(9920) A. R. Van H. asks: 1. Will a four or a five inch spark of an induction coil penetrate a piece of glass or a piece of hard rubber 1/32 inch thick? If it will, will it penetrate the same, 1/16 inch thick? A. The electrical energy of a spark four inches long through the air would probably pierce a thin glass, or a piece of thin hard rubber. We have no figure for the thickness. The discharge points should be brought close to the glass on opposite sides, and the discharge be made as suddenly as possible. 2. I read in one of your papers of the number of pounds of water that flows over the Niagara Falls a second, but I cannot find it now. Would you please tell me the number? I think it was 213,000, but I am not sure. A. The commonly accepted volume of water passing over Niagara Falls is 224,000 cubic feet per second. This is 14,000,000 pounds per second. Falling 160 feet it gives about 7,000,000 horse-power continually.

(9921) H. M. asks: Does the buoyant or floating power of a tank filled with air vary in accordance with the depth to which the tank is submerged? For example: Would the lifting power of this tank be greater when the top of the tank would be one foot below the surface of the water than it would be if the top of the tank were ten feet below the surface of the water? If you could refer me to any literature which dwells on subjects of this kind, your kindness would be most highly appreciated. A. A tank closed airtight and submerged in water is buoyed up by the weight of the water it displaces, that is by amount equal to the weight of a volume of water which is the same as the volume of the tank. This is independent of the depth of submergence. If, however, the tank is open at the bottom, so that water enters it, its buoyant power decreases as it is sunk deeper into the water, since water enters and compresses the air into a smaller volume. The only point involved is the volume of water displaced. The principle is called Archimedes's principle, which may be found in any text-book of physics. Probably Kent's "Engineering Pocket Book," price $5, will give you the most assistance in matters of hydraulic engineering.

(9922) P. C. G. asks: Will you please describe to me just what is "denaturized" or "denaturalized" alcohol, that is now before Congress for entry free of duty? A. Denaturized alcohol is common alcohol to which some substance has been added to render it unsafe for its natural use; that is, if a small percentage of wood alcohol be added, the mixture is poisonous, and cannot be used for making any liquors for drinking, but it can still be used for mechanical purposes, or in the arts. There are other substances which may be added to alcohol with like effect. The word denaturized is not in the dictionaries as yet.

(9923) W. E. B. asks: In your issue of February 3, in an article headed "New Conceptions in Astronomy" by Prof. Edgar L. Larkin, he says: "A trillion is a million million." Webster's unabridged says: "A million million is a billion." Can Notes and Queries throw any light? A. You surely do not read your Webster as we read ours. Ours states under "Billion; according to the French and American method of numeration, a billion is a thousand millions, or 1,000,000,000; according to the English method, it is a million millions, or 1,000000,000000." The English method places six figures in each period; the French, three figures in a period. A trillion in a book published in England is 1,000000,000000,000000; in a French or American book a trillion is 1,000,000,000,000—only a millionth part of an English trillion. Prof. Larkin is an American and names numbers according to American custom. Webster's Dictionary, under "Numeration," states the matter clearly; so, also, does it under "Billion" and "Trillion." We follow the French or American method of writing and reading numbers.

(9924) A. C. asks: We had a discussion in our shop, and as we cannot try it I would like you to decide:. Weigh a tubful of water and then put in a 10-pound fish and if the fish does not touch the bottom will it weigh any more? A. If a fish alive or dead is put into a tub of water and no water runs over, the tub and fish will weigh as much more than the tub weighed before as the weight of the fish. That is because the fish is added to the contents of the tub. If a live fish is put into a tub entirely full of water and the fish floats in the water without resting any weight on the bottom of the tub, as much water in weight as the weight of the fish will flow over as the fish enters the water, and the tub, fish and remaining water will weigh the same as the tub and water weighed before the fish was put into the water. Every body submerged in a liquid is buoyed up by a force equal to the weight of the liquid displaced. If the fish sinks to the bottom and bears any part of its weight on the bottom of the tub, the tub will weigh more with the fish in it than it did before the fish was put into the tub. This last is, however, rarely if ever the case.

(9925) L. R. asks: What is the expansion of a zinc bar 40 inches long, during a variation of five degrees—say from 100 to 105 deg. F.? Is there any metal or alloy that will give a greater expansion? If so, what and how much? A. The expansion of a bar of zinc 40 inches long for a change of 5 deg. Fahrenheit is a trifle more than three ten-thousandths of an inch. Cadmium will expand slightly more than zinc, about in the ratio of 30 to 29.

