statements above. Some organs have subsidiary bellows to allow a variation of pressure.

(8993) F. F. W. asks: I would like you to give me the dimensions of an 11-inch Wimshurst machine, size of tinfoil sectors, number on each plate, size inside and out of Leyden jars, and whether or not it is large enough for X-ray experiments; if not, the size of one for such. Also a way for cutting glass circles and perforating plates for spindles. Also how to make collecting combs for the machine. A. A Wimshurst machine with 11-inch plates will not actuate an X-ray tube powerfully enough for any real work. If our correspondent would make an effective apparatus, he should make an 8 or 12-inch coil. We cannot advise him to attempt cutting glass plates unless he is an expert in cutting glass. He then only needs a round pattern and to cut around it with his diamond. The hole is made through the center by the sharp corner of a broken file wet with turpentine in which all the camphor it will take has been dissolved. SUPPLEMENT 548 contains plans for making a good Wimshurst machine. We should advise plates as large as 24 inches.

(8994) G. H. asks: In the experiment of the electrolytic decomposition of water to the two gases, hydrogen and oxygen, can you give me any figures of the size of plates or plate surface necessary to produce one cubic foot of oxygen gas at atmospheric pressure in one hour and power required, and would such gas raise under pressure a gasometer after the style of a gasometer in a gas works? A. The size of the plates is not important in the decomposition of water by the electric current. The plates are of platinum, and a large plate is too expensive. You will require 136 coulombs to decompose 1 cubic foot of oxygen in one hour. At least 1.5 volts must be used; more will give less heat, since fewer amperes will be needed. If you use 10 volts and 14 amperes, you will have a fair result. The gas produced will be like any other gas in pressure and other properties. This method of producing oxygen is a most expensive one. The chemical way is much better.

(8995) G. O. H. asks: I have been amusing my grandchildren by magnetizing the blades of their pocket-knives with a horseshoe magnet, using the "single-touch," as I believe it is called: drawing the magnet straight forward, and returning in the same direction, using the same pole a number of times without change. Is there a simple process better than this? A. The best and simplest way to magnetize a piece of steel with a magnet is to draw the steel off one pole of the magnet, perhaps ten times in the same direction; then draw the other end of the piece of steel off from the other pole of the magnet the same number of times. The magnetism is fixed by forcibly pulling the piece of steel through and away from the field of the magnet.

(8996) R. C. asks: Would you kindly explain to me the workings of the radiometer? A. The radiometer consists of a bulb of glass exhausted to a vacuum of about one centimeter of mercury. Within are two cross arms turning upon a pivot. These arms carry disks of mica, which are covered on one side with lampblack. The other side is metallic, shiny. When heat falls upon the vanes, the black side absorbs more readily than the metallic side and becomes hotter. The molecules of the gas remaining in the bulb coming in contact with the blackened surfaces are heated more than those striking the shining surfaces, and consequently rebound from the blackened sides of the vanes with more force than from the shiny side, thus causing a greater pressure upon the blackened faces. The vanes being able to move revolve by the reaction, their blackened faces moving away from the source of heat. If the vacuum is either too high or too low, no motion is produced. If exposed to an intensely cold body, the vanes revolve in the opposite direction.

(8997) W. W. L. asks: A train going at the rate of one mile a minute, with a cannon on one of the cars, loaded so as to give a firing velocity of one mile per minute, the cannon to be fired while the train is going at that rate in the opposite direction. How far apart will the train and the cannon ball be at the end of one minute? The resistance of the air is not taken into consideration. A. If a train is going at the rate of a mile a minute, and a ball be fired from the train with a velocity of a mile a minute in the opposite direction to that of the train, it will in one minute be one mile away from the train. This is because the cannon threw the ball a mile a minute. The train with the cannon on it, and the ball both before and after it was discharged, traveled by its inertia a mile in a minute in one direction, while the force of the powder sent the ball a mile in a minute in the opposite direction. These two motions will put the ball and the train a mile apart in a minute. But if you stood by the side of the train as the cannon was discharged, you would seem to see the ball fall from the mouth of the cannon to the earth and the train simply move away from it one mile in one minute. 2. Again, if the cannon were fired the same way the train was going, how far would the ball be from the cannon at the end of one minute? A. If the cannon were fired in the same direction in which the train was going in one minute the ball would be one mile ahead of the train, since it would have the velocity of one mile a minute by the inertia of the train and a velocity of one mile a minute by the force of the powder. It would actually have the velocity of two miles a minute.

