tact with water, for reasons which are not known. Such substances are known as cements. Plaster of Paris is found in nature in the form of gypsum or anhydrite, and consists of calcium sulphate and water. A granular form of gypsum is called alabaster. Calcium sulphate is difficultly soluble in hot and cold water. When heated to 100 deg. Cent. or a little above, it loses all of its water and forms the powder known as plaster of Paris, which has the power of taking up water and forming a solid substance. The hardening is a chemical process, and is caused by the combination of the water with the salt to form a crystallized variety of calcium sulphate.

(10105) H. H. M. says: Would you kindly inform me if I could get an object to float that is heavier than the water it displaces? For instance, are these large ocean steamers heavier than the water they displace? A. If a rigid body or solid be immersed in a liquid, both being at rest, the resultant action upon it of the surrounding liquid is a vertical upward force called the "buoyant effort," equal in amount to the weight of the liquid displaced, and acting through the center of gravity of the volume of displacement. From this it will be readily seen that you cannot secure an object to float which is heavier than the water it displaces. In the case of the vessel, because of the particular form of the hull, the law of displacement remains the same. The weight of the water displaced by the hull equals the entire weight of the ship and its cargo.

(10106) J. D. W. asks: Can it be proved that a right angle can be trisected? A. The trisection of a right angle is a very simple proposition. The radius of a circle is equal to the chord of 60 deg. If the radius be laid off as a chord from one extremity of the arc of a quadrant, or the arc subtending a right angle, and a radius be drawn to the other extremity of the chord, the angle formed on one side will be 60 deg. and on the other side the angle will be 30 deg. or one-third of a right angle.

(10107) A. E. N. asks: Why do steam boilers explode when, through misfortune, a steamer sinks? A. The explosion of boilers in steamers that are wrecked is probably due to the sudden stopping of the engines and the abandonment of the fireroom by the firemen without the proper precaution to check the fires. It takes but a few minutes in such cases for the steamer to overbalance the outlet of steam from the safety valves, when the rise in pressure ruptures the boilers. When one explodes, others follow by damage from the exploded boiler.

(10108) G. J. R. asks: Can you give me the reason for the vibration in a motor or generator when the armature and shaft are balanced as nearly as possible? I would like to see what your opinion is in regard to it. A. The slightest excess of weight on one side will cause a perceptible vibration of an armature. As little as one-thousandth of the total weight will cause a very considerable vibration. If an armature is perfectly balanced, it will run so quietly that it is difficult to tell whether it is in motion or not. The process of balancing an armature is described in Crocker's "Electric Lighting," Vol. I., price $3 by mail.

(10109) C. H. W asks in reference to the answer to query regarding the attraction of a 5-pound and 15-pound mass upon each other. The mutual attraction between the masses is given by the formula $F. = K \frac{m\,m'}{d^2}$; and to this quantity the larger mass contributes three times as much as the smaller. It is true that this attraction acts upon both masses equally, and will give to each the same quantity of motion. In the case of the earth, when a body falls toward it, the earth also falls with the same quantity of motion toward that body. But the greater portion of the motion comes from the mass of the earth, since that is enormously greater than the mass of any body falling toward it, and therefore the small body moves much farther from this attraction than the larger one does.

(10110) H. L. B. asks: 1. Would you please tell me what produces the curly effect in bird's eye maple? A. We do not know how the mechanical forces act in the growth of the wood to produce the burls in the bird's eye. A while ago the question would have been answered, "It is the nature of the tree to grow that way." 2. Why is it necessary to only put ten 16-candle-power 104-volt lamps on a circuit? A. The amount of current which is allowed to flow through one cutout in a building is regulated by the rules of the Board of Fire Underwriters and is determined by the risk of setting fire should a fuse blow.

(10111) G. H. E. writes: In an informal conversation the statement was made that of the energy stored in a given amount of coal an extremely large proportion is lost in the attempt to employ it productively, as in the steam engine, and that the utilization of the energy wasted by the present methods is an important scientific and economic problem. This statement was challenged, and in the resulting discussion the following questions arose. 1. How large a proportion of energy stored in a given amount of coal is lost by methods commonly in use? A. From 20 to 25 per cent, and sometimes more, of the heat value of the coal is now lost. 2. At what stages in the process of transformation, and how, do the chief losses occur? A. Mostly by the heat going up the chimney, and to a small degree by bad stoking and radiation of heat from defective insulation of boiler setting and pipes. 3. What percentage of the energy in a given amount of coal can be (not is) used in producing steam? A. The possibilities for utilizing the full energy of coal are very small. Little may be expected over the best practice of to-day. It is the converting of the steam into active power wherein the trouble lies. 4. How is the amount of energy in a given amount of coal ascertained? A. The absolute amount of energy in coal is found, first by an analysis of its combustible constituents, from which the heat units are computed; second, by actual combustion of a given weight and measuring its heat producing property by absorption of the heat in water or by melting ice in a calorimeter.

