SCIENTIFIC AMERICAN

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Vol. XXXVII. No. 23. [NEW SERIES.] NEW YORK, DECEMBER 8, 1877. [$3.20 per Annum. [POSTAGE PREPAID.]

IMPROVED FAUCET.

We illustrate herewith a new and simple form of faucet, the advantages claimed for which are that it is not liable to be injured by being screwed into or out of the cask, that it is not liable to leak, cannot be left open through carelessness or accident, and has its button protected from injury.

The portion of the device which enters the cask is tapered and screw threaded. Near its outer end is an octagonal portion adapted to receive a wrench. Beyond this part, as shown in section in Fig. 2, is a screw-threaded projection which engages with the outer portion of the device. A is the valve seated on a shoulder, as shown. The stem passes up through the casing and terminates in a button which is surrounded by the cup-shaped top. In a chamber in the casing is a a spiral spring, B, which acts against a collar applied to the valve stem. It will be evident that, by pushing in upon the button, the valve, A, will be moved from its seat, the liquid will pass it and flow out at the nozzle. On the valve stem is a shoulder, C, which, when the valve is moved from its seat, closes the orifice through which the stem passes and prevents any ilquid entering the spring chamber. Should, however, any liquid enter this portion of the device it at once escapes, by the channel shown, into the nozzle. Patented through the Scientific American Patent Agency, September 18, 1877. For further particulars address the inventor, Mr. William S. Lempert, Fort Davis, Presidio county, Texas.

Fig. 1

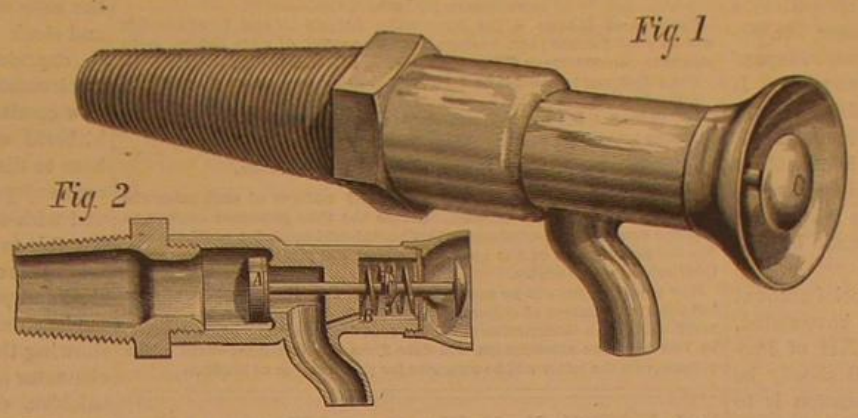
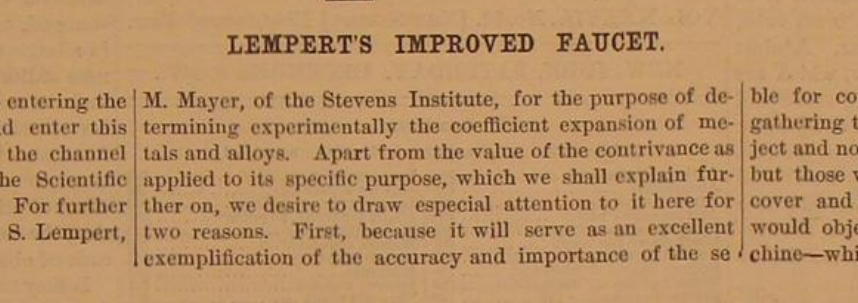


Fig. 2



LEMPERT'S IMPROVED FAUCET.

PROFESSOR MAYER'S' NEW METHOD OF FINDING THE COEFFICIENT OF EXPANSION OF METALS AND ALLOYS.

In the accompanying engraving we illustrate a new and exceedingly ingenious apparatus devised by Professor A. M. Mayer, of the Stevens Institute, for the purpose of determining experimentally the coefficient expansion of metals and alloys. Apart from the value of the contrivance as applied to its specific purpose, which we shall explain further on, we desire to draw especial attention to it here for two reasons. First, because it will serve as an excellent exemplification of the accuracy and importance of the series of articles "On the Minute Measurements of Modern Science," written by Professor Mayer, and which now are in course of publication in the SCIENTIFIC AMERICAN SUPPLEMENT. No such series has ever been published, nor has any physicist yet attempted to gather and present, in the very complete form which Professor Mayer has adopted, the refinements which now exist in the art of measuring. We need not point out of what value to every mechanic a thorough knowledge of this branch of science is. Perhaps the chief peculiarity of modern mechanism is its accuracy and perfection of fitting, and to these qualities the machine tools of to-day owe in large measure their remarkable capabilities.

Our second reason for asking especial notice for Professor Mayer's apparatus is that it is a capital instance exemplifying how a thoroughly scientific investigator goes to work. There is so much dore now-a-days that is called scientific investigation which far from merits the title, that we are almost ready to credit the idea that some recognized standard, showing how a typical investigation ought to be conducted, would be valuable for comparative purposes. Such work involves the gathering together of every thread connected with the subject and not merely those that are plain and easy to follow, but those which the skill of the investigator is taxed to discover and take account of. Doubtless Professor Mayer would object quite strongly to our taking the present machine—which is only one bit of apparatus out of a long and

Fig. 1

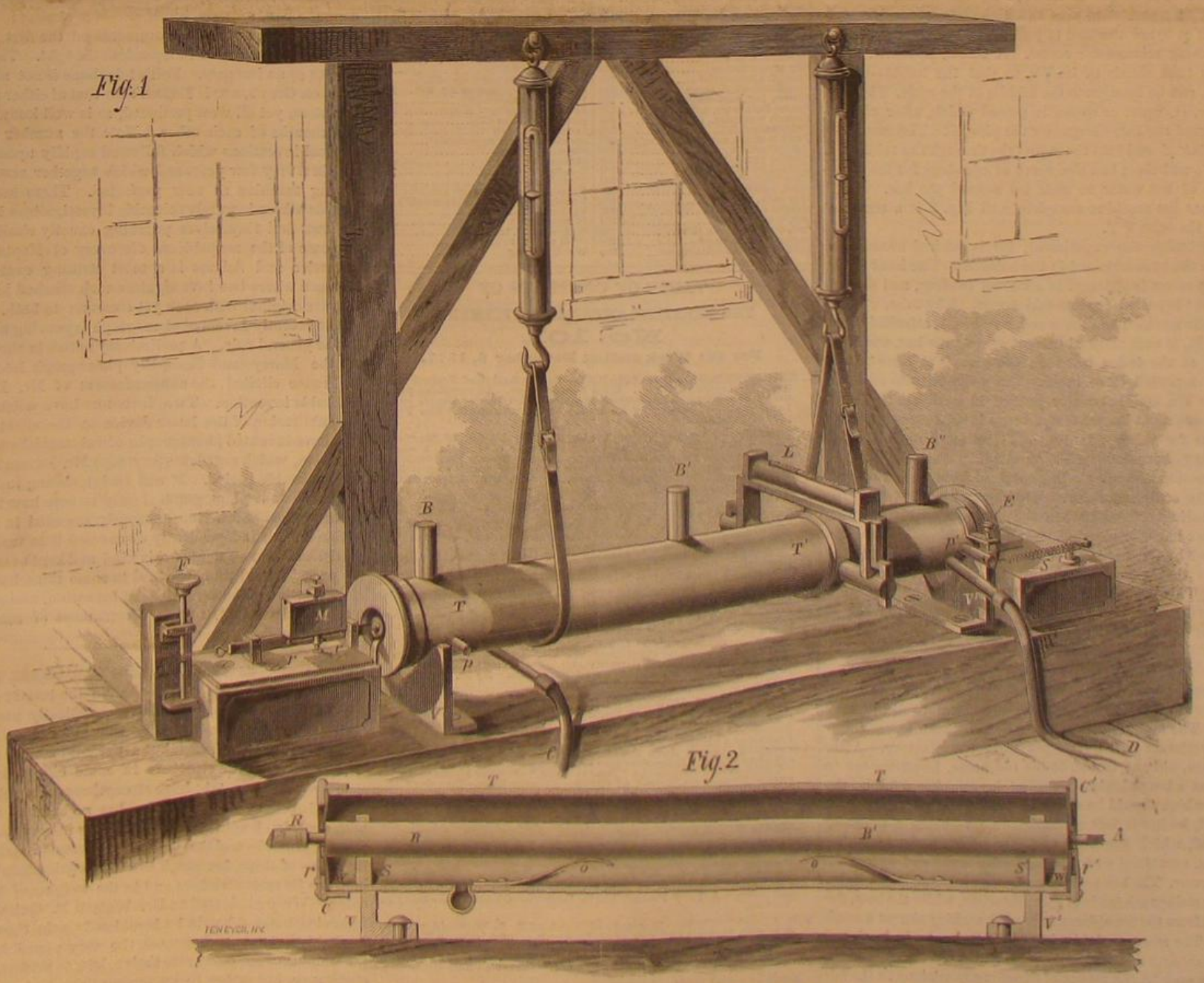


Fig. 2

PROFESSOR MAYER'S NEW INSTRUMENT FOR SHOWING THE ELONGATIONS OF METALS.

splendid series—as representative of his general mode of working; and, in fact, he himself states that there are objections to it in its present form, to eliminate which he points out the way: but, nevertheless, the apparatus may stand as a model of ingenious contrivance, showing how fertile is the mind of the investigator in devising means, and how thorough and refined these last, when placed in tangible form.

