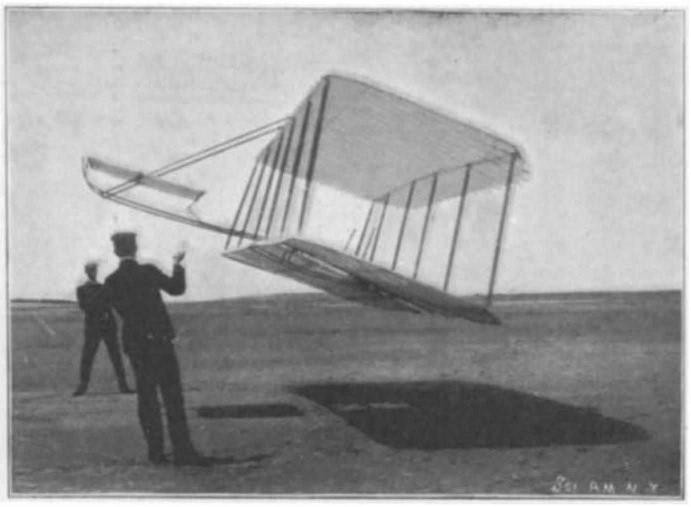
gen given off. It acts as a reducing agent when mixed with copper or lead oxides, and the metal is set free. M. Moissan has made a number of analyses of this body and finds that it has the formula KH.

SOME AERONAUTICAL EXPERIMENTS.

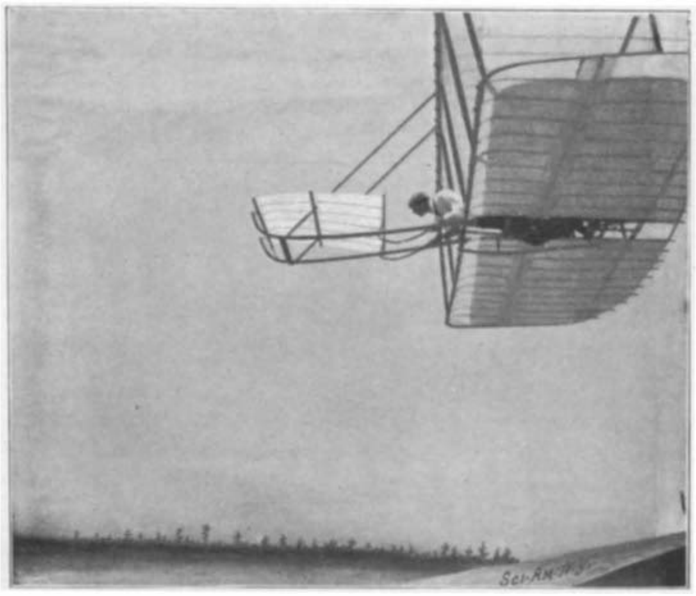
Mr. Wilbur Wright, of Dayton, Ohio, recently read a most interesting paper before the Western Society of Engineers, entitled "Some Aeronautical Experiments," and this paper was afterward published in the Journal of the Society. Through the courtesy of the Society we are enabled to present a series of engravings illustrating the article. Mr. Wright's attention was drawn to the study of aeronautical problems a number of years ago, and his active interest dates back to the death of Lilienthal in 1896. The experiments of Pilcher and Chanute also stimulated Mr. Wilbur Wright and Mr. Orville Wright to try some experiments in 1900, which were conducted on the seashore of North Carolina. These gentlemen have been bold enough to attempt some things which neither Lilienthal, Pilcher nor Chanute dared to do. They have used surfaces very much greater in extent than those which hitherto have been deemed safe, and have accomplished very remarkable results. It was the plan of Messrs. Wright to glide from the tops of sandhills. It seemed reasonable that if the body of the operator could be placed in a horizontal position, instead of the upright, as in the machines of Lilienthal, Pilcher and Chanute, the wind resistance could be very materially reduced, since only one square foot, instead of five, would be exposed. As a full half-horse power could be saved by this change, they arranged to try the horizontal position. The first machine had an area of only 165 square feet. It was first tested as a kite, and valuable data as to the angles were obtained. They then turned their attention to making a series of actual measurements of the lift and drift of the machine under various loads. The results obtained were most astonishing, for it appeared that the total horizontal pull of the machine, while sustaining a weight of 52 pounds, was only 8½ pounds, which was less than had previously been estimated for head resistance of the framing alone. On the other hand, it appeared sadly deficient in lifting power as compared with the calculated lift of the curved surface of its size.

