in operation, and arranged to prevent leakage, as the valve proper is held to its seat by the pressure-supply and opens against the latter when manually actuated.

Designs.

DESIGN FOR A WHISK-BROOM HOLDER.—M. A. SKALL, New York, N. Y. In the present case the ornamental design relates to a whisk-broom holder. The upper part of the holder comprises three hinged mirrors. The lower part consists of an ornamental tapering broom holder.

DESIGN FOR COFFEE-POT OR SIMILAR ARTICLE.—E. PIEPENBRING, Washington, D. C. This design is for a coffee-pot or the like of symmetrical form elongated vertically and narrowing toward its upper and lower ends, the spout and the handle being correspondingly elongated and the spout uniting with the body near the lower end thereof and extending upward alongside of and conforming to the curvature of the body to a point near the upper end of the spout where the latter is curved outwardly.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(9110) T. W. A. asks: 1. A railroad train going at a rate of over 60 miles per hour rounds a sharp curve. Will the train if it should leave the track be likely to fall outward, or does the raising of the outside rail overcome this tendency and make it likely to fall inward? Grant the following: If the track were level, the train would fall outward, now if the outside rail is raised, will it fall inward? A. A railway train rounding a sharp 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. 2. What nationality was the captain of the "Columbia" in the last cup races? A. Capt. Barr commanded the "Columbia" in the cup races. He was born in England.

(9111) 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.

(9112) E. R. says: Would you please oblige me by answering a few questions concerning the motor given in SUPPLEMENT No. 1210, under the heading "How to Make a Sewing Machine Motor Without Castings," by Cecil Poole, for about $5, with the labor? The wire alone cost me $6.66—3 pounds of No. 21 wire on each field coil, 27 layers deep, and 66 turns wide. Why must the field have so many ampere turns? Would this motor work as a generator with an adjustable rocker arm? Would it light nearly two 110-volt lamps? A. If you build the motor according to the last paragraph of the description on page 19394 of SUPPLEMENT No. 1210, for ¼ horse power, and connect it in shunt, you will probably be able to light two 16-candle 110-volt lamps with it as a dynamo. As to the figure of cost given by Mr. Poole ($5), while this was true in 1899, it can hardly be expected to remain true indefinitely. Prices of material are very much higher now than they were then.

(9113) 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.

(9114) 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' "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, causing 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.

(9115) A. M. says: 1. In answer to query 8996 in the issue for May 9, you clearly explain the working of a radiometer. Please tell me why it will not work as well in open air as in a vacuum. A. The radiometer only works at a particular degree of vacuum. Too little gas in the tube, and there is not enough energy to the radiation to rotate the disks; too much gas, and there is too much resistance to the motion for the feeble energy of radiation to start the disk. 2. Why will a single-phase alternating electric current not start a direct-current motor, if the relative polarity of field and armature be the same, whatever be the current phase? A. An alternating current will only run a direct-current motor when the alternations exactly coincide with the change of the brushes from one segment of the commutator to the next. This is the case when the speed of the armature is in step with the alternations. For this reason the motor must first be brought up to speed by some outside motor and the current then switched on. 3. Will the precession of the equinoxes put the seasons, after a time, in different months, for example, summer in October or November? A. The calendar is adjusted so that the year will always correspond with the season. Winter will be as now and summer in the same months as now forever.

(9116) O. D. says: Kindly inform me whether or not there is a substance which will resist the lines of force of an electric magnet, I mean to resist them, not screen them as iron will. A. There is no known material which will present resistance to the passage of magnetic force. It must be apparent that a force which has passed through the earth and the air will not be retarded any more by passing through materials the same as it has already passed through. The screening action of iron upon lines of magnetic lines of force is perhaps not understood. It screens a space from magnetic force because iron furnishes an easier path for the magnetic lines than any other material. Hence the magnetic lines leave that space and pass through the iron. Iron presents less resistance to the passage of magnetism than any other known material.

(9117) C. K. B. N. writes: Can you tell me where I can get a complete report of the findings or extracts from the report of the delegation which came to this country several years ago from Russia, and which made a tour of investigation of our scientific schools? A. If you write to the United States Commissioner of Education, Washington, D. C.; we think that he will be able to tell where you could obtain the report you desire.

(9118) J. B. M. asks: Can a single wire carry a current to produce electric light, run a sewing machine, operate telegraph instruments, and a telephone service, all to be in use at the same time, and with perfect safety to the operator? A. We suppose the same current can be used for all the purposes you name and for all others at the same time. It is done all the time. It is only necessary to have the various motors and instruments wound for the voltage of the current. We cannot guarantee *perfect safety*, however. Electric service is safe if ordinary caution is exercised in its use at all points.