The object of the apparatus, as already noted, is to obtain the co-efficient of expansion of metals and alloys. By co-efficient is meant a factor, which serves as a multiplier; and the co-efficient of expansion of any metal is that fraction of its length which the metal elongates or shortens by the addition or subtraction of one degree of temperature. This fraction of the length of a given metal bar is expressed decimally, and hence to ascertain the absolute amount of the expansion of any given length of the metal, we multiply the given length by the co-efficient.

In order to measure the minute differences in length of the bars, Professor Mayer desired to use Saxton's comparator, on account of various advantages which that device offered. A complete description of that instrument, as well as a very interesting biographical sketch of its inventor, Mr. Joseph Saxton, will be found in No. XI of Professor Mayers' series of articles above referred to, in the SUPPLEMENT. It will suffice here to say that it consists essentially of a mirror, which reflects a beam of light over double the angle through which the mirror is revolved, and this beam acts as an index by being caused to sweep over a graduated scale, having for its center the center of the axis of the mirror. It will be obvious how measurements may be made by this arrangement.

We can do no more here than present a very brief account of how Professor Mayer solved the problem we have stated, as our readers will find all the details in No. XII of Professor Mayer's SUPPLEMENT series, which will shortly be published. The bar, whose co-efficient of expansion is to be determined, is supported on standards in a brass tube, which is made about ⅛ inch shorter than the bar. Against the ends of the bar are placed rubber washers, which are perforated so as to allow the ends of an abutting screw and a rod connecting with the moving mirror of the comparator to come in contact with the ends of the bar. Arrangements are provided which hold the washers perfectly water and steam tight against the ends, while the bar is perfectly free to expand or contract in the tube. Inside the tube are supporting springs, which relieve the standards in some degree from the weight of the bar.

In our engraving Fig. 1, T T' is the tube, supported on V's, V V'. Its weight is relieved by the spring balances shown. At *p* and *p'* are pins, to which springs (one of which is shown at S) are attached to pull the end of the bar against the abutting micrometer screw. A screw, E, serves to rotate the tube slowly in its V's, so that the bubble of the level, L, can be brought to the middle of the scale. Through the tube, D, water or steam is passed which, after circulating around the bar, escapes by the pipe, C. Thermometers may be introduced into the main tube through the tubulures, B B' B''; and these last also serve as openings for the introduction of hot water to melt ice around the bar. Fig. 1 represents the machine complete, and Fig. 2 is a sectional view of the tube T T.

In beginning the experiment, ice is packed around the bar, and the tube adjusted in the balances. The head of the abutting screw is adjusted to a known reading, and the end of the bar is pulled against said screw. The tube, T T', is then made level. The mirror rod, *r r'*, Fig. 1, attached to the mirror, M, is next allowed to abut against the bar, when the reading of the index beam on the scale is at once noted. This is repeated three times. The tube is now removed from its V's, and hot water poured in until all the ice is melted. Steam at known temperature is then passed through the tube for thirty minutes, and the same operation for measuring above described is repeated.

Subtracting the scale reading obtained from the bar when it was in the comparator surrounded by melting ice, from the scale reading obtained when the bar was enveloped with steam, we have for remainder the amount of scale deflection produced by the bar in expanding from the length it has at 0° C. to that which it assumes at the temperature of the steam. This scale length, converted into linear motion of the mirror rod, gives the actual expansion of the bar in fractions of an inch or of a millimeter.

A Porcelain Fiddle.

Venice is considerably excited at present over a very unusual sort of a fiddle, the only one of its kind, probably, ever made. The manufacturer of this porcelain fiddle was formerly a workman in a Saxon porcelain manufactory. After his return, old and feeble, to his old home, he attempted to carry out a long cherished project for making a fiddle, the box of which should be of china. With the aid of a boy, it is stated, he has in fact succeeded in producing a fiddle of this kind, which has a tone of rare purity and astonishing richness, combined with charming harmony and extraordinary power. The box part, or resonator, is exceedingly light, and the strings are made of metallic wires, while the bow, departing from the usual form, is curved, making almost a semicircle. The success of this clever Venetian, who had enjoyed the advantages of the skill acquired in a German porcelain factory, may be the means of directing musicians to the advantages of the clear, ringing, but fragile china and glass, for various similar uses in acoustics.

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VOL. XXXVII., No. 23. [NEW SERIES.] *Thirty-second Year.*

NEW YORK, SATURDAY, DECEMBER 8, 1877.

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(Illustrated articles are marked with an asterisk.)

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IS THERE A LAW OF INVENTION?

Whether we are to conclude with Buckle that there are laws governing human action which exist unknown and which only future and wiser generations will discover; or whether we adopt the theory of epidemic thought and assume that there is a bond of unconscious ideation forming some subtle link between minds pursuing like objects, the fact remains that no one can study the progress of invention without becoming impressed with a definite notion that there is some extraneous cause which impels inventors to reach similar conclusions and make like discoveries at about the same time. Of course this cause must be dependent upon antecedents, and these last are the steps which go to make up scientific progress, with which all may by study render themselves familiar, and thus may as it were place themselves under like influences. The question for speculation however is whether there even can be proved to exist a law which taking into account certain circumstances will enable us to recognize conditions when the production of a certain new and original conception is predicable.

Analogies in this regard are by no means wanting. In the case of artificial selection, horticulturists, agriculturists and stock breeders the world over are constantly engaged in experimenting under every imaginable combination of circumstances and conditions with the object of reaching new results which it is hoped may be superior to any hitherto obtained. The constant study of mankind has been to discover those circumstances under which the human race enjoys the highest point of mental and physical culture; and with such success has this been attended that it is quite possible to conceive of an ideal man, the product of present attainable conditions, who in all his attributes, certainly physical and probably mental, would be a far superior being to modern men. There are many instances which can be cited showing that occurrences seemingly of the most fortuitous character are subject to definite fixed laws. The number of suicides, of murders, of marriages, of letters posted unstamped, and so on through almost every imaginable event in a large community, is nearly invariable; the great business of life insurance rests upon the law of probabilities, and finds its stability in the hypothesis that out of a given number of policy holders the ratio of deaths may be definitely forecast. The entire onward march of scientific investigation is toward the formulation of these laws. The highest effort of original investigation is the grand general deduction, the establishment of a theory on the basis of a multitude of observed facts.

It may not therefore be unreasonable to suppose that, some day, laws governing invention will be revealed. No great or striking invention, not even one moderately out of the common run, appears, but that others similar to it at once come to light, not as improvements on the first announced but as the outcome of independent thought. Take the telephones as an instance. Bell's telephone is not an improvement on Gray's, nor is Edison's on that of either of the other inventors, yet all were produced, as is well known, within a few months of each other. Note the number of entirely original inventions which followed rapidly upon each other within a very few years and which together resulted in the sewing machine as now perfected. There are abundant records where in purely scientific investigations independent students find themselves pursuing exactly similar objects. The case of the magnificent discovery of Neptune by both Leverrier and Adams is a most striking example of an instance where two investigators each reached his aim in a manner original with each yet common to both.

The recently invented phonograph is proving no exception to the general rule. A preliminary notice in these columns of the Marey and Rosapelly phonograph lately devised in France elicited the announcement of Mr. Edison's remarkable invention. Two inventors have written us since the publication of the latter device to the effect that they also have invented phonographs of substantially similar construction, which antedate (they say) Mr. Edison's device by a considerable period. It will be interesting to watch the progress of the phonograph if only to note how many other inventors have been simultaneously engaged in its investigation or have independently discovered it in various forms. Statistics based on data of this kind and kept over a reasonable period would probably lead to some remarkable conclusions relative to the conditions of invention, and possibly, as we have intimated, to the discernment of some general laws.