Their attention was next turned to gliding, and a small hill which rose from flat sand to a height of more than 100 feet was selected, the slope having an inclination of ten degrees. A dozen glides were made with the wind blowing at 14 miles an hour. The operator placed himself in a horizontal position, and two assistants started the machine. Neither machine nor operator suffered any injury. The control of the apparatus proved even better than they had dared to expect, responding to the slightest motion of the rudder. With these glides the experiments for the year 1900 closed. The new machine for 1901 was exactly like the previous machine in theory and method of operation, but its lifting power was increased from 165 square feet to 308 square feet, although so large a machine had never before been deemed controllable. A special building was erected to house the apparatus. Quite a party went south to view the experiments, which were begun with the wind blowing 13 miles an hour. Various glides were made in order to find the center of gravity of the operator. The machine sailed off and made an undulating flight of a little more than 300 feet. To the onlookers this flight seemed very successful, but to the operator it was known that the full power of the rudder had been required to keep the machine from either running into the ground or rising so high as to lose all headway. The experiments also showed that one of the greatest dangers in machines with horizontal tails had been overcome by the use of a front rudder, and the operators escaped from positions which had proved very dangerous to preceding experimenters. In subsequent experiments the machine, with its new curvature, never failed to respond promptly to even small movements of the rudder. Many glides were made whenever the conditions were favorable.

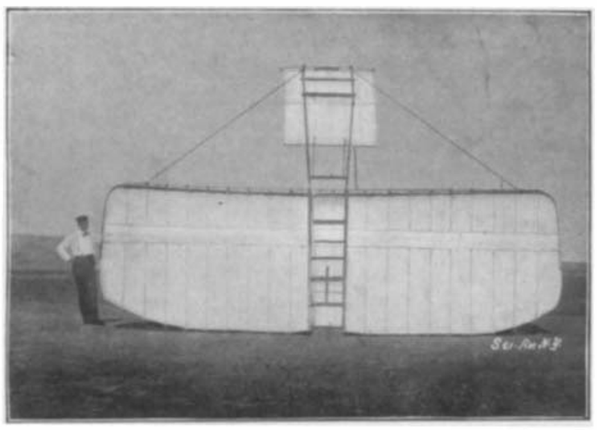
A most interesting series of photographs were taken, some of which we reproduce. Our readers are referred to Mr. Wright's original paper for an elaborate technical description of the principles involved in the experiments.



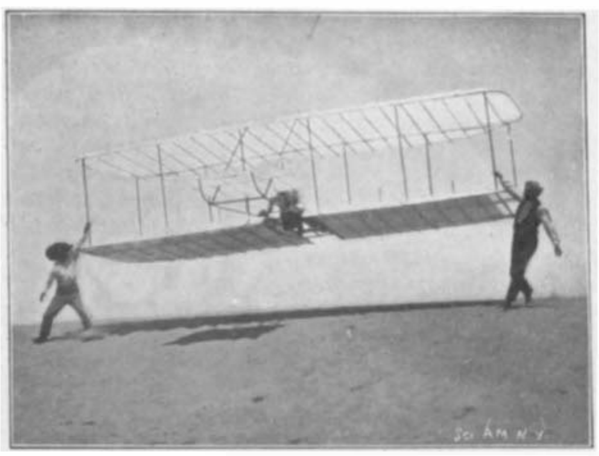
In Midair.



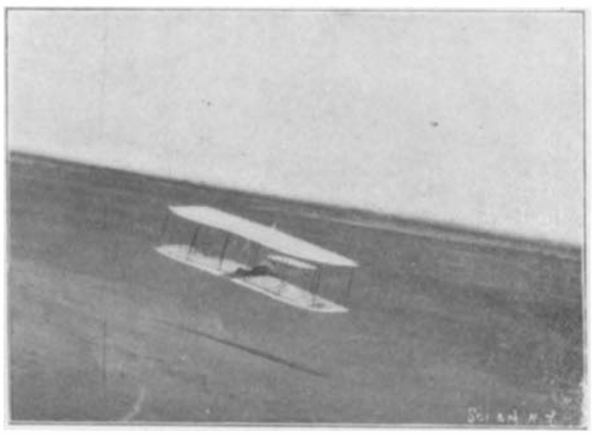
Soaring.



