ANSWERS TO CORRESPONDENTS

S. R. should paint his iron fence according to the directions on p. 295, vol. 28.—R. R. R. should correspond with a boat builder.—A. D. B. will find the manufacture of collodion described on p. 171, vol. 28.—C. C. D. & Co. should write to the inventor, whose address we gave on p. 407, vol. 26.

I. N. P. asks: What does the word *bacteria* mean, and what is its origin? Answer; Bacteria are vegetable forms of life of the lowest order. They are mere points of organized matter, liable to appear in any solid or fluid substance containing vitalized matter. The Greek *bacteria* means a staff or support, but the etymology of the word as applied to organic life is unknown to us.

E. N. M. asks: 1. What meaning have the small capital letters placed on the four corners of the postage stamp of Great Britain? 2. How many volumes were there in your old series? 3. What is the difference between a sulphide and sulphate? Answers: 1. They are merely for the guidance of the engravers of the plates. 2. Fourteen. 3. A sulphate is a compound of sulphuric acid with a base a sulphide is one of hydrosulphuric acid with a base.

C. H. G. asks: How can I make an elastic clear varnish? Can india rubber be dissolved in alcohol, and how? Answer: India rubber cannot be dissolved in alcohol. Its proper solvents are, ether, chloroform, or, better, bisulphide of carbon. An elastic varnish can be made by dissolving 1½ ozs. india rubber, cut as small as possible, in 1 pint of bisulphide of carbon.

S. P. & Co. ask: How can we deposit bright copper on unpolished cast iron by dipping? Answer: Use a solution of sulphate of copper 3½ ozs., sulphuric acid 3½ ozs., and water from 1 to 2 gallons. Small articles can be conveniently coated by jerking them about in sawdust or bran soaked in the above described solution.

P. S. asks: 1. How can I get hazel nut stains out of a linen shirt bosom? 2. Is there such a thing as a miner's compass? Answers: 1. Soak the spots with a strong solution of oxalic acid, and then throw the acid away, as it is a poison. 2. You can get a miner's compass at any optician's store. Very small samples of any substance can be sent by mail.

A. R. G. says: We are having some trouble in taking the oxide off sheet iron. We are working now with a lead tank, ½ inch thick, placed in a wooden tank; but it continually leaks. We use the oil of vitriol and water heated by a jet of steam; but when we solder the cracks, it eats the solder off. Is there any other material that will do to make boxes? We have tried wooden boxes, but cannot keep them tight. What is the best process to take the oxide off sheet iron, so that it will answer for tinning and galvanizing? Answers: You are using a good material and process for removing the oxide from the surface of the iron. The trouble with the lead lined tank can be removed by burning or melting the edges of the sheet lead together by the blowpipe, instead of soldering. This is done in the erection of sulphuric acid chambers by men called "lead burners," with some one of whom you should communicate. There is consequently no necessity for casting so expensive a contrivance when ordinary sheet lead, enclosed in wood, can be made to answer.

N. O. A. asks: How can I tell gold from other metals? How can I ascertain the fineness of gold? Answers: Metallic gold can be almost invariably distinguished by an experienced eye by its rich yellow color. Touch it with a drop of strong nitric acid and notice whether any oxidation, effervescence, etc., takes place. If no effect is produced, the article may be considered as gold on the outside. This test is, of course, only a very partial one, as the gilded sham jewelry may withstand it. To ascertain the fineness of gold, that is, how much real gold there may be in or on a gilded metal or alloy, the specimen must be analyzed by a chemist. This can be done by dissolving the gold material in *aqua regia*, and afterwards precipitating the gold by a solution of protosulphate of iron (copperas). The precipitate (washed, dried and gently heated) is weighed as pure gold.

B. F. D. asks: Is there anything that will take the stain of nitrate of silver from the hands as well as cyanuret of potassa, and be less poisonous? Answer: Try a solution of the hyposulphite of lime, potash, or soda.

J. W. asks: How can I get rid of the unpleasant odor arising from new feathers? They have been thoroughly washed in hot water, sun aired, and well dried. Answer: Wash the feathers with a weak solution of carbonate of soda, or water to which a little solution of chloride of lime has been added, then rinse in clean water and dry thoroughly.

B. asks: Can you inform me what liquid Professor Tyndall used (in his lectures last winter) to blow his large soap bubbles with, and (2) how hydrogen soap bubbles are blown? Answers: 1. As far as we know, he used a very strong solution of hard soap. 2. Hydrogen bubbles are blown in the same way as air bubbles, hydrogen gas being delivered into the bowl of the pipe instead of air. Hydrogen is easily made by pouring dilute sulphuric acid upon scraps of zinc.