UNITED STATES COINAGE AND THE GREAT PYRAMID.

Some one who fails to see wherein the benefit of importing obelisks from Egypt exists sarcastically proposed not long ago that Yankee ingenuity should astonish the world by floating, not an obelisk but a pyramid across the Atlantic, and erecting the structure in some city park. The satirical proponent might have strengthened his scheme if he had added that while this nation has no bond of connection with obelisks, it actually has something in common with the Great Pyramid—and that we have a direct national interest in that mass of stone, inasmuch as a most curious analogy exists between its measurements and in the weights of our several coins. We are indebted to Dr. Watson F. Quimby for the following letter, wherein he ingeniously points out this remarkable linkage, and suggests the very plausible idea that the weights of our coins owe their origin to no fortuitous circumstance, but rather to customs established at a period dating back beyond history. Dr. Watson says:

"In the admirable work of Professor Piazzi Smith, entitled

"Our Inheritance in the Great Pyramid," it is shown that the Great Pyramid of Egypt contains in its interior standards of inch measure, while the exterior gives the same standards in the sacred cubit of 25 inches. One of the most important units of measure is the length of the so-called king's chamber, which is 412·5 English inches, and its breadth 206·2 inches. Now our silver coinage corresponds to these numbers, as the "dollar of the fathers" weighs 412·5 grs., the half dollar 206·2 grs., and the quarter dollar 103·1 grs., which last is a very important pyramid number. On inquiring at the mint why the silver dollar was made of this weight, I was informed that it was the weight of a coin that would readily pass current in the Eastern Asiatic trade. It is therefore a traditional coin, by whatever name it may have been known, for thousands of years.

"But not only does the silver coinage correspond to the inch standard of the pyramid, but our gold coinage corresponds to the cubit measure. The height of the pyramid in sacred cubits is 232·5, and our gold eagle, the unit of gold coinage, weighs 232·2 grs., and the half eagle 116·1 grs.

"The relation of these numbers is such that 'the area of a square having 103.03 on the side, is equal to the area of a circle having 116·26 for its diameter.' (Phillips.) Now as there are 360 degrees in the circumference of a circle, its diameter in terms of seconds is 412529, and its circumference is 1296000. Then the number 412·5 is the thousandth part of the diameter of a circle in terms of seconds, and 1296, the number of square inches in an English square yard, is the thousandth part of the circumference of a circle in terms of seconds. This at once connects English with pyramid measure, and may indicate the origin of both.

"From the standard square yard all the rest of our measures may be deduced. The old English gallon contains 231 cubic inches, which is a number intermediate between the height of the pyramid in cubits, 232·5, and the height of the king's chamber in inches, 230·89. The diameter of a circle is to the side of a square of equal area, as 9 to 8 very nearly.

9 : 8 :: 116·023 : 103·132.

"It thus appears that in the weights of the quarter dollar and the half eagle, we have had the squaring of the circle problem typified without knowing it."

NOTES OF PATENT OFFICE DECISIONS.

The Commissioner of Patents, in deciding the interference case of Martin *vs.* Bogle *et al.*, awards priority of invention to Martin, who first perfected the operative device in interference, although Bogle was the first to apply it in series, in the manner designed for use. The reason for this is that, while the arrangement in series may be more satisfactory and permit nicer adjustment of subordinate mechanism, yet it proves operativeness no more than the test of the single device itself.

The Commissioner also holds that the fact that in one instance a claim is for a single device, and in another for a series of them, does not constitute difference of invention. The state of the art, and the Office latitude in allowing claims, may level the distinction. He also holds that the preliminary statement must be rigidly adhered to, where there is a substantial departure therefrom in the interference contestant's testimony.

The Acting Commissioner, in the interlocutory appeal in the matter of the application of Siemens for a re-issue of letters patent, decides that the applicant may include, on re-issue, matter which was neither described nor claimed, but which was actually contained in the original invention; and that the failure to describe such matter in the original patent is no bar to doing so in the re-issue application within the limits of the invention.

SHOOTING STARS.

The phenomena of shooting stars and of star showers have, undoubtedly, existed since the formation of the solar system. On any clear evening, a watchful person may see, on an average, two shooting stars every five minutes, and on certain nights of certain years, and on certain hours of the night, they appear in such vast numbers as to receive the name and deserve the title of star showers. Other meteors do not fall in showers emanating from certain constellations, but move in all directions, and from every part of the sky. Such meteors, though, as far as known, differing in no particular from those which come in showers, are called "sporadic." In their normal condition, that is, before visibility, these vagrant bodies are called meteoroids, and only while self-luminous from excessive heat by friction and arrested motion in our atmosphere, are they called shooting stars or meteors. It is important that this distinction be borne in mind, for, if true, then can no meteoroids ever be seen from the earth. In their natural condition they are circum-solar bodies, obeying the laws of motion and gravitation as rigidly as do the planets, and must be treated as such, though more numerous than the leaves of summer. The velocity with which they plunge into our atmosphere is very great, probably about 48 miles per second. The length, in arc, of their visible path varies widely. Occasionally one flashes up, and, increasing in size and brilliancy, disappears, without seemingly having moved a particle. The motion of such a meteor was exactly towards the observer's eye, and consequently it ought not to have any apparent motion. Another observer 20 or 30 miles distant may have seen the same with a path several degrees in length. Their paths may be considered to vary from zero to 90°, or even more. The length of their real paths, that is, in miles, also varies greatly, but the average is about 42 miles. By the time this distance is accomplished, unless the meteoroid is a large one, it is heated, melted, evaporated, and extinguished, all within the period of not over one second of time. The height at which they are heated to visibility is sometimes as great as 200 miles, but the average is about 75 miles, and at extinction, about 50 miles.

The above assumed rate of motion at which they enter our atmosphere is the result of the sum of the orbital motions of both the earth and meteoroid, but, owing to the earth's attraction, this motion is really very much greater than 48 miles per second, especially for those which move retrograde.

We are now prepared to understand why they are burned up, and so quickly vaporized. The heat thus generated, though all produced where the atmosphere is inconceivably rare, is estimated to be equal to three million degrees Fahrenheit. No known substance, unless of considerable size and density, like the meteoric stones which occasionally reach the earth, can long withstand such a degree of heat, unchanged in form and structure. Before the above facts were known the height of the earth's atmosphere was usually considered to be about 45 miles, but that it is, at least, five times, and probably ten times that distance, is clearly proved by the researches in meteoric astronomy.

When it is considered that, accordihg to Professor Newton, four hundred million shooting stars are daily burned up in our atmosphere (including those that are telescopic), it would seem that the earth must constantly be increasing in weight and size from this cause, and such, no doubt, is the case in fact as well as in theory. Unfortunately the data for arriving at any very exact value as regards their size and weight rests on insufficient evidence. Professor Harkness, of the Naval Observatory, who has made a thorough discussion of all accessible evidence bearing on the subject, has arrived at the astonishing conclusion that their average weight does not exceed one grain. If we assume that those which are wholly telescopic are not larger than sand grains, and probably they are not, those that are visible to the naked eye as conspicuous objects, and especially those that are seen over a radius of 150 miles and fill several cubic miles with smoke must contain several ounces, and perhaps pounds, of meteoric matter, whatever that may be. Suppose we base our calculation on the estimate of ten grains for each meteoroid, this would equal 4,000,000,000 grains, or 290 tons a day, or 106,000 tons a year, sufficient, if distributed equally over the earth's surface, to form, in 4,000,000 years, a stratum equaling in thickness the paper upon which this journal is printed. The moon, as she revolves round both the earth and sun, must also meet with these all-pervading meteoroids, but, having no atmosphere to arrest their motion, they cannot be heated. They must strike on its surface and be instantly converted into the finest powder. This meteoric dust, from excessive attenuation, must be of a light color, perhaps a pure white, which may go far to explain the cause of her reflection of so much light, the which, when her size and distance are considered, seems out of all proportion.