(9926) R. T. asks: 1. How many amperes does a 110-volt incandescent lamp require? A. A 16-candle lamp at 110 volts takes about one-half an ampere. 2. What is the principle of a pedometer? A. A pedometer is moved by the rocking motion of the body in walking. It will register by the same motion when one is not walking. The motion of a rocking chair may make it run. 3. How long will a storage battery retain its full charge? A. A storage battery does not lose charge by leakage. So far as that goes the charge will be retained indefinitely.

(9927) G. A. R. asks: 1. A spark cannot be passed between two electrodes separated by a vacuum. Are we to infer from this that a vacuum is a perfect insulator? A. A perfect vacuum would be a perfect insulator. 2. The distance separating two particles can be halved. This second distance can then be halved and so on—according to mathematics, infinitely—which would require infinite time. Yet practically it can be accomplished in a finite time. How is this explained? A. It is quite true that mathematical zero cannot be reached by the successive division of a number by two, or by halving a certain space. But that need disturb no one. It is easy to reach a value less than any assignable value, and that is practically zero. Thus in the case of our money. When a sum has been halved successively till it is reduced to less than one mill, the process must end, since there is no denomination in which to express the value. Practically the problem you present is a logical quibble, of interest only to a mathematical quibbler. There ought always to be common sense back of logic, but unfortunately it is not always plainly visible.

(9928) A. A. F. asks: 1. How do they get this very low zero you speak of in February 10, 1906, No. 9887? A. Absolute zero is computed from the behavior of gases when cooled. Their contraction leads to the belief among scientific men that all heat would be gone from matter if it were cooled to 459 deg. F. below zero. 2. What is the lowest natural temperature known, and the lowest artificial cold yet produced? A. The lowest thermometer reading ever reported upon the earth is from a self-registering thermometer which was left for a number of years in the Arctic regions. It showed 95 deg. F. below zero. Previous to this the lowest observed was at a place in Siberia, 90 deg. F. below zero. 3. Please explain this; Haswell on page 879 asks: How many fifteens can be counted with four fives, operation

$$\frac{4 \times 3 \times 2 \times 1}{1 \times 2 \times 3} = \frac{24}{6} = 4.$$

A. The formula you give for fifteens to be made from four fives is the ordinary formula for combinations demonstrated in algebra. You will find it in any large algebra. 4. Why is it colder at the south pole than at the north? A. The southern hemisphere is largely covered with water, hence it is colder. The earth is farthest from the sun in July, which is the mid-summer month of the southern hemisphere. This makes the summer there a little colder than the northern summer.

(9929) E. H. asks: Would you kindly inform me where I could find a good description of Marconi's magnetic detector which is used in connection with a Wheatstone recorder? How are the inductance coils that are used in both the receiving and sending station wound and what size wire is used? What is the resistance of the choke coils used in the receiving circuits? A. You will find the Marconi magnetic detectors described in Maver's "Wireless Telegraphy," which we can send you for $2. Several sizes of choke coils are also described in the same book, as also are the induction coils.

(9930) J. D. writes: I have purchased some selenium for the purpose of making electro-light experiments, about which I have read so much in technical papers. I think it must go through some sort of a process before it can be used, for I find it to be a poor conductor of electricity. With a 1,000-ohm telephone ringer not the slightest effect is produced upon so delicate an apparatus as a telephone receiver. A. Selenium is not a conductor of electricity in any condition. It is a better conductor after it has been prepared than in the ordinary condition. It is kept for several hours at a temperature just below its melting point. It is then spread over the space between parallel wires, better wound upon a porcelain tube, so that the two wires are quite near together. When it has cooled it is in the sensitive state. The current sent from one wire to the other will be increased by allowing light to fall upon the selenium cell, as it is called. The resistance will be several hundred ohms probably at the lowest. We would advise you to apply to the professor of chemistry or physics at the University in your city. These men are always glad to give advice and assistance to others.

(9931) A. R. asks: Does a cannon ball fired from a cannon follow the tangent of the barrel a short distance after leaving the mouth of the cannon or does its path describe an arc with a diminishing radius beginning at the mouth of the cannon? A. A cannon ball becomes a falling body as soon as it clears the mouth of the gun, and falls in the same manner as far as distance and velocity is concerned as if it were to fall from rest with no forward motion. It does not follow the tangent of the barrel at all.