(10112) J. A. M. writes: Will you kindly inform me whether the following facts are new, or only so to the writer? The mechanical equivalent of heat as given by Dr. Joule's experiment of a weight falling through air, actuating thereby wings in water, is 778 foot-pounds according to William Kent. Now you will note that the relative weights of water and air are as 1 to 774. Is there not an equation here between work, water, heat and air? Might not the slight variation of 774 and 778 pounds be due to the slip of the water? William Ripper gives the equivalent as 772 pounds. A. The mechanical equivalent of heat, which is called Joule's equivalent, as determined by Dr. Joule, was 772 foot-pounds. That is, to lift 772 pounds to a height of 1 foot requires the same amount of work as to heat 1 pound of water 1 deg. Fahr. This work was done between 1840 and 1843. Considering the advancement of mechanical science at that time it was a marvelous piece of work. He employed the friction of water and measured the heat produced. Joule also determined the equivalent by means of the electric current. Others investigated the same constant by other methods, the compression of metals, the specific heat of air, the induced electric current in metals, and the velocity of sound, with results fairly in agreement with that of Joule. Joule's method was that of direct determination of the number of foot-pounds of work used in actually heating one pound of water one degree. Other methods were indirect. That these coincided fairly well with the direct method was all that could be expected. All methods are open to errors, and more or less close approximations are all that could be attained. In 1879 Prof. Rowland took up the problem with the finest appliances of modern science. He employed water friction, as did Dr. Joule. His results were immediately accepted. Probably the work will not be done over again for a generation. Some of his results involved as many as 12,000 distinct observations. He proved that the mechanical equivalent varies with the temperature. Between 41 deg. and 68 deg. there is a change of nearly eight-tenths of one per cent in the latitude of Baltimore. The mean of Prof. Rowland's results is 778 foot-pounds, which for all ordinary purposes is at present considered the true equivalent. Prof. Rowland's experiments showed that the specific heat of water diminishes from 32 deg. to 84 deg., and then increases till the boiling point is reached. Rowland was able to produce a change of 63 deg. in the water where Joule could produce a change of only 1 deg. He also used the sensitive air thermometer instead of the slow mercurial thermometer.

(10113) An old subscriber says: I have several old daguerreotypes which until recently were in a good state of preservation. Now I find that the surface of the plate has apparently oxidized and the portrait has disappeared from view. Can you give me instructions for restoring the pictures and preserving them? A. The removal of the deposit from the surface of the daguerreotypes is such a delicate operation that, if possible, it should be intrusted to one who has had experience in that process. If, however, you wish to try it yourself, you may proceed as follows: Carefully separate the cover glass from the silver-coated plate, being especially careful that the surface of the latter is not touched even by anything so light as a feather. Soak the daguerreotype first in water, and then in a solution of potassium cyanide, from five to ten grains to the ounce; rocking the dish till the deposit is removed. A 20-grain solution of sodium hyposulphite may be used instead of the cyanide, although it is not always so successful. When the deposit has been removed, the plate should be well washed under a gentle stream from the tap, or in several changes of water, finishing with distilled water. The method of drying is important. The plate, after slight draining, should be taken by a corner by a pair of pliers and held over the flame of a spirit lamp or gas jet, allowing just sufficient heat to evaporate the remaining film of water, the evaporating of which may be assisted by gently blowing across the surface. The restored daguerreotype and cover glass, the latter after thorough cleaning, should then be bound together as before, and the more completely this is done so as to exclude the atmosphere, the longer will the image retain its pristine beauty. Potassium cyanide is a deadly poison. It should be used with care.

(10114) C. S. asks: About how much current does a ¼-inch spark coil take to give full length of spark? A. A good authority gives about 10,000 volts as the pressure required for a spark of ¼ inch. The current, or amperes, is insignificant. 2. Is a relay necessary in wireless telegraphy? A. Yes. 3. Is it necessary to have oscillators on the coil in wireless telegraphy? A. Yes. 4. With good usage how long should an induction coil last? A. Forever. There is no deterioration by use in an induction coil. 5. Can you explain why a Geissler tube still glows when connected with only one wire of the secondary of the coil? A. Because of electrical induction. The waves go through space from one pole of a coil to the other. The Geissler tube held between the two poles of the secondary will glow when it is connected with neither wire. The same experiment can be performed with the bulb of an incandescent lamp. Hold it in the hand by the metal base between the terminals of the coil.

(10115) R. W. W. asks: 1. The object-glass of my telescope consists of two lenses, one being convex and the other concave-convex. When they are together they are the same as an ordinary convex lens. Why is a single one not used? A. The two glasses are used to prevent the objects seen from being bordered with a colored fringe. Remove the concave glass and you will see the difference. Then study in some textbook of physics about achromatic lenses. 2. Why is it that copper wire is used for electric lighting and power currents and iron or steel for telegraph and telephone wires? A. There is a very small flow of current in the telegraph and telephone wires, and a large flow over the lighting and power circuits. Copper is a much better conductor than iron, and though it costs much more in the first place, it is far cheaper in the end. 3. What is the difference between a continuous and an alternating electric current? A. A continuous current flows like a stream of water steadily in one direction. An alternating current flows by rising to its full voltage and then falling to its least. There are alternations of the electromotive force, which has all possible values in a series.