While the writer was observing the memorable star shower of November, 1867, he witnessed a phenomenon which will linger long in his memory. A brilliant meteor from *Leo* passed in a westerly direction, leaving a luminous train of some forty degrees in length. Its head seemed to increase in size and brilliancy as it progressed, when, as suddenly as though it had struck a target, it vanished from sight. Soon a cloud formed, assuming a variety of fantastic shapes, several being perfect delineations of letters of the alphabet. Twice in its peregrinations was the letter N thus formed, these changes occupying some fifteen minutes. Finally, gathering to itself its scattered particles, it became a round symmetrical disk, probably a sphere, which centrally occulted the nebulous cluster in called *Cancer* the Beehive. For almost two minutes it was, from this cause, lost to view. After the occultation it continued visible for ten minutes longer. During its visibility, which was twenty-five minutes, it drifted about fifteen degrees to the north, confirming by observation the truth of the theory that the heated air of the tropics flows to the north through the upper regions of the atmosphere.

ADAM SCOTT CAMERON.

It is with regret that we announce the death of Mr. Adam Scott Cameron, of New York, who undoubtedly was personally known to a great many of our readers. He passed away on the 14th ult., of an attack of acute pneumonia; his illness was sudden and painful, but of short duration.

As a manufacturing engineer and constructor of steam pumps he had a wide and excellent reputation; and as a business man of sound principles, his loss will be felt in the many circles where he was prominent.

Mr. Cameron was a native of Scotland, but came to this country when eight years of age. During his youth he evinced a strong desire for acquiring knowledge and an aptitude for self-culture. He attended public day and evening schools, and soon became sufficiently proficient to keep books for a New York firm. He was observing, thoughtful, and industrious, entered into business with indomitable pluck, energy, and perseverance, and studied with assiduity the questions of capital, labor, and finance. The greater part of his life was spent in the construction of the well known Sewell and Cameron steam pumps. Before he was twenty-one years of age he was taken into partnership with his brother, and to the time of his last illness applied himself to business with great success. He was a friend and counsellor to the workmen in the employ of his firm (Cameron & Co.), and a member of some excellent associations for the advancement of mechanical science. At the commencement of a small pamphlet issued to his employees in 1869, proposing the system of co-operation as a practical business movement, the following sentence occurred: "To assist a person in improving his condition by his own efforts is to make a man of him." Other pamphlets on such subjects as "The Necessity of a Bureau of Mechanics," "The Eight Hour Question," "An Address to the Intelligent Workmen of the United States," were written by him, and widely circulated.

During the spring of 1873 Mr. Cameron was elected president of the Bull's Head Bank of the city of New York; and although the youngest president of any bank, at least in New York city, he displayed wonderful tact and sound judgment in arranging the complicated affairs of the institution; he had suits set aside, obtained subscriptions for new capital, re-opened the bank, and put it in a prosperous condition. This transaction was commented upon by the London *Times* as a notable one, from its having been the first of the kind, and the setting of an example which has since been followed in several instances. The last and recent public utterance by Mr. Cameron closes with these significant words: "Until we return to the old-fashioned habits of honesty, industry, and frugality, our sins will rest upon us. If our *virtues* will not, our *necessities* must bring us back to prosperity. Then we shall be envied among the nations of the earth." At the age of thirty-three Mr. Cameron closed a busy and useful life, in which integrity, generosity, and benevolence were always conspicuous.

THE DISTANCES OF THE PLANETS FROM THE SUN.

Sir George Airy, the British Astronomer Royal, has recently published a report on the telescopic observations of the transit of Venus of 1874, made by the English expeditions. Pending the appearance of the deductions to be made from the complete measuring of the photographs, the results reached must be regarded as provisional only. The mean solar parallax determined is 8·764", and this is one tenth of a second less than has been given by the most reliable previous investigations upon different principles. From Professor Newcomb's calculations, now adopted in most of our ephemerides and based on observations of Mars, the lunar equation of the earth, the parallactic inequality of the moon, the transit of Venus of 1769, besides Foucault's experiments on light, it appears that the mean distance of the earth from the sun is 92,393,000 miles. According to Sir George Airy's determination this distance must now be considered as increased to 93,321,000 miles.

For purposes of comparison and also to correct some errors which were present in our recent article on "how our world looks from other worlds," which we translated from the French of M. Flammarion, the well known astronomer, we append the following statement of correct distances of the planets from the sun. Mercury, average mean distance, 35,392,000 miles; Venus, 66,134,000 miles; Earth, 93,321,000 miles; Mars, 139,311,000 miles; Jupiter, 475,692,000 miles; Saturn, 872,137,000 miles; Uranus, 1,753,869,000 miles; and Neptune, 2,745,998,000. As regards the fixed stars, the distance of α Centauri, probably the nearest, is about twenty billions of miles, and light occupies about 3½ years in traveling from that star to the earth.

The New Steamship "City of Washington."

If comparison is made between capacity and strength, this steamship, just placed on the New York, Havana, and Mexican Mail Steamship Line, appears to be undoubtedly the strongest mercantile iron vessel ever built in this country. She was constructed by Messrs. John Roach & Son, at Chester, Pa., and is of superior model and plan. The plates of the hull are ½ inch and upwards in thickness. There are three decks, the two upper ones being mostly of iron. The length of this vessel is 323 feet; beam, 38 feet; depth, 37 feet 6 inches; draught when loaded, from 21 to 22 feet; tonnage, 2,618 tons. She can carry 10,000 boxes of sugar, besides light freight, and her outward passage capacity in bulk is 2,500 barrels. The saloons and staterooms are attractive for their comfortable appearance and elegant fittings. The engines are of the compound type, and have a high pressure cylinder 40 inches in diameter; low pressure cylinder 74 inches in diameter, with a stroke of 6 feet. The pressure of steam carried is 80 lbs. The condenser has 4,000 square feet of condensing surface. Diameter of propeller is 16 feet, with a mean pitch of 26 feet. The engines are constructed with steam valves on the Corliss principle, and are reversed quickly with little manual exertion. Steam is supplied by two vertical boilers having square bases. There are eight furnaces in each boiler, and altogether about 3,000 tubes, 2 inches outside diameter and 7 feet long. There 370 square feet of grate surface and 1,400 square feet of heating surface. The engines are rated at over 2,000 horse power, and with 63 revolutions per minute, an average speed of 14 knots per hour is attained.

F. Alexandre & Sons, the owners, state that the City of Washington will make the voyage between New York and Havana in less than four days.

COFFINS from Norway, says the *British Trade Journal*, represent the latest phase of foreign competition, a cargo of several hundred having been landed, ex steamer Cambria, during the past month. In this lugubrious branch of home industry America is also competing, and in a warehouse almost within a stone's throw of our office may be inspected a stock of 2,000 American coffins and caskets.

THE ABANDONMENT OF THE CLEOPATRA AT SEA.

We have already noted the particulars of the somewhat eventful voyage of the famous obelisk Cleopatra's needle, from Egypt to its destination in England, which last it does not seem likely to reach for some time to come. In the annexed illustration is represented the scene of the abandonment of the obelisk vessel at sea in the Bay of Biscay during a severe storm. A heavy sea struck the craft, broke some of her rail ballast adrift, and left her with a strong list to starboard. Fearing that another sea would swamp the vessel altogether, her captain signaled for assistance and a boat's crew was sent to her, but the boat and all on board were lost. Further efforts were then made to take the Cleopatra's crew from their perilous position, which in the end proved successful, and the towing steamer Olga left the obelisk to its fate.

Within two days' time the Fitzmaurice, a vessel bound from Middlesborough for Valencia, sighted the wanderer in lat. 44° 53' N., long. 7° 52' W., took her in tow and carried her to Ferrol, Spain, where the obelisk now is and will remain until the legal questions relative to the matter of salvage are settled.

CIGARS are now being made at the Cape of Good Hope, but only for local consumption.

Glue for Polished Steel.

The Turks glue diamonds and other jewels to their metal settings with a mixture made as follows: Dissolve five or six bits of gum mastic, each the size of a large pea, in as much spirits of wine as will suffice to render it liquid. In another vessel dissolve in brandy as much isinglass, previously softened in water, as will make a two ounce phial of strong glue, adding two small bits of gum ammoniac, which must be rubbed until dissolved. Then mix the whole with heat. Keep in a phial closely stopped. When it is to be used set the phial in boiling water. This cement perfectly resists moisture, and it is said to be able to unite effectively two surfaces of polished steel.

Prevention of Fire Damp Explosions.