(9119) A. F. S. says: I am building a Ruhmkorff induction coil to give a 6-inch spark and write for some advice, for which I would be very grateful. I propose to make the coil in eight sections insulated from each other with hard rubber disks and paraffine. The size of wire to be used in the secondary is No. 36 B. & S. Now what I desire to know is this: Can a coil of this size be made to operate successfully by using single cotton-covered wire instead of silk, having the coils boiled in paraffine? I think that cotton would do well enough, especially if it is soaked in paraffine. And other precautions taken to thoroughly insulate the windings. I made a small coil, using cotton-covered wire in the secondary when silk was advised, and the coil worked well, so I am thinking that cotton-covered wire would work successfully with a large coil if built in a number of sections. If you know of coils being built by using cotton-covered wire, would like to know of it, as it would give me some confidence in cotton. A. We do not advise the use of cotton-covered wire in a coil built to give a spark as long as 6 inches. The reason for using silk is not that silk is a better insulator. No porous insulation is any better, of course, than the same thickness of air. Silk is used because it does not occupy as much room as cotton and more turns can be put into the same space. It is most important to bring the turns as near the primary as possible where the induction is strongest. With silk insulation this is best secured. We do not doubt that a coil can be constructed from cotton-covered wire to give a long spark. More wire per inch will be required if cotton-covered wire is used.

(9120) 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.

(9121) 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.

(9122) F. H. says: In Notes and Queries of June 13, 1903, No. 9056, C. B. C. asks: "What would happen if a direct-current motor were connected with an alternating current dynamo?" You answer: "If the alternating current were sent through a direct-current motor at rest, it would be heated and burn out." The theory here may be all right, but in practice it does not work. I had a No. 2 Porter motor, and a 110-volt direct-current dynamo, which I ran with a 110-volt alternating current. The dynamo would run as a motor with the full current, but the Porter motor required to have some assistance put in the circuit, or else it would burn out the one ampere fuse which I used. Both motors would start from a standstill, but the armature of the dynamo had to be placed in a certain position, or else it would stick and emit a buzzing sound. What was the cause of the noise? It seems to me that as you can reverse a direct current, and have the motor go, just the same, an alternating current which simply reverses back and forth, continually, would run the motor just as well as the direct current. A. The dynamo which you say will stand an alternating current of 110 volts is probably series-wound, and so has the benefit of the entire resistance of its coils to act by their self-induction in cutting down the current. If you would turn the current upon a large shunt-wound motor, we think you would see the fire fly or the fuses blow. Your dynamo did not start from rest in a proper sense. You say you had to set the armature to make it start. The usual way to run a direct-current motor on an alternating current is to have the armature turning rapidly when the current is thrown on. The "sticking" of which you speak is the refusal to turn. There is no sticking in the ordinary sense. The buzzing sound you hear is the note produced by the alternations of the current in the wire of the dynamo. It can always be heard in an arc lamp and coils generally when an alternating current is passing through them. Your reasoning about reversing a direct current and still having a motor go, and applying this to an alternating current, is not correct. When a direct current is reversed in a motor, both the field and armature has the current reversed in them, and the resulting polarity is the same. Two reversals leave the current the same as before. This is of course not the case with an alternating current.

(9123) 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.

(9124) 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.

(9125) 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.

(9126) 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 calculate 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.

(9127) G. G. L. says. Will you kindly answer the following? I refer to two-cycle gasoline engines. 1. What are considered the best relative positions of exhaust and inlet ports. Should the exhaust be full open before the inlet is uncovered, or should it open some time before? What is the cause of back firing? Is it due to slow burning of the mixture or bad position of ports? A. Theoretically, the exhaust valve should fully close and the inlet valve should open wide at the same instant—when the piston is at the end of its travel. In practice these conditions are fulfilled as nearly as possible. The exhaust valve should close just as early as is possible without compressing the burnt gases in the cylinder, and the inlet valve should open just as soon as the exhaust valve is closed. If the action of the inlet valve is slow, it may sometimes be set to open just a trifle before the exhaust is fully closed. Back firing is usually caused by the failure to explode the gases in the cylinder and their burning after they are exhausted. 2. What is the best ratio for compression space and how far can compression be carried without danger of premature explosions? A. A common proportion for the clearance or compression of a gas engine is 33 per cent of the cylinder volume or piston displacement. The best proportion varies somewhat, however, with the size, make and speed of the engine. Compression could be carried much beyond the point reached with the above proportions without fear of its causing premature explosion. 3. What is the rule for computing compression? Suppose we have a cylinder with 6 inches piston travel, and it is pushed up 3 and 4 inches respectively. What would be the pressures? A. A very approximate rule for computing roughly the compression is: "The absolute pressure is increased in the same proportion that the volume is decreased." This would be exactly true if the temperature of the gases remained constant during the compression. As the gases are heated, the pressure is somewhat higher than this rule indicates. Example: Suppose a cylinder with 6 inches piston travel and 33 per cent clearance. Total volume = 8 inches × piston area. If piston is moved up 3 inches, volume = 5 inches × piston area. Absolute pressure before compression = 15 pounds. Pressure after compression = 15 × 8-5 = 24 pounds absolute = 9 pounds above the atmosphere. In the same way, if the piston moved 4 inches the pressure would be 15 × 8-4 = 30 pounds absolute, or 15 pounds above the atmosphere. The exact formula is:

$$p_0 V_0^{1\cdot405} = p V^{1\cdot406}$$

where p_0 and V_0 are the pressure and volume before expansion and p and V are the pressure and volume after expansion. 4. What is the best proportion of bore to length? Is there any objection, other than the cost of manufacture, to have the stroke say 50 per cent more than the bore? A. There is no rule governing the ratio of cylinder diameter to stroke except the consideration of cost and convenience in manufacture and convenience in cooling the cylinder with water jackets. For small engines a common proportion is to have the diameter equal the stroke, but for larger engines the stroke is usually greater.

(9128) W. B. M. says: Will you kindly answer the following inquiry? Is the weight of water in a boiler "under steam pressure," additional pressure on bottom of boiler? Is the result the same when the water is above boiling heat, and when it is not? What makes a good belt dressing? A. The weight of water in a boiler under steam pressure *is* additional pressure on the bottom of the boiler, and the result is just the same when the water is above the boiling heat. Heating water does not change its weight. One-half neatsfoot and one-half castor oil makes a good belt dressing.

(9129) E. C. T. says: I want to perform before our Sunday school an experiment to illustrate the effect of sin upon a life, and then the redeeming power. I know of such an experiment having been performed, and would like to know just what solutions to use. I prefer to start with a clear solution, and then by adding another preferably clear solution to get a bright and attractive color, then by adding more of the same or another solution to gradually darken it until it becomes black, then I want to add something that will bring it back to its original clearness. If you can suggest the solutions you will confer a great favor upon me. A. There are many ways of obtaining a dark precipitate from two colorless solutions, but none of these are easily or quickly cleared to a colorless state again. They do not answer your purpose as an illustration of sin and forgiveness. But why use a dark or black color at all? Scarlet or crimson are the colors given in Scripture (Isaiah i: 18). These can be produced and cleared off very easily. Make a strong alcoholic solution of phenolphthalein, and a strong solution of sodic hydrate in water. Add the first solution to the second slowly with shaking. At first as bright and delicate a rosy color as you may wish can be obtained. As the strength increases, the color deepens to any degree of darkness, deep enough for the verse referred to. Then add hydrochloric acid, and the red will immediately disappear. This would seem to meet your wishes. We give you also a process by which you can obtain a dark brown muddy deposit and dissolve it quickly. Take the phenolphthalein and sodium hydrate solutions as above, but more dilute, and proceed as above; then add to the bright red solution a few drops of solution of iron chloride, more or less to produce a thick muddy brown mixture. A solid is precipitated from the solution. It is hydrate of iron. To clear this away, add hydrochloric acid. This leaves a yellow liquid which, in a dim light, will look almost white or clear. Some practice may be needed to obtain the desired strength of solution, but when the solutions are right, the effect is surprising to those inexperienced in chemical manipulation.

(9130) F. R. M. asks: 1. What is the green deposit that comes on the binding post of the carbon of a LeClanche cell, and also of a Bunsen cell? A. The green substance formed on the binding posts of LeClanche cells is principally chloride of copper from the copper which the brass contains. In a Bunsen cell it might be nitrate of copper. 2. How are LeClanche and Joule commonly pronounced? A. The custom in America is to pronounce LeClanche as an English word of two syllables, as if spelled Ler-clanch, *a* having the sound *ah*. The second syllable is like the word *avalanche*. The correct French pronounciation is in three syllables, the first two pronounced as above, and the third like *shay*. The accent is on the last syllable. Joule is an English name, pronounced Jool. The *ou* has the sound of *oo* in school. 3. What is the pronunciation of Prof. Curie's name, he of radium fame? A. The credit of the discovery of radium is due to Mme. Curie, and not to her husband. The name is pronounced Cu-ry. *Cu* has the sound of *ku*. 4. What causes the great heat that is developed in a water rheostat? The one I have experimented with has lead plates and dilute H_2SO_4. A. The energy of the current is dissipated in heat in a rheostat, and the heat increases as the second power of the current. Twice the current gives four times the heat. 5. Why does the resistance fall off so rapidly as it heats? Is it due entirely to the rise in temperature? A. We have no data for the change of resistance of water by heating. As an electrolyte its resistance is less when hot, and more current would flow, which would in turn produce more heat. You probably have some salt in the water, and it would make the heating greater. 6. With a bi-convex lens is it possible for both object and image to be larger than the lens? If so, how can the diagram be drawn? The customary way is to draw from each extremity of the object one line through the center of the lens and one either through the principal focus or parallel to the principal axis. But this latter line could not be drawn in this case. How then can the extremities of the image be located? A. Certainly, both object and image may be larger than the lens which forms the image, else how could a photograph be made any larger than the opening of the lens? The rule quoted for drawing images is only useful in simple cases. The higher works on optics give general rules which depend upon the index of refraction and which will resolve any case. 7. On what principle does the spark coil used in gas lighting operate? The one in my cellar has no make and break, and yet it gives a continuous spark at the burner. A. There are many forms of gas lighters, and we cannot explain the operation of yours from your brief statement about it.