J. D. B. asks: How are transfer pictures put on, and what are the ingredients? Answer: Dissolve 2 ozs. glue, ½ lb. starch, 4 table spoonfuls glycerin in ½ gallon water. Put two coats of this on the paper to be printed, and then print in colors. Transfer the picture by damping the print, and then placing it on the object to be ornamented, the surface of which should be previously varnished.

R. B. B. asks: How can I dissolve isinglass? Answer: If you mean isinglass, a species of fine glue, it is soluble in water. If you mean mica, the transparent mineral used in stove doors, and which some people call isinglass, it is insoluble.

D. P. W. asks: Will discharging the exhaust steam into the chimney injure the same? Answer: Yes; eventually it will soften and disintegrate the bricks and mortar.

B. C. M. C. says: Please give best process for annealing small steel forgings, from ½ lb. to 10 lbs. in weight? Answer: Heat them in a muffle or sand, and allow them to cool slowly.

J. E. E. says: In your issue of October 11, page 225, under the heading of "Scientific and Practical Information," there is an account of the instantaneous lighting of the Jewish synagogue on Lexington avenue, New York city. Was the light produced by a preconceived plan? If so, please explain the *modus operandi*. Or was it involuntarily produced by the electrical influence upon the audience? Answer: It was produced by electrical influence upon small bits of platinum wire placed over the orifices of each gas burner. Series of these bits of platinum were connected by ordinary copper wires with a galvanic battery. On closing the circuit, the electricity passed through the wire and through the platinums, which, being very small, offered so much resistance to the passage of the electricity as to become heated white hot; and the gas, being at the same moment turned on, was instantly ignited.

W. A. says: It is a well known fact among practical men that no rule for width of belts is reliable, as no two rules give the same results. The greater the width of the belt, the greater is the error. If a 1 inch belt at a velocity of 750 feet per minute is right for a horse power, why do we not use a belt 50 inches wide to transmit 50 horse power? It seems that the experiments upon which the formulas have been obtained have been from small belts of single thickness. Practical results show that the power of a belt to transmit force is more nearly as the square of the breadth. "I will cite a few cases as examples, the pressure being taken in the cylinders: 1. Engine 8 x 12, pressure 70 lbs., 90 revolutions, with 5 feet driving pulley to 24 inch one on line shaft; belt 9 inches wide, of double thickness, and 41 feet long.

$$\frac{50{\cdot}26 \times 70 \times 160 \text{ feet} = 562912 \text{ foot pounds}}{\text{speed of belt } 15{\cdot}70 \times 80 = 1256 \text{ feet per minute}} = 448{\cdot}17 =$$

49·77 lbs. per inch of belt. 2. Engine 13 x 30, pressure 60 lbs., 62 revolutions, with 5 feet driving pulley and a heavy fly wheel, 15 inch double belt driving on to a 32 inch pulley on line shaft; distance between centers of pulleys, 17 feet.

$$\frac{132{\cdot}73 \times 60 \times 310 = 2468778 \text{ foot pounds}}{\text{speed of belt } 15{\cdot}70 \times 62 = 973{\cdot}40 \text{ feet per minute}} = 2536{\cdot}24$$

=169·08 lbs. per inch. 3. Results from an elevator strap 2½ inches wide, single belt, driving pulley 18 inches diameter, 124 revolutions; driving on to a 14 inch pulley without slipping; between centers of pulleys, 10 feet. Effect, 1000 lbs. raised 31 feet per minute.

$$\frac{31000 \text{ foot pounds}}{\text{speed of belt } 4{\cdot}712 \times 124} =$$

53·05=21·42 lbs. per inch. This weight was the utmost capacity of the belt, and more would cause it to run off. Many cases to the contrary, where bad judgment had made the results quite insignificant through the slipping of the belts, might be cited. Answer: In case proper constants are obtained by experiments with small belts, there seems to be no good reason that they should not apply to large ones. The driving power of a belt depends upon the friction between it and the surface of the pulley, which is proportional to the pressure or tension of the belt, and independent of the width. Hence, if we could make a belt one inch wide strong enough, it might transmit as much power as another belt 20 inches wide. The last example cited by our correspondent is a reliable one, giving observed results; and it is experiments of this kind which we would desire our readers to forward to us. The other examples, in which the power is calculated, do not seem to be so reliable. The calculations take no account of the back pressure in the cylinder, of the loss of pressure between the cylinder and boiler, of the expansion and cushion, if any, and of the friction of the moving parts. The judges at the Fair of the American Institute may have an opportunity to make tests of the value of pulley coverings in comparison with the ordinary method of transmitting power on smooth pulleys; and we hope that if they do investigate the matter, they will determine some rules that will be of value to the engineering community.