The London *Lancet* offers the following suggestion for the prevention of fire damp explosions in mines: "Let tubes of small calibre be so laid throughout the mine that the atmosphere of every part may be brought under observation in a laboratory at the pit's mouth. A small exhausting pump would draw a current of air through the tubes rising from the several parts of the mine. These continuous currents should, in their course, feed each a distinct chamber containing a flame, the behavior of which would instantly indicate the condition of the air coming from the particular part of the mine with which it was connected. The flame, as is well known, would change color, elongate, and finally become diffused in proportions as the air is charged with gas. The different lamps could be exposed side by side in a frame, so that a difference of color or form would be instantly detected. By means of electrical alarm bells, or by the telephone, the miners could be at once warned of the presence of danger. Even in the event of a sudden escape of gas there is generally time to escape if notice is at once given. One man watching the flames at the top of the mine would be sufficient to prevent all possibility of accident. This apparatus might at first seem too costly, but the value of life and ruin caused by explosion far outweighs any such considerations."

BLUING IRON AND STEEL BY BOILING.—If iron or steel articles be boiled in the following mixture they will take a fine blue tint: Dissolve 4 ozs. hyposulphite of soda in 1½ pints of water, and then add a solution of 1 oz. acetate of lead in 1 oz. of water.

SOME interesting researches on the specific heat-conductivity of several substances have recently been made by Herr. J. Stefan, of Vienna. Taking the heat-conducting power of copper at 1,000, that of iron is given by him as 0·17, ice 0·0057, water 0·0015, hydrogen 0·00037, hard india rubber 0·00026, and air 0·000055.

THE ABANDONMENT OF THE OBELISK AT SEA.

HOW TO PAINT MAGIC LANTERNS.

The colors used for painting magic lantern pictures on glass must be either transparent or semi-transparent. The former include Prussian blue, gamboge, carmine, verdigris, madder brown, indigo, crimson lake, and ivory black; the latter, raw sienna, burnt sienna, cappah brown and Vandyke brown, are semi-transparent. By combinations of these almost any desired tint can be produced. No particular mixing of the colors is requisite, but if oil colors are used megilp is the best thinning material. Water colors for first washes should be laid on with a hot solution of trans parent gelatin. Camels' hair pencils are preferable to sable for painting on glass, as their elasticity is less and the trouble of working out the brush marks, which must always be attended to, not so great. Dry colors may be mixed with varnish, in which case the glass must be covered with a coat of turpentine which must be allowed to dry. The simplest way of producing the picture on the glass is by using a series of stencils, as represented in our engravings. Fig. 1, for example, is the picture to be reproduced. The artist places over this a piece of oiled paper, and on this he traces the outlines of all that portion of the picture which is to be tinted with yellow or in which yellow enters in the compound tints. This portion of the design is represented in Fig. 2. Next, on another piece of paper, the red portions are traced as in Fig. 3. On a third piece are traced the green parts; and lastly, on a fifth piece of paper, are drawn the blue parts. The colors on these bases to be used would be gamboge, carmine, verdigris, and Prussian blue. Next, with a sharp penknife, the portions of the several papers included in the various outlines are carefully cut out, so that each piece of paper becomes a stencil. It only remains to apply the stencils, in the order already named, to the glass, and rub the color over them, in turn to produce the picture, the different colors being superposed, and consequently combining. When the paint is dry it is coated with colorless varnish and the edges of the glass are surrounded with strips of strong paper.

Fig. 1.

Fig. 2.

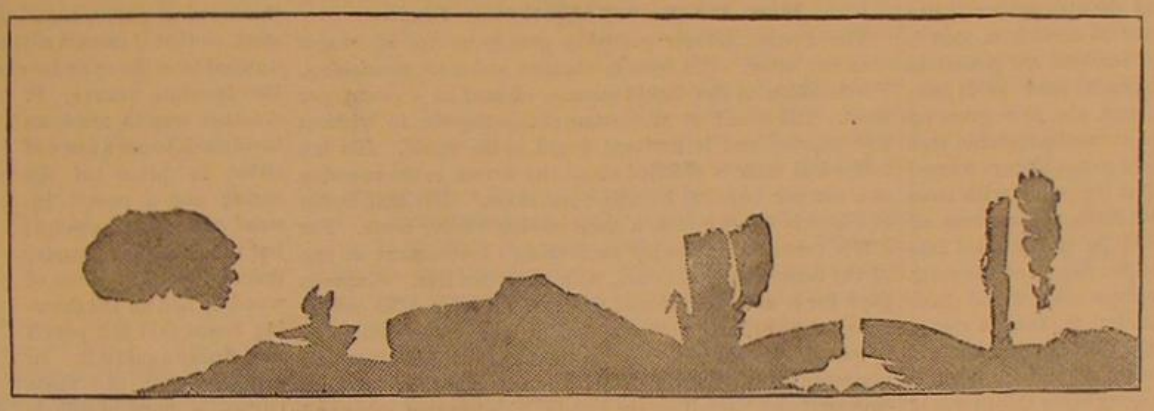


Fig. 3.

Fig. 4

Fig. 5.

METHOD OF PAINTING MAGIC LANTERN SLIDES.

Real Antiquities.

If one wishes to see the oldest parts of the world let him go to Trenton Falls, and, after visiting the excavations made by the natural action of a mountain torrent into the ancient rocks, go to the hotel and see the collection made by the landlord, at an expense of ten thousand dollars, of specimens which prove the record of a geologic age so remote that no imagination can grasp it. Professor Agassiz declared that the land reaching from Trenton Falls to Saratoga was the first that appeared above the sea on the creation. Here are the trilobites in great variety, all modeled in black marble, so perfectly preserved in form that the multitudinous lenses of their eyes are as apparent under the microscope as are those of a living fly. Millions of years before man walked the earth these creatures lived their life, the limestone took on their forms, and here they are! What are *scarabæi* and ancient *intagliі*, or any other engraved or modeled semblance of the old life, compared to the trilobites? These creatures not only lived, but had become everlasting stone millions of years before there was a living man to see them.

The old hotel keeper is enthusiastic over his treasures and proud of the distinguished visitors who have been attracted by what he has to show them. Dr. J. G. Holland reports in *Scribner's Monthly* that he said to him, with a touch of pardonable pride, "I shall have Tyndall, Huxley, and Darwin here altogether in September, for they have written me that they are coming.'

It is a really exceptional case to find a landlord of a hotel who is a connoisseur in art and a lover of science, and who understands his business at the same time and is able to conduct a hotel. Paintings, old and new, adorn the walls; here is a Durand, there a Bouteille, besides many paintings by Hicks. They are on all the walls of the first story of the large house; while the collection referred to stands in the office, and is the admiration of all scientists and lovers of nature.—*Manufacturer and Builder.*

The Origin of Petroleum.

It is needless to say that the origin of petroleum has been the subject of much speculation, but from the scantiness of the facts hitherto collected nothing definite has been arrived at. The most generally received hypothesis is that it is formed, under conditions unknown to us, from vegetable matter; that it has, in fact, the same primary origin as coal. This theory is supported by the fact that we can, by chemical means, extract from coal and other vegetable matter bodies very similar in composition and properties to real petroleum.

But, at the best, this is merely a hypothesis with very few facts to support it; and Mendeleef, the well known Russian chemist, has recently proposed a new theory of the rmation of petroleum. From he fact that in Pennsylvania the petroleum occurs in the Silurian and Devonian formations, he considers it very probable that the hydrocarburets are the result of the decomposition of organic *débris*, because organic life at the period was very scanty. His theory, in conformity with the hypothesis of Laplace on the formation of the globe, supposes the existence of large masses of iron occurring with inorganic carbon in the heart of the earth. Water penetrating from the surface comes in contact with the iron in a state of fusion, and is decomposed, the oxygen combining with the iron, while the hydrogen, under the influence of the heat and pressure, combines with the carbon and produces the hydrocarbons of petroleum.

Every opinion of Mendeleef is worthy of the most respectful consideration ; but, at the same time, we have a right to treat it as we would that of any other man. As this is not a question of fact, but one of theory, we will proceed to examine it. Regarded simply from a chemical point of view, this theory is a possible one. But the author of it starts with the assertion that organic life was not plentiful in the Silurian and Devonian periods of geology, and therefore that there was not sufficient organized material to provide for the formation of the vast quantities of petroleum which have been yielded and are still contained in the American deposits. It is true that we find but few fossil organized remains in the deposits referred to: but any one conversant with modern scientific thought on this subject will know that this fact is not regarded as any proof of the actual amount of organic life then existing. It has been put almost beyond a doubt that only a very small portion of the living beings existing at any one period are preserved in a fossil state: and that by far the larger bulk undergo the ordinary process of decay, and entirely disappear. Professor Mendeleef, therefore, unjustifiably assumes the position from which he endeavors to overthrow the older theory.

