B. W. F. is informed that an American gallon contains 231 cubic inches; an English imperial gallon, 277·274.—F. D. L. will find a description of a process for black enamel on iron on p. 208, vol. 26.—P. S., who asks questions as to roofing, etc., should send his name and address.—H. E. J. should consult our advertising columns for books on carpentry.—J. F. F.'s reply to V. C. is incomprehensible.—W. H. S. will find directions for making vinegar on p. 58, vol. 30. Solid opodeldoc can be made by using more soap in the mixture.—G. O. D. will find recipes for gilding on glass on p. 288, vol. 30. Asphaltum varnish is described on p. 238, vol. 26. For painting on glass, see p. 123, vol. 30.—T. F. will find directions for a cement for mending china on p. 241, vol. 27. Tempering springs is described on p. 251, vol. 29. Black asphaltum varnish for cast iron is described on p. 238, vol. 26.—J. T. B. will find a recipe for jet black ink on p. 203, vol. 29.—S. A. M. will find directions for making marking ink on p. 251, vol. 29.—For whitewash, see p. 280, vol. 29. For paper boats, see p. 168, vol. 27.

W. F. H. asks: 1. How can I find the velocity of water in any sized flume? A. By experiment. 2. What percentage of power do overshot wheels usually yield? A. From fifty to seventy-five per cent. 3. Can you give me a rule for laying out bevel gears? A. You will find it in any treatise on mill work.

A. M. B. says: 1. In vol. 30, No. 12, you speak of an ice boat going nearly three times as fast as the wind. B. says that this is against common sense. Can you explain it? A. You will find the matter clearly explained on p. 176, vol. 28. 2. What would be the real lifting power of an engine of 4 horse power? A. It would be able to lift 132,000 lbs. one foot high in a minute.

In our answer to L. E. I., in the SCIENTIFIC AMERICAN for April 4, 1874, the sentence that "port area one half that of the piston" should read: "port area from one twentieth to one fifteenth the area of the piston."

G. A. B says: We use two kinds of brake shoes on our cars, one of wood, the other of iron. My friend says that the iron ones are the best, for the reason that he can screw down brakes as hard as he pleases with the iron shoes, and the wheel will scarcely ever slide on the rail: but with the wooden one, half the force expended will cause the wheel to slide. I, on the contrary, say that the wooden one is the best, for it is the one which retards the revolving of the wheel most with the least expenditure of "elbow grease;" we do not question which is the best material for shoes for general usage, but which will stop a train in a given time with the least power expended by the brakeman. Who is right? A. The friction between the wheel and the wooden shoe would ordinarily be greater for the same pressure, than when the iron shoe was used. 2. What gum can I get which will dissolve in alcohol and after drying be again soluble in water? A. We do not know of any.

G. W. M. asks: About how deep will cast or wrought iron rust, if exposed to all weathers? A. Experiments have not been very extended, but it is supposed that, if the metal is not subjected to strain, it will rust about 1-16 of an inch deep in 25 years.

S. H. D. asks: Why is it that a common portable pump, used on a portable steam engine to feed the boiler, will not take hot water but will take cold water? A. The vapor formed by the hot water creates such a pressure that the valves cannot open.

G. R. B. asks: Is the weight or pressure upon the valves of a steam engine the area of the ports or openings which are covered by the valves multiplied by the pressure per square inch, and are the valves balanced when the ports or openings are not covered by them? In short, is the theory of no port, no pressure, correct, and do the rules which apply to the figuring of the weight or pressure on the valves of an engine also apply to the pressure upon the piston packing? In other words, can the rings of the so-called steam piston packings be set out by steam? A. The pressure of the valve is that due to its own weight and the unbalanced pressure of the steam on it. Thus, if an equal area is pressed on top and bottom of the valve, all the pressure will be taken off. There are several styles of piston in which the packing rings are set out by steam pressure.

W. C. M. asks: 1. Is tallow the best thing for lubricating an engine cylinder? Is there anything that will improve it for the purpose? A. Some prefer oil. 2. How can I bleach tallow without injuring it? A. Melt and strain it before using.