(8998) R. B. C. asks: What causes a change of direction of the current in a simple dynamo during each revolution of the armature? A. The dynamo produces a current in the armature coils by whirling them across the lines of force of the field. These cross from one pole piece to the other through the armature. A coil of wire when flatwise receives the lines of force in one direction through it. When it has turned through a half circle, it receives these lines in the opposite direction. The current produced by the lines passing through the coil in one direction is the reverse of the current produced by the same lines passing through the same coil in the opposite direction. So that the direction of the current from a coil of the armature changes each half revolution. The current is called alternating. A commutator of a direct current machine acts to reverse every other one of the alternating impulses, and so the current comes out constantly in one direction. All dynamos generate alternating currents in their armatures. Dynamos with commutators give direct currents outside. You would understand this much better by reading some book, say Swoope's, price $2, or Jackson's "Elementary Electricity," price $1.50 post paid.

(8999) H. J. S. asks: Supposing the diameter of the moon's orbit was reduced so that the moon would revolve around the earth so near to its surface that it would barely avoid scraping the mountain tops, and suppose there was no resisting atmosphere to complicate the problem. Suppose also that it was moving in its orbit at its present rate of motion. What would be the time required for one revolution around the earth? Would the earth's gravitative power draw the moon to itself, or would its momentum, or centrifugal tendency, send it back into the heavens to revolve eventually in the same orbit that it now does? A. If the moon or any other body were to revolve around the earth so as just to escape its surface, its time of revolution would be 1 hour 24 minutes 39 seconds. This may be computed as an application of Kepler's Third Law, for which consult any astronomy. The supposition that the moon in this position should move with its present rate of motion cannot be allowed. It could not move with its present rate and be so near the earth. It would fall into the earth very speedily. Its present rate of motion is exactly right for its present distance from the earth. To prevent it from falling into the earth at the nearer distance supposed, its rate of motion must be greatly increased, so that it would go around the earth in the time given above. As to what would happen later on, what you will say to that depends upon whether you accept Darwin's hypothesis of tidal evolution. Into this question we will not enter, since we have not the space for it. We will refer you to Young's "Text-book of General Astronomy," price $3.50, or to Ball's "Story of the Heavens," price $3.50, the last chapter of which is devoted to this subject.

(9000) C. H. asks: 1. Would you kindly let me know of some cheap way of making oxygen that could be used for an oxyhydrogen flame? A. There is no cheap way of making oxygen. It is commonly made by heating a mixture of equal parts of chlorate of potash and dioxide of manganese in a metallic retort, but is not a safe operation except for a person with some knowledge of chemistry. 2. Does hydrogen mixed with oxygen give much more heat than mixed with air? A. Hydrogen gives a hotter flame with oxygen than with the air. It is not, however, used for the oxyhydrogen blowpipe unless for metals which melt above the temperature required for platinum. Street gas is commonly employed with oxygen in the so-called oxyhydrogen blowpipe, and this flame is hot enough to melt platinum. 3. Kindly let me know will sand readily melt when heated with the above gases, or does it require to be mixed with some other substance, and if so kindly mention which is cheapest and how mixed? A. Silica (sand) is not melted by the oxyhydrogen flame. The heat of the electric arc is employed for that purpose. If, however, the sand be mixed with an alkali, soda or potash, as in making glass, it may be melted in an ordinary furnace. For this, see works upon glass making.

(9001) R. R. wants to know how to bend flash boiler tubing without flattening ends. A. For making bends in ⅜ extra strong iron pipe as small as shown in your sketch, you must heat the parts of the pipe represented by the bend and slowly bend it to the required shape. If it flattens a little, it may be squeezed sidewise in a vise to keep it round. A good blacksmith can bend such pipe with very little distortion.

(9002) W. C. asks for a method of "setting" the colors of pressed flowers. A. Either dust salicylic acid over the plants as they lie in the press, or prepare a solution of 1 part of salicylic acid in 14 parts of alcohol; soak blotting paper in this solution, and place a sheet so soaked above and below the flowers when pressing.