(9932) R. S. McF. asks: Would you kindly explain how I could use a 100-volt induction motor on a 110-volt current? I tried one way by connecting a 10-volt lamp in series with it, but had no satisfaction. A. A small resistance coil placed in series with your motor will take up the extra ten volts and enable the motor to run with safety. The wire must be of a size which will carry the current without heating too much. The small lamp you used was not able to carry the current required. Its filament had too high a resistance to allow current enough to flow for the motor, and so the motor did not get current enough to turn it.

(9933) C. W. asks: In your issue of February 10, 1906, page 137, Notes and Queries (No. 9887), you state that absolute zero is —459 deg. Is it a fact that scientists have accepted this as absolute zero? On what is it based? How was it determined? and how is it measured? What does absolute zero mean? Is it a condition of temperature at which no heat whatever exists or is radiated? A. It may be positively stated that all modern scientists accept 273 deg. C as absolute zero, or the temperature at which molecular motion would cease, all heat would be gone from matter. Astronomers believe that this is the temperature of the spaces outside of the earth's atmosphere. The degree we gave, —459 deg. F, is the Fahrenheit equivalent of —273 deg. C. The idea of absolute zero is based upon the fact that all gases at the freezing point of water expand and contract by the same amount if the temperature is changed one degree and this amount is 1/273 of their volume if the temperature is changed one degree Centigrade. Since the volume of a gas is dependent upon its temperature it is evident that the cooling of a gas degree by degree will cause it to shrink proportionately till if it is cooled 273 degrees its power to shrink will be gone also; that is, all the heat will have left the gas. This reasoning is not weakened by the fact that the gas would change to liquid before the absolute zero is reached. Dewar has gone within a very few degrees of absolute zero in the attempts to liquefy helium. The absolute scale was devised by Lord Kelvin and is very frequently employed in giving temperatures in scientific papers. It is the only scale in which the degrees have a direct quantitative relation.

NEW BOOKS, ETC.

High-Tension Power Transmission. By the High-Tension Transmission Committee of the American Institute of Electrical Engineers. New York: McGraw Publishing Company, 1905. 8vo.; pp. 466. Price, $3.

At a meeting of the Board of Directors of the American Institute of Electrical Engineers on September 26, 1902, the resolution was passed to appoint a committee for the purpose of collecting data on present practice in electric transmission at high voltage. The work covered a large scope, including data upon line construction, insulators, insulator pins, and the like, and conditions of operation at different voltages and under different climatic conditions, also conditions attendant upon the switching of high-tension circuits, and data respecting lightning and static disturbances, and the use of grounded protective wires. The work of this committee brought out much valuable information, which is here collected in compact and convenient form, and should prove a very valuable addition to engineering literature.

Wireless Telegraphy and Telephony. By Prof. Domenico Mazzotto. Translated by S. R. Bottone. New York: Macmillan & Co., 1906. 16mo.; pp. 416; 253 illustrations. Price, $2.

The object of this work is to present to the reader in as simple a form as possible the principles on which the wireless system of signaling is founded, and to describe the apparatus required. It also follows step by step the progress of different inventors who have revised wireless systems, and it traces chronologically the progress made in wireless telegraphy from the first experiments of Marconi at Bologna to the last results of transatlantic wireless signaling.

Taschenbuch der Kriegsflotten. VII. Jahrgang, 1906. Mit teilweiser Benutzung amtlichen Materials herausgegeben von B. Weyer, Kapitaenleutnant. Mit 410 Schiffsbildern. Muenchen: J. F. Lehmanns Verlag. Cloth, 16mo.; pp. 392. Price, $1.75.

This year's annual of the world's navies, edited by Capt. Weyer, shows considerable improvement over last year's volume so far as the amount of material published is concerned. Furthermore, the number of pictures of vessels actually in commission has been increased. There is hardly a single type of vessel that is not illustrated both by photographs and by clear diagrams. Naturally, the most marked changes to be noted in the volume before us are the records of the Russian loss and Japanese gain in naval power. An admirable feature of the book is the collection of naval programmes of the various countries. Capt. Weyer announces the intention of publishing an appendix in the month of June, which will contain whatever modifications have been made in the navies of the world since January, 1906.