H. B. says: I commenced ferrotyping, but I get nothing but more or less foggy pictures. I am sure the fault lays in the nitrate bath. Whenever I make the bath, as soon as the silver dissolves in the water, it gets a milky appearance and gradually comes to a chestnut brown. If I leave it to stand for 24 hours it gets clear, and a brown precipitate forms. I use common well water, filtered through paper. Can you tell me what causes this brown precipitate in the nitrate silver solution? Answer: Your trouble is due to bad water. You should always use distilled water for a photo bath. You can easily make distilled water by placing a tin funnel over a water pot and boiling the water. The inner edge of the funnel should be turned up so as to form a ledge to catch the condensed water, and there should be a spout to lead off the drip. The steam that rises is condensed by contact with the funnel, runs down into the ledge and out at the spout. A common iron pot, used in the kitchen on the stove, will do.

J. G. asks: 1. What would be the best way to stop a leak in a gas pipe, where there is great expense incurred in getting at the leak? Is there any chemical composition that I can pump through the pipes to rust the leak up without injury to the pipes, as the leak is small but very troublesome? 2. Why does lightning sometimes tear and splinter trees from the ground upwards, and at other times downwards? Answers: 1. You might coat the interior of the pipe with hot coal tar, and then you could inject some rusting composition which would be drawn to the hole; after it had set, the remainder could be washed out. 2. It may be that in one case the tree is struck directly, and that in the other the stroke is communicated from the ground.

C. H. H. asks: Is there anything with which I can produce a white color on iron or brass, except by painting with ordinary white paint? Answer: You can apply a white enamel, such as you see in some iron pots. See page 149, volume XXVIII.

A. A. F. asks: 1. What makes it dangerous to load a cannon without thumbing it? What causes the powder to catch fire? 2. What particular properties have flint and steel, that fire is seen when they are brought together with quick rapid strokes? Answers: 1. The vent is closed to prevent the admission of air. 2. The friction between the two substances raises the particles that are broken off to a red heat.

W. & L. ask: What do you think of petroleum as an agency for the removal of scales from boilers? Would not an agent which is sufficiently powerful to remove or decompose a substance formed upon the flues and plates of the inside of a steam boiler also destroy the iron, as the scale is harder than iron? Petroleum possesses the property of removing the hardest scales in any steam boiler that I have yet seen. It has been brought into general use here in our locality, and more explosions have occurred here than ever before. Engineers are competent, water seemingly good, and our boiler iron has stood a tensile strain of sixty thousand pounds to the square inch. Answer: So far as we know, the petroleum does not injure the iron. It is quite possible that the boiler you speak of may have been much corroded, and that the removal of the scale revealed the defects.

C. H. S. asks: How can I make a dip for cleaning brass rough castings, so that they will look bright and retain their color when exposed to the weather? Answer: Brass, however highly polished, will not retain its bright surface long when exposed to the weather. We would therefore advise you to use a simple lacquer or varnish for the brass after it is well polished. This you can make by dissolving 8 ozs. of shellac in 1 quart of strong alcohol, and using the clear portion, applied by a fine brush on the polished brass. A good polish for brass is rottenstone made into a paste with sweet oil. You can give brass a fine color, by washing with a strong lye of red alum (1 oz. alum to 1 pint water), then rinsing with clean water, and finally finishing with fine tripoli.

J. A. asks: How many horse power have I in a stream of water with a fall of nine feet? Answer: You do not send enough data to enable us to answer this question. Probably if you communicate with water wheel manufacturers, you can obtain such information as you desire. Send them the height of the water over the bottom of the opening, or the mean velocity with which it flows through the opening.

C. F. B. asks: How can I lay out a small bracket from a large one so as to have them both of the same pattern? Answer: You can do it by means of the pantagraph, described and illustrated on page 99, vol XXVIII.

K. F. asks: Can galena be roasted in the open air by staking, as the ordinary sulphurets are? Answer: We have never heard of the process of roasting galena being practiced. From the fact that galena melts before the blowpipe, owing to the large percentage of lead (85 per cent), if its roasting were attempted in the way indicated it would be apt to fuse and run together, thus defeating the object in view.

A. Q. N. asks: What course shall I pursue in order to become a civil engineer? What amount of education is requisite, and how can I get into the business? Can I teach myself drawing; if so, what are my best aids? Answer: It is possible for any young man with energy and talent, to educate himself, but of course there are many difficulties in the way. A good civil engineer must understand mathematics and the principles of natural philosophy; and there are many other things, which he can only acquire by experience. Try and get some position in the surveying party on a railroad, to make a start. Professor Warren's elementary works on drawing are well suited to those who wish to instruct themselves.