(9131) C. M. asks: Kindly inform me if I can make a plate electric machine from a sheet of glass 2 feet x 2 feet x ⅛ inch, or if I shall need a heavier piece of glass. A. A Holtz or Wimshurst machine can be made from plates of glass ⅛ inch thick. There is little lateral strain in running them at any usual speed.

(9132) E. S. asks: 1. Will a current from an alternating-current dynamo drive an electric motor, such as fans, sewing machines, etc.? A. An alternating current will drive an alternating current motor either for running a fan or sewing machine or any other machine. The motor must be adapted to the current which is to run it. 2. Is the current as powerful after it has gone through the motor as it was before, or not? A. A current is not as powerful after it has done its work as before. If a motor requires but a part of the voltage of a current, the remaining part can be used after the first has been used; but if all the voltage is taken by the first motor, there is nothing left to run a second. 3. How many small motors, say 1-60 horse power, could be run on one circuit of batteries, say four cells of ordinary dry batteries? A. As many small motors can be run on four dry cells as will use up the voltage of these cells. They will give about 5½ volts if put in series.

(9133) D. N. S. says: 1. I am supplied with electricity for lighting my house, which is supposed to be a current at a pressure of 50 volts. I have incandescent lamps that were purchased for a current of 55 volts. When placed on my circuit of 50 volts they give less light than the regular 50-volt lamps. Do they use a correspondingly smaller amount of electricity? That is, when the electric light company reads my meter, will it register a smaller amount if I use the 55-volt lamps than if I use the 50-volt lamps? A. It is not economical to use a 55-volt lamp upon a 50-volt circuit. It uses proportionally less current, to be sure, but it does not produce a proportional amount of light; it produces less light than a proportional amount. This is due to the fact that the smaller current does not heat the filament to as high a temperature as it should be heated to produce its rated candle power of light. 2. After incandescent lamps have been in use a considerable time, they give less light than when new. Do they use a correspondingly smaller amount of electricity? That is, if the light from an old 16 candle power lamp is about equal to that of a new 8 candle power lamp, will the meter register faster if the old 16 candle power lamps are used than if the 8 candle power are used? A. An old 16 candle power lamp which is giving but 8 candles has passed its "smashing point," and should be broken forthwith. It will use more current than a new 8 candle power lamp. The decrease in the amount of light an incandescent lamp gives is due to these causes: 1, the filament becomes smaller by the driving of the particles of carbon over upon the glass bulb; 2, the inner surface of the bulb becomes black and partially opaque, so that all the light which is produced does not pass through the glass; 3, the filament becomes more able to emit heat, and thus does not become as hot as at first with the same current. These changes in the filament continue till it breaks. 3. The manager of our electric light company says that an incandescent lamp that has been used a considerable time gives less light but uses more current than new lamps, so that it is economy to throw away lamps after they have been in use some little time, even though the light given by them is sufficient for the purpose for which they are used. Is this true? A. The lamp takes less current than when new because its filament is smaller, as is shown in answer to last question. It does not take more current than when new, but it takes more in proportion to the light it gives than when it was new. It is good economy to throw a lamp away when it has become reduced to 80 per cent of its initial candle power. The whole subject is fully discussed in Crocker's "Electric Lighting," Vol. ii., price $3, in the chapter upon Incandescent Lamps.

(9134) G. H. H. asks: 1. Will you please explain how to calculate the drop of a primary battery—a Bunsen for instance? A. The explanation of the calculation of E. M. F. of a primary cell is hardly a topic for Notes and Queries. It is quite too abtruse, and would occupy too much space. We would refer you to the electro-chemistries; Arrhenius, price $3.50, or Jones, price $1.50, are reputable authors. The subject occupies large chapters in each of these works. It is calculated from the osmotic pressure and solution pressure of the substances. You will require a working knowledge of the calculus to read the works in question. 2. Also how to construct a Bunsen primary cell which shall have a drop of 13 per cent in E. M. F. at normal discharge. A. We confess we do not know and cannot find in any of our reference books how a cell can have "a drop of 13 per cent in E. M. F. at normal rate of discharge." So far as we know, every cell has a drop of its entire E. M. F. on connecting its poles by a wire, whether the rate of discharge be normal or not. 3. The internal resistance of a battery is made less by having the plates close together. What determines how close they may safely be put? A. The distance between the plates of a battery may be as small as will allow a circulation of the liquid. The liquid becomes weak in the action of the cell, and if it cannot diffuse and bring other and stronger liquid into contact with the plates, the cell will give out sooner than it should. 4. If you want to construct a given number of primary batteries to give a certain number of ampere hours, will the exact number of ampere hours do, or is it better to increase them by say 20 per cent? In other words, should a battery be completely exhausted in practice? A. An allowance should be made in constructing a battery, so that it will give the desired current during the whole time of service. Otherwise the latter portion of the time the service will be feeble. The principle is the same as a factor of safety in an engineering work, such as a bridge. 5. What is the resistance of r_1 r_2 r_3 in parallel? Is it