Lectures on Mathematics. By Edward Burr Van Vleck, Henry Seely White, Frederick Shenstone Woods. New York: Macmillan Company, 1905. 12mo.; pp. 187. Price, $2.

This book is published for the American Mathematical Society, and contains the papers read at the Boston Colloquium, in 1903. The subjects covered are Linear Systems of Curves on Algebraic Surfaces, by Mr. White; Forms of Non-Euclidean Space, by Mr. Woods; and Selected Topics in the Theory of Divergent Series and of Continued Fractions, by Mr. Van Vleck.

The World Almanac for 1906. New York: Press Publishing Company. Pp. 569. Price, 25 cents.

The 1906 edition of the World Almanac and Encyclopedia, which has just been issued, differs little from its predecessors of other years, beyond the usual addenda, corrections, and enlargement necessitated by the occurrences of the past twelve months. The book is so well known and so largely used by many of the reading public that it needs little recommendation at the hands of the reviewer. It will often be found invaluable as a supplement to reference works of a general character, for the comprehensive information contained in its pages is of necessity concise and brief. Particularly varied and brief are the facts relative to New York city and vicinity, and this portion of the publication forms an excellent guide book and directory, not only for the stranger, but for resident New Yorkers as well. The arrangement of the major part of the general information in tabular form, together with the wide cross-indexing of the table of contents, is of great assistance to the reader in locating any of the data in the book.

Congress of Arts and Science. Universal Exposition at St. Louis, 1904. Edited by Howard J. Rogers, A.M., LL.D., Director of Congresses. Vol. I. History of the Congress by the Editor. Scientific Plan of the Congress by Prof. Hugo Muensterberg. Boston and New York: Houghton Mifflin Company, 1905. 8vo.; cloth; pp. 626. Price, $2.50.

To the readers of the technical press, the papers which constitute this first volume of the Proceedings of the Congress of Arts and Science, which met at the Universal Exposition of St. Louis, 1904, are more or less familiar. Their collection and publication in book form assuredly gives them the permanence which they deserve. Among the more important papers which were contributed may be mentioned Prof. Simon Newcomb's "Evolution of the Scientific Investigator"; Prof. Ladd's "Development of Philosophy in the Nineteenth Century"; Prof. Ostwald's "Theory of Science"; and Prof. Poincare's "Principles of Mathematical Physics."

Weltausstellung St. Louis, 1904. Die Chemische Industrie (Unter Rücksichtnahme auf das Unterrichtswesen). By Dr. Paul Cohn, Alfred Hölder, K. U. K. Hof- und Universitäts-Buchhändler. Vienna: 1905. 4to.; pp. 112.

In this monograph Dr. Cohn has presented a very comprehensive view of the chemical exhibits of the St. Louis Exposition of 1904. After a general introduction in which the general scope of the chemical industry is set forth, and its relation to expositions explained, he passes to a discussion of metallurgy and anorganic industrial chemistry. The progress of the industry in each country is discussed in detail. The second division is devoted to fuels and organic technical industries and discusses at some length dye-making in various countries. The third division is devoted to pharmaceutical operations, essential oils and perfumes. In the fourth division, fats, soaps, candles, glycerine, and explosives are treated. The fifth division is a special treatise on educational work and scientific instruction. A summary closes the monograph.

The Pennsylvania Railroad System at the Louisiana Purchase Exposition, Locomotive Tests and Exhibits. Philadelphia: The Pennsylvania Railroad Company, 1905. 8vo.; pp. 734; 800 illustrations Price, $5.

This valuable work is a compendium of the elaborate series of tests carried out by the Pennsylvania Railroad Company in connection with their exhibits at the Louisiana Purchase Exposition at St. Louis. This plant was the most complete locomotive testing plant ever erected and the tests of the eight locomotives that were submitted were made with every refinement known in the art of carrying out mechanical tests of this character. In planning the plant, it was laid out with sufficient capacity to accommodate locomotives of widely varying types and dimensions. It was intended originally to present the plant merely as an exhibit, and at the close of the exposition to remove it to the Pennsylvania Railroad's property; but it was ultimately determined to carry on at St. Louis a series of tests and enlist

the interest of the engineering profession and railroad company in making them as comprehensive as possible. In all, eight locomotives, of widely varying character and design, were tested, and the results are embodied in the present volume. After a description of the general exhibit of the company, the testing plant is described and illustrated in great detail, working drawings being given of all the parts. Then follow chapters on the formation of the advisory committee, and on the plan, scope, and method of recording the tests. Each of the eight locomotives is taken up in its turn, detailed working drawings being given of each one, and a mass of tables and diagrams which, considering the high professional skill with which the data have been gathered, are unique in the history of the locomotive. This work will prove invaluable to everyone who has to do with the design and operation of the steam locomotive.