G. W. C. asks: 1. How can I melt brass and copper? 2. What kind of molds should be used? Will wooden ones do? Answers: 1. Use a crucible made of fire clay or black lead. 2. Molds can be made of sand or plaster of Paris. Wood will not answer.

W. asks: 1. Will you please give me a rule for finding the diameter of a wheel when the circumference is known, and *vice versa*? I have two arithmetics, one of which gives 3·14716 or 3⅛ as the divisor or multiplicand, and the other, 3·1416. Which is right? 2. In making calculations for spur gear wheels, should I draw the circumference to the base of the teeth or calculate from the outer circumference? 3. In a process as that described on page 194, present volume, does the water evaporate or lose its bulk by expansion and condensation when there is no escape by leakage? 4. Will you name some good book that will aid me in making patterns for models? 5. Will you please tell where I can get the book that is to be issued monthly at the Patent Office? Answers: 1. The number 3·14159265 is the approximate value to be used. More commonly, we employ 3·1416, which is sufficiently correct for general operations. 2. Calculate the circumference at the pitch line, between the points mentioned. 3. The water evaporates, and has its bulk increased. The steam is then condensed, thus restoring the original bulk. 4. We do not know of any single work that will give you the desired information. 5. We suppose you refer to the weekly volume. This is not sold to private individuals.

C. C. T. asks: How far will a siphon draw water? Answer: The water will rise in a siphon to a hight due to the pressure of the atmosphere, or nearly to 34 feet.

L. H. asks: How can I construct a force pump? Does it make any difference whether I put the air chamber between the two check valves? I want it to lift water about 2 feet. I tried a ½ inch receiving valve and a ⅜ discharging valve. Answer: We get very little idea from your letter as to what you wish to accomplish. Place the air chamber beyond the delivery valve of the pump.

A. W. F. says: In your issue of August 23, 1873, on the "Manufacture of Oil of Vitriol," by J. F. Gesner, M. A., I find sulphuric acid described as H_2SO_4 and in another place as SO_3H_2O, and water as H_2O. My knowledge of chemistry would make the former HSO_4 or SO_3HO, and the latter HO. Please inform me which is the correct way. Answer: The writer of the article referred to has followed the best and most recent authorities. Chemists differ as to the symbolic notation of water, but whether we write it HO or H_2O, no difference is implied in the relative weights of the combining elements. When water is submitted to electrolysis, it is well known that hydrogen is given off at one pole and oxygen at the other. The relative weights of the gases thus evolved always remain the same, that is 8 parts by weight of oxygen are given off to 1 of hydrogen, 9 parts of water always yielding these proportions. But there are two volumes of hydrogen to one of oxygen, and the question is: Shall we regard these two volumes of hydrogen as 1 equivalent and the volume of oxygen also as 1, and regard water as a binary compound, or shall we call the 2 volumes of hydrogen, 2 equivalents, making equal volumes the equivalents of each element and regard water then as a ternary compound? Under the first supposition water is written HO, and under the second H_2O; but in H_2O, oxygen is regarded as having twice the atomic weight of the oxygen in HO, thus preserving the relative weights. Under this system the atomic weights of several other elements are also doubled, as those of carbon, sulphur, etc., hydrogen being taken as the standard.

H. H. T. asks: Are cast iron sectional boilers as safe as wrought iron boilers? Answer: In regard to sectional boilers a committee of the American Institute Fair, in 1871, made the following remarks: "Your committee feel confident that the introduction of this class of steam boilers, will do much toward the removal of the cause of that universal feeling of distrust that renders the presence of a steam boiler so objectionable in every locality. The difficulties in thoroughly inspecting these boilers, in regulating their action, and other faults of the class, are gradually being overcome, and the committee look forward with confidence to the time when their use will become general, to the exclusion of the older and more dangerous forms of boilers."

H. P. M. asks: 1. In building a chimney 75 feet in hight, which would create the most draft, one started at 2 feet square on the inside at the base, and spreading out to 3½ or 4 feet at the top, or one 2 feet square all the way up? What is the theory? 2. What is the best method of brightening up small castings in a mill? Answers: 1. Probably it would do better if made of the same size all the way up. 2. The castings may be dipped into sulphuric acid, and then placed in a revolving cylinder, or polished on a wheel.

W. S. asks: Which will sustain the greater weight, a solid stick of timber sawn 10 inches square and 30 feet long, with the ends resting upon blocks without any other support, or the same amount of timber in three separate pieces, each of 3⅓ inches in thickness, set up edgewise, side by side? If there is any difference, please give the principle. Answer: If all the sticks are of the same quality, the same amount of weight can be sustained in both cases.

