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THE STABILITY OF WAR SHIPS.

The modern war ship is a very composite affair. The vessels of Nelson were primarily ships, and were provided with cannon to enable them to fight. There was no idea of making the gun determine the quality of the hull and of adapting all particulars of construction to the efficiency of the whole as a fighting machine. One of the first instances of doing this is found in the old mortar-boats of the days of Louis XIV. and invented during his reign. These are spoken of by Voltaire, in his famous life of that monarch, in terms which show that the author realized that the mortar-boat was merely a platform for the piece of ordnance which it carried. This view of the functions of a special war ship is now more widely applicable. The modern naval vessel must be constructed with a view to providing the best possible gun platform. Her stability and her rolling qualities must be adapted to this end, as far as consistent with her uses as a ship.

These views have given a special value to determinations of the stability of ships. The heeling test has been applied to many of our naval vessels to determine the location of the center of gravity, which, in connection with the metacenter, controls not only the stability, but, what is of equal importance, has a great effect upon the rolling period. A ship of high stability, one which might be considered of exceptional safety, is liable to be so bad a roller as to be uncomfortable and a very poor gun platform. Even in the case of sailing vessels, too great stability brought about by the depression of the center of gravity is regarded as dangerous. The quick return in the rolling motion threatens the safety of the spars and strains the hull. A load of pig iron or of rails stowed too low has imperiled or foundered many a ship, because it gave too high a factor of ultimate stability. Initial stability, as brought about by a flat light-draught model, with high center of gravity, makes a ship easy in her motions. But too high a center of gravity gives a dangerously low critical angle, or angle of vanishing stability, as it is termed; in other words, the angle at which the ship would capsize becomes too small.

The naval constructor therefore stands between two fires. If he makes his heavily weighted ship, with most of her side armor, protective deck, and part of her coal bunkers, perhaps, above the water line, of high initial stability and of easy rolling qualities, she may be a good gun platform, but a very unsafe one. The filling of a single compartment with water might suffice to overturn her. Then if the center of gravity is too much depressed, her violent motions in a seaway would render gun practice from her decks very uncertain.

The monitor type of ship presents a curious combination. A vessel like the Miantonomoh may have a very high meta-center, and be of really exaggerated stability, but in a sea-way the ship is more under water than over it and is supposed to suffer much less from rolling than would a vessel of high freeboard.

The object of the heeling test as applied to a ship is to determine the location of her center of gravity. The position of the meta-center is entirely a matter of calculation, and is determined by computations based on the shape of the immersed portion of the ship. The displacement of the ship in tons is also a matter of calculation and is based on the same data as is the other. Now the stability of a ship at any given angle of heel is determined by the weight of water displaced acting upward at a distance from the vertical axis of the hull determined by the height of the meta-center above the center of gravity. The heeling test gives this distance by determining the position of the center of gravity of the ship.

The ship is placed in still water, preferably floating in a dry dock. A plumb-bob with graduated arc beneath or back or it is established on her deck. A known weight is now placed on her deck to one side of the central axis, and the angle of inclination produced thereby is read from the scale beneath the plumb-bob. The weight is shifted outward, and a second reading of the increased angle is taken. Then the weight is moved back and controlling readings are obtained. The maximum inclination given need not exceed two degrees. The weight being known and its distance from the center of the ship being known, the wanting data are supplied for determining the position of the center of gravity.

An interesting variation on this method has been applied. A steelyard has had its weight-hook attached to the sponson of a ship. Its fulcrum hook was connected to a powerful steam crane. A lifting strain was then applied and its intensity was determined by weighing it upon the steelyard. In this way the desired factors were obtained.

The decreasing of rolling in ships is really a very important problem. In passenger ships it is merely a matter of comfort to those carried. It is secured by low meta-center or high center of gravity. So little sail is now carried that stiffness, almost necessarily coupled with bad rolling qualities, is not required, as in the old sailing ships. The whole subject is a curious and interesting one, and has received a practical illustration in the lengthening of the two gunboats, Machias and Castine, to increase their stability.

Trial of the Sandy Hook Search Light.