ALTERNATING CURRENTS: THEIR THEORY, GENERATION, AND TRANSFORMATION. By Alfred Day, D.Sc., M.I.E.E. New York: The D. Van Nostrand Company, 1906. 8vo.; pp. 291. Price, $2.50.

In the present volume Mr. Day has attempted to gave a general account of the principles, construction, and use of alternating current measuring instruments, generators, motors, and transforming machinery. A great deal of attention has been given to methods of testing. The book is clearly and concisely written and many matters which are not generally understood, or which are of too recent origin to have found their way into text books, are thoroughly gone into. The book is very practical in character. It is illustrated by no less than 178 diagrams. All types of alternating current motors and dynamos, as well as the latest form of motor operating upon either direct or alternating current, are described with the aid of the diagrams. The book goes into the theory and practice of alternating current machinery in a most thorough manner.

THE MOST POPULAR HOME SONGS. New York: Hinds, Noble & Eldredge, 1906. Price, 50 cents.

This is a very complete collection of secular and religious songs which have been popular in this country at all periods of its history. Besides well-known English and American songs, some of those of other nations are included.

YEAR BOOK OF THE PENNSYLVANIA SOCIETY, 1905. Edited by Barr Ferree, secretary. New York: The Pennsylvania Society, 1905. 8vo.; pp. 208.

The Pennsylvania Society was organized seven years ago with the purpose of collecting historical material relating to the State of Pennsylvania and keeping its memory alive. The present volume is the fifth year book issued by the society. It contains much historical matter of interest chiefly to Pennsylvanians and is illustrated with half-tone plates of old houses, historical events, etc. A full report of the sixth annual dinner of the society, which commemorated the 117th anniversary of the ratification of the Constitution of the United States by the Pennsylvania Convention, and which was given in honor of Senator Philander C. Knox, is fully reported in this volume.

FAULTY DICTION, OR ERRORS IN THE USE OF THE ENGLISH LANGUAGE AND HOW TO CORRECT THEM. By Thomas H. Russell, LL.D., editor-in-chief of Webster's Imperial Dictionary. Chicago: George W. Ogilvie & Co., 1905. Pp. 150; bound in leather. Price, 50 cents.

This small vest-pocket aid to the use of correct English will be found both interesting and useful to all those who desire to speak correctly. The words are arranged in alphabetical order. The errors which are discussed are those of grammar, construction, or faulty rhetoric, and unauthorized words. The correct pronunciation of words which are sometimes mispronounced is also given in many instances.

VIOLINS AND OTHER STRING INSTRUMENTS, AND HOW TO MAKE THEM. Edited by Paul N. Hasluck. Philadelphia: David McKay, 1906. 16mo.; pp. 160. Price, 50 cents.

This book is compiled by the editor from the columns of Work. It contains explicit directions for the making of violins, violoncellos, mandolins, guitars, banjos, zithers, and dulcimers. The introductory chapter treats of the materials and tools required in making these instruments, while other chapters are devoted to the making of violin molds, the varnishing and finishing of violins, Japanese one-string violins, and a double-bass violin. The book contains much valuable information condensed in a small space.

HANDBOOK ON REINFORCED CONCRETE. By F. D. Warren. New York: D. Van Nostrand Company, 1906. 12mo.; pp. 271. Price, $2.50.

This handy little volume is intended as a reference book for architects, engineers and contractors who have to do with the designing of concrete structures. The work treats of a general form of design rather than any one particular system. The treatment of the many phases entering the design has been carried out upon well known formulæ based upon the theory of elasticity, and not upon empirical formulæ based upon experiments wholly. Sufficient tests were made, however, to determine the co-efficients and constants needed. The book is in four parts, the first of which gives a concise *résumé* of the subject from a practical standpoint and tells of the difficulties met with in practice and the remedies for the same. The second part contains a series of tests which justify the use of constants and co-efficients employed in preparing the tables in Part III. These tables should give the designer all the necessary information for ordinary use. It does not cover the more intricate designs, however. Part IV treats of the design of truss roofs from a practical standpoint.

INDEX OF INVENTIONS

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