strong enough to withstand the explosion, the cylinder will not break. This is what is done in a gas engine. If the cylinder is not strong enough, it breaks. The gas-engine cylinder is strong enough.

(9708) W. G. asks: Could you tell me how I can determine the positive and negative side of a live wire, not tracing it to the station or to the lamp or motor, etc.? Is it possible? A. The direction of flow of an electric current in a wire may be told by a compass needle placed so that the current flows along the needle, that is, lengthwise of the needle as the needle stands north and south. In this case the needle will be turned more or less across the wire by the magnetic action of the current. To determine the direction of the current, hold the open right hand over or under the conducting wire, but so that the wire is between the hand and the needle, so that the palm of the hand is toward the needle, and so that the thumb is extended in the direction in which the north or marked end of the needle is deflected; the fingers will point in the direction of the current.

(9709) E. B. E. writes: In your paper for April 15 is given a rule for the approximate extraction of square root. The first part of the rule is a well-known method, and applies quite generally and not merely to numbers within the limits given. The second part seems rather obscure, and is not easy to remember. The best rule is perhaps that given by Charles Hutton, a prominent mathematician of the eighteenth century:

$$\sqrt{N} = \frac{3N + r^2}{N + 3r^2} \times r \text{ approximately.}$$

(Where r is an approx. root.)

Example: Let $N = 271$, $r = 16$

$$\sqrt{271} = \frac{3 \times 271 + 256}{271 + 768} \times 16 = 16.4620 \text{ approx.}$$

True value 16.4621

The corresponding formula for cube root is:

$$\sqrt[3]{N} = \frac{2N + r^3}{N + 2r^3} \times r$$

Example: Let $N = 271$, $r = 6$

$$\sqrt[3]{271} = \frac{542 + 216}{271 + 432} \times 6 = 6.469$$

True value 6.471

A. The rule given above is far more simple than the one formerly printed in this column. If one needs an approximation for the square root, we should advise that this rule be copied and employed.

(9710) E. R. MacP. says: 1. *Re* inquiry 9615, under date April 15: I quite follow your reply, but I think that your correspondent must have been thinking of the influence of wind on a bullet; for it is a well-known fact that when the wind is blowing in the same direction as a bullet (or any projectile) it has a tendency to elevate the bullet above its usual trajectory. And just the reverse happens when the wind is against the bullet. 2. What is the formula for measuring rain? It runs something like this, I think: "So many square inches of catchment area require so many cubic inches in order to measure one inch of rain." A. To measure the fall of rain in cubic inches, it is necessary to have as many cubic inches of water as there are square inches in the "catchment area." A better way of determining the depth of rainfall is to use a rain gage. The United States Weather Bureau rain gage is a metal dish about 8 inches in diameter at the top. The rim is of heavy copper turned to a sharp edge. This opens below into a narrow dish, whose sectional area is exactly one-tenth of the area of the upper dish, and whose depth is 20 inches. It is obvious that the water will be ten times as deep in the lower dish as it would be if retained in the upper dish. The rain caught is measured in the lower dish, and the depth divided by ten gives the rainfall. Two inches of rain would fill the lower dish. 3. Is it possible to calculate an "angle of safety" for a circular cycle track? For instance, I want to build a circular track 50 feet in diameter. What would be the angle of safety for that? When I use the term "angle of safety," I mean the greatest possible angle that the track can be inclined without the rider being thrown off, granting of course that he is riding at a high rate of speed—say 15 or 20 miles an hour. A. The "angle of safety," as you term the angle of inclination of a track on which there would be no tendency for a bicycle to slow in going around a corner, will vary with the speed of the rider and also with the radius of the track. If the track is W feet wide, the proper elevation (measured in feet) at the outside can be found from the following formula:

$$\text{Elevation} = W \times \frac{z^2}{32\,R}$$

Where z^2 = the velocity of feet per second, and R = the radius of the track in feet.

(9711) T. A. B. asks: There are two grounded telephone lines—entirely separate—running parallel at a distance of about 100 to 150 feet apart. A conversation on one line may be distinctly heard on the other. One line is private, and the other runs to a switchboard. A. Wherever two telephone lines interfere with each other, the cause is always the induction of the current in one line upon the other line. It can be remedied by the use of a metallic circuit, with twisted or crossed wires.