H. W. says: 1. We attribute to Newton the discovery of the law of gravitation. Is there an opposite law of repulsion? A. Yes, but it acts at very small distances. Molecules repel each other according to the amount of heat they contain; the temperature of space, supposed to be 300° Fah. below zero, is sufficient for ether vibrations. 2. Newton dignified his discovery by declaring the law of gravitation to be a principle inherent in matter. In the same sense, is there not also an opposite law of repulsion which is a principle inherent in matter? A. No. 3. I suppose it may be said that gravitation is not now considered to be a principle, but an effect of force. In this view of the case, is there not repulsion which is in the same sense an effect of force? A. No. 4. Do or can astronomers explain the movements of cosmical bodies satisfactorily upon the theory that they are balanced between the centripetal and the centrifugal forces, or do they offer any satisfactory explanation of such movements on any basis which ignores the existence of a law, a principle or an effect, of repulsion which is independent of the above named forces? A. The moon falls toward the earth one twentieth of an inch every second, instead of going off at a tangent. See Loomis' "Treatise on Astronomy." 5. If the earth swings around the sun in an orbit predetermined only by its momentum, its centrifugal, and its centripetal force, why is it that, when its orbit is once disturbed or varied, as it has been thousands of times by the planet Mars, for example, that the variation does not remain a permanency? [A. Where two bodies have exactly commensurate orbits, the orbit of the smaller body is entirely changed. Hence the gap in Saturn's ring has been caused by one of its satellites. In the formation of a solar system, only those orbits survive which are incommensurate with each other. 6 Comets which come to the center of our system are hurled back into the depths of measureless space. What is the power which operates with such irresistible certainty? Can their eccentric orbits possibly be referred to the equal and unvarying centrifugal force? Is not every known mechanical supposition opposed to such a theory? A. All bodies move with their greatest velocities at the perihelion passages. Hence their ability to get away again. 7. But all orbits of all cosmical bodies are like those of comets, namely, they have an ellipsoidal form of revolution. Does not this indicate the idea that the laws which compel them to retain their orbits are in all cases the same as those affecting cometary revolutions? Here end the questions I desired to ask. The theory of a principle of repulsion has already been announced. It remains to ascertain how this law or principle or effect comes into existence. Take two balls of some light substance, dried pith is as good as any. Let one of these be surcharged with electricity, and it will attract the other. Let the two balls remain in contact with each other a short time, long enough for their electrical condition to become equalized, and they will repel each other. Now suppose the sun to be a highly charged electrical body, and a comet to be relatively an uncharged body, it follows that the comet will be drawn toward the sun by electrical attraction. It is true that the comet will be drawn by the force of the attraction of gravitation also, and will be governed by its centrifugal force, but the electrical attraction will supplement these forces. Arriving near the sun, the electrical condition of the comet becomes changed by reason of its proximity, and hence is repelled just as one pith ball is repelled by the other when the condition of the two has become equalized. It is proper to say here that while many various phenomena of electrical action are recognized, yet the whole subject of electricity, its connection with heat motion, the contraction or expansion of bodies by heat or from other causes, its development by motion or from contiguity of bodies, in short, the whole theory of the correlation of forces, can hardly be said to be understood, and in many respects is halting and unsatisfactory. Whether the sun is surrounded by what may be called an atmosphere of electricity, which reaches beyond the boundaries of the outermost planet, or whether the electrical condition of cosmical bodies is excited by their expansion by heat when they arrive at their points of closest proximity to the sun (which appears improbable), one thing is certain, which is that there is a law or principle or effect of repulsion which is a necessary law, and which defines those circular boundaries in space which the worlds may not overpass. A. Electrical forces appear to play a very subordinate part in Nature. Stars are seen to drift about in currents and vortices with an occasional collision. The resulting combinations are in exact accordance with the law of gravitation. The motes in a sunbeam, the shining *noctiluca miliaris* in the sea, or Brownian movements of minute particles under the microscope, may serve to illustrate these currents of circulating stars.

E. B. W. asks: 1. What is the rule for finding the area of a segment of a circle? A. It is equal to the area of the circular sector, bounded by the same arc, diminished by the triangular portion of the sector. 2. Also of an ellipse? A. The area of an ellipse is equal to 0·7854 times the long diameter multiplied by the short diameter. 3. What causes a liquid to circulate when running downwards through a hole, as, for instance, through an opening in the bottom of a vessel? A. The motion is given to it by the spiral form of the hole, or the position of the hole in reference to the center of the vessel. 4. What is the best recent work on surveying? A. Trautwine's works are among the latest and best.

T. G. asks: 1. How can I solder or braze two pieces of brass together steam tight? A. See p. 251, vol. 28. 2. What is the best thing to remove scale from a boiler? A. Try putting about two ounces of muriate of ammonia in the boiler twice a week. 3. Ought a person who wishes to be an engineer to study any books, or is practice alone sufficient? If not, what books are the best? A. By all means study good books. Begin with Bourne's "Catechism of the Steam Engine." 4. What is the best paint for a smoke stack? A. See p. 295, vol. 28.

C. R. asks: 1. How can I make a good cement for filling air holes in cast iron? I want something that will stand heat. A. You can tap the hole, and screw in a piece of metal. 2. Which drags the most water, a side wheel steamer or a propeller, both hulls being of the same size and shape? A. Generally there is no drag in either case.

D. B. S. says: 1. In a lecture on electricity, a piece of money was placed in a saucer of liquid that looked like water, and a person could have it if he could pick it out. In one hand was to be placed a ball connected with the wire of a battery, which did not have any effect on the person until the other hand touched the liquid, when that hand would immediately fly upward the length of the arm. What was the liquid? A. Probably water. 2. Why did the effect take place? A. The water in the basin was connected with the other pole of the battery, so that, on touching it, a violent shock was given to the system, with the result you describe. 3. Are caoutchouc and gutta percha the same? A. No. 4. Will a bell give the same volume of sound if struck on the outside that it will when struck on the inside, the blow being equal in both cases? A. Depends upon the size and form of bell. Small bells, we believe, give better sound when struck upon the outside.