(9003) J. E. W. asks: What is the best material for putting a bright finish on hasps, hooks, and staples? A. Charcoal mixed with the sawdust in the tumbling barrel, without oil, is much in use for brightening tumbled work. The oiling should be a separate operation after the cleaning, which may be done with sawdust wet with linseed oil.

NEW BOOKS, ETC.

PERSPECTIVE DRAWING. Instruction Paper. American School of Armour Institute of Technology. Chicago. 1902. Pp. 69. 8vo.

The correspondence schools are playing so prominent a part in education, that their publications deserve attention. It must be confessed that the presentation of the subject in this book is clear, and particularly well adapted for school purposes.

THE CHEMISTRY OF INDIA RUBBER. Including the Outlines of a Theory of Vulcanization. By Carl Otto Weber, Ph.D. London: Charles Griffin & Co., Ltd. Philadelphia: J. B. Lippincott Company. 1903. 8vo. Pp. x, 314. Price $5.50.

It is the purpose of this book to deal with the analytical methods which are most exclusively the work of R. Henriques, more particularly as regards rubber substitutes, so called, and the author's researches, chiefly concerning India rubber itself, and the vulcanization problem. This refers to work done within the last ten years. Before that time India rubber analysis, if it existed at all, was unknown to the outside world. Manufacturing processes as such, have not been dealt with. To have done so would have resulted in the destruction of the unity and aim of the work. The book is probably the best on the chemistry of India rubber which has so far been published.

THE ART OF ILLUMINATION. By Louis Bell, Ph.D. New York: McGraw Publishing Company. 1902. 8vo. Pp. 345.

The book deals not with the problem of distributing the illuminants but with their application, and treats of the illuminants themselves only in so far as a knowledge of their peculiarities is necessary to their intelligent use. To compress the subject within reasonable bounds, the general principles have been discussed rather than concrete examples of artificial lighting. A book of this character should tend to correct some of the commoner errors and failures in illumination.

FACTORY ACCOUNTS. Their Principles and Practice. By Emile Garcke and J. M. Fells. London: Crosby Lockwood & Son. New York: D. Van Nostrand Company. 1902. 12mo. Pp. xviii, 248. Price $3.

No doubt this book was the first attempt to discuss scientifically the principles relating to factory accounts, and the methods by which those principles can be put into practice and made to serve important purposes in the economy of manufacture. The authors are probably correct in their statement that warehousemen and business-men are for the most part content to accept accounts which are not capable of scientific verification and which can be regarded only as memoranda of transactions. In this present fifth edition some matters of factory routine and registration, not previously dealt with, are included. Although the book treats the subject largely from the English standpoint, it should be welcomed by American factory proprietors.

THE STEAM TURBINE. By Robert M. Neilson. London, New York, and Bombay: Longmans, Green & Co. 1902. 8vo. Pp. xii, 163. Price $2.50.

Since the steam turbine is likely to be extensively used in the future, a book on the subject should be of unusual value. Literature on the turbine has so far consisted chiefly of descriptions of the principal features only, or of accounts of the results of tests. The author has endeavored in this book to describe, not only the principal parts of leading types of steam turbine, but also small details which have such a preponderating influence in determining success or failure. The mathematical reasoning contained in the book is simple.

AN ELEMENTARY TREATISE ON THE MECHANICS OF MACHINERY. With Special Reference to the Mechanics of the Steam Engine. By Joseph N. LeConte. New York: The Macmillan Company. London: Macmillan & Co., Ltd. 1902. 8vo. Pp. x, 311. Price $2.25.

The author tells us that this book is the outcome of a course of lectures on kinematics and the mechanics of the steam engine. The first two parts embody the more important principles of what is generally called the kinematics of machinery, though in many instances dynamic problems which present themselves are dealt with, the real purpose of the book being the application of the principles of mechanics to certain problems connected with machinery. The third part treats of the mechanics of the steam engine, since that machine is perhaps the most important from the designers' point of view.

REAL THINGS IN NATURE. A Reading Book of Science for American Boys and Girls. By Edward S. Holden, Sc.D., LL.D. New York: The Macmillan Company. London: Macmillan & Co., Ltd. 1903. 16mo. Pp. xii, 443.

This is a children's book intended to be as useful and interesting as it can be. It explains in an easily grasped way something of scientific things, which every boy and every girl sees. The field covered is wide. The author has divided his work into nine books. The first deals with Astronomy; the second with Physics; the third with Meteorology; the fourth with Chemistry; the fifth with Geology; the sixth with Zoology; the seventh with Botany; the eighth with the Human Body; and the ninth with the Early History of Mankind. The boy who reads this book or studies it from beginning to end ought to know more than many of his elders.

CHAMBERS'S CYCLOPEDIA OF ENGLISH LITERATURE. New Edition by David Patrick, LL.D. A History, Critical and Biographical, of the Authors in the English Tongue from the Earliest Times Until the Present Day. With Specimens of Their Writings. Vol. I. London, Edinburgh, and Philadelphia: J. B. Lippincott Company. 1900. Pp. 832.

Most of our readers are probably familiar with the old Cyclopedia of English Literature edited by Dr. Chambers. The work was the first of its kind published in England, giving as it did a conspectus of English literature by a series of extracts from the more memorable authors, set in a biographical and critical history of literature itself. In this new edition, which may well be regarded as an entirely new enterprise in itself, the essential plan of the original cyclopedia has been adhered to, but considerably developed. Old English literature, formerly discussed in three pages, now occupies more than ten times the space; middle English has no longer some twenty pages allotted to it, but ninety. In the first volume alone, over fifty authors not named or hardly named in the older issues, are treated and illustrated by selections from their works. One of the characteristically modern features of the new Cyclopedia is to be found in the work of specialists. Dr. Stopford Brooke, Andrew Lang, Sidney Lee, George Saintsbury, and Edmund Gosse are a few of the more prominent critics who have contributed special articles on men with whose writings they are intimately acquainted. The historical surveys prefixed to the several sections were unknown to the old Cyclopedia, and constitute a most valuable addition to the new book. The same holds good of a large number of critical and biographical articles. Summing up this new enterprise as a whole, it may be said that the aim has been to carry out Dr. Chambers's plan more perfectly than he was himself able to, and to produce a cyclopedia more fully representative of our present and past literary history at the commencement of the twentieth century.

AMERICAN ELECTRIC AND AUTOMOBILE PATENTS MONTHLY. Compiled by James T. Allen, Examiner United States Patent Office. Washington, D. C.: American Patents Publishing Company. Price $5 per annum.

Mr. Allen has undertaken the task of preparing a compilation of the patents included in over four hundred sub-divisions of the Patent Office classes. The publication contains digested patents covering the subjects of electro chemistry, electric lighting, electric railways, electric signaling, electric conductors.

N. W. AYER & SONS' AMERICAN NEWSPAPER ANNUAL. 1903.

The Ayer Annual comes to us this year, portly and complete as ever. It contains a carefully prepared list of papers and periodicals published in the United States, Territories, and Dominion of Canada, with valuable information regarding their circulation, issue, date of establishment, political or other distinctive features, names of editors and publishers, and street addresses in cities of fifty thousand inhabitants and upward, together with the population of the counties and places in which the papers are published, according to the United States Census of 1900. In this new volume will be found a most valuable list of newspapers and periodicals published in Hawaii, Porto Rico, Cuba, and the West Indian Islands, which list, we are assured, is compiled from the latest obtainable information. A description of every place in the United States and Canada is given in which a newspaper is published, and likewise some brief account of railroad, telegraph, express, and banking facilities. Colored railroad maps to the number of fifty-eight indicate the location and number of railroads of the United States and its possessions, Canada, and the West Indies. The vote of states and counties at the Presidential election of 1900 likewise finds a place in the volume. In the latter portion of the book will be found a list of the newspapers of the United States and Canada arranged by counties, with a description of each state, territory, province and county, giving the location, character of surface and soil, chief products and manufactures. Separate lists of railroads and agricultural publications will prove of help to the manufacturer.

ANNUAL REPORTS OF THE WAR DEPARTMENT FOR THE FISCAL YEAR ENDED JUNE 30, 1902. Supplement to the Report of the Chief of Engineers. Reports of the Mississippi River Commission and Missouri River Commission. Washington: Government Printing Office. 1902. Pp. 215.

DIVINE SCIENCE AND HEALING. By Malinda E. Cramer. A Text Book for the Study of Divine Science, Its Application in Healing, and for the Well-being of Each Individual. San Francisco. 1902. Pp. 293.