(9712) E. M. B. says: If an Archimedean screw is placed so that the opening in the lower end is under water during its entire revolution, will the screw raise a continuous stream, or will the flow from the upper end be intermittent, and why? A. If an Archimedean screw is placed so that the opening in the lower end is under water during its entire revolution, the flow from the upper end will be continuous, provided the conditions are such that there is any flow at all, if the pitch of the screw is uniform, and the speed of rotation is uniform; otherwise, it will vary. If the angle of the screw is too great, or if the pitch of the screw is too great, or if the speed of rotation is insufficient, there will be no flow of water at all.

(9713) F. De M. asks: About what is the resistance of the dry cell in common use, standard size 2½ x 6¾ round, such as the Mesco, Columbia, New Standard, etc.? A. The internal resistance of dry cells is not constant, and must vary during the life of the cell. Since the E.M.F. of these cells is not high, the internal resistance should be low. Some makers give the resistance of their cells as low as 0.15 to 0.25 ohm. This quantity is difficult of measurement because these cells polarize very rapidly, and the current changes for that reason.

(9714) W. F. W. asks: 1. There is a widely prevalent belief that a razor by being kept in constant use loses its good shaving qualities, and that by allowing it to "rest" for a while unused it will recover its original shaving qualities. Has that belief any real foundation? If so, please explain the cause for such remarkable metallic peculiarities. A. The only suggestion we can give you as a foundation for the belief that allowing a razor to rest would improve its shaving qualities is as follows: The literal *edge* of a razor is only of microscopic thickness. This edge, when exposed to the atmosphere, oxidizes rapidly. The tendency of "rest" therefore would be to produce a jagged edge, which when very much magnified would look somewhat like the edge of a saw, and it is well known that a rough edge, when keen, will cut better than an edge which is too smooth and uniform. We believe, however, in spite of the facts that we have just described, which may have improved the cutting qualities of razors in a few exceptional instances, that imagination, which plays all kinds of freaks with things too small to be seen, is the real foundation for the belief to which you refer. 2. Why do blacksmiths pour water upon the burning coals in the forge? I have never been able to get an entirely satisfactory explanation from the blacksmiths themselves. A. Blacksmiths pour water on their forges in order to control the size of their fires. As a rule, they wish to heat their iron only for a limited distance along the bar, and therefore must control the diameter of their fire. The water also serves two other useful purposes. It tends to make the coal cake in such a way as to be nearly impervious to the blast. Thus a nearly air-tight ring or chimney may be formed around a fire, which will help to concentrate the air from the blast at the point where it is most needed. This caking of the coal helps in the process of transforming blacksmith's coal into coke, in which condition it forms a better fuel and produces a better fire than could be obtained from green coal. From this last reason, blacksmiths will often be found wetting their coal to aid in the process of manufacturing coke, when wetting the fire would not be necessary for the particular job they have at hand. 3. What are wash drawings, and how are they made? A. "Wash drawings" are ordinary India-ink drawings on paper which have been tinted with water-color paint, to make them more accurately represent in appearance the object for which they are made. Architects' drawings are often prepared in this way, and the practice was common with engineers a generation ago. 4. Please explain how the "parallax stereogram" pictures were made which were exhibited at the St. Louis Exposition. Portions of the objects projected forward, appearing to be in front of the frame, and other portions appeared to be considerably farther back. A. Parallax stereograms are constructed of sets of lines, so that each set forms its part of the scene represented. Some of the dailies have been issuing these pictures as supplements, so that now they are very common.

(9715) H. H. S. asks: Please let me know through the SCIENTIFIC AMERICAN how to find the gage of wire. In other words, of a certain piece of wire of known diameter in fractions of an inch, what is its number? A. There is no way of finding the gage of a wire except by the use of a wire table, which gives the number of a wire and its diameter in thousandths of an inch. Nor is a wire known unless the name of the gage by which it is measured is expressed as B. & S., Stubs, or some other. The whole matter of gages is in a bad condition, and some unification should be made. The best would be to denote a wire by its diameter.