(10116) D. P. asks: Does electricity occupy space? A. No. Electricity is not ordinary matter, as, for example, lead is. Whatever it may be, it is not a material substance.

(10117) E. O. M. writes: I have two textbooks on physics which disagree. Mr. Spottiswoode, of London, had an induction coil made which gave a 42-inch spark. One says it required 5 Grove cells to give the 42-inch spark; the other says 30 Grove cells were required. Which is right? A. The statement in Gordon's "Electricity" is that with five Grove cells the coil gave a spark 28 inches long; with 10 cells the spark was 35 inches, and with 30 cells it was 42½ inches long. 2. What difference of potential was required to force the spark across the gap of 42 inches? A. We do not know. Probably hundreds of thousands of volts.

(10118) J. C. A. asks: Please inform me how to make a strong magnet of Jessop steel. I have tried to make some ½ inch square by 3 inches long, straight bars, by passing them through a spool of wire with a 300-volt current, by which they were strongly magnetized, but lost almost all magnetism in about three weeks. How can I make such magnets which will retain their strength for a long time? A. Heat the bars to be magnetized to a red heat and plunge them into water. They are then to be magnetized. Straight bars do not retain magnetism well. They should lie in pairs with opposite poles toward each other, side by side, not end to end, or else in pairs with an iron keeper across the poles. They may be laid four in a square with opposite poles against each other. Laid down alone without keepers, the magnetism is rapidly lost.

(10119) W. F. G. asks: Will vulcanized fiber answer for the insulation on static machines, and are vulcanite and vulcanized fibers identical? A. Vulcanized fiber will be but little better than wood as an insulator in this position. Vulcanite is hard rubber and is a different substance from fiber.

(10120) E. L. asks: 1. Can you tell me, without knowing the amperage, the voltage being 50 volts, if a 75-watt dynamo or 1-6 horse power as motor will light 5 lamps of 10 candle power at full capacity? A. Ten-candle lamps may be taken to be from 3 watts to 4 watts per candle. One lamp will consume from 30 watts to 40 watts, and 75 watts will light two such lamps. 2. What is the resistance of No. 16 iron wire? A. Pure iron has a resistance of 6 times as great as copper. Ordinary telegraph wire has a resistance 15 times as great as that of copper of the same size. No. 16 copper wire has 248.81 feet per ohm. Pure iron wire of the same size would have 41.47 feet per ohm, and No. 16 ordinary iron wire would have 16.19 feet per ohm. 3. If a current of 10 amperes at 108 volts goes through 540 feet of No. 16 iron wire, what will be the electromotive force and current remaining after it has gone through, and how to calculate it? A. There will be 10 amperes remaining. But there will not be any volts remaining, if the wire constitutes the entire circuit between the mains. The same amperes flow through the entire circuit and come out at the other end, just as the water flows through the entire length out of a pipe open at both ends and comes out at the other end. The drop of potential along a wire is proportional to its length, provided it is of uniform sectional area, as it may be presumed to be in this case. This being so, there will be a drop of one volt for each four feet along the wire. 4. Can we run a direct-current motor with an alternating current? The motor is not loaded. A. Yes; if it be started and brought up to synchronism with the current by hand, or by some other power. It will then keep step, and run by alternating current.

NEW BOOKS, ETC.

The American Battleship in Commission. By Thomas Beyer, U.S.N. Published by the Author. New York: Army and Navy Register. 12mo.; pp. 248.

The author of this work, Thomas Beyer, is a first-class ship fitter of the United States navy, an enlisted man who has given his views of the service. The amount of information contained in this book is certainly remarkable. The author begins with a general view of the organization of the navy, and then passes on to those subjects which laymen are most curious about. He tells, for example, how a battleship is prepared for a voyage; how it is handled at sea and in port; gives a clear picture of the daily life of the officers and men, and describes the drills of the week and their purpose. This chapter may be considered perhaps the most interesting in the book, inasmuch as it gives an enlisted man's own views of life on a man-of-war. The remaining portions of the work are devoted to chapters on the more material part of the bluejacket's life, such as the opportunities which the service offers him, his amusements and pastimes, the manufacture of ordnance and ammunition, the designing of a battleship. The last portion of the book is taken up with a collection of man-of-war yarns. The author is to be congratulated upon the praiseworthy manner in which the book has been issued. The illustrations are certainly the most interesting collection of pictures that we have ever seen. The typography is excellent. The book is one that we can heartily recommend for a good, clear, impartial account of the United States navy.

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