F. E. P. says: In electroplating sewing machine attachments, I find it very difficult to deposit the silveron the solder at the joints. I have tried several dipping compounds, but with poor success. I have tried copper plating; but the copper will not stick firmly enough. Can you give me any information on the subject? Answer: To prepare your articles for plating: first boil them in a solution of caustic potash to free them from grease. Then dip quickly in red nitrous acid to remove any oxide from the surface, and afterwards wash well to remove every trace of acid. Then dip into a solution of mercury in cyanide of potassium (not too long), and afterwards wash in water as before. The amalgamation of the surface effected promotes the adhesion of the film of silver.

M. A. P. asks: What can I use to cement the joints of vitrified pipe for conveying strong acetic acid? Answer: Mix equal parts of pitch, resin, and well dried plaster of Paris. This is used for the masonry of chlorine chambers and vitriol works.

H. F. asks: Are there three rails used on the track of the Rigi railway? Answer: Yes, and the central rail is a rack into which a toothed wheel of the locomotive gears.

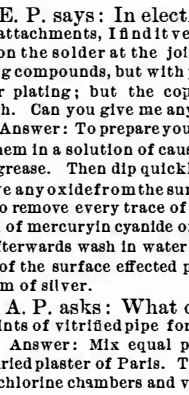
T. H. asks: What is an anemometer? Answer: The usual instrument for measuring the velocity of the wind is formed of two wires crossing at right angles, at each end of which is a cup-shaped vane, placed with its concave side to receive the current. A counter is employed to register the number of its rotations; and it must be nearly free from friction, or its indications will be valueless.

J. H. M. asks: Can you give me a recipe for staining butternut wood in imitation of black walnut? Answer: The following is highly recommended: Water 1 quart, washing soda 1½ ozs., Vandyke brown 2½ ozs., bichromate of potash ¼ oz. Boil for 10 minutes and apply with a brush.

L. C. asks: 1. What book contains the most accurate tables of the number of bricks required for walls and cisterns; the quantity of lime and sand for a certain number of bricks; the day's work for bricklayer; and the cubic yards to be excavated for a cistern, tank or cellar? 2. How is puddling for bottom of water reservoir made, and how thick should it be? Answer: We know of no book that can be relied on to give you this information. Consult a good mason, or builder. 2. Read our article on page 240, current volume.

U. T. K. asks: Can a low pressure single cylinder marine beam engine be worked with one cylinder head broken out? If it can, what course can be taken to form a vacuum in the condenser? Would it be necessary to take any buckets off the wheels? Answer: In King's work on the steam engine, page 98, this matter is referred to as follows: "Disconnect the steam and exhaust valves from the damaged end of the cylinder, if the engine be fitted with poppet valves, and let the atmospheric pressure force the piston in one direction, the steam being used for the opposite direction. Should the engine be fitted with a slide valve, close up the opening into the damaged end of the cylinder by fitting in, steam tight and in a substantial manner, a block of soft wood." In such a case, it would probably be necessary to remove some of the paddle floats, or to reef them.

T. L. B. says: In answer to my inquiry as to how I could supply a small boiler with water, you say: By the direct pressure of the steam, using an arrangement like an equilibrium oil cup. Will you please give a more definite description of the article? Answer: The appended sketch will probably enable you to understand the arrangement. A is a vessel of suitable size, connected by a pipe, B, to the check valve of the boiler, by C to the steam space, and by D to the water supply—each of these pipes having a cock or valve, so that it can be closed at pleasure. E is an escape pipe and valve, opening into the air. The operation is as follows: Close valves in pipes B and C, and open those in pipes D and E. The water will then run into the vessel A. When it is full, close valves in pipes D and E, and open valves in pipes B and C. The vessel A being above the boiler, the water will run into the boiler, as the steam pressure on top of the water in A is the same as the pressure on top of the water in the boiler.



H. C. P. asks: What weight will a flat bottomed boat, with perpendicular sides, 16 feet long x 3 feet wide x 14 inches, carry? The weight of the boat is 200 lbs. How much weight will it carry when drawing 6, 8 and 10 inches of water respectively? Can you give me a formula for it? Answer: You do not send enough dimensions to enable us to make the calculations, but we will give you the method and you can apply it. Find the area of the bottom of the boat, in square feet. Suppose that it is A square feet. Then the boat, when drawing 6, 8 and 10 inches of water, respectively, will carry the following loads: When drawing 6 inches, $A \times \frac{6}{12} \times 62{\cdot}5 - 200$. When drawing 8 inches, $A \times \frac{8}{12} \times 62{\cdot}5 - 200$. When drawing 10 inches, $A \times \frac{10}{12} \times 62{\cdot}5 - 200$.