(9716) J. McL. asks: In SUPPLEMENT No. 1215, page 19474, you have an article advising the use of dilute phosphoric acid in water to ward off old age, etc. I have seen a warning in some book to not use more than 15 drops of dilute acid in water three times a day. I believe there is sound reason in the article referred to, and would ask if it would not be a good idea to print same in SCIENTIFIC AMERICAN soon, with the warning to not use more than 15 drops of the acid in water three times a day. What would be the effect on the teeth of using same, or if any hollow teeth were present would it affect the jawbone? A. Phosphoric acid is a very excellent tonic, and if one's physician prescribes it, we should certainly advise you to take it. We should not advise anyone to prescribe for himself even a most excellent remedy. Let medicines alone till some one outside of yourself orders them. That is good advice for anything beyond simple household remedies, such as catnip tea and the like, which do no harm when they do no good. When phosphoric acid is to be taken, it is usually given in the form of a phosphate or phosphite. The soda fountain drink orange phosphate, so popular of late, is simply an acid phosphate with orange syrup added. As to the action upon the teeth we cannot pronounce, since the doctors have not decided just what causes the necrosis of the bone in the case of workers in match factories. We cannot advise one whether to study mechanical drawing or photo-engraving. The man should study the one he likes best and can do the work best in, or the one which is nearest his hand. All sorts of wages are paid in both trades, and a good man can get a living at either, though he will not get rich at either working on a salary.

NEW BOOKS, ETC.

CAMS AND THE PRINCIPLES OF THEIR CONSTRUCTION. By George Jepson. Cambridge, Mass.: The University Press, 1905. 8vo.; pp. 59.

Cams are one of the most important parts of nearly all machinery; and a clear and concise work on their design and construction will be found valuable to all mechanical engineers. This little volume is such a work, and we heartily recommend it to the engineering fraternity. It is largely filled with exceedingly clear drawings of different kinds of cams used for various purposes, and there are several half-tone plates of cams on different machines.

CELLULOSE, CELLULOSE PRODUCTS, AND ARTIFICIAL RUBBER. By Dr. Joseph Bersch. Translated from the German by William T. Brannt, Editor of "The Techno-Chemical Receipt Book." Philadelphia: Henry Carey Baird & Co., 1904. 8vo.; pp. 345. Price, $3.

This work is a very complete treatise on that most useful industrial material, cellulose. Cellulose, as is well known, is used in many ways, its use extending from the preparation of nitro-compounds to the manufacture of artificial silk and distillation of alcohol. All these uses are gone into and fully described in the present volume. The author first tells how cellulose is prepared from wood or straw, and how parchment is manufactured from it. He afterward describes the methods of obtaining sugar, alcohol, and oxalic acid from this substance. Later on in the work he discusses the production of viscose, the nitro-celluloses, and cellulose esters, artificial silk, celluloid, rubber substitutes, oil rubber, and factis. The work is very complete, and will be found of great value to all who wish to gain a knowledge of the uses and nature of this substance.

FLORA AND FAUNA OF THE BLOOD. By Henry G. Graham, M.D. Chicago.

This is a very interesting little pamphlet, the result of six years of hard labor, descriptive of the infusoria contained in human blood. It is illustrated with two colored plates, showing these microscopic animals as they appear under varying conditions. The book is well worth the perusal of all interested in the wonders of the human body. It is written in a popular manner, and may be understandingly read by any person of ordinary intelligence.

STAIR BUILDING MADE EASY. By Fred T. Hodgson. New York: The Industrial Publication Company, 1904. 12mo.; pp. 160. Price, $1.

The third edition of this small volume will be found very helpful by all young carpenters, and even by those of greater experience in the building of stairs and stairways. It gives a full and complete description of all kinds of staircases, and instructions for designing and erecting the same. It is fully illustrated with over 100 engravings, and is provided with a glossary and index, which make the information it contains easily obtainable.

MACHINE TOOLS AND WORKSHOP PRACTICE FOR ENGINEERING STUDENTS AND APPRENTICES. By Alfred Parr. New York: Longmans, Green & Co., 1905. 8vo.; pp. 444; ill., 550. Price, $4.

The aim of this textbook is to explain the construction and use of machine tools in a connected form. The book covers a large range of subjects, and will be found especially helpful to the practical worker, as it will enable him to study the action of the machine tools he uses, and give him hints on how best to do the various kinds of work which these tools are calculated to perform. The book contains, among its many chapters, several on Measurement; Turret Lathes; Grinding; and Milling, which have been prepared and illustrated in great detail, on account of their importance to the student and practical worker. The illustrations are both in half-tone and line cuts. They are numerous, and will aid greatly in instructing the student.