$$\frac{1}{\frac{1}{r_1}\ \ \frac{1}{r_2}\ \ \frac{1}{r_3}}$$

A. Your expression for the combined resistance of three resistances in parallel is correct. See Thompson's "Elementary Lessons," price $1.50. 6. What is the normal rate of discharge of a primary battery, and how do you find it? How do you construct a battery to have a given normal rate of discharge with a given external resistance? A. We never saw the phrase "normal rate of discharge of a battery," so far as we can recollect. If you had referred to the book and page where it occurs, we might determine its meaning.

(9135) L. M. H. asks: Will you kindly tell me if there is any way of telling accurately the amount of electricity in a storage battery? I find in my launch that the voltmeter does not fall much until the energy is very much exhausted. A. A storage battery should be recharged when the voltage has run down to 1.8 volts per cell. This you can calculate from the reading of the voltmeter. You can also keep account of the ampere hours which have been taken from the battery and know how many remain. The ampere-meter will enable you to do this. Apart from the instruments, there is no certain mode of telling the condition of the battery.

(9136) H. M. W. says: Will you kindly tell us if a reversing gear as used on a gasoline launch should be capable of reversing the direction of the propeller instantly, when the engine is running at full speed? We are inclined to think the reverse should be applied with a certain amount of time to allow the clutch to engage. The effect of a gear we have, when suddenly reversed, is to stop the engine dead. Some claim that the engine should scarcely feel the reversing of the propeller. A. No reversing gear which is positive in its action should be thrown in suddenly with engine running at full speed. The engine should be stopped or brought nearly to rest before the propeller is reversed. To instantly reverse the propeller at full speed would require an infinite force, and it is not to be wondered at that the attempt to do so should stop the engine. If sufficient time is allowed, the engine will not feel the reversing of the propeller.

(9137) C. S. says: I have a No. 7 Root blower making 100 revolutions per minute; discharge pipe is 24 inches in diameter; the blower is used for a pneumatic cash system of 75 stations. Now I would like to know if I can discharge the exhaust air from the blower into my smokestack without interfering with the draft of my furnaces. I have in use two boilers, 125 horse power each; the stack is square, 3 feet x 4 feet 6 inches, and also has an offset a little above the center of the stack. The only place where I could exhaust into the stack now is about five feet *below* the boiler flue, that would be at the bottom of the stack. If I can't exhaust in this place, I would have to carry a line of pipe up on the outside of the building to a point above the boiler flue. Which would be the best? And would I need an elbow in the stack, so the air shoots up, or is it unnecessary? A. You do not give the height of your stack, nor the velocity, pressure and volume of the air from the Root blower, so that it is impossible for us to make any exact calculation; but unless you have a draft very considerably in excess of what you actually require when forcing your boilers, it would not be wise for you to discharge the blower into the stack, because that would have the effect of materially reducing the size of your chimney. On account of the distance of the stack from the boilers, it is more doubtful if you have the draft to spare. In case you try the experiment, insert the discharge pipe from the blower at the base of the stack, with an elbow pointing upward.

(9138) 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.

(9139) H. E. asks: 1. Has the Roentgen ray or a similar device ever been perfected to that extent that the human eye can see through a solid body; as, for example, the human hand while the fingers are being moved? A. There is no way known by which the eye can see through an opaque body, such as the hand. By the X-ray we commonly speak of seeing through the hand and other dense bodies. The action is in reality as follows: X-rays traverse many opaque bodies quite freely, but the eye cannot see X-rays. Bones are not easily traversed by X-rays, flesh is. Certain chemical salts transform X-rays into light rays; then the eye can perceive the light rays. On the inside of the box which is held over the eyes is a chemical which thus glows in the X-rays. Place the hand on the end of the box. The bones cut off the X-rays more than the flesh does. The chemical does not glow as much where the bones cut the rays off as where the flesh is, hence the bones cast a shadow on the screen. This is called seeing through the hand. What we see is a shadow. Thick flesh casts more shadow than thinner flesh. By this fact much can be made out regarding the condition of interior organs of the body. It is wonderful enough, but it is not seeing through opaque bodies in any proper sense of the term. 2. Has there been manufactured and in use a slot machine into which a solid body such as the human hand might be introduced and then seen through? A. We do not know whether the slot machine has been applied to X-rays or not. There would be no difficulty in doing this.