The monster Schuckert search light, which was mounted on the Manufactures building at the Columbian Exposition of last year, was purchased by the government and erected on a tower 150 feet high at Sandy Hook, N. J. We illustrated this search light in our issue of September 2, 1893, and the tower is shown in one of the illustrations of rapid fire guns in issue of June 30, 1894. The test of the search light began June 26, to determine the practical value of search lights for coast defense and for signaling purposes. The trial will be continued for a week.

The top of the apparatus stands 8½ feet above the platform, and the diameter of the projector is 5 feet. The mirror, which is of silvered glass, has a clear working diameter of 5 feet, with a thickness of about ⅞ of an inch. It is carefully ground and polished on both sides, the labor requiring over five months for its completion. The back of the mirror is provided with a heavy coat of silver protected by a specially prepared paint. The training of the projector can be effected either by hand or by means of the electric motor placed under its base. When the electric motor is used, it can be operated from any distance.

The lamp used in the projector requires a current of 150 amperes at 50 volts, and consumes about 10 electrical horse power. The surface intensity of the light in this mirror is 194,000,000 candle power. The carbons may be adjusted to project either a convergent or a divergent beam, moving them inward toward the mirror producing the divergent beam and moving them in the opposite direction producing the convergent beam. The average intensity of the rays received by the mirror is 45,600 candle power, and the mirror takes up a beam having an angle of 140°. This angle includes the most intense rays, which lie between 40° and 60° from the normal.

The tests showed that messages could be transmitted a distance of seventeen miles with great ease, messages being communicated to local forecast official Elias B. Dunn, on the Equitable building in New York. Boats in the channel near the Hook were shown up plainly. Tests regarding the distance to which the light can penetrate will be looked for with interest.

The Berliner Patent.

Arguments were begun June 14 before Judge Carpenter in the United States Circuit Court, at Boston, in the suit of the United States government to annul the Berliner patent of the American Bell Telephone Company. The *Electrical World* says: The bill of complaint states that Emil Berliner, of Germany, filed in the Patent Office at Washington on June 4, 1877, an application asking a grant of letters patent for certain improvements in combined telegraphs and telephones alleged in said application to be invented by him. The application rested in the Patent Office until November 17, 1891, or about 14 years after the application was first filed, and the patent was granted on that day, but to the American Bell Telephone Company as assignee of Emil Berliner.

The United States contend that the Bell Company controlled the Berliner patent during this period before the issuing of the letters patent, and that it made no attempt to secure the letters patent in that time, which was probably due to the fact that it was enjoying the privileges of the Bell patent, which controlled the electric transmission of speech. It is charged that the patent was unlawfully obtained and issued by the Commissioner of Patents, and is an illegal grant and ought to be annulled, for reasons, and further, as an act of duty and justice toward the citizens of the United States, whose rights and privileges are unlawfully and unjustly abridged by the Berliner patent.

A Cheap Mushroom Bed.

According to the *Musée des Familles*, the following is a very simple and cheap method of preparing a mushroom bed that will yield a crop all the year round.

In a pine box about twenty inches in depth, and three feet square, place a four inch thick stratum of a mixture of three parts of dry cow manure and one part of garden soil. Having procured some mushroom spawn, break it up and sow it in a second stratum of manure and earth two inches in depth. Slightly compress the whole and cover with an eight inch layer of earth, which should be kept damp by watering through a fine rose.

In six or eight weeks the first crop of mushrooms will appear at the surface, and will continue to do so for at least two years, provided the bed is kept damp.

A small quantity of aqua ammoniæ added to the water with which the bed is moistened will hasten the appearance of the fungi.

The box should be placed by preference in a place where the light is not too bright, say in a cellar in which the temperature is moderate and equable, or in a dark part of a stable.

Dust in Nature.