LLOYD'S REGISTER OF AMERICAN YACHTS, 1905. Published from New York office of Lloyd's Register of Shipping, 15 Whitehall Street, New York. Pp. 542, colored plates 42. Price, $7.50.

With the opening of the yachting season comes the new volume of the American Yacht Register for 1905, published by Lloyd's Register of Shipping. Though only in its third season, this book is already well known in all parts of the United States and Canada as the standard work of reference for yachtsmen.

The Register is a book of 542 pages, with 59 colored plates of club burgees, national ensigns, and owners' private signals, the latter to the number of 1,440. The total number of yachts listed is 3,389, of which 2,130 are sailing craft and 1,259 are propelled by steam or some other power. The tendency of the times is shown by the fact that while but a year ago the sailing yachts made 67 per cent of the total, this year they make but 62 per cent.

Among the power yachts the new gasoline cruisers in all sizes from 30 to 80 feet figure conspicuously, this type of craft being deservedly popular from its great utility, its adaptability to all waters, and the comparatively low cost of running.

In addition to the main list of yachts, giving the most complete particulars of hulls and engines, there are lists of signal letters, of former names of yachts, of builders and designers of the United States and Canada, and a very complete list of over 3,100 yacht owners, with addresses and clubs, as well as the yachts owned by each.

OUTLINE OF INDUSTRIAL CHEMISTRY. A textbook for students. By Frank Hall Thorp, Ph.D., Assistant Professor of Industrial Chemistry in the Massachusetts Institute of Technology. Second edition, revised and enlarged, and including a chapter on Metallurgy by Charles D. Demond S.B. New York: The Macmillan Company, 1905; 8vo., pp. 618. Price, $3.50.

Prof. Thorp's outline of industrial chemistry has been used more or less constantly by the Editor of this journal ever since its publication in 1898. The practical use to which the volume has been put during those seven years has enabled him to form a more just estimate of its technical value than can possibly be attained through the cursory reading which is usually alloted by the reviewer to a newly-published volume. The work has proved itself an excellent handbook of ready reference on industrial chemistry, and its excellent references to bibliographies at the ends of divisions have more than once proven of value. In this new edition, Prof. Thorp has included an account of the more important advances made in the chemical industries during the last seven years, and has therefore considerably improved the technical value of his volume. Mr. Charles Demond's elementary chapters on metallurgy constitute a feature which, as far as we know, is new in textbooks of industrial chemistry, but which we venture to state is likely to be found in them ere long. This metallurgical review, although necessarily brief, nevertheless gives one a very good idea of the elementary chemical principles that underlie most modern metallurgical processes.

DUALITY OF THOUGHT AND LANGUAGE. An Outline of Original Research. By Emil Sutro. New York: The Physio-Psychic Society, 1904. 12mo.; pp. 300. Price, $1.50.

Starting with Gladstone's utterance, "The scientific investigation of the spiritual is the most important subject before the public today," the author endeavors to prove the supremacy of spirituality over matter, in man. His theories, from our present-day standpoint, are nothing if not peculiar, but he is nearly always interesting, and at times helpful and inspiring.

LECTURE NOTES ON SOME OF THE BUSINESS FEATURES OF ENGINEERING PRACTICE. By Alex C. Humphreys. Published by the Department of Business Engineering of Stevens Institute of Technology, 1905. 8vo.; pp. 187.

This book has been written by Prof. Humphreys with a view to aiding students under his tuition by giving them a *résumé* of the lectures delivered in the course on business engineering. All the matter included in the course is not found in this volume, but that which is most difficult to comprehend is given, and will be found of great aid to the student. The book also contains notes on the law of contracts by Howard E. White, Esq., and the Commencement address delivered by Walter C. Kerr to the Class of 1904.

STEAM PIPES: THEIR DESIGN AND CONSTRUCTION. By William H. Booth. New York: The Norman W. Henley Publishing Company, 1905. 8vo.; pp. 187. Price, $2.