(9140) A. C. says: We have a well 184 feet deep that we wish to force water out of to a tank 65 feet above ground. The water stands 16 feet from the top of ground, but we do not know how low it will go when pumping is commenced. The outside casing of well is 8 inches. The suction pipe and discharge pipe is 5 inches. It goes down in the well 163 feet. The air pipe is ¾ inch and goes down 157 feet. The air pressure is 100 pounds. The question is, how far can the water lower and still allow the pumping to go on successfully? In other words, how far must the air pipe be down in proportion to the amount of elevation of water? A. One hundred pounds air pressure will lift a column of water 230 feet high, neglecting friction. The amount of friction will depend on the mechanism used; if the friction is 30 per cent, the 100 pounds air pressure will life a column of water 161 feet high, or from 96 feet below the ground to a tank 65 feet above it.

(9141) J. A. says: I inclose an extract from a letter from John Anderson, Road Commissioner for the State of New Hampshire, in the White Mountains, to Prof. C. H. Hitchcock, of Dartmouth College: "Won't you consult your chemist at Hanover in relation to a fire-extinguishing powder that can be used in fighting forest fires? If we could send one hundred men into the woods, each having hung over his shoulder thirty or forty pounds of such material, which thrown by handfuls into the blazing points or scattered broadcast into a running fire would deaden it, enabling the shovel men to finish it by throwing on fresh earth, we would have a practical solution of the question that is now in the minds of all in this section. In view of the enormous annual loss it might avert, it would not really matter if such material were expensive. It should be provided by the State in all localities subject to these fires." A. Sodium tungstate might answer the purpose, but it would be too expensive. We do not believe that a forest fire will ever be extinguished without resorting to the methods already in use by all lumbermen, such as beating out, denuding the forest to form a fire belt, etc. Powders are better adapted for extinguishing fire in rooms. We think that the chemical fire extinguisher might prove practical for fighting forest fires.

(9142) C. J. S. says: How long is the scaling ladder in use in the New York Fire Department, and where was it invented, and how long is it in use in Berlin? Which is more improved—New York or Berlin? A. The scaling ladders used in the New York Fire Department were first used in 1883, and they run from 12 to 20 feet—12, 14, 16, 18, 20; at about the first time they were used, a very successful rescue was made by now Chief of Battalion Binns. We have no information relative to the scaling ladders in use in Berlin, except that they are used. In general, we may say American-built fire engines are the best made, and we have never heard it questioned that the secondary part of the fire equipment was any less good. Owing to the methods of construction employed abroad they have fewer fires, therefore there is no such demand for improvements in fire apparatus as here.

(9143) S. B. E. writes: If G. B., Notes and Queries, 9,076, of your paper of July 11, will consult "Popular Astronomy," pages 38 to 52 inclusive, by Camille Flammarion, translated by Y. Ellard Gore, he will find the information he is seeking concerning the eleven motions of the earth.

(9144) F. R. M. says: I have been intensely interested in the unusually fine articles on radiation, etc., that have appeared in the SUPPLEMENT during the past four weeks. But there are naturally several statements that I cannot understand or reconcile. Crookes, on p. 23,015, middle of third column, says the "free positive electron is not known." This does not seem to agree with Rutherford's X-rays referred to on p. 22,951, middle column, when they are called positive ions traveling toward the cathode. Is any distinction agreed upon between electron and ion? Will cathode rays act on a photographic plate if let out of the tube through Lenard's aluminium window? and if so, how powerfully compared to Roentgen rays? On p. 22,998, bottom of third column, "unless the gases in the tube are extremely rarefied, the rays are quickly stopped and scattered by molecular obstructions." Then why are not the rays immediately stopped and scattered when they reach the air after passing through the aluminium window? Dastre, on p. 22,998, middle of second column, says cathode emission is rectilinear. Crookes, on p. 23,015, middle of second column, says electrons "can turn corners." How can these be reconciled? A. We do not wonder that you are at a loss sometimes among the varied and well-nigh contradictory statements concerning electrons and other minute things claimed to exist by the more advanced theorizers. It is, of course, the office of a scientific periodical to print the papers read at the various meetings of scientific bodies, but they rest for authority, not upon the periodical, nor upon the society, but upon the repute of the persons presenting them. We cannot decide between the claims of the several scientists, but must leave the matter just where they leave it. Only one engaged in investigation can speak with any authority about such matters as you refer to in your note.

(9145) O. N. writes us: Is a 16 candle power bulb frosted more luminous than one that is not frosted? That is to say, will one 16 candle-power frosted bulb give more light than one that is not frosted? A. An incandescent electric lamp with clear glass bulb will emit more light than one with a frosted bulb. The bulb cuts off light. No arrangement of the bulb can increase the light of the filament. It is the filament which gives the light, and not the bulb. Even a bulb of clear glass absorbs some light. One of partly opaque glass will, of course, absorb more light.

