Correspondence.

Metallic Copper in Trees.

To the Editor of the SCIENTIFIC AMERICAN:

In a recent number of the SCIENTIFIC AMERICAN, reference was made to the occurrence of muriate of copper in the roots of pine trees. A peculiar case of the occurrence of copper in the plant world fell under my observation recently. An oak tree died in one of the parks of the city of Minneapolis, and while cutting up and removing the trunk, a peculiar copper-colored powder was noticed as coming from the wood. So remarkably bright and beautiful and so abundant was this powder, that it immediately attracted attention. Analyses indicated almost pure copper. Under the microscope, the powder appeared as flakes, the larger ones partly rolled up so as to fit in the pores of the wood. Some of these larger flakes, when unrolled, measured one and a half millimeters in diameter.

Analyses of the wood showed certain parts of the tree to contain comparatively large quantities of the metal, while other parts contained only a trace. The outer rings contained nearly all of the metal, the heart and the inner annual rings containing only a trace. The maximum amount of copper seemed to be in the fourth and fifth annual rings from the bark. This part of the tree contained 4 milligrammes of copper per 100 grammes of wood. The origin of the metal has not yet been determined.

GEORGE BELL FRANKFORTER.

University of Minnesota, January 16, 1899.

Experiments in Aerial Navigation.

To the Editor of the SCIENTIFIC AMERICAN:

The announcement that the government of the United States has appropriated $25,000 for experiments in aerial navigation by the Board of Ordnance, under direction of General Greely, Chief Signal Officer, cannot but stimulate inventors. This is the first time in our history that any money has been directly appropriated for such purpose.

Two months before the opening of our war with Spain, in communications to the Secretary of War and to the Chief Signal Officer, I urgently recommended the construction of several war balloons for captive observations, and the creation of at least one aerial warship for observation and assault, to combine all the then existing features of known value practically attainable.

The answer was that whereas the great advantages of a practical airship were realized, yet the department had then no funds for either construction of or experiments with an airship, and that in the matter of balloons, should the necessity arise, I would be further communicated with. The war followed, and found us utterly unprepared in the matter of aerial warfare and almost the same as to captive balloons for observation. As a result, I was called upon to speedily build twenty-one captive war balloons, ranging from the largest size suitable for such work to those exclusively used for signaling. Our war was too brief to bring these into action otherwise than as practicing apparatus for the balloon corps, under instruction of one of my selected aeronauts, at Tampa, Fla.

With an efficient apparatus, already in order, it was among the easy possibilities to discover Cervera's fleet lying snug in Santiago Harbor, instead of our worrying weeks about a spook fleet threatening our coast, and wasting time and money in non-discovery, to say nothing of our chance of early observation, and interception and capture without destroying it, as it escaped from Santiago Harbor.

Our limited aeronautical equipment permitted only a preliminary observation of the defenses of Santiago by our balloon signal corps just before the assault. Was the subsequent advance of our captive balloon 80 yards in front of our columns a shrewd "Yankee trick" to draw the Spanish fire, and thereby distract the aim of their Mausers and artillery from our assaulting troops, by offering instead this alluring sky target for their practice at short range? This balloon banner was thus as much in evidence and bore its bullet marks as bravely in the front of battle as any other standard, though it finally fell, wounded but not destroyed.

As a matter of fact, under fair conditions, it is very difficult to hit a distant captive balloon, and scarcely possible to hit any balloon sailing free and high in air, and any wounds, however inflicted, can be repaired by a competent operative.

Our past experience illustrates anew the old saying, "In time of peace prepare for war." With funds now available, there is a great natural curiosity to know what may be done with them. Two systems present themselves for attaining aerial navigation. One, mechanical flight, by wings or aeroplanes and screw propellers. The other, a gas-buoyed vessel propelled by any means. Mechanical flight has troubled men's minds for centuries before the balloon appeared. The balloon is the only means by which man has yet risen free from the ground.

