at about 40 to 50 mile rate over an average good track, and up-and-down motion if there is any. A. We have no data in regard to the amount of rocking of the cab top. 3. What is the specified side clearance of tracks of our present steam railroads, and also top clearance? A. The clearance between rail and wheel flange is from ¼ to ⅝ of an inch, increased by wear to a ½ inch or more. 4. I would like to know the name of the best railroad block signal system in existence in the United States at present, and about the cost of construction per mile and maintenance. A. We cannot designate the best block signal system in use. Both pneumatic and electric systems are in use by different railroads.

(9268) E. F. S. asks: Kindly inform me how to figure wave lengths of different tones, and where I can find a list of lengths of sound waves, and number of vibrators necessary to produce different tones. A. The wave length of a tone is found by dividing the velocity of sound by the number of vibrations required to procure that tone. The number of vibrations for an octave is usually given in any textbook of physics. They are relatively, taking the fundamental as 1, or unity, 1, 9-8, 5-4, 4-3, 3-2, 5-3, 15-8, 2. Each octave requires double the number of vibrations of the next above it. The standard for "international pitch" has 435 vibrations for A, the sixth of the middle octave of the piano. Taking 3-5 of this number of vibrations, we have for C, as fundamental, 258.6 vibrations. From this the series of tones in the untempered scale can be calculated by the ratios given above. For the scale of equal temperament, which is used in pianos, organs, etc., use 258.6 for C as fundamental, and use as a multiplier 1.05946, to obtain the number of vibrations in the tones of the chromatic scale, with sharps and flats. The results are for the middle octave with A in second space treble clef:

C	258.6	G	387.5	
C♯	274.0	G♯	410.6	
D	290.3	A	435.	Standard
D♯	307.5	A♯	460.9	
E	325.8	B	488.3	
F	345.2	C	517.3	
F♯	365.8			

If now 1120 be taken as the velocity of sound in a warm room, you can by dividing find the wave length for all tones. These are not of practical consequence, since we tune pipes and strings to tones, and not to wave lengths. The diameter of a pipe affects the length required to produce a tone, and wave length alone is not enough for tuning a pipe. The whole matter is exhaustively treated in Helmholtz's "Sensations of Tone," which we can supply for $9.50.

NEW BOOKS, ETC.

INDUSTRIAL USES OF WATER. By H. De la Coux. Translated from the French and revised by Arthur Morris. London: Scott, Greenwood & Co. New York: D. Van Nostrand Company. 1903. 8vo. Pp. 354. Price $4.50 net.

The chemical action of water in nature and the phenomena of hydrochemical activity observed in a large number of industrial operations are so closely related that their study will help to determine the cause of difficulties with water, and assist at the same time in discovering the necessary remedies. If water were actually what its chemical formula represents it to be, simply a compound of hydrogen and oxygen, the difficulties and troubles which arise when it is put to industrial uses would not be possible. The present volume is an exhaustive treatise on water and its uses in the arts. The question of the solubility of salts, feed water for boilers, water in dye works, print works, and bleach works, water in soap works, laundries, canning, paper making, photography, artificial ice, beverages, distilling, are all adequately considered. Special attention is also given to the filtration, distillation, and sterilization of water. It is an admirable treatise, which will be warmly welcomed by the chemist and technologist.

TUBE, TRAIN, TRAM AND CAR; OR, UP-TO-DATE LOCOMOTION. By Arthur H. Beavens. With an Introduction by Llewellyn Preece, M.I.E.E. London: George Routledge & Sons, Ltd. 1903. 12mo. Pp. 291. Price $2.50.

Mr. Beavens has presented a popular account of electric locomotion, in which he has discussed not only subways and tunnels, and their relation to urban transportation, but also the tram car and the motor car. This is not a book which the mechanical engineer is likely to read with any profit; but which the man in the street, who wishes to know something of the great civil engineering feats by which it is possible to transport masses of people safely from place to place, will read with profit. The work commends itself to those who want an untechnical book.

THE MOTH BOOK. A Popular Guide to a Knowledge of the Moth of North America. By W. J. Holland, D.D., Ph.D., Sc.D., LL.D. New York: Doubleday, Page & Co. 1903. 8vo. Pp. 479. Price $4.

There are 48 plates in color photography containing 1,500 figures, and there are 300 text cuts illustrating a majority of the large species of the moths of North America.

The author will be best remembered when his butterfly book is cited. This work practically revolutionized the study of insects, and added greatly to the popularity of the science. The moths of North America are remarkably beautiful, and far exceed butterflies in interest, from the standpoint of form and color. Such subjects as the method of collecting specimens, the history of silk culture, the economic importance of insect life, are fully treated.

LIQUID FUEL AND ITS COMBUSTION. By William H. Booth. New York: E. P. Dutton & Co. 1903. Quarto. Pp. 411. Price $8 net.

The subject of liquid fuel has been agitated by engineers for the last twenty-five years. The author has endeavored to put together what has been done in the burning of liquid fuel since its first introduction. The discovery of Texas oil has put an entirely new aspect upon the whole question of liquid fuel. The work is one which will greatly interest all mechanical engineers and those who are concerned with steam raising.

KNOWLEDGE DIARY AND SCIENTIFIC HAND BOOK FOR 1904. London: Knowledge Office, 326 High Holborn. 1903. 8vo. Price $1.

The Diary comes to us this year with the usual number of good descriptive articles. Among these may be mentioned those on the "Camera Applied to Science in Natural History," "Practical Meteorology," "Physics," "Practical Work with a Small Telescope," "Full and Complete Astronomical Summary and Account of Terrestrial Phenomena for the Year," "Some Uses of the Microscope and Variable Stars."

HARPER'S COOKBOOK ENCYCLOPEDIA. Arranged like a dictionary and compiled under the direction of the Editor of Harper's Bazar. With Contributions by Famous Authorities on Cooking. New York: Harper & Bros. 1903. 12mo. Pp. 443. Price $1.50.

For the purpose of enabling the housekeeper to find at once exactly what she wants, the recipes of this book have been alphabetically arranged. An elaborate system of cross references facilitates the looking up of any recipe. The arrangement not only gives direct reference to particular subjects, but by grouping together recipes on the same subject, suggests new possibilities. A few practical hints regarding some of the simple principles of cooking, recipes for the chafing dish, cooking for invalids, kitchen time tables, tables of weights and measures, proportions, cooking utensils, etc., will be found of help.

THE ENGINEER IN SOUTH AFRICA. By Stafford Ransome, M.I.C.E. New York: E. P. Dutton & Co. 1903. 12mo. Pp. 319. Price $2.50.

Mr. Ransome has written a review of the industry of South Africa, and has given some idea of the region's present engineering position, and has endeavored to present a proper conception of its future possibilities. The study here presented is the result of a ten months' visit to the British possessions south of the Zambesi River, a visit made at the request of the London Engineer for the purpose of giving to British readers a frank and full account of the various problems that have been evolved by recent events. In Mr. Ransome's opinion the war has had the effect of clearing the political atmosphere of South Africa, except in Cape Colony. But here the growing strength of the industrial centers is slowly but surely effecting a change for the better. The industrial prospects of South Africa, he believes, are brilliant, but they must be developed slowly, because the country must have time to recover from the effects of a long and devastating war. On the whole, it must be confessed that Mr. Ransome has done his work with thoroughness and impartiality.

PRINCIPLES AND PROBLEMS OF IMPERIAL DEFENCE. By Lieut.-Col. Edward S. May, C.M.G., R.A. London: Swan Sonnenschein & Co., Ltd. New York: E. P. Dutton & Co. 1903. 12mo. Pp. 332. Price $3.

This book has been written from a standpoint that is only too often lost sight of, the standpoint of the business man. Poets and generals, artists and admirals, have pretty well succeeded in diverting the popular attention from the prosaic side of war, and have done all they could to heighten what may be termed the chivalrous side. Lieut.-Col. May points out that the conduct of a war is essentially a business transaction. The health and lives of his men represent the capital of the general. Apathy in peace and panic in war are dangers that have to be avoided. To legislate in order to make the most of what we have, to employ it so that it may be productive and remunerative in the future, should be our aim, so that war can be conducted without a panic. Politics and strategy should go hand in hand. Co-operation of the services, too, is a most important feature in imperial defense—co-operation above all in the council chamber. For the earnestness of its tone and the fairness with which its information is presented, Lieut.-Col. May's book deserves to be commended.

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