Without dust there would be no blue firmament; the heaven would be blacker than we see it on moonless nights. On this black background the glowing sun would shine out sharply, and the same sharp contrast of intense light and deep shadow would characterize the surface of the earth. There would be nothing to subdue this sharp contrast but the moon and stars, which would remain visible by day. The illumination of the earth would be similar to that which we observe when looking at the moon through a telescope; for the moon has no atmospheric envelope, and, consequently, no dust in suspension. It is due entirely to the dust that we enjoy our soft, uniformly diffused daylight, for which our eyes are specially adapted; and it is the dust which contributes so much to the beauty of the landscape. But while the foregoing explains how the dust makes the whole vault of heaven light, it does not explain why it is chiefly the blue rays of the white sunlight that are reflected, and only to a small extent the green, yellow and red rays. This is dependent on the size of the dust particles. It is only the finest of them that are borne by the air currents into every stratum of air, and it is only these fine, widely diffused dust particles that are of any significance in this connection. Now, let us consider the mechanism of light and the extreme shortness of the ether waves which constitute its essence. These waves, although all microscopically small, vary considerably in length. The fine atmospheric dust includes many particles large enough to reflect the short blue ether waves, fewer particles capable of reflecting green and yellow, and still fewer large enough to influence the long red ethereal waves. The red light, consequently, passes through the great majority of the dust particles comparatively unhindered; the blue rays on the contrary, are intercepted and diffused, and so become visible. This is the reason that the finest dust—and so, too, the firmament—appears blue.

So, then, the finest dust appears blue. You may observe that the wreath that curls upward from the burning end of a cigar is blue, while the smoke drawn through and exhaled is whitish. The particles in the latter case have united and become large enough to reflect white light. So, too, in the country, on a clear day, the sky is blue; but in the city it appears whitish, because of the greater number of coarse dust particles in the air. It is especially on mountain heights that the sky is so intensely blue, because the rarefied atmosphere supports only the finest dust particles. At great height the sky would be almost black, if there were no dust particles in suspension. We see it grow pale as we turn our eyes to the lower strata of air toward the horizon. But why is the sky in Italy and in the tropics so much deeper blue than with us? Is the dust finer there? As a fact, it really is. Not that finer dust rises there; but in our climate the dust particles are soon saturated with water vapor, which makes them coarser. In warmer regions, however, the vapor retains its watery character and does not condense on the floating dust. It is not until the aerial currents have borne it to higher and colder regions that it is condensed to clouds.

This brings us to the most important role played by dust in our atmosphere: its influence in determining rainfall, due to the fact that vapor fluidifies upon the dust particles. It may be accepted as beyond question that of all the water evaporated by the sun from the surface of land and sea, not one drop returns which has not condensed upon a particle of dust as a nucleus. This is easily demonstrated. We fill a large flask with air which has been filtered through cotton waddings until all the original dust is driven out and the flask is full of dustless air. Into this dustless air turn a current of steam from a kettle and you will find it transparent, and, therefore, invisible. Not a trace of the cloudy appearance we associate with steam. The only thing noticeable is that the inner walls of the flask begin to drip; the vapor condenses here as it cools, because there is nothing else for it to condense on. But blow ordinary dust-laden air into the flask and the vapor at once assumes the familiar cloudy appearance due to its condensation on the dust particles, and it begins to rain in the flask. The reason for this is that the vapor condenses on the dust particles and freights them until they sink as rain drops.

Without dust, then, we would have no fog, no clouds, no rain, no snow, no brilliant-hued sunsets, no cerulean sky. The surface of the earth itself, the trees, the houses, along with man and beast, would be the only objects on which the vapor could condense, and these would begin to drip whenever the air was cooled sufficiently. In winter everything would be covered with a crust of ice. Our clothes would become saturated with water condensing upon them. Umbrellas would be of no avail. The vapor-laden atmosphere, moreover, would penetrate to our rooms and condense upon the walls and furniture. In short, the world we live in would be quite another world if there were no dust. Since scientists began to realize the important part played by dust in the economy of nature, measures have been taken to count the particles in a given space. In London and in Paris at the surface a cubic centimeter has been found to contain nearly a quarter of a million particles. On the top of the Eiffel Tower there are about half as many, while in the high Alps there are only about two hundred particles to the centimeter. A great deal of the dust at high altitudes is cosmic dust, consisting, like the meteorites, of carbon and iron.—*Die Gartenlaube* (*Leipzig*).

Ocean Meadows.