Of late costly experiments have been made with propelled aeroplanes, without achieving practical success in carrying man aloft. Maxim, who has spent more money on the aeroplane than any other man, over $100,000, it is reported, recently declared in his lecture in New York, reported in the SCIENTIFIC AMERICAN, December 24, as a result of his experiments, that "the aeroplane system would not be found successful, but that a totally different plan would be necessary," the conditions attending a toy experiment not being akin to larger operations. Furthermore, he declares that in his opinion the sum of "$25,000 will be found completely inadequate" to properly attempt the subject, and that $100,000 or more will be necessary.

My own experiments, which include both of the systems, corroborate those of Maxim, though not approaching them in the matter of large expenditures upon the aeroplane alone. Indeed, I do not think that large expenditure is necessary in any experimental system for aerial navigation, as most of the tests are simple and may be cheaply made, and quite as successfully in a small way as if larger. In this field I believe it to be a fact that what will not succeed in a small way will not in a large way, so far as relates to mechanical flight or aeroplane buoyancy. The chief difficulty in aeroplane flight is the fact that buoyancy is entirely dependent upon aerial resistance, and this resistance devours force.

To illustrate: From common observation it would seem that if a thin lath (1 inch by 4 feet) were to be buoyed up by its swift passage through air, it should naturally be projected lengthwise, like an arrow. The facts are directly otherwise. The lath projected lengthwise would chiefly meet resistance and be buoyed up by the air first touching its front under edge or surface, one inch wide, the remaining portion, trailing rearward, being comparatively of little use, because not meeting much resistance. On the other hand, if the whole longedge of the lath be projected broadside, with this front edge slightly elevated, it would be buoyed up along the whole 48 inches. Its resistance would, however, be much greater than one inch, say 48 times as much, roughly speaking, but the entire weight of the apparatus relative to effective buoyant surface would be less than with the first experiment.

The construction of a bird's wing is based on this law, and it is composed of single narrow feathers, which are in turn composed of minute slats, like common blinds, overlapping and separable, and capable of presenting many times the effective aerial resistance of a single united surface.

This mode of wing or aeroplane construction has limitations, however, and its economically effective range does not appear to exceed 2 inches in width for any bird's feathers, while the wing of the largest bird seldom exceeds a few inches in width and is never a few feet wide from front to rear when extended in flight. The only resource, then, is in the multiplication of wings or feathers or lath surface drifting edgewise, upborne by aerial resistance. The effective aeroplane must of necessity become a vast, subdivided, and complex system, possessing great surface in order to buoy up great weights, and this requires powerful propelling force sustaining it in swift flight, as it cannot pause a single instant without falling. Besides its effective buoyant surface, its power mechanism and propellers possess bulk, and consequently resisting surface not available for buoyancy. These observed facts have been the result of considerable practical experimenting which cost me more time than money. I regard them as inevitable and opposing conditions.

Surface being the chief resisting factor, I next sought how to evade resistance. Given a necessary body, hull or case for containing passengers, goods, and appliances for buoyancy or propulsion, what form should this body have? This inquiry seems to have escaped the research of most flying machine fanatics.

I began by building various forms of bodies and dragging them through still water or immersing them in water currents while held by simple spring scales to note the comparative pull or resistance. I next built buoyant gas models like those forms found most valuable, and towed or floated them in air currents, attached to spring scales for noting comparative pull. All these were quite early experiments, and showed me that the two elements, air and water, were vastly different mediums in their influence on hulls of vessels completely immersed in them.

These experiments were followed by a series for testing swifter flights of bodies, including all forms of projectiles, of equal weight and sectional area, impelled by ramrods fired from a spring gun of known force, for accurate comparison. Incidentally these bodies were fired into air, water, snow, sand, wood, ice, and metal plates. They revealed one fact which is a scathing criticism upon our imbecile system of modern bullets and cannon balls. It was known at this time that if a slug or cylinder required or consumed a certain force in overcoming air resistance, say for comparison 6 pounds, then a globe or hemisphere might only consume one-half this force, or 3 pounds, while a cone of same sectional area might only need one-third of this force, or 2 pounds. Here investigation seemed to have stopped, though it is evident that the sharper a cutting tool or projectile became, the more effectively it could cut or pierce, if well supported. Now it would seem, certainly, that if a needle could not be improved by breaking off its point, or a razor by dulling its edge, or a cold chisel by cutting its tooth off square across, then a bullet would not have increased penetrating power by treating it likewise.