G. S. T. asks: Will sulphur water affect a boiler injuriously, and to what extent? Is there any way of counteracting its effect, or of purifying the water? Answer; We do not think the sulphur water will injure your boiler; and we do not know of any method you can employ, to purify the water, that is sufficiently practicable for general use.

A. B. asks: How can I dissolve rubber so as to mold it into any required form? Answer: Immerse the rubber in a mixture of bisulphuret of carbon 95 parts, and rectified spirit 5 parts, until it swells into a pasty mass. It may then be molded into any desired form.

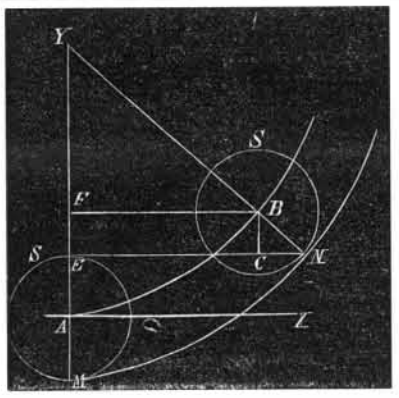
H. J. W. says: 1. Are the fumes from hot aniline dyes injurious? 2. Where can I find some account of the manner of preparing aniline colors? 3. I want small steel wire in the coil, cut into lengths of three inches; what is an ordinary and cheap process for straightening the latter? Answers: 1. We think not. 2. Reimann's work on "Aniline and its Derivatives," will give you the desired information. 3 Draw the pieces through an opening in which they bear at three points. Such an arrangement can readily be made with three nails.

E. A. P. asks: 1. Is there any known law by which to determine the amount of pressure per square inch required to compress common atmosphere to any desired volume: that is, to reduce two volumes to one, three to one, etc.? Answer: Mariottes law is: The temperature remaining the same, the volume of a given quantity of gas is inversely as the pressure which it bears. Therefore a pressure of two atmospheres will reduce the volume to one half, of three to one third, etc.

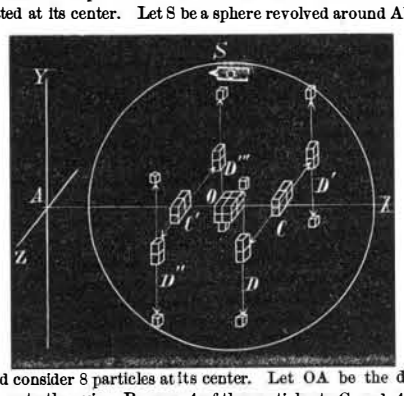
J. M. B. says, in reply to R. A. C., page 27, current volume: "I have made an entire destruction of willow swamps by chopping the trees around at any convenient hight, and stripping the bark to the ground and letting it remain; when the sap is in flow, in July or August, is as good time as any. Do not chop them down for a year or two. 4. A certain cure for nose bleeding is to extend the arm perpendicularly against a wall or post or any convenient object for a support. The arm on the side from which the blood proceeds is the one to elevate."

C. A. D. says: C. M. N. can precipitate nitrate of silver and sal ammoniac by adding to a solution of the former salt a solution of chloride of sodium or hydrochloric acid, which immediately precipitates the silver as a white flocculent precipitate, the new compound being, in the language of the chemist, Ag Cl (chloride of silver). Sal ammoniac can be precipitated by bichloride of platinum; the precipitate is of a light yellow color. These are also characteristic tests for the above named salts.

J. B. W. says: C. H. A. (page 87 of your current volume) can find the solution of his problem in Smith's "Mechanics." Of course the surface of the revolved fluid may be replaced by a rigid paraboloid, and a material particle without friction will remain at rest upon any part of the surface. The case of a ball rolling on a surface is, however, different. I will assume (and afterward prove) that the centrifugal force generated by a revolving ball is the same as if the mass were concentrated at the center of the ball. This true, the ball will be at rest when its center is confined to a parabola, whose equation, referred to the axis of revolution and a tangent at the vertex, as the axis of x and y, is $x^2 = \frac{2g}{w^2} y$, where g = force of gravity = 32·+, w = no. of feet per second passed over by a point one foot from the axis, x = the abscissa and y the ordinate of the curve: *Proposition:* If the center of the sphere S is confined to the parabola AB