In the explanation of his own theory he makes another assumption, which we hardly think will be borne out. That is to say, "His theory supposes the existence of large masses of iron occurring with inorganic carbon in the heart of the earth, and this supposition is said to be "in conformity with the hypothesis of Laplace on the formation of the earth." Laplace's nebular theory, here referred to, amounts to this. At some period in the infinitely remote past the globe had no existence as such. The matter composing it existed in space, but at such a high temperature that it was not merely liquid but a gas. Everything of which the earth is now composed—iron, gold, granite, as well as water and air—existed only in the form of incandescent vapor.

In the course of ages this mass of gaseous matter gradually cooled, and the globe assumed first the form of a ball of melted matter surrounded by dense clouds; then it became covered with a solid crust, the clouds gradually disappeared, and the earth assumed its present form. This theory, startling at first, becomes more plausible as our knowledge increases, and if not itself the final explanation of globe formation, is at least a long stride toward accurate knowledge. From the experience men have gained in the operations of smelting and other processes requiring intense heat, we are enabled to predict with great certainty what would be the state of things during the gradual condensation of the globe from a gas to a solid. And the knowledge thus gained leads us to the conclusion that it is extremely improbable that carbon could exist in the earth in a solid state. Every one knows what would be the effect of exposing white-hot carbon to the atmosphere. It would burn rapidly and disappear. Metallurgists will understand further that if a limited amount of air were supplied to a number of combustible bodies, the carbon would burn first. Sulphur, phosphorus, white-hot iron, zinc, and many other substances, all burn, that is, they all use up the oxygen of the atmosphere. But it is well known that charcoal is used to smelt iron, that is to say, when heated iron and heated charcoal are placed in contact with a limited amount of oxygen, such as is contained in hæmatite and other good ores, the iron gives up its oxygen to the carbon, and we get as results metallic iron and carbonic acid gas. Carbonic acid gas is always formed when carbon is burnt in the air. It is the same with most other materials. The carbon would extract from them all the oxygen they contained, and would be transformed into gas. It may be said that carbon in the center of the earth would be protected from the atmosphere and would have no chance of burning. Our contention is, that it would never get into the center of the earth. Remember that the whole material of the earth is in a state of vapor. As this gradually cooled, carbon and iron among other things would separate as solid or liquid masses at more than a white heat. And it is impossible to suppose that the carbon would not immediately seize upon all the oxygen surrounding it and be instantly converted into the permanent gas, carbonic acid.

Further, Mendeleef assumes that water could penetrate soil which was sufficiently hot to keep iron in a melted state. If the water could creep down a crevice to the melted iron, it is certain that steam could escape by the same passage, and the heat generated by the neighborhood of the masses of melted iron would certainly cause every particle of water to disappear long before it would come in contact with the iron itself.

If there was not sufficient organic life in the Silurian and Devonian periods to supply the materials for the formation of petroleum; if carbon and iron could exist in a melted state in the center of the earth and could reach that position before the carbon was completely oxidised and converted into gas; if water could penetrate the intensely heated soil without being transformed into vapor and restored to the atmosphere; if water could come in contact with heated iron or carbon, it is possible that petroleum might be formed through the combination of these materials. But it is evident that this involves too many suppositions to be worthy of great confidence, and until we have obtained more facts we must content ourselves either with the older theory or with the statement that we know nothing about the origin of this important commodity.—*The Ironmonger.*

Arrow Poison.

Lovers of the weird and ghastly will be gratified by the perusal of the account of the poisoned arrow manufacture as carried on by the Samoan islanders, and related to the Fellows of the Linnæan Society by the Rev. Thomas Powell. An old chief of Efat—one of the Sandwich Islands—thus reveals the mystery of the poison craft to his son Pomare. The initiated, distinguished by wearing the *os femoris* of a pig inserted between the arm and armlet, watch for the death of a sufferer laid low by any acute disease which may be accompanied by delirium. They note the place of his burial, and six months afterwards open his grave by stealth. From thence they carry the large bones of both extremities, and the parietal bones of the skull. Of these, by sundry sawing, polishing, and scraping, they make the points of spears and arrows. For a saw they use the spines of a large echinus, of which they need a goodly quantity, as the edge is soon worn out Three plants are pressed into service for the poison—the toto, the putu, and the fanuamamala. The most virulent is the toto, a large tree. When cut, a white milk exudes, which causes blindness; its sap introduced into the circulation causes death. A band of freebooters once landed on the western end of Efat. Proceeding eastward, they came to a place called Mole, where the inhabitants prepared for them an inhospitable reception. There was an enclosure of water on the beach, which, at low tide, served both for drinking and for bathing. The people dried some toto leaves and strewed them in the water. No sooner landed, the invaders rushed into the cooling lake. Immediately they were thrown into convulsive agonies. Those who only bathed in the impregnated water became blind, whilst those who drank, died. These three plants, the toto being chief, carefully picked and desiccated, were pounded in a mortar with a wooden pestle made of the ara. Next a species of holothuria was taken from the lagoon, put into a leaf of *colocasia Indica*, and placed in the shade till it became a putrid liquid, to which the powder was added in sufficient quantity to form a thin paste. One last ingredient was *na let*, or wasp food, and the villanous concoction was worked up with the expressed juice of an old cocoa-nut, stirred for a month at intervals till the mass became a dark cloudy oil, which, when bottled and preserved for twelve months, was fit for use. Great precautions were employed in applying the poison to the tips of spears and arrows. Every trace of moisture was got rid of by careful drying in the smoke. The poison, taken internally, was always fatal. When received into the system on the spear point, recovery might be effected by making instantaneous free incisions in different parts of the body, to allow the escape of the poisoned blood. Whenever fatal the same symptoms followed—convulsions, lock-jaw, death. Tetanus was one of the invariable results. Imagine the old Samoan noting the grave for which delirium had found an occupant, exhuming the fever corpse to barb his weapons with the poisoned bones; then, with a skill and patience which no modern pharmacist could surpass, mixing, evaporating, and perfecting his vile compound.—*Chemist and Druggist.*

How the French Workman Lives.

The French laborer probably gets more for his wages than any other. His food is cheaper and more nourishing. His bouillon is the liquid essence of beef at a penny per bowl. His bread at the restaurant is thrown in without any charge, and is the best bread in the world. His hot coffee and milk is peddled about the streets in the morning at a sou per cup. It is coffee, not slops. His half bottle of claret is thrown in at a meal costing twelve cents. For a few cents he may enjoy an evening's amusement at one of the many minor theaters, with his coffee free. Sixpence pays for a nicely cushioned seat at the theater. No gallery gods, no peanuts, pipe, smoke, drunkenness, yelling or howling. The Jardin des Plantes, the vast galleries and museums of the Louvre, Hotel Cluny, palace of the Luxembourg and Versailles, are free for him to enter. Art and science hold out to him their choicest treasures at small cost, or no cost at all. French economy and frugality do not mean that constant retrenchment and self-denial which would deprive life of everything which makes it worth living for. Economy in France, more than in any other country, means a utilization of what America throws away, but it does not mean a pinching process of reducing life to a barren existence of work and bread and water.

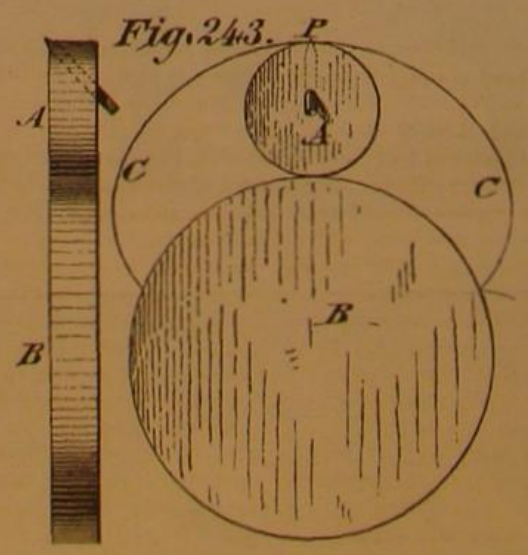
PRACTICAL MECHANISM.

BY JOSHUA ROSE, M.E.