This book forms a practical treatise on the principles of steam conveyance, and the means and materials employed in practice to secure economy, efficiency, and safety. The book is well illustrated, and gives many useful ideas with regard to the making of pipe joints, expansion offsets, flexible joints, and self-contained sliding joints for taking up the expansion of long pipes. The chapters on the flow of steam and expansion of pipes will be found extremely useful to all steam fitters. The pressure strength of pipes and the method of hanging them, as well as valves and bypasses of all kinds, flanged joints and their proper

proportions, exhaust heads and separators, etc., are well illustrated and described. A valuable chapter to the large steam user is the one on superheated steam and the saving of steam by insulation. The loss of heat in thermal units from covered and uncovered steam pipes is given in suitable comparison tables. The book will be found extremely useful to all interested in steam-pipe construction.

A TREATISE ON ROCKS, ROCK WEATHERING, AND SOILS. By George P. Merrill. New York: The Macmillan Company, 1904. 8vo.; pp. 411. Price, $4.

Although the origin, structure, and mineral composition of rocks, particularly those of erupted varieties, have received particular attention from petrologists since the introduction of the microscope into petrographic work, there has, however, been very little time devoted to the study of rocks in a weathered condition. In many cases where chemical analyses have been made, the chemists have disregarded the physical and mineralogical nature of the material analyzed. Other workers have studied the physical properties of decayed rocks, i. e. soils, but have, in turn, disregarded their mineral and chemical nature. The author has endeavored to bring together results obtained by these various workers—results which, it is believed, will be to the mutual benefit of all concerned. The state of comminution reached by rocks during the process of long-continued decay, and the amount of leaching such have undergone, are of as much practical interest to the agriculturist as they are of theoretical interest to the geologist. A very general scheme of classification is adopted in the present preliminary volume, as the author desired to introduce into it as few new terms as possible. The analyses given were made by the author himself from materials which he collected, and which, he believes, are truly representative samples of rock, concerning the lithological identity of which there can be no doubt. The reason that so little use has been made of other analyses is that information is generally lacking relative to the mutual association of fresh and decomposed materials and the mineralogical and physical nature of the residual product. The book is divided into five parts, as follows: The Constituents, Physical and Chemical Properties, and Mode of Occurrence of Rock; the Kinds of Rocks; the Weathering of Rocks; the Transportation and Redisposition of Rock Débris; and the Regolith. Some twenty-five full page plates, in addition to nearly half a hundred other figures, completely illustrate the work.

THE BERLIN-ZOSSEN ELECTRIC RAILWAY TESTS OF 1903. Translated from the German by Franz Welz, E.E. With an Introduction Discussing the General Subject of Train Resistance by Louis Bell, PhD. New York: McGraw Publishing Company, 1905. 4to.; pp. 100. Price, $3.

This is a full and complete report of the test runs made on the Berlin-Zossen experimental railroad from September to November, inclusive, 1903. These tests occupy a unique place in the history of modern engineering, for they represent a very thorough and highly successful effort at solving the greatest problem of twentieth century transportation, viz., the application of electric traction to greatly increased railway speed. The introduction by Mr. Bell sums up the results that were attained, while the rest of the volume deals with the preparatory work that was gone through with before the tests were made, and the results of these tests as to the time required for starting and stopping, the air and train resistance, the power consumption, the behavior of the car during service, and the behavior of the new roadbed during the tests. The book has an appendix concerning a high-speed railway from Berlin to Hamburg. It contains numerous diagrams and test charts. It is a thorough *résumé* of the tests that were made.

INDEX OF INVENTIONS

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Envelop, J. W. Knebler	794,720
Evener, horse, J. J. Larson	795,140
Exhaust mechanism, variable, C. L. Pagenhart	794,881
Extension table, J. W. Lindow	794,990
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Eyeglasses, G. A. Stiles	795,178
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Eyelets with flexible material, method of and apparatus for covering, P. R. Glass	795,033
Faucet, lock, C. C. Connell	795,027
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Fence post, Pierce & Williamson	794,739
Fence post, G. E. Blaine	794,845
File, bill, G. H. Maurer	794,993, 794,994
Filing device, A. C. Wiechers	794,827
Filter and cleaner, L. E. Rogers	795,066
Filter, water, M. N. Lynn	795,047
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Fire apparatus, S. A. A. Stenberg	795,176
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Formaldehyde candle, Bauer & Hollister	794,771
Foundation, H. Ericsson	794,971
Fountain. See Drinking fountain.	
Friction device, G. Westinghouse	794,761
Friction top can, E. W. Carnes	795,102

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