C. H. does not send his name and address.—J. G. can bend sleigh runners by following the directions on p. 43, vol. 30.—C. K. will find recipes for waterproof glue on p. 379, vol. 30; for polishing iron and steel on p. 133, vol. 31.—H.C. K. will find a description of ice-making machinery on p. 243, vol. 30. Pure butter needs no artificial coloring.—F. C. M. will find instructions concerning induction coils on pp. 215, 218, 363, 378, 379, vol. 30.

(1) T. S. K. asks: What will be the proper size of a boiler for a cylinder 1½x3 inches, and what will be the size of the flues for such a boiler? Of what plate should it be made, and what amount of horse power will it give? A. You do not give sufficient data.

Will calcined plaster be fit for cores for small castings? A. Yes.

Will white metal wear as well, for a small engine, as brass? A. Yes.

(2) J. C. S. asks: Given the diameter of a circle, how can I find the length of a chord that will cut off one third of the area? A. The chord is about 0·964 of the diameter.

(3) H. W. asks: 1. Of what size and how set should a boiler be to run an engine of 1 inch bore by 2½ inches stroke at 200 revolutions per minute at 15 lbs. on the square inch? A. Vertical boiler 12 inches in diameter, 3 feet long, with 6 tubes, 1½ inches in diameter. Set it upright, with fire underneath, and casing around. 2. How thick should it be to hold 45 lbs. steam? A. One eighth of an inch. 3. Of what size should the safety valve be? What should be the distance between the notches, each notch denoting 5 lbs.? A. One quarter inch diameter. Distance between notches depends upon the weight.

How much steam will one gallon of water produce if confined in the same space? A. One gallon.

(4) G. E. asks: I wish to construct a small steam engine to run on a lathe of 7 inches swing. How large a cylinder will be necessary? What should be the area of ports? What should be the diameter and weight of fly wheel? What proportion should the connecting rod have to the length of stroke? A. Make the engine to develope about ¼ horse power. Ports 1-20 area of piston. Fly wheel, 6 miles diameter; weight, 15 lbs. Connecting rod, from 2½ to 3 times length of stroke.

Is there any work published for amateurs or others on the construction of small engines? A. There is no such book; but you will find many valuable hints and suggestions in back numbers of the SCIENTIFIC AMERICAN.

(5) B. R. asks: 1. What is meant by lap and lead of a steam engine, and what is the proper method of setting a slide valve? A. Consult Auchincloss on "Link and Valve Motions." 2. What power would a high pressure engine of 16 inches cylinder by 30 inches stroke, at a pressure of 60 lbs., running at 40 strokes per minute have, and what power would the same engine have with a condenser? A. You can answer this by multiplying the mean effective pressure of steam on piston by distance in feet that the piston moves in a minute, and dividing by 33,000.

What is a good work on bird stuffing? A. Brown's "Taxidermist's Manual."

(6) C. M. C. says: I am operating an engine with a cylinder 8¼ inches by 14 inches stroke; the bed frame sits fair on top of boiler. There are two 6 feet driving wheels; the crank shaft is 3¼ inches in diameter; the bearings of the crank shaft are 5 inches in length. The wristpin is 3 inches in diameter and 3 inches long. Key up the connecting rod as I may, the engine has a thump that can be heard 200 yards off at all speeds up to about 160 revolutions; above that speed the thump appears to cease; but as soon as the speed slacks, it commences again. If I tighten up the connecting rod brasses, they heat and cut in spite of all the oil that we can put on them; if I leave them slack, they cut without heat. The main journals will also heat if a little tight, and cut if slack. I have tried every plan that I have ever heard of. I have run it tightened up and slack. I have lengthened my main rod and shortened it. I have put in liners until the strap key would hardly enter. I have tightened my cylinder rings, and I have run them loose, and all to no effect. What shall I use for it? A. It appears from your account that the valves are not set properly. Possibly the piston may be loose. An indicator diagram would be very apt to show the cause of the trouble.

(7) J. W. E. asks: 1. If I have a number of blocks of ice, about 2 feet square and 1 foot thick, frozen all round 1 or 2 inches in thickness, there still being 8 or 10 inches of water in the center, and I store these cakes all together in an ice house, will they freeze solid? If so, will they keep as well as if they were frozen solid before being stored? A. They will not freeze solid. 2. Is there any book published on ice, or the proper construction of ice houses? A. We do not know of any. See answer No. 29, p. 251, vol. 31.

(8) H. C. asks: Please give me a formula for preparing cotton, to be not so explosive as guncotton, yet to burn rapidly and leave no perceptible ash? A. Sulphuric acid of specific gravity 1·70, 6 ozs.; dried nitrate of potassa 3½ ozs.; water 1 oz. Mix the acid and water in a porcelain vessel, and add the pulverized niter, gradually stirring with a glass rod until the lumps disappear and the mixture becomes transparent. Place a thermometer in the mixture, and when it indicates between 140° and 100° Fah., the cotton should be immersed. Take 60 grains clean cotton, separate it into 10 or 12 bolls, and immerse the bolls separately; and leave the whole in the mixture for 10 minutes. The temperature should fall to 140°. Float the cup on boiling water, and maintain it between 140° and 150°. At the expiration of 10 minutes, lift the cotton with glass rods, and squeeze out the acid quickly; and dash the mass into a large vessel of clean, cold water, separating the mass so as to wash it thoroughly and quickly; complete the washing by immersion for several hours in running water, then spread it out to dry spontaneously.

(9) G. H. R. asks: What is the method of obtaining the latitude of any place by the use of the box or pocket sextant? Is there any work which explains the use of the sextant? A. You will find the information you desire in Loomis' "Astronomy."

(10) B. A. C. asks: How is lead pipe made? A. It is forced over a die by hydraulic pressure.

(11) H. M. asks: I am about building a cheap rain water cistern. 1. Is it practicable to dig my cistern to the required dimensions, and then to cement directly on the walls without the use of bricks, giving it two or more coats? If it can be done, would it make a substantial job? A. It is not safe to attempt the construction of a cistern on the plan you propose; but if your soil is hard enough to stand to the line when your excavation is made, you can line it with a 4 inch wall of brick laid up in cement and plastered with the same on the face. If this is laid hard up to the bank, it will make a tight cistern. 2. I wish to raise the water with a pump; can I construct a pump by rabbeting the sides together, using square buckets? A. If you inquire the price of pumps, you will find it more economical to buy one than to make it and risk the chance of failure.

(12) H. D. S. says: I am building a small engine, 1x2 inches. What sized boiler should I use, to run it, driving a sewing machine? Would copper or iron be best? A. Make one 12 inches in diameter, 2 feet high, with 6 flues, 1½ inches in diameter. Either copper or iron ⅛ of an inch thick will answer, the former being more durable of the two.

(13) G. A. B. asks: Suppose a rope is stretched moderately tight between two trees, and a weight of 140 lbs. is suspended from the center, what is the strain in pounds on the rope on each side of the weight? Is it 70 or 140? A. If t = tension of rope, w = weight, α = angle between parts of rope on each side of the weight, then $t = \frac{w}{2\cos.\ \alpha}$. From this equation you will see that the tension of the rope is equal to the weight when the angle is 120°.

(14) D. H. E. asks: Will a stream 3 inches square in cross section under 8 feet or 6 feet head, afford power to run a 50 saw gin? A. No.

(15) M.A. asks: If a wheel rolls down an incline with nothing but inertia to resist its descent, where is its axis, theoretically? A. The axis is a line passing through the center of inertia of the wheel, which generally nearly coincides with the geometrical center.

(16) F. O. S.—In general, machinery can be driven with less power by belting than by gear wheels.

(17) H. W. G. asks: 1. What does the best flint and crown glass cost per lb., such as is used in the best achromatic object glasses? A. Chance's flint glass, such as is used in making small object glasses for telescopes, costs $2.50, and crown glass of the same quality $3, per pound. Camera glass, which is less expensive, is used for cheaper achromatic lenses and photographer's tubes. 2. To calculate the earth's distance from the sun by the transit of Venus, does not Venus' distance from the sun (or what is more likely, from the earth) have to be known before the problem can be solved? A. The relative distances of the planets from the sun being computed from their times of revolution by Kepler's third law, the earth's distance is to Venus' distance as 1,000 is to 723. The ratio of Venus' distances from the earth and sun is as 277: 723, and Venus' parallax measured on the sun's disk is in miles 2·61 times the distance in latitude between two observers on the earth. The linear value of a second of arc at the sun being about 460 miles, the solar parallax, or angle which the earth's radius subtends at the sun, will be about 9 seconds of arc, and his distance 91,500,000 miles.

(18) J. H. S. asks: How can I obtain a certificate as an engineer? A. You must apply to the local supervising inspector in your district. 2. To whom should complaint be made of a steamer, run, on an inland lake, by a common machinist who never ran an engine of any kind before, and is not a competent man in any way? A. To the inspector.

(19) M. M. asks: What is the best way to regild parts of a mirror frame? A. See p. 96, vol. 30.

How is it that when the moon is visible the aurora is not? Has the moon anything to do with the appearance of the aurora, or is it merely a coincidence? A. The light of an aurora is usually so faint that it is not visible except on dark nights.

Are atoms all of one and the same size? A. No.

(20) D. B.—The cost of an analysis would be larger than such a recipe would be worth.

(21) T. C. asks: In a small spring of water, near where the water emerges from the ground, I found a crab similar to the salt water crab, but of a darker color. Can you tell me how it came in such a place? A. A. Your description is too indefinite. It might have been a fresh water shrimp.

(22) H. W.—Filtering water through brick is commonly done, and is a most efficient method.

(23) H. I. H. asks: What is the rule for finding the number of square inches in any circle? A. Square the radius in inches and multiply by 3·1416.

(24) C. S. B. says: I have discovered a new rule for the solution of a certain kind of equation which I think preferable to the one usually given in the text books. It is applicable to all equations which can be reduced to the following form: $(x^2+ax)^2 \times b(x^2+ax) = c$. The rule usually given in books is this: Reduce by inspection the given equation to the above form; then consider the compound term as a single quantity, find its value by completing the square and extracting the square root of both sides of the equation, from which the value of x is easily found. My rule is this: Extract the square root of the left hand member of the equation as far as possible, which will show you a numerical quantity that must be added to the left hand member of the equation to complete the square, add this quantity to both sides of the equation, extract the square root of both sides, and you have an equation from which the value of x is easily found. The advantage of this rule above the one usually given is that it is sometimes very difficult to reduce the given equation to the above form, whereas that necessity is obviated by the last rule. A. We do not know that we understand your method thoroughly. We append two examples which are readily solved by the ordinary method. If you will send us solutions in accordance with your rule, we shall be better able to compare it with the old method. 1. $\frac{4x^2}{7} + \frac{2x}{7} + 10 = 19 - \frac{3x^2}{7} + \frac{58x}{7}$

2. $a^2+b^2-2bx+x^2 = \frac{m^2x^2}{n^2}$

(25) J. G. W. asks: Where can I get any information that will aid me in foretelling the weather by the aid of a barometer? There are times when the mercury is well up in the tube, and yet considerable rain falls without much falling of the barometer. At other times when the barometer is falling, there is no rain. A. Read T. A. Jenkins' pamphlet on the barometer, thermometer, hygrometer, etc.

(26) M. A. asks: 1. Why is it that the contact breaker in an electro-magnetic machine stops and makes the current jump, very nearly stop, and then jump again? Is it because the platinum is not good? A. The spring and face of the hammer should be perfectly clean, as should also all connections. The trouble may lie in your battery and not in the coil. We do not understand your other question. Copper, not iron, wire is used in the coil.

(27) S. K. S. asks: How large a tube would be required for the barometer referred to on p. 331, vol. 30? A. From 3 to 4 feet long.

I made a storm glass according to the rule given on p. 234, vol. 29, but could not tell anything by it, the liquid remaining cloudy all the time. On the lowering of the temperature, it would form crystals like snow flakes. A. Your trouble is probably due to impure chemicals. These glasses are not considered as absolute indicators. Some claim that they are affected by electrical disturbances.

What is meant by the power of spy glasses, 10, 15, 25, etc.? In the last instance, does it mean that an object 25 miles off can be seen as plainly as it would if it were only one mile distant with the naked eye? A. Yes but this is not absolutely true, as the intervening atmosphere, with its varying density and humidity, is never taken into account.

(28) I. T. O. says: I tried to make marine glue after the recipe you give in your book; I first put the rubber in one bottle and the shellac in another and then poured, as I thought, enough ether on each to dissolve it; I put them on a warm stove, removing the corks to let the gas escape. Both bottles took fire and burst. A. Fill your bottles with ether, stopper tightly, and keep in a cool spot for forty-eight hours. The bottles, because of their extremely volatile and inflammable contents, should be kept cool, and at a safe distance from fire of every kind. We are sorry for your accident.

(29) O. S. C. asks: 1. How can a permanent gold color be given to metallic lead? A. By alloying it with a certain percentage of copper. 2. How can the specific gravity of metallic lead be increased? A. The specific gravity of pure lead is unalterable, but an alloy of lead with either gold or platinum may be made, the specific gravity of which will be greater than that of lead alone.

(30) H. D. M. asks: 1. How can I apply paraffin to heavy canvas to make it waterproof? A. Saturate with solution of paraffin in naphtha. 2. How shall I make it of a dark color? A. The paraffin is first melted and then digested for a short time with coarsely powdered or bruised anacardium nuts, the fruit of the *anacardium orientale*. This nut contains a black vegetable fat, which combines intimately with the paraffin.

(31) L. L. G. asks: Why does a piece of lead pipe become filled with holes when it runs through certain soils? A. There are many mineral salts which, when dissolved in water or when brought into contact in a moist condition with lead, corrode it. Which salts are present in the water or in the ground through which your pipe runs could only be determined by analysis.

(32) H. F. asks: What is the specific gravity of ordinary vulcanite, vulcanized for 2 hours under a temperature of 320°? A. We will determine the specific gravity of such a piece of vulcanite; but we have none at present in our possession.

(33) C. G. H. asks: 1. If a man built an engine, boiler, and boat, and put them together, would he be considered fit for an engineer, to run said boat? A. This is a question that could only be answered by the inspector. 2. What does a boat's certificate cost? What does an engineer's certificate cost? A. Licence for boat costs $25. Licences for captain, pilot, and engineer, first class, $10 each, second class $5.