of this instability of the sand by planting over broad areas dune grass (Spartina) in regularly separated and alined bunches and covering the farmed area with pine boughs carrying cones. The rotting and dispersion of the grass, reinforced by the occasional dropping of the pine seed and its development was expected to furnish a substantial remedy for overcoming the unstable sands. It has proved a success. The illustration shows the long distances of sand, between the high hill, past the water station at Provincetown, and the Race Point Life-Saving Station, covered with the planted grass.

In the "peaked hill" district on the road to the life-saving station at that point is a desert of sand lying between elevated summits almost invariably topped by grass. These summits seem anchored by the grass, and form resistant points around which the sand accumulates. The extension of the government work is watched with interest. Its practical benefits will be great, and, as a demonstration, under the most obstreperous conditions, of the steadying effects of vegetation upon large non-coherent bodies of sand, subjected to the most powerful impacts of air, of great importance.



INTRODUCTION OF DUNE GRASS TO PREVENT THE DRIFTING OF SAND.

The Rome correspondent of The Morning Post reports that, after several months of experiments and trial trips, the electric railway between Milan and Varese has been opened to the public. The railway, which is 90 kilometers (about 46 miles) in length, is the first line in Italy to be built on the "third-rail system." It consists of a double line of ordinary rails, between which runs a single conductor rail raised about a foot from the ground on earthenware insulators. The cars, which are about 40 feet long, are not unlike those of the Central London Railway, though they are somewhat more spacious. Each car is furnished with four projecting arms, at the end of which is a steel brush in contact with the conductor rail. On the journeys from Milan to Varese the arms to the right of the cars are in contact with the rail, and on the downward journey the left arms are in contact. At the level crossings the conductor passes underground, but as none of the crossings are 40 feet wide, the car remains in constant touch with the rail by means of its fore and aft arms. Under the car is placed an electric motor, and each car is furnished with an electric air pump for the Westinghouse brake and the whistle. The current is furnished from a station on the banks of the Ticino, where it can be generated either by water or by steam power, as the railway company has duplicate plant in case of a breakdown. Both plants dispose of 11,000 horse power. The current is conveyed from the generating station to the third rail by an elevated cable. Each car conveys 73 persons, and covers the distance from Milan to Varese in an hour. Departure takes place from Milan and Varese every 15 minutes.

Mr. J. Pierpont Morgan has purchased Raphael's Madonna of San Antonio for $500,000. This is the highest price ever paid for a picture, and the painting, which has been on the market for a number of years, is far from being one of Raphael's best. This sale naturally raises the question, What would a masterpiece like the Sistine Madonna sell for? Mr. Morgan is also said to have purchased the Psalmorum Codex, printed by Füst and Schoeffer, in 1459, for $26,000.