(9146) N. A. N. says: Will you please decide if there is a difference between a mile square and a square mile? I hold that a mile square is a mile around it, and a square mile is four miles around it. A. A "mile square" and a "square mile" have each the same area, but the phrases have very different meanings. A mile square is a figure one mile on each side, and all its corners right angles. A square field one mile on a side is a mile square. A square mile contains 640 acres, and may be in any shape whatever, circular, rectangular, etc., or of any irregular form.

(9147) F. A. F. asks: Kindly answer the following mathematical problem to set your readers right: We have an aquarium, a globe, 6¼ inches in diameter, 6½ inches high; the question is, How many pellets or buckshot ¼ inch in diameter will this globe or aquarium hold? A. The problem you send us may admit of a mathematical solution, but so far as we know it only admits of solution by experiment. Fill the globe with shot and count them. The globe is apparently an irregular solid. You give the dimensions as 6¼ x 6½ inches. This is not a spherical solid, and its shape is not determined by two dimensions only. The rate of curvature of its parts is not given by knowing two dimensions only. If it be assumed that the dimensions are the axes of an ellipse, then the solid is an ellipsoid of revolution and its form is definitely known. But it can hardly be assumed that a globe of glass blown by ordinary processes of the shop is an ellipsoid of sufficient accuracy to base a mathematical calculation upon. If its solid contents simply are known, the number of spheres which it would contain could not even then be calculated without more data. And if the problem were solvable, what would be the use of doing it? We are fond of working upon problems which lead to results of practical value, and though we sometimes work out problems for correspondents, which are simply puzzles, we always feel that the time is misspent, since we are beyond the age when we do such work simply for mental gymnastics.

(9148) A. L. asks: 1. What is the best kind of iron or steel to make a magneto? A. A magnet may be made of tool steel. The higher the grade of steel, the better. 2. What is the best method of making a magnet the most powerful? A. The magnet should be hardened at the ends as hard as it can be made. The middle may be soft. It can then be magnetized by stroking with another magnet or the poles of a dynamo, or by placing it in a coil of wire through which a current of electricity is flowing. All these methods are fully described in textbooks. 3. When a magnet's lifting power is 6 pounds and the object it is lifting is a magnet weighing about 7 pounds and having a lifting power of also 6 pounds, will the former lift it, or must the latter weigh exactly six or lower? A. If a magnet can lift six pounds, it can lift anything less than six pounds. If one of two magnets can lift seven pounds, it will hold up seven pounds or hold itself up against the other if suspended from it. 4. Has a magnet the same amount of repelling force as attractive? A. A magnet will repel with the same force as it attracts. The lifting power of a magnet means that it will lift in actual contact with the weight to be lifted, and not at any distance from it through the air. A narrow gap of air reduces the power of a magnet very greatly.

(9149) W. C. B. says: I am informed that there is a process for making ice whereby liquid air is utilized in place of ammonia; that the installation of a plant of that character can be installed for much less money than the ammonia plant; that the maintenance is much less than the ammonia plant; and that it has other advantages. Will you be kind enough to give me some information on this subject? Is it in its experimental stage, or is the system being used to any extent? Can the tubes of air be secured commercially like ammonia? I am told they are used principally for small plants, but that larger plants use the ammonia. In your opinion, would a plant of 20-ton capacity per twenty-four hours be manipulated more economically with the air or the ammonia systems? A. We think we are safe in saying that nowhere in the world is liquid air in use for ice-making or refrigeration, and in our judgment it will be a long time before it is used for any of these purposes. It is many times as expensive as the ammonia process, and has other disadvantages in comparison with it.

(9150) A. S. asks: A friend of mine says if a piece of iron is laid where the sun can shine on it, it will get hotter than a thermometer would show the atmosphere to be. I claim he is wrong. If it would be as he says, the iron would have the property of drawing heat, and an iron pail of water would show a greater registration on a thermometer than the air would. Nearly every one I have spoken to says he is right, so as a last resort I turn to you. A. Any metal laid where the sun can shine fully upon it and at the same time be protected from drafts of air will become much hotter than the adjacent air. We have just laid out a roll of sheet copper in which was a thermometer. The ends were closed by paper to protect the air from passing through the roll and cooling the thermometer. By its side in the sun was another thermometer, and still a third was in the shade close by. The thermometer in the shade showed 82 deg., that in the sun showed 122 deg., while the one in the copper roll read 138 deg. As the mercury rose to the very top of the bore of the stem, it is not certain but that the temperature was higher still. Any one who ever picked up a piece of iron which had lain in the sun of a summer day and found it too hot to hold in the hand, knows that the air in the neighborhood is cooler than the piece of iron; or if as a boy you have walked barefooted over stones, or in the sand, on which the sun shone with full force, and had your feet burned, the same fact could have been learned. The scientific reason for this is not difficult to understand. Water is used as the standard for measuring the quantity of heat required to produce a certain rise of temperature. One pound of water is raised 1 deg. by a certain quantity of heat. It will require only one-fourth as much heat to raise a pound of air one degree, one-eighth as much to raise a pound of iron one degree, and one-tenth as much to raise a pound of copper one degree. The same quantity of heat produces very different effects upon different substances upon which it strikes.