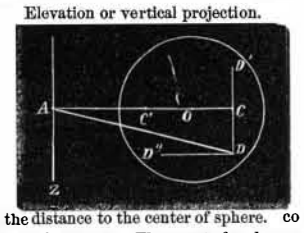


by means of the curve MN, on which the sphere rolls, the curve M N is not a parabola. Let F be the focus of the parabola and draw F B its semi-principal parameter. Draw also NBY, a normal. From the nature of the parabola, we shall there have: FB = 2FA and angle NYM = 45°. When the sphere has its center at B, the resultant pressure of the centrifugal force and gravity is in the direction BN; BN is therefore a normal not only to the parabola but also to the curve MN. But the curve at N being perpendicular to the normal, it makes an angle of 45° with YM, ∴ if it is a parabola, NE, perpendicular to YM, must be its semi-principal parameter, and E, its focus; and we must have EN = 2EM. But $EN = EC + CN = EC + \frac{1}{2}\sqrt{2}\,BN = FB + \frac{1}{2}\sqrt{2}\,AM$, and $2EM = 2(FA - FE + AM) = 2(FA - \frac{1}{2}\sqrt{2}\,AM + AM) = 2FA + 2AM - \sqrt{2}\,AM$. ∴ $FB + \frac{1}{2}\sqrt{2}\,AM = 2FA + 2AM - \sqrt{2}\,AM$. But FB = 2FA. Substituting, $\frac{1}{2}\sqrt{2}\,AM = 2AM - \sqrt{2}\,AM$. Dividing by $\sqrt{2}\,AM$, we have $\frac{1}{2} = \sqrt{2} - 1$, or $1\frac{1}{2} = \sqrt{2}$, which is not true. ∴ MN is not a parabola. *Proposition:* The centrifugal pressure of a revolved sphere is the same as if its mass were concentrated at its center. Let S be a sphere revolved around AY,

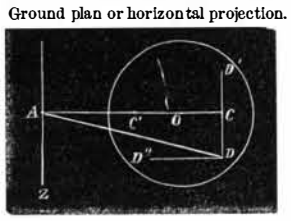


and consider 8 particles at its center. Let OA be the distance to the axis. Remove 4 of the particles to C and 4 to C′, so that AC − AO = AO − AC′. Then place 2 each at D D′ D″ D‴, equally distant in front and behind AX. Finally separate each pair by raising one particle and lowering the other a certain distance. We have now taken the 8 particles from the center and placed them in correct position in the sphere, and as this figure is symmetrical with respect to a line parallel to A Y through its center, all the particles, supposed to be concentrated at the center, may be removed by 8s and placed in position to make a homogeneous sphere. We will now show that such a change produces no change in the centrifugal pressure. Let a be the weight of a particle, ao = b, the distance to the center of sphere. co = c′o = c, the distance of removal. Then centrifugal pressure of 8 particles at the center will be $8w^2b\frac{a}{g}$, of 4 at c it will be $4w^2(b+c)\frac{a}{g}$, and of 4 at c′ it will be $4w^2(b-c)\frac{a}{g}$. Adding these, we have, for the 8 particles after removal Centrifugal pressure $= P_c = 4w^2\frac{a}{g}(b+c+b-c) = 8w^2b\frac{a}{g}$, the same as when they were at the center. Taking now a ground plan and letting cd = cd′ = d, also ad = e, we have,

Elevation or vertical projection.



Ground plan or horizontal projection.



for the centrifugal pressure of 2 particles at d: $P'_c = 2w^2e\frac{a}{g}$, but this pressure is in the direction ad, and we must resolve it into 2 parts, one in the direction cd, which will be destroyed by the opposite component of the pressure produced by the 2 particles at d′, and the other in the direction d″d, which, combined with the corresponding component of d′, will result in a pressure in the direction ac, the same as if the particles were at c. Resolving, we have for the pressure in d″d: $p''_c = 2w^2e\frac{a}{g}\cos.\,cad = 2w^2e\frac{a}{g}\frac{b+c}{e} = 2w^2(b+c)\frac{a}{g}$; and as there are 2 pairs of particles the whole pressure is $P'''_c = 4a^2(p+c)\frac{a}{g}$, the same as if the 4 particles were at c. Lastly, it is evident that there can be no change of centrifugal pressure produced by moving the particles parallel to the axis, and therefore the pairs may be separated in this manner. Therefore the particles being moved from the center of the sphere into position in its body, no change is produced in centrifugal pressure.

P. K. D. says, in answer to C. C.'s query as to press power: I would suggest that to give the amount of pressure exerted against W, it will be necessary to know the distance from B to the center of track roller. If the power was applied at the center of the track roller, then the amount would be obtained thus: Divide the length of lever E (measuring from center) by the distance from center of track roller c to a perpendicular line drawn from the point of lever attachment (to W) to the track. Multiply this by 8 (the power obtained by the line) and the result thus obtained by the 1600 lbs. This will give about 75024 lbs. Now to solve the problem given: Diminish this result in proportion to the distance that B is moved up the lever from center of track roller.

