curve at a high speed cannot under any supposable conditions fall over in the inner side of the track. The elevation of the outer rail is made such as to overcome the tendency to overturn to the outward side of the track, and the train goes round the curve as if on a level, when it moves at the speed for which the elevation of the outer rail was calculated. If the velocity of the train very much exceeds the velocity for which the outer rail has been elevated, the train would leave the track on the outer side of the curve. The tracks for bicycle racing are made very steep at the turns in order to enable riders to go round the turns at full speed, and when rounding a turn the rider feels in equilibrium while leaning far in toward the center. To him he is as if riding on a level. The centrifugal force is neutralized by the elevation of the track or rail.

(10575) A. H. S. asks: How much more sunshine is there at the equator than at the north pole during the year? Where are the longest days—at the equator or the North Pole? We have a great argument over this question. A school teacher and others contend that the sun shone longer at the North Pole than at the equator, and I thought it absurd, so we decided to leave it to your good judgment. A. At the equator the sun rises and sets at six the entire year. All days are twelve hours long, and all nights of the same length. Disregarding the effects of refraction and cloudy weather, the sun is above the horizon at any place on the equator and shines just half of the year. This half-year of sunshine is divided into equal parts of twelve hours each. At either pole the sun is above the horizon for six months and below it for six months of the year. There is but one day of six months' duration and one night of the same length in a year. You will see from this that there is the same duration of sunshine at the poles as at the equator. The same is true for any place on the earth. Add the length of sunshine for all the days in a year in our latitude, and the sun will be just a half year. The longest day is at the pole, and it is six months long.

(10576) G. T. asks: How to remove gases of combustion and decomposition from a small room. Passing the air through a liquid would not be objectionable. A. To purify air, remove the solid particles by passing the air through cotton; the moisture and ammonia and germs, by passing through sulphuric acid; the sulphur, by passing through a solution of lead acetate. Pass now through calcium chloride or soda lime to remove last traces of moisture, etc. Only pure oxygen, nitrogen, and argon remain.

(10577) F. C. F. asks: 1. What is the best method to produce lantern slides in which the high lights will be clear glass and the shadows dense enough for the lime light? I print by contact, and have used for developing hydroquinone, metol-hydroquinone, and pyro, and an acid fixing bath, yet there always is a slight veil over the high lights. A. The only mode in which lantern slides can be produced with no development in the sky and high lights is to have a negative which is opaque in the high lights. 2. Can you give a simple method by which an amateur could color lantern slide transparencies? A. To color slides requires artistic sense and knowledge of the mixing and applying of color. We think that is all that is required. Much assistance can be had from the chapter on coloring slides in Hopkins's "Experimental Science." This book also gives instructions for making slides as well as cameras, and an exhaustless amount of scientific experimenting. 3. Why is it that water when flowing through a funnel or into a small outlet always whirls, producing a depression or an opening over the outlet? Why is the whirling always counter-clockwise? A. There is probably something in the shape of the outlet of a funnel or wash basin which determines the course of the liquid as it runs out. A loss of equilibrium is soon seen, and the water whirls. Centrifugal force is produced, caused by the opening into the pipe below. We would try to explain why the whirling is always counter-clockwise if it were so. We have just tried a wash basin, and found the motion always clockwise when left to itself. By a motion of the hand it could be made in either direction. Probably some inequality in the orifice determines the matter.

(10578) A. B. S. writes: As a long reader and subscriber of your publications, I desire to ask if there is any secret in the preparation of fluoroscopic screens for X-radiance, or if the high price is due to the high-priced material — platino-barium-cyanide (or tungstate of calcium). Where can they be procured? A. There is no secret in making a fluorescent screen for X-ray work. Skill only is required to distribute the crystals with perfect evenness and to attach them to the cardboard by the adhesive employed. The crystals must also be of uniform size, sifted through a sieve of rather a fine mesh. We should buy rather than try to make one. The cost is in the material used. It is advised that barium-platino-cyanide only will be satisfactory, since tungstate of calcium is fluorescent for quite a time after it is excited. It is cheaper but poorer, and is little used now.