(9151) A. F. O. says: I know all about the ordinary thermometric scales, F., C., and R., and their mutual reductions, but "600 deg. A" in President Swinburne's address in the SUPPLEMENT is new to me. Will you kindly enlighten me? A. "600 deg. A" are degrees of absolute temperature. The absolute zero is 273 deg. below the Centigrade zero. Temperatures are often expressed in the absolute scale, since then the relations are in an exact ratio to each other. 400 deg. A is twice as hot as 200 deg. A. Of course 400 deg. C. is not twice as hot as 200 deg. C., since both are reckoned from the freezing point of water, which is not a real zero of heat. Ice is still 273 deg. C. above zero.

(9152) C. H. S. asks: 1. Without using wireless telegraphy, is there any way to receive a current of magnetism or of electricity from one boat to another, 100 feet or less away, to affect the needle or an electrometer? A. We do not know any way of sending and receiving electrical signals which is not equivalent to wireless telegraphy; that is, an induction coil and receiving instruments, such as a coherer of telephone, or some equivalent electromagnetic device must be used. 2. Can an electrometer be made to register such a current, no matter how feeble? Don't mean to telegraph or telephone. A. An electrometer is not the instrument to employ. It receives and registers static charges, not currents. A galvanometer is probably intended. This may be used in the way mentioned.

NEW BOOKS, ETC.

THE ELEMENTS OF ELECTRO-CHEMISTRY TREATED EXPERIMENTALLY. By Dr. Robert Lüpke. Revised and augmented by M. M. Pattison Muir, M.A. London: H. Grevel & Co. Philadelphia: J. B. Lippincott Company. 1903. 8vo. Pp. 255. Price, $2.25.

Although the main purpose of the book is to set forth the purely scientific aspects of electro-chemistry, the practical sides of the subject have not been left altogether unnoticed. Technical electro-chemical processes, and especially the processes of electro-metallurgy, which are so important at present, are referred to in their proper places. The experiments, which form an essential part of the book, are carried out with the simplest possible apparatus.

LES INDUSTRIES CHIMIQUES ET PHARMACEUTIQUES. Par Albin Haller. Paris: Gauthier-Villiers. 1903. Vol. I. 4to. Pp. 405. Vol. II. Pp. 445.

In these two stately volumes Prof. Haller reports on the chemical and pharmaceutical industries which were represented at the last Paris Exposition. After a scholarly introduction he discusses the chemical industry of every European country and of the United States, passing then to improvements introduced since 1889. His second chapter discusses pharmaceutical products and minor improvements, not the least valuable portion of the chapter being devoted to a *résumé* of antiseptics and antipyretics. In a chapter on artificial colorants and the raw material from which they are made, Prof. Haller gives an admirable review of the development of this important branch of organic chemistry since 1889. The products of the distillation of wood, resins, coal, and mineral oils are treated in a chapter by themselves, as are also artificial and natural perfumes. The sixth chapter is taken up by descriptions of mineral colorants or pigments, lacquers, varnishes, paints, inks, blacking, and the like. In the seventh chapter soap-making and stearine industries are treated.

DIE WEISSGERBEREI, SAEMISCHGERBEREI UND PERGAMENT-FABRIKATION. Ein Handbuch fuer Lederfabrikanten. Von Ferdinand Wiener. Vienna: A. Hartleben. 1903. 12mo. Pp. 376. Price, $1.75.

Mr. Wiener's book is essentially a practical reference book for the leather manufacturer. Its style is such that the process described can be comprehended even by the layman. In this second edition of his work Mr. Wiener has carefully revised the text and incorporated descriptions of the more important improvements which have been made since the appearance of the first edition.

TECHNIK DER RADIERUNG. Eine Anleitung zum Radieren und Aetzen auf Kupfer. Von Josef Roller. Vienna: A. Hartleben. 1903. 12mo. Pp. 376. Price, $1.25.

Prof. Roller's handbook on etching is intended not only for the artist, but also for the art connoisseur. The work discusses thoroughly and clearly the various operations of etching on copper, and likewise contains many an interesting remark on artistic printing and a very instructive review of the various calcographic methods.

THE CHEMISTRY OF PIGMENTS. By Ernest J. Parry, B.Sc., and John H. Coste, F.I.C., F.C.S. London: Scoot, Greenwood & Co. New York: D. Van Nostrand Company. 1902. 12mo. Pp. 280. Price, $4.50.

The publishers of this work have a reputation for issuing important books upon technical subjects and the present book fully sustains this reputation. It indicates the chemical relationship, composition, and properties of most of the better known pigments. The various colors are treated in groups allied chemically, rather than chromatically; an excellent arrangement. The methods of manufacture of colors have been considered rather from the chemical than the technical point of view. It is not suggested by the authors that the present work is in any