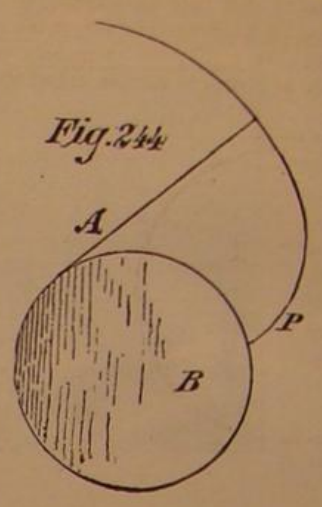
NEW SERIES—No. XXXV.

CURVES FOR GEAR WHEEL TEETH.

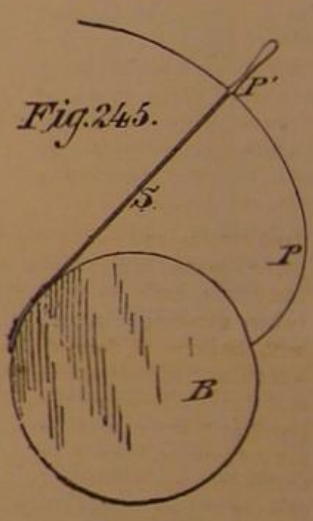
An epicycloid may be described or generated by a point in the circumference of a circle that rolls, without slip, upon the circumference of another circle. Hence to produce this curve, take two pieces of wood, having circular edges, A and B in Fig. 243, and bore a parallel hole obliquely in A to receive the tightly fitting and hard piece of pencil shown at P in the Fig. 243, which is to serve as a tracing point. It should be made to protrude well through the wood, be filed even with the circular edge of the same, and brought to a point by filing from the back and on the two sides. By adopting this plan of sharpening the pencil point we ensure



that it shall stand even with the circle of the wood, which is of great importance; and, furthermore, we can let the point protrude well, enabling us to see distinctly the operation of the point and place to any mark upon the base circle, B. Lay the radial face of the base circle, B, upon a sheet of drawing paper and, while holding it in a fixed position, take the piece, A, and placing its perimeter in contact with that of B, and pressing the two together to avoid slip, revolve A around B. The point, P, will then mark upon the paper the epicycloidal curve, C C. In this operation A (the moved circle) is called the generating circle and B (the stationary circle) the base circle. It will readily be perceived that the shape of the curve thus traced will vary with the size of the generating circle, but the properties of the curve will remain the same. If the diameter of the generating circle, A, be supposed to be infinite, than a portion of its circumference may be represented by a straight line, such as A in Fig. 244, and if this straight line be made to roll upon the circumference of a circle, as shown in Fig. 244, then the curve traced will be involute, P. In practice a piece of flat spring steel, such as a piece of clock spring, is used for tracing involutes. It may be of any length, but at one end it should be filed so as to leave a scribing point that will come close to the base circle or line, and have a short handle, as shown in Fig. 245, in which S represents the piece of spring, having the point, P′, and the handle, H. The operation is to bend the spring around the circle, B, holding the point, P′, in contact with the drawing paper, securing the other end of the piece of steel, so that it cannot slip upon B, and allowing the steel to unwind from the cylinder or circle, B. The point, P′, will mark the involute curve, P.

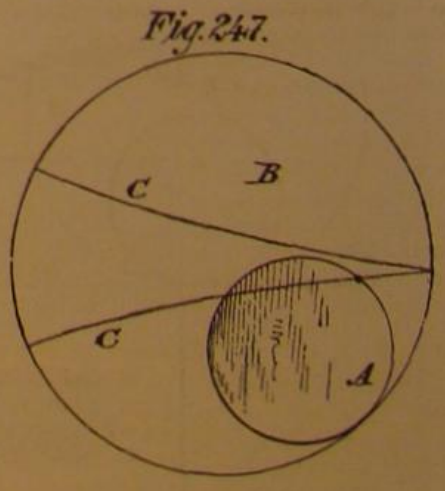


Another way to mark an involute is to use a piece of twine in place of the spring and a pencil instead of the tracing point; but this is not so accurate, unless, indeed, a piece of wood be laid on the drawing board and the pencil held firmly against it. In tracing any of these curves a hard pencil is necessary to obtain a fine line, and it is best to go over the operation twice, and if then the curve is a fine and not a double line, it is a proof of correctness.



Returning now to a generating circle of finite dimensions, we will suppose the radius of the base circle to be infinitely extended. A portion of its circumference may then be represented by a straight line, and the curve traced by a point in the circumference of the generating circle as it rolls upon the base line is termed a cycloid. Thus in Fig. 246, B is a portion of a base circle of infinite diameter, A is the generating circle, and C C is the cycloidal curve traced by the

point, D, when A is rolled along B. If now we suppose the line, B, to represent a rack, it will be obvious that the part of the cycloid which meets B at one end is suitable for the face on one side of the tooth, and the part at the end is suitable for the other side of the tooth.

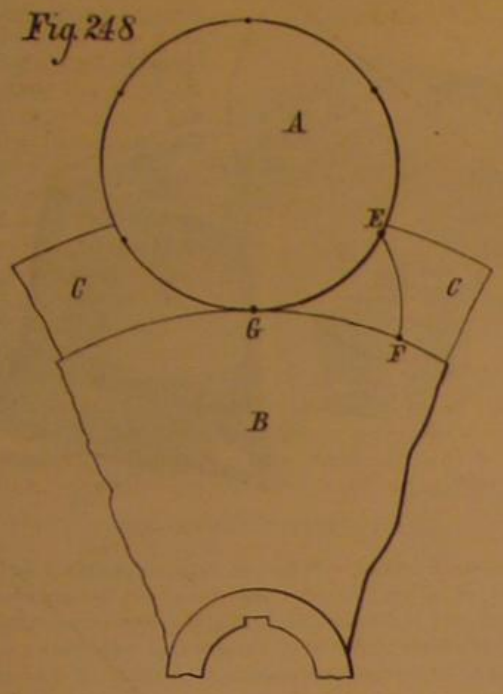


Let us now suppose that our base and generating circles have finite dimensions; the generating circle is rolled within instead of upon the circumference of the base circle, and

a point upon the periphery of the generating circle will then describe a curve called an hypocycloid. Thus, in Fig. 247, B represents a bore forming the base circle, and A a cylindrical piece of wood forming the generating circle. Then a point at the periphery of A would, upon rolling A within B, describe the hypocycloidal curve, C C. Now though in the four cases here given the curves produced by the prescribed mechanical means are called by different names, yet, as the conditions are the same, it is the same general curve throughout, and is known as the cycloid. If we consider the case of Fig. 243 as positive, then that of Fig. 244 is negative, that of Fig. 246 is neutral, and that of Fig. 247 infinite.

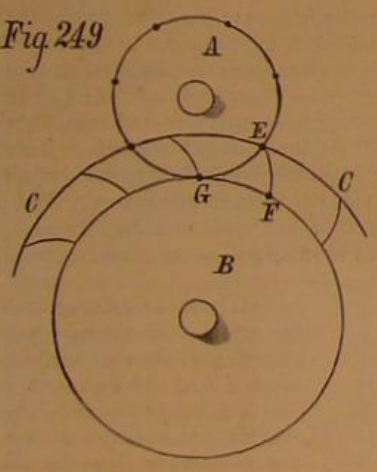
To demonstrate that, by the application of these curves, motion from one wheel to another may be communicated with as much uniformity as by frictional contact of the circumferential surfaces, let A B, in Fig 248, represent two plain disk wheels which are at liberty to revolve about their

Fig 248



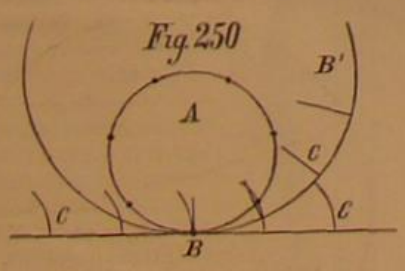
fixed centers, and let C C represent a margin of stiff white paper attached to B, so as to revolve with it. Now suppose that rotary motion to A and B commenced when the point, E (where a tracing point or pencil is attached), in conjunction with the point, F, formed the point of contact of the two wheels, and continued until the points, E and F, had arrived at their respective positions, as shown in the figure. The pencil at E will have described upon the margin of stiff paper the small portion of the epicycloid denoted by F E, and as this movement took place by the contact of the circumferences of the wheels it is evident that the arc, G F, must be equal to the arc, G E. The conclusion, therefore, is that the motion of the wheel, B, would be communicated uniformly to the wheel, A. Again, if we suppose a series of these small portions of epicycloids, as shown at E F in Fig. 249, to be arranged at equal distances around the wheel, B, and a series of points set up at equal and corresponding points around A, which we will call the pinion, then the wheel, B, in revolving in the direction from G to F, would impart a continuous and uniform motion to the pinion, A.

Fig 249



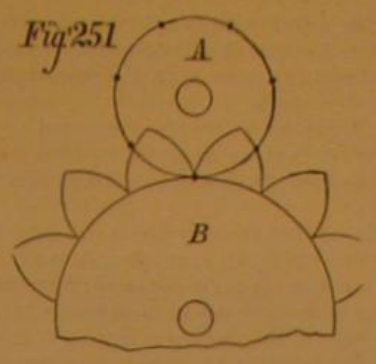
In Fig. 250 is shown a similar case applied to a rack and an internal wheel. The line, B, with the series of short curves, which are portions of cycloids struck with the gene-

Fig 250



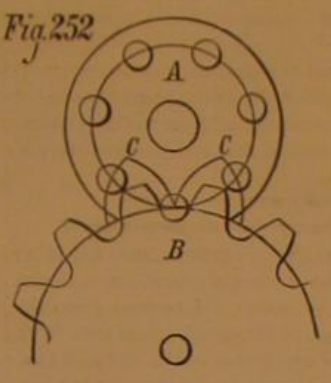
rating circle, A, representing the rack, B', with its small portions of hypocycloids representing an internal wheel, or more strictly the elements of one. In our figure the generating circle, A, is drawn half the diameter of the base circle, B, and consequently the hypocycloids are straight radial lines, which will not be the case where these two proportions are different, although the practical construction would remain the same. It will be seen that, by the arrangement of curves and points shown in our two figures, rotary motion may be either transmitted or converted into a plane motion, but it will be noted that this arrangement would transmit the motion in one direction only. To enable it to operate in both directions we have but to add another set of portions of cycloids, as shown in Fig. 251, and we shall have arrived at an elementary form of gearing, known as the wheel and lantern.

Fig 251



To render this device useful in practice all that remains is to increase the points to a suitable diameter, making them into rungs possessing the requisite strength. This will necessitate a diminishing of the teeth (to afford space for the rungs to fall into) by the same amount we have added to the points, or, strictly speaking, by rather more, since it is necessary to allow a little for irregularity in the workmanship and to permit of the free passage of the rungs. Fig. 252 represents this process carried out. A B represents the wheel, as before, C C the primitive teeth, as in Fig. 251; and by setting the points of a pair of compasses to a trifle more than the radius of the rung, and marking off a number of points of that distance from the curves, C C, we are enabled to trace out the same curves; that is to say, teeth adapted to work correctly with and allow space for those rungs.

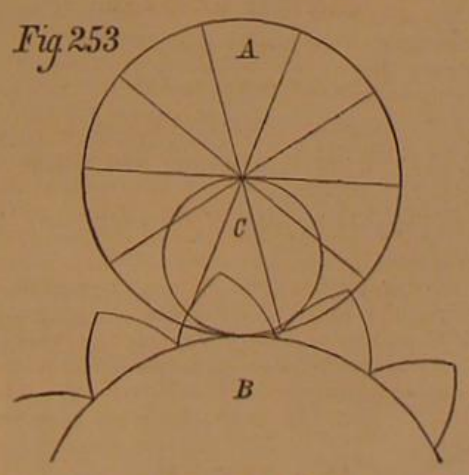
Fig 252



It is considered as established that the correct form to be given to the teeth of a wheel that is to drive or be driven by a lantern, trundle, or wallower (which are synonymous terms) must be epicycloidal with the curves generated by the rolling of a circle whose diameter is the same as that of the lantern, measured at the centers of the pins or rungs, which diameter represents, in this case, the pitch circle; the teeth being first drawn out as if the rungs were points, and then diminished by curves drawn parallel to the first, but set back, as it were, so as to make room for the full size of the rung and allowing a small portion for clearance. It is obvious, however, that such method of communicating rotary motion is unsuited to the transmission of much power, because the pins in the pinion, A, would be considerably weaker than the teeth in the wheel, B, and the pins would soon wear away from the small amount of wearing surface they possess.

Let us now suppose that instead of points we have radial

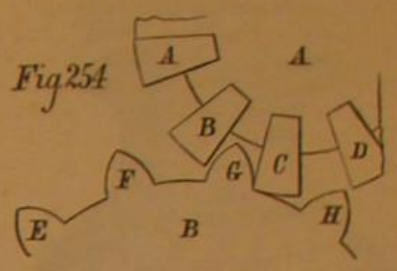
Fig 253



lines, representing the surfaces of projecting radial ribs, arranged at equal distances around the plane of the disk, A, as in Fig. 253. To determine the shape of the teeth of the wheel, B, to work with those lines, we take a circle, C, in the figure of half the diameter of A, and cause it to roll along in contact with the internal circumference of A, and a tracing point at its circumference will draw radial lines upon A, but the circumstances will not be altered if we suppose these three circles to be movable about their fixed centers and let the centers be in a straight line; and if under these latter circumstances we suppose motion to be imparted to these three circles, through frictional contact of their perimeters, a point on the circumference of C would trace epicycloids upon the revolving plane of B and hypocycloids upon that of A. The latter being a radial line, and therefore the proper curve for the teeth of these two primitive wheels, will be epicycloidal for B and hypocycloids, or radial lines, for A, as shown in the figure. Now let us render these teeth, which are adapted to work with radial lines, capable of practical use, by allowing for the thickness of the ribs, of which the radial lines represented the surface: or, in other words, let us proportion the strength, which we do by increasing the width of the radial lines on A, so as to represent the thickness of the ribs, and striking the epicycloidal curves with the same generating circle, but those formed with C rolling in one direction nearer to the roots of those struck when it rolled in the other, so as to reduce the thickness of the tooth to permit of the passage, between the teeth, of the radial arms, and we shall find that we have arrived at the form of teeth shown in Fig. 254.

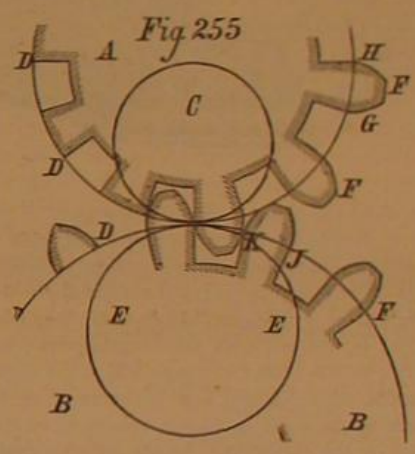
Now although the formation of teeth that shall enable any two wheels in a set to work practically correctly together is a subject not as yet under consideration, yet it is proper to here point out that a wheel having teeth of the form of those upon A, in Fig. 14, can only work in gear with one having the form of those upon B, and *vice versa*, and that, although these two forms of teeth were struck with the same generating circle, yet neither two of the wheels B and two of A will work together. We may, however, by means of the employment of another generating circle, carry the process a step further forward and form teeth that will do so. Then we

Fig 254



have in Fig. 255 the same two wheels shown in Fig. 254, with the shape of the teeth in that figure shown at D D and D D. We now introduce a second generating circle, shown in Fig. 255 at E E, and of half the diameter of B, and by rolling it outside of A a point on its circumference will mark or add to the teeth shown on A at D, the epicycloidal curves, G and H, G being marked with the circle, E, rolled in one direction, and H, with it rolling in the other direction, care being, of course, taken to let the tracing point start at each operation of tracing from the exact edge or corner line of the teeth or marks at D. So likewise, with the teeth upon

Fig 255



B, we place our generating circle in contact with the inside of the circle of B and bring the tracing point on its circumference exactly even with the face of the tooth at the pitch line, and then rolling the generating circle will trace a line representing the flank, as, for example, at J in the Fig. 255; then by going through the same operation, rolling the generating circle in the other direction, we mark lines on the other side of the tooth, as shown at K. Thus by the introduction of our last generating circle we have added epicycloidal faces to the teeth on A, shown at D, and hypocycloidal flanks to the teeth on B, shown at J K: giving us the form of tooth shown on the respective wheels at F, the circles forming A and B now representing the pitch lines of their respective wheels, the form of tooth thus arrived at being epicycloidal with hypocycloidal or radial flanks.

How Scorpions Sing.

At the September meeting of the London Entomological Society, Mr. J. Wood-Mason announced the discovery