F. A. W. says, in reply to P. T.'s query as to the consumption of water by engines in cold as compared with that in hot weather: A few years ago three boilers were situated on the higher floor of a building, and were heated by gas that would otherwise escape. This gas was admitted to the boilers and regulated by means of sliding gates. The speed of the blowing cylinders was governed of course by the velocity of the engine, and the latter by an ordinary governor; but this not being sufficiently accurate, it was necessary to throttle the engine to drive it at the required number of revolutions per minute. Much practice enabled us to admit just sufficient gas to the boilers to maintain a pressure of 60 lbs. with hardly the variation of a pound in a week, and sometimes in a longer period. Nearly a year of such experience showed us that, in cold, damp weather, it was necessary to admit more gas, and in warm, pleasant weather to admit less. Of course, difference in charging would make a change in the quantity and quality of the gas, and perhaps augment the resistance of the air that was being forced into the furnace; but a long continued series of experiments, such as we were obliged to make, eventually established the fact. The boilers were supplied with a constant stream of water, regulated arbitrarily by a cock, and so accurately as not to require moving sometimes for days together. "I do not apprehend that the cold damp weather had any appreciable effect in requiring the admission of more heat to the boilers, except by the increased condensation of steam, which was not more than in ordinary engines. This same condensation will undoubtedly account for the difference, if there is any, between the effect of steam and air in a locomotive."

D. M. says, in answer to the question proposed by C. H. A. (page 187, vol. XXIX): Let there be a system of rectangular axes, having c for their origin, bc being the axis of X. Since the number of revolutions of the ball a is constant, a line equal to its distance from the axis of X and perpendicular to the same axis, may be taken to represent the centrifugal force, the force of gravitation being represented by a constant line parallel to the same axis, and which I denominate by g. Therefore at any point, x′ y′, of the curve, the resultant of the two forces will pass through the point, x′ y′, and also through a point whose equations are x = x′ − g, and y = 2y′. Therefore the equation to the resultant is $y - y' = -\frac{y'}{g}(x - x')$ which is evidently the equation to the normal of a parabola having 2g for its parameter. (See Davies' "Analytical Geometry.")

G. W. says, in reply to H. H. J., who asked as to making a combined reaper and thresher: It cannot be done. At the time grain ought to be cut, it is not dry enough to thresh; and if left standing until it is dry enough to thresh, it will shell out so as to lose half the crop, especially if the grain be oats. It was this which made useless a harvester in the western states. It cut the heads off and left the straw standing; the heads were to be stored in cribs or bins, like corn. But the heads proved to contain so much moisture as to cause mold and rot.

W. W. H. says, in answer to T. M. Jr., who asks how to preserve grapes in the bunch, fresh as when taken from the vines: When the grapes are fully ripe, clip the bunches from the vines carefully, and get a water tight keg or box. Place in the bottom of the box a layer of dried grape leaves, half an inch thick, then layers of grapes and leaves alternately until the vessel is filled; nail a board on top, and bury the vessel in the ground, where water will not stand, out of reach of frost. Grapes put up in this way will keep fresh and sound until April.

J. W. H. says, in reply to C. P. T., who wants a heavy foam on a tonic beer: Use the whites of a dozen or more eggs in a 10 gallon keg.

J. M. B. says: "I think the blistering of varnished cement tiles, which D. U. B. complains of on page 171, current volume, is caused by the expansion of the moisture contained in them when varnished. A remedy would be to drive the moisture out."

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On the Million Dollar Telescope. By W.M.R.
On Canal Navigation. By T. K.
On Hatching Eggs. By B. F. S.
On Spectroscopic Manipulation. By C. A. D
On Perpetual Motion Seekers. By F.
On Financial Science. By J. E. E.

Also enquiries from the following:

H. C. B.—C.G. T.—M. W.K.—A.V. L.—J. N. P.—G.M.—J.W. S.—W. H. B.

Correspondents in different parts of the country ask Where can I get a cross-cut saw for getting out trunks of large trees? Where can I obtain cotton seed oil machinery? Who makes shoe peg machinery, and what does it cost? Makers of the above articles will probably promote their interests by advertising, in reply, in the SCIENTIFIC AMERICAN.

Correspondents who write to ask the address of certain manufacturers, or where specified articles are to be had also those having goods for sale, or who want to find partners, should send with their communications an amount sufficient to cover the cost of publication under the head of "Business and Personal," which is specially devoted to such enquiries.

[OFFICIAL.]

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Letters Patent of the United States

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September 30, 1873,

AND EACH BEARING THAT DATE.

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