the strong smell while burning in a lamp or wick oil stove? A. A good quality of kerosene will not give much odor in burning in a lamp or wick oil stove, if care be taken to keep the wick well trimmed, and to adjust so that it will burn without smoke. There is no way of further purifying kerosene oil, as to make it burn without odor.

(10481) B. E. Co. asks: What kind of solder can be used to solder iron to iron that will in no way be affected by contact with quicksilver? Are there any other cheap metals besides iron that quicksilver will not affect? A. We know of no kind of solder which would not be more or less affected by mercury. Zinc and lead, which are the only other cheap metals, are both affected by mercury. Copper likewise.

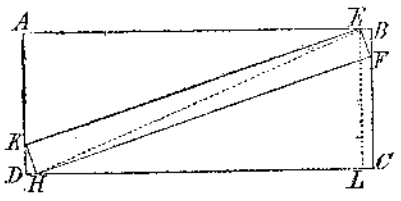
(10482) J. E. R. inquires whether or not a current water-wheel under a 3-foot hydraulic pressure, with paddles 10, 12, or 16 feet long by 3 or 4 feet wide, will run a 12-inch centrifugal pump, elevating water all told 12 feet (total lift 12 feet). The average fall of the stream is 10 feet per mile and it has a velocity of 6 feet per second. The diameter of waterwheel any size you may suggest. What would be the horse-power of a current water-wheel, length of paddle 14 feet long by 4 feet wide, and 16 feet in diameter? A. The 14-foot wide current wheel as described should give you 36 horse-power, and with a good centrifugal pump should raise 6,000 gallons of water 12 feet high per minute.

(10483) S. R. D. writes: Some time ago you published a formula for softening steel. A. To make steel very soft, heat to a full red for a few minutes, let it gradually cool until it turns black, then quench in warm water.

(10484) W. L. L. writes: In connection with my planing and lumber mill I have hundreds of tons of sawdust and shavings from the planers that I would like to utilize, but lack the necessary knowledge as to how to do it. I have been informed that you can give me the desired information as to what kinds or forms of petroleum or other material, and what kinds of machines, and where obtained, that it would be necessary to use in working this refuse up into marketable fuel. A. Mill shavings and sawdust have been compressed with coal tar, resin, or anything that will make the material stick together, but have been found too expensive unless other fuel was at very high price. In woodworking factories in the Eastern and Middle States, the whole product of the mill is burned under the boilers by enlarging the fire chamber by lowering the grate. Sawdust drawn to a bin by a fan blower, and wet by a water spray just enough to fix the dust, is shoveled directly into the fire chamber. Clean shavings are much utilized by baling and selling to stables for horse bedding.

(10485) N. L. writes: In the Scientific American of March 2, page 199, question 1, No. 10409, your author has made so many glaring mistakes in his reply as to merit a severe calling down. An occasional error is always pardonable, but a series of misstatements, given out as authority, likely to mislead the uneducated, surely needs a correction. You say: "If a vessel begins to sink, it must continue to sink until it reaches the bottom. Water is not compressed to any extent at greater depths than it is near the surface. If anything can sink at all in water, it will go to the bottom before it stops." All three of these statements are at variance with all known authorities in hydraulics. A hundred demonstrations are known to the average schoolboy to the contrary. Is it not an established fact that any body sinking in any liquid will sink until it reaches a point where the weight of the liquid above it will just balance the weight of the body, at which point it will rest? Your statements are all at variance with the long and well known law of upward pressure or buoyancy or liquids. This reply to question 1 would not be worthy of any great notice were it not for the fact that it may mislead a great number who may be reading your replies for knowledge they expect to be absolutely correct. The question is an old one, and, as you say of question 2, it "has traveled for a century," but you must remember that every year brings forth a new set of uneducated readers. A new generation comes up seeking knowledge, and it is hardly fair to ridicule even the most common of questions, *as you frequently do.* A. We do not know what data our correspondent has for his very positive statement contradicting our answer to query 10409. The compressibility of all materials is given in the reference tables. The latest and, we think, the best at our disposal is the Smithsonian Physical Tables, published under the authority of the Smithsonian Institution, Washington, D. C., the last edition of which was issued in 1903. On pages 82 and 83 will be found the compressibility of liquids and solids, for one atmosphere. The compressibility of sea water is given at 0.000044. The compressibility of several metals is given: Copper, 0.000086; lead, 0.000276; steel, 0.000068. All these are for one atmosphere or 15 pounds per square inch. It is seen that steel is 1½ times as compressible as sea water. By compression it increases more rapidly in density than does sea water, as it sinks in the ocean. Steel is about 7.8 times as heavy as water at the surface of the ocean, and will grow heavier by compression as it sinks in the ocean faster than the water in which it is sinking. It will therefore be everywhere heavier than water. Now, how much heavier is water at the bottom of the ocean than it is at the surface? The depth of the deepest place yet found in the Pacific is off the Fiji Islands as given by Prof. Davis, of Harvard University, in his Physical Geography, and is 30,930 feet. The same most reliable authority gives the deepest sounding in the Atlantic as 27,366 feet. Allowing 34 feet of water as equal to an atmosphere, this depth will produce 910 atmospheres, and will compress sea water 910 x 0.000044 of its volume. This is 1/25 part, and a cubic foot of sea water, which weighs 64 pounds at the surface of the ocean, will at the bottom of the deepest place yet found weigh 66.56 pounds. Under the same pressure a cubic foot of steel, which weighs about 487 pounds at the surface of the ocean, will at the bottom of the deepest place yet found have its weight increased 0.062 part, and it will there weigh 517.29 pounds. At the deepest place in the ocean yet found a cubic foot of steel will weigh 450.73 pounds more than a cubic foot of water at the same place. Will steel sink in water at the bottom of the ocean? We think it will. Now steel is compressed less by pressure than other metals and materials, and hence other materials will be less likely to float somewhere between the surface and the bottom of the ocean than steel is. Finally, we may be permitted to quote Prof. Davis's words on this very point: "Although water is easily moved, it is very little reduced in volume even when compressed by great force. Hence, in spite of the great pressure of the upper layers of the ocean on those beneath, the ocean is of nearly uniform density from top to bottom. *Anything which is heavy enough to sink at the top will sink all the way to the bottom.*" We are content to be classed with Prof. Davis in making "so many glaring mistakes as to merit a severe calling down" by our esteemed correspondent. Now we wait for him to produce his "authorities in hydraulics." We do not know any demonstration to the contrary, and we have been teaching hydraulics for forty years. Will N. L. tell us some of his hundred? The question which he puts at the close of his letter we answer, No, nothing of the kind. A floating body sinks till it has displaced its weight of water. A body heavier than water, volume for volume, such as a stone, does not displace its weight of water anywhere. It displaces its volume of water; and as its volume of water weighs less than the stone itself weighs, the stone sinks, and will continue to sink to the bottom. So will our ship in five miles of water, since every ballasted vessel even of wood will be heavier than its volume of water if water gets into the interior and drives out the air from the ship. Now as to ridicule; we would ask our readers to refer to the answer and see if they can discern any attempt to hold the inquirer up for a laugh at his expense. We cannot see any attempt to make any sport upon the matter. Certainly there is no attempt to raise a laugh on the questioner. As to the frequent requests to answer questions whose answers have been in our columns within a year or so, we must say that our readers ought to keep their files of papers, and before sending in a question go through the papers and see if they cannot find the answer without requiring a separate letter written to them.

(10486) I. J. P. writes: I send herewith a solution to the problem asked for in Notes and Queries No. 10198, and would like the asker's address if it is all right to ask it. I have used algebra. I do not see how he could think to use calculus, since the required number is a constant, although more than one value, as may be noted by revolving the inner rectangle on its center or by the equation of the fourth degree.



Problem: In a given rectangle 10×20 feet inscribe diagonally a rectangle 2 feet wide, to find its length.

In given rectangle, A B C D, to inscribe E F H K, given the length of E F (= H K), required length E K (= F H).

Triangles E B F and F C H are similar and right triangles.

$\therefore EB : BF :: FC : CH$ or $\overline{EB} \times \overline{CH} = \overline{BF} \times FC$ in which

$$CH = CD - DH = CD - EB,\ FC = BC - BF$$

$$\therefore EB(CD - EB) = BF(BC - BF) \quad (1)$$

and

$$\overline{EB}^2 + \overline{BF}^2 = \overline{EF}^2 \quad (2)$$

From (1) and (2) eliminate B F and arrange for E B.

$$\therefore 4\overline{EB}^4 - 4\overline{DC} \times \overline{EB}^3 + (\overline{BC}^2 + \overline{DC}^2 - 4\overline{EF}^2)\overline{EB}^2 + 2\overline{DC} \times \overline{EF}^2 \times EB - \overline{BC}^2 \times \overline{EF}^2 + \overline{EF}^4 = 0.$$

Given DC = 20, BC = 10, EF = 2, which substitute, and ÷ 4.

$$\therefore \overline{EB}^4 - 20\,EB^3 + 121\overline{EB}^2 + 40\overline{EB} - 96 = 0.$$

$$\therefore EB = 0.7816258.$$

Draw E L parallel to B C. Draw E H and in right triangles E F H and E L H, $\overline{HF}^2 + \overline{EF}^2 = \overline{EL}^2 + \overline{LH}^2$, in which EF = 2, EL = 10, LH = DH − (DH + LC) = DH − 2EB = 20 − 1.5632516.

$\therefore HF^2 = 10^2 + (18.4367484)^2 - 2^2 = 435.9138916$, and HF = 20.88094566.

Giving the required length as 20 feet 10.57 inches.

A. We give a correct solution to the problem of inscribing a rectangle of a given width in another rectangle. It is not our policy to give much space to the solution of mere mathematical problems. There are good mathematical journals devoted to that work. Some physical or mechanical problems are legitimate to our purposes, and to these we usually give attention, although we cannot spend much time in digging out puzzles. We add the remarks upon the solution of the problem above by Mr. L. Leland Locke, Adelphi College, Brooklyn, N. Y. He shows the impossibility of having more than one rectangle of the greatest length inscribed in another rectangle. The matter was referred to him since I. J. P. states in his letter that there may be more than one longest rectangle in this case. The solution of the problem given above is correct in principle. We have not verified the numerical work. This is not a problem of maxima as stated by the proposer of the problem in the original note, for the reason that there is but one rectangle which meets the conditions of the problem. If a rectangle of a given width be turned so that E and F, vertices of one end, remain respectively in sides A B and B C of larger rectangle, and point K with K E variable follows line A D, there is but one position in which H will be on C D; in other words, the path of H is a curve which cuts C D but once, and hence only one rectangle with a width of 2 feet can be inscribed in a given rectangle all of whose vertices are upon the sides of the given rectangle. This is also shown by the fact that the biquadric equation yields but one positive and real root. Its other real root is negative. If it were possible to revolve a rectangle of given width and variable length, keeping its corners on the sides of a larger rectangle, it would be impossible to secure a determinate equation involving its length.

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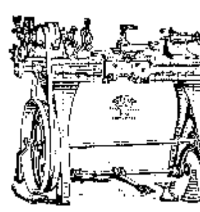

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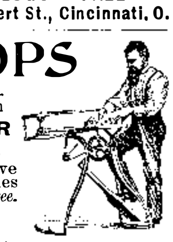

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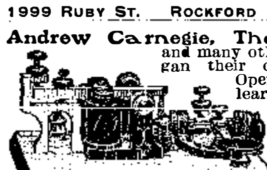

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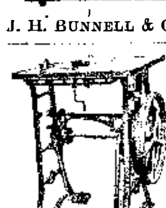

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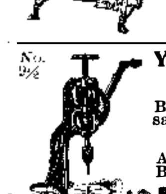

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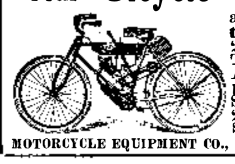

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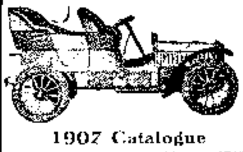

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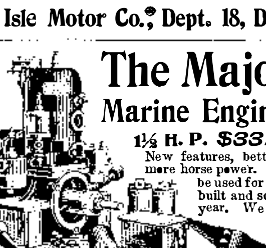

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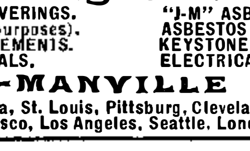

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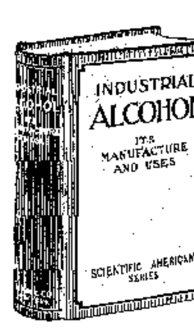

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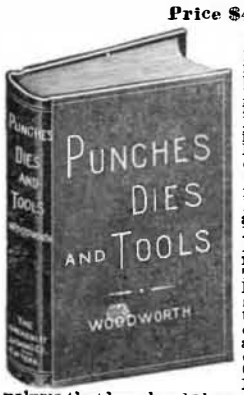

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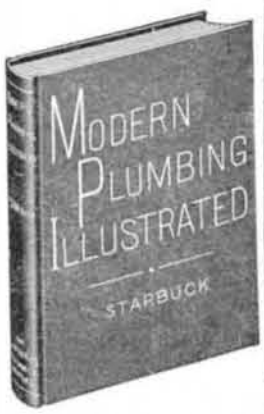

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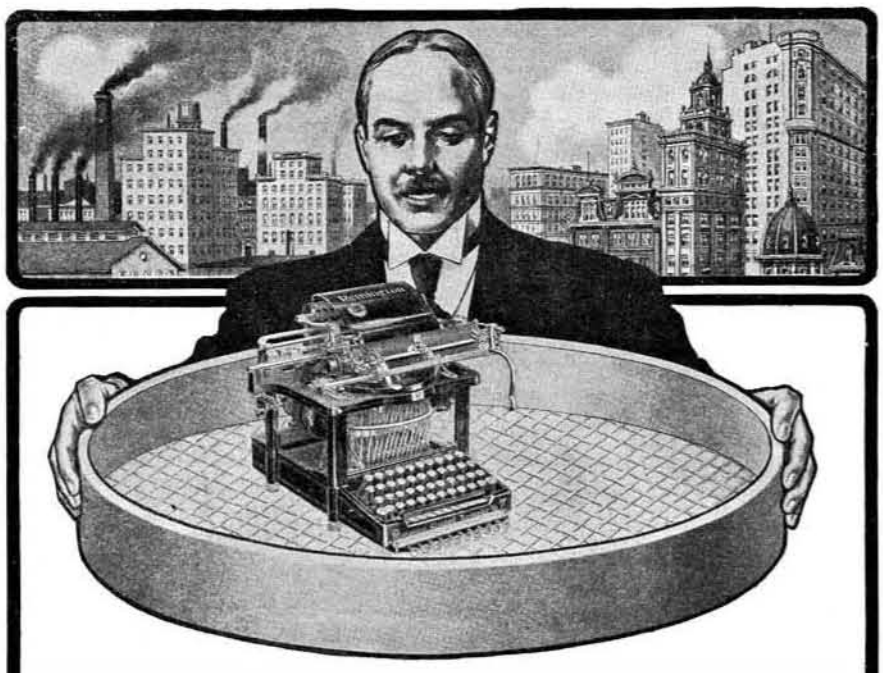

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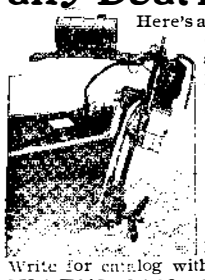

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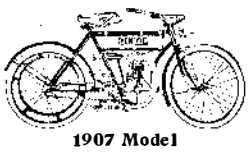

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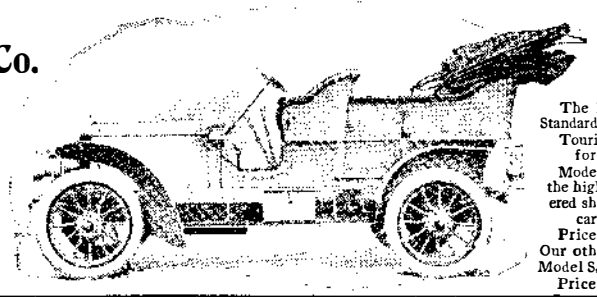

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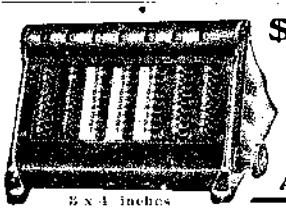

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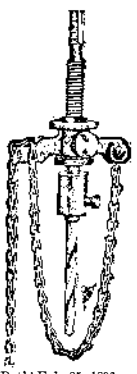

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