Whatever the practical reasons may be for these obtuse forms of projectiles in use, it became quickly evident that for aerial navigation a tub or a globe or cone was unsuitable, and that it was of the utmost importance to create a new form of air-piercing projectile whose bulk or uncouth form would not be a serious feature when speed or economy in driving power was desired. The problem finally narrowed itself to one of extreme simplicity—the evolution of an entirely new air vessel or projectile which evaded all aerial resistance in theory, by having the ability to convert the resistance or air pressure in front to an equally propelling influence applied to the rear to urge it forward in equal degree. This I practically attained in a symmetrical vessel containing and braced by hydrogen for preservation of form and buoyancy, with space for other requisites, as motive power and supplies. This body resolves itself into a mathematical formula, governed entirely by the two elements of its length and breadth, or speed versus carrying power, great relative bulk being impracticable with high speed as a purely physical and mathematical fact.

The success of aerial navigation at this moment seems to be dependent upon a practical light motive power, of great force, and not upon any mystery of bird's flight, or sustaining power of aeroplanes or special forms of screw or other propulsion. No complex system of surface buoyancy known at present has equaled the work or prolonged stay in the air of the ordinary hydrogen balloon, while with equal motive power the gas vessel of superior form will give more prolonged results, cover greater distance, carry greater weights, and entail more safety for the passenger than can the best aeroplane, using equal power and carrying a passenger. With the 300 horse power steam motor of Maxim many of the gas vessel systems invented in this country could have made a better showing than has any mechanical flight or propelled aeroplane system thus far shown, the one fatal defect of all such systems being the inability to safely stop or hover in the air. It constantly risks destruction through irregularities or perturbations in air currents, or turmoils in the air, while the gas vessel itself is becalmed during any storm when it ceases to urge itself forward or struggle against it. Its endurance becomes a matter of gas-holding power. Absolute imperviousness is insured, not by any special varnish, but simply by superimposed, multiple tissues of suitable varnish applied by machinery, by which all underlying microscopic pores are plugged up and overlaid by many succeeding films too thin to reveal their total bulk to a micrometer caliper, yet denser than hydrogen and holding it prisoner. Hydrogen balloons built by me within the past year had from eight to twelve such coats, with little increased weight after the first two coats, because applied smoothly and homogeneously, with every particle of surplus varnish removed to insure only the thinnest films, which are generally as effective as if thicker. Long voyages with gas vessels henceforth may depend entirely upon expert manipulation of supplies carried, as with suitable treatment little gas or ballast need be expelled.

CARL E. MYERS.

Frankfort, N. Y.

A Refrigerating Plant for Manila.

The Chief Quartermaster of the Department of the Great Lakes, U. S. A., has invited proposals for the erection of a large refrigerating plant at Manila, for the use of the commissary department of the United States army in the Philippines. The plant as designed will be one of the largest of the kind ever built, and will include a number of ice-making machines and equipment for a large cold-storage plant. The estimated cost of the apparatus will be $100,000. The cold-storage rooms will have a capacity of 1,200 tons of beef and 150 tons of mutton, 100 tons of vegetables, 50 tons of butter, and 50 tons of canned goods. Special rooms are to be built for every class of supplies, so that they will be kept in good condition for months in the tropical climate. Under this arrangement soldiers at all times will be furnished with fresh meat and other foods. The plant must be ready for use within six months after the contract is awarded. Bids will be opened on February 1.

Death of the Builder of the Transcaspian Railway.

Gen. Michael Annenkoff, the distinguished Russian engineer, who constructed the Transcaspian Railway, is dead. He was born in 1838 and had a military career. He was later assigned to the work of constructing strategetic railways, and he soon distinguished himself in this direction. He completed the great Transcaspian line. He was noted for the ingenuity and the process of construction which he employed and the rapidity with which they were carried on.