A Bottom View.



Beginning of a Flight.



A Low Glide.

SOME RECENT AERONAUTICAL EXPERIMENTS.

Alloys for Brass and Bronze.

Manufacturers of door trimmings, locks and hinges, etc., may find some valuable hints in the subjoined matter from a recent article by Percy Longmuir, condensed by us from The Foundry.

The author says: The term gun metal was given to various alloys of copper and tin for the purpose of making ordnance in days bygone, but, although no longer used for that work, the same alloys are exceedingly valuable for art work generally. Triple alloys, that is to say, copper, tin and zinc, have replaced the old double ones—copper and tin only—and in some alloys four or five different metals can be found. Zinc, lead, aluminium and manganese are all employed for specific purposes, and are therefore considered in this discussion. The properties of alloys have distinct qualities, and range from very hard and rigid to soft and to some extent elastic, and a general grouping includes the subjoined properties: They should be more or less elastic when cast, and have good torsional strength, together with a low melting point and fill the molds sharply. The range in alloys of the kind mentioned is very wide, and most founders have their own formulæ, which differ but slightly from those in use by others, but these very differences, minute though they be, have a great effect in some directions upon the character of the work turned out. A low percentage in the use of a deleterious element in the metal for a brass bearing may cause the same to heat badly, and similar alloys for high pressure boiler work may be dangerous. This last should have a composition somewhat as follows: Copper 86 to 88 per cent, tin 8 to 10, and zinc 2 to 6 per cent. The tensile strength is 12 to 16 tons per square inch of section, with 8 to 14 per cent elasticity in a length of two inches. This composition is an expensive one, and where the tin is high and the zinc relatively low does not machine well. A composition for a good average quality of metal is made with copper 80 per cent, zinc 10, lead 6, and tin 6 per cent, or a change in quality can be made by using the same proportion of copper and only 5 per cent of lead and 5 per cent of tin.

These cast sharp and machine well. Ordinary brass castings usually contain a greater or less proportion of scrap brass; it is usually obtained from dealers and is by no means uniform in quality, and must be sorted and graded carefully. The common proportions of scrap brass are copper 70 per cent, lead 4, tin 4, and scrap 18 per cent; but according to the grade of the scrap almost any grade of alloy can be produced. The addition of lead, up to a certain point, gives a good color, renders the metal easy to machine, and very much reduces the cost, so it is an inducement to use it as much as possible.

Bearing brasses should have a special composition, much harder than common brass; the following proportions are found to serve the purpose well: Copper 80 to 82 per cent, tin 10 to 14, zinc 2 to 4. Some use this formula: Copper 84, tin 12, and zinc 4. A cheaper bearing brass is made from copper 51 per cent, tin 8, hard scrap 41 per cent. To some extent the mixtures just described are being displaced in favor of certain proprietary bronzes and by anti-friction white metals, but there is always occasion for the use of the formulas mentioned previously on standard work.

In preparing alloys of any kind experience and skill are indispensable; in some cases the several metals are melted and cast into ingots, to be subsequently remelted when ready to pour into castings. In the latter operation the copper is melted first and the more volatile metals, tin and zinc, added afterward. For ordinary castings alloys may be used direct or in conjunction with scrap. A charge for a 150-pound crucible would be 100 pounds of new metal and 50 pounds of scrap. During melting there is always more or less loss by volatilization, oxidation and absorption of gases; these losses should be allowed for in weighing out the charges, but the loss varies in different furnaces, so that it is necessary to standardize the working of the furnace, after which no difficulty will be found in charging for given weights.

The rate of melting is a matter of some importance, the ideal condition being, whether in a reverberatory furnace or crucible, to bring the alloy to a red heat and then quickly reduce the composition to the melting point. Dull, pasty metal, so called, is very liable to absorb gases like a sponge, which is liable to spoil the casting, while the reverse is the fact with metal more quickly melted. Alloys high in tin and copper and relatively low in zinc are very sensitive to the conditions above mentioned, and every-day experience in brass founding enforces the importance of the question of temperatures. It will be found that castings melted at low heats show in the fracture that the several metals of which they are composed have separated and crystallized in masses by themselves.

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