Out in blue water, poised on the surface of thousands of fathoms of sea, the traveler finds it hard to realize that he is crossing a meadow of plants, evading observation as individuals, and even, under ordinary circumstances, inconspicuous in the mass, yet everywhere present, affording nutrition to minute forms of animal life, which in turn supply the food of shoals of fishes. The study of these ocean meadows and of the animal life that they support suggests a variety of questions which are of practical and economic, as well as theoretical or scientific, interest. They are the feeding grounds of fishes; they open out fields of inquiry to naturalists; they offer difficulties to students of geology; and the validity of evolution demands an explanation of the problems connected with their appearance.

One of the most interesting directions in which science has recently advanced is exhibited in the records of the existence of a flora and a fauna of universal occurrence in the most inhospitable wastes of the sea. The phosphorescence, or luminosity, as it is better termed, of the ocean is well known to be due to the presence of organisms in it in vast numbers. This phenomenon, almost as brilliantly exhibited on our western coasts as in tropical seas, has at all times attracted notice; but the conditions of its exhibition are even now imperfectly understood. From the earliest times to the present there are direct and indirect records of the occurrence of transient phenomena of a like kind to be seen in the open light of day.

Many speculations have been hazarded as to the origin of the name of the Red Sea. Herodotus helps us merely to the name, and Pliny begins, as was to be expected, the work of mixing matters, having collected idle tales about King Erythras, the reflection of the sun's rays, the color of the sand, and the nature of the water. Montaigne, in his memoir on the subject, assigned the true origin of the name to the periodical occurrence in its waters, and in the tropical Indian Ocean as well, of floating banks of a microscopically minute seaweed. *Trechodesmium erythræum.* Ehrenberg and others had previously witnessed and commented on the fact, and Candolle had described a similar reddening of the waters of the Lake of Morat, owing to the presence, in extraordinary abundance, of an allied organism. Captain Cook, Hinds in the voyage of the Sulphur, Darwin in the Beagle, and many other observers, have noted similar phenomena in widely distant seas, and have, some of them, remarked the offensive odor accompanying such manifestations. Visible occurrences such as these are probably much more common in the ocean than is supposed, and an inquiry into their mode of origin leads us to the facts that such organisms do ordinarily exist at all places in the sea, and that it is merely under the most favorable conditions that we observe this sudden increase in the numbers of particular species.

Those who knew that the whole bulk of animal life in the ocean must be directly and indirectly dependent on the vegetation of the ocean were puzzled for many years by the difficulty of accounting for the apparent disparity of their volumes, since the marine vegetation of the coasts alone is manifestly insufficient to preserve the balance. The least observant eye notes that, on the great carpet of green which covers the earth, the animal life is but a faint pattern; in the ocean the proportion seems to be reversed. Owing to the action of sea water in intercepting light, which is necessary for the nutrition of all plants except parasites, there is complete darkness below 700 fathoms or less; but long before this depth is reached the quality of light in relation to its action on plants is so profoundly modified that marine vegetation penetrates to a trifling depth. On the other hand, the marine fauna ranges into the great depths, and the impossibility of balancing a mere fringe of vegetation along coasts, plus floating Sargasso banks, against the animal life of the whole ocean was apparent to all who considered the matter. The balance has been adjusted by the discovery of a ubiquitous marine vegetation, causing the tropical seas to glow with phosphorescent beams, and discoloring polar ice where the sea breaks on it. The existence of these meadows of plants is made plain to us by the direct evidence of tow-netting the upper layers of water with fine silk nets, when their capture, together with the minute forms of animal life that live upon them, is effected. The minute animal life in turn furnishes food for shoals of fishes, and the importance of an inquiry into the whole life history and seasonal occurrences of such organisms—the basis of the nutrition of marine life, as green plants are of terrestrial life—can scarcely be overrated.—*Quarterly Review.*

Science Notes.

Preservation of Wood.—A new process for the preservation of wood, says *Le Genie Civil*, has recently been made known by Dr. Zironi, of Zurich. It consists in heating the wood, say by means of a worm, in a closed vessel in which a vacuum is created. The heating is done in a vacuum in order to extract the sap that fills the pores of the wood. After this has been effected, a solution of resin in a hydrocarburet is introduced into the vessel. After the wood has become saturated, the liquid is drawn off, and a jet of steam is introduced. This removes the solvent, while the resin remains in the pores of the wood, which, through this process, undergoes a great increase in weight.

A Toluol Thermometer.—Mr. R. J. Grosse, says *Die Natur*, has just registered a trade-mark in Germany for a new thermometer in which toluol is substituted for the mercury and alcohol that have been employed up to the present. The advantages of such substitution are claimed to be many. In the first place, toluol is a liquid of a deep black color, which renders the column very visible; in the second place, the freezing point of this liquid is very remote from its boiling point; and, finally, it costs less than mercury, and the manipulation of it is attended with no danger to the health of the workmen.

Coating to Render Cement Acid Proof.—According to the *Journal des Inventeurs*, a very good acid-proof coating for cement may be obtained by intimately mixing pure asbestos in an impalpable powder with a thick sirupy solution of commercial silicate of soda as alkaline as possible. The asbestos is first brayed with a small quantity of silicate, so as to obtain a paste analogous to colors ground in oil, and that may be preserved in a closed vessel. Subsequently, it is only necessary to thin this paste with a new quantity of dissolved silicate in order to obtain a sort of paint, of which two or three coats applied with a brush protects the surface of reservoirs, etc., against any acid in the form of either liquid or acid. This liquid may also be used to form a mortar for sealing blocks of sandstones.

The Rifle Balls of the Future.—The reduction of the caliber of guns is necessarily accompanied with a diminution in the weight of the projectile. The length of the latter, in fact, cannot exceed a certain limit, beyond which it would no longer have sufficient stability in its trajectory. It would therefore be of considerable interest to have at our disposal, for the manufacture of rifle balls, a metal of reasonable price and heavier than lead. One of the metals upon which hopes may be founded, remarks the *Revue d'Armes Portatives et de Tir*, is tungsten. This metal, which is almost as hard as steel, has a density varying from 17 to 19·3, say one and a half times that of lead. By reason of such qualities, balls of tungsten, of equal dimensions, possess a power of penetration much greater than that of lead. Thus, a tungsten ball penetrates a steel plate 3 inches in thickness at a distance of 650 yards, while a similar one of lead penetrates a 2¾ inch plate at 325 yards only. The present obstacle to the use of tungsten is its relatively high price, but there are indications that this will soon be lowered to reasonable figures.

Factitious Rum.—The ingenuity displayed by certain manufacturers in the production of factitious substances designed for the human stomach is well illustrated in the case of rum, which is, or should be at least, the product of the distillation of sugar cane molasses after fermentation. Good rum, however, is rarely sold without being diluted with water and alcohol, the latter often of poor quality.

According to the *Revue Mensuel* of the Ecole de Physique et de Chimie, the flavor indicated by the label on the bottle is given by means of formic, butyric and acetic ethers. In many cases the liquor is composed entirely of water and pure spirits, with the addition of prunes, cloves and tar, substances capable of giving a color pleasing to the eye, and, finally, of raspings of tanned leather, which communicate an aroma that is particularly relished by the consumer. Infusions of raisins, carob, oak bark, catechu and caramel may serve the same purpose. Things are so managed that the final degree of the liquor shall be 52.

Clapboards.—The name "clapboard" for a thin, narrow board used to cover the sides of houses, and placed so as to overlap the one below, has been supposed to be an Americanism, but, like many other alleged Americanisms, it was brought over to this country by the early English colonists. According to very old dictionaries published in England, clapboards were thin boards formed ready for the cooper's use, for the manufacture of casks. They were originally *cloveboards*, because they were "cloven" out by hand, and not made with a saw, as other boards are. In course of time, the word was abbreviated to *cloboards, claboards* and *clapboards*.

In the laws of Massachusetts Colony, in 1641, the price of these articles was three shillings for *claboards* five feet in length. The legal price for the work performed by hired labor was: "If they cleave by the hundred, they shall be paid six pence per hundred for five-foot boards."