M. asks: 1. Do you think I can master mechanical drafting without the aid of a teacher, other than books? Whose work would be the best on drafting? A. You can learn a great deal from a book, but there are many things that a draftsman should know that can only be acquired by experience. We can recommend Professor Warren's works. 2. Why will a screw propeller make more turns, other things being the same, in running against the tide than in going with it? A. We would like some good evidence that this is a fact before seeking for a reason.

M. W. H. asks: 1. Will vegetable or any freezable bodies freeze in alcohol? Will they freeze as soon as the alcohol gets below 32° Fah.? A. When the temperature of the alcohol sinks below the freezing point of the substances contained in it, they will freeze. 2. Why does a telescope magnify if we look through from the big end at anything close to the little end, while, when looking at anything a few feet off, it makes it smaller? A. In the former case the rays proceeding from the object glass enter the eye as a diverging beam. 3. Is there such a thing as a single glass telescope, or thing that can be used as a telescope? A. A single glass telescope is not possible. 4. Will nitro-glycerin explode as soon as the acids and glycerin are poured together, or does it have to be stirred together and left to stand for a while? What are the proportions of chemically pure nitric acid, sulphuric acid, and glycerin, by weight, to make nitro-glycerin? A. See p. 283, vol. 30.

M. M. asks: 1. Where gas from the city works can be bought for $3 per thousand feet, would it be economy to generate hydrogen by the action of sulphuric acid at 3 cents per lb. upon iron turnings at 1 cent per lb., and give it luminosity by passing through a filter saturated with coal oil at 20 cents per gallon? A. If these figures represented the entire expense of the manufacture, it would be. 2. What is the cheapest method of procuring oxygen upon a large scale without expensive apparatus? A. The oxygen companies use chlorate of potash heated in iron pots. The simplicity of the plant employed and the purity of the gas compensate them for the cost of an expensive material. 3. Is the calcium light made by a jet of common air through a flame of illuminating gas upon a piece of chalk of sufficient intensity to use as an illuminating agent? A. No.

J. H. says: I have two coal shafts, both sunk to the same vein, one for downcast and the other for upcast. I am using for a ventilating power, at the bottom of the upcast, a large furnace: and in addition to the furnace I have the upcast elevated 45 feet above the level of the down cast; both shafts are of the same size, 7x14 feet. If I make the mouth of the downcast 18 feet square in place of 7x14 and bring it down to the regular size at 18 feet down the shaft, which I think would make a kind of receiver, would it add to the weight or pressure of air in that shaft, and be any help to the furnace? A. No. 2. Is coal tar injurious to wirerope? A. No.

G. E. D. asks: How can I make sensitized paper? A. Take albumen paper, and float (prepared side downwards) on a bath of 1 oz. nitrate of silver in 18 oz. distilled water: add a few drops of citric acid to dissolve the first precipitate. Float for half a minute and dry in a dark room.

E. D. B. asks: 1. Are the grounds of cameos colored artificially after being cut, especially the beautiful green ones? If so, by what means? A. No. The different colors belong to the various strata of the stone. 2. What work on geometry has a full description of the curves of the fourth order? I have heard that, by the use of the cissoid, an angle could be trisected; is this so? A. In treatises on the calculus. The cissoid is a curve of the third order. It is described in Newton's "Universal Arithmetic." 3. Has there ever been a supposed metallic base of hydrogen discovered, or is any such supposition entertained by Science? A. It is considered a reasonable hypothesis by some scientists; but so far as we know, no such metallic base has been discovered. 4. Is the ultramarine water color made from the stone *lapis lazuli*? If not, what is the reason of its great cost? 4. Yes. Artificial ultramarine is also made, and sold much cheaper.

D. B. asks: 1. Where is the proper place to bolt a portable engine to a boiler, on the side or on top? A. Either place will do, if the boiler is properly braced. 2. Is a portable engine, placed on the top of the boiler and using a double crank, as strong as one bolted to the side of the boiler, using a single crank? A. Yes, if well proportioned. 3. I have a portable engine, cylinder 5 x 10 inches and speed 120 revolutions per minute; the firebox is 20½x19½ inches, with 32 flues (1¼ inches) of copper, 32 inches in length. I use the exhaust blast, contracted to ⅓ an inch, in a stack 8 inches in diameter and 17 feet high. The pressure is 30 or 40 lbs. Would it be more economical to lengthen the boiler to 4 feet, using the same number of flues? A. We would not recommend this change.

C. O. asks: 1. What is the difference between the actual and nominal power of a steam engine? A. Actual power depends upon actual conditions under which the engine works. Nominal horse power is obtained from assumed conditions. 2. What would be the power of an engine that has 36 inches stroke, 16 inches diameter of cylinder, and 45 revolutions a minute worked with 70 lbs. of steam? A. You do not send sufficient data. See article on "Indicating Steam Engines," p. 64, vol. 30. 3. How much is to be deducted for friction? A. From 20 to 50 per cent. The precise, amount can only be determined by experiment. 4. Is half the power lost by the crank in converting rectilinear into circular motion? A. No.