(10579) J. B. S. says: I want to excavate earth and move the same to make a fill of about 60,000 cubic yards. If you know of any machinery that will do this, I would be pleased to hear from you. I do not want to go to the expense of a steam locomotive excavator. A. The only suggestions that we have to offer you for excavating earth are a steam shovel or to use hydraulic means in case there is a sufficient supply of water in the vicinity.

(10580) T. C. G. says: Can you give me reliable rules for finding the sets of elliptical and spiral car springs? Also the length a bar should be to make a spiral car spring of a given free height? Do you know where I could buy a book dealing with car springs? A. The question of calculating elliptical and spiral car springs to give definite results is an exceedingly complicated one, and one that requires considerable experience as well as theoretical knowledge. You will find quite a complete discussion of the theoretical side of this subject in the last edition of Lanza's "Applied Mechanics," with which we can supply you for $7.50 by mail.

(10581) A. E. K. says: The owners of one of the mills in this vicinity are having a great deal of trouble with foaming of the water in the boilers, and have made a trial of very nearly everything that has been suggested to remedy this. A sample of the water was sent to the University of Minnesota for analysis, and I inclose copy of a letter received in reply. If you can suggest anything that would be of service the favor will be greatly appreciated. A. We doubt if it will be possible for you to avoid trouble from foaming with water containing as much organic matter as the analysis which you inclose shows. If it is possible, we would advise another source of supply, even though the expense of procuring it is considerable. If this is impossible, the only practical suggestions which we have to offer are: 1. Blow off your boiler very frequently and very generously, so as to prevent the impurities becoming concentrated. 2. Do not force your boiler, but if necessary, increase your boiler capacity so as to be able to generate the steam that you require at a low rate of evaporation. 3. In case you have a sufficient supply of water, we would strongly advise you to introduce surface condensers, only adding enough impure water to your boilers to make good the leakages. 4. In case there is not sufficient water supply to enable you to use surface condensers in the ordinary method, we would advise your building a shallow evaporation tank to cool the condensing water, so that you may use the same condensing water over and over again in your condensers. This will require only enough water to make good the evaporation. Either of the suggestions contained in No. 3 or No. 4 will give a satisfactory solution of your problem, but we doubt if anything else will.

(10582) M. F. F. asks: 1. State what effect oil or greases in a boiler may have upon the boiler itself. A. In answer to your first inquiry, we would say that greases in a boiler are almost always injurious, as they cause foaming and are apt to decompose, forming acids which affect the plates of the boiler injuriously. A small amount of pure mineral oil like kerosene will sometimes tend to loosen a scale which is troublesome and prove beneficial, but grease should not be used for this purpose. 2. Where low-pressure engines are used, state what vacuum is maintained? A. We infer that your questions regarding low-pressure engines refer to marine practice. The vacuum maintained here varies with the design of the engines and the condensers from 24 to 25 inches of mercury to 27 or 28 inches. 3. What is meant by this amount of vacuum? A. The amount of vacuum is usually expressed in inches of mercury. If the vacuum were perfect, it would be equal to the full atmospheric pressure, which varies with the weather, but on an average is equal to 29.9 inches of mercury, or 14.7 pounds per square inch. A condensing engine can never have a perfect vacuum because it cannot cool the exhaust steam far enough. The lower the temperature to which it does bring the exhaust steam, the more perfect will be the vacuum.

(10583) T. N. K. says: Will you kindly give me horse-power of a fore-and-aft compound engine 8 and 17 x 12, 200 pounds boiler pressure, 300 revolutions per minute, 25 inches vacuum? A. You do not give sufficient information in your letter to make it possible for us to exactly calcuate the horse-power of 8 and 17 x 12 tandem compound engine which you mention. The power varies with the point of cut-off in the two cylinders, the amount of compression and the throttling of the steam during the admission and exhaust. If the engine is well designed, however, the power does not probably vary very much from 250 horse-power when running at 300 revolutions per minute with a boiler pressure of 200 pounds and 25 inches vacuum. We would require indicator cards from both cylinders to give information necessary to figure exact horse-power.

(10584) F. A. T. asks: Is there any gain in power by using an Archimedes screw beyond the power required to work an ordinary pump? A. There is no gain in power by using an Archimedes screw over the power required for an ordinary pump. Its efficiency is so low that it is not used in practice, and we therefore cannot tell you where you can see one. The principle of its action is just the same as that of the screw conveyors used for feeding coal into furnaces, to convey grain, etc.

NEW BOOKS, ETC.

LE CARBONE ET SON INDUSTRIE. By Jean Escard. Paris: H. Dunod et E. Pinat, 1906. Paper; 751 pages; 129 illustrations. Price, $7.50.

M. Jean Escard in his new work has taken for his end as complete and wide a description as possible of the recent applications of the different forms of carbon, putting stress on those which have a particular interest or an especial industrial application. After a general dissertation on the properties of carbon so as to familiarize the reader with the modifications which will be presented to him later, and also to avoid repetitions in the following chapters, the author commences with a study of the diamond and its applications. Graphite, which is worthy of next being discussed, is dealt with at length. The author does not fear to lay great weight on the physical and chemical characteristics of a number of the many varieties of this substance, and to describe with care the principal localities in which this mineral is found. In the next chapter, the reader can gain some idea of the interest that is shown in investigating the properties of amorphous carbon, each variety having special applications of its own. The last two chapters, given over to bituminous coal, are particularly alluring. The author gives not only a view of this mineral and of its properties, but a description of the localities in which it is found in France as well as in Europe and in the other parts of the world, and he has endeavored to interest the reader by adding some new considerations on the exhaustion of coal mines, and on the fuels of the future. M. Escard in many places evolves his own hypotheses on the formation of certain forms of carbon parallel to those which other authors have already set forth. The many researches that he has carried on in the mines, as well as his particular studies of locations, will give to the reader confidence in his assertions. It is certain that this work, the first that has appeared on the question of the industrial uses of carbon, will receive a great welcome in the industrial world.

LES FORCES HYDRAULIQUES ET LES APPLICATIONS ELECTRIQUES AU PÉROU. Par Em. Guarini, Professeur à l'Ecole d'Arts et Métiers de Lima. Paris: H. Dunod et E. Pinat. 8vo., 24 pages, 12 illustrations. Price, $3.

M. Em. Guarini, in this pamphlet, tells of his journey in the south of Peru, to Mollendo, Tambo, Arequipa, and Lake Titicaca. He gives special consideration to the hydraulic possibilities of this region, and to their utilization as sources of electricity. Numerous drawings, and examples of application with calculations allow one to gain an idea of the great resources of Peru, and of the means of utilizing them economically. The possibility of making use of Lake Titicaca is the most important part of this interesting work.

TECHNISCHE ANWENDUNGEN DER PHYSIKALISCHEN CHEMIE. By Dr. Kurt Arndt. Berlin: Mayer & Müller, 1907. 12mo. pp. 304.

The author has written this book primarily to meet the requirements of engineers, proprietors of industrial works, teachers, and students. The explanations are clear and do not demand much preliminary knowledge. The author has relied more upon a system of concrete reasoning than upon theoretical abstract discussions to drive his truths home. The chapters include excellent summaries of the Fixation of Atmospheric Nitrogen; Gas Making; Contact Process of the Manufacture of Sulphuric Acid; Production of Ammonia and Ozone; Reaction Accelerators; Vaporization and Condensation; Solutions of Alloys; Colloid Solutions; Dissociation Pressures; and Measurements of High Temperatures.

DIE BETRIEBSSICHERHEIT DER EISENBAHNEN. Sonderabdruck aus dem "Archiv fuer Eisenbahnwesen." Von C. Guillery, königlicher Baurat. Verlag von Julius Springer in Berlin N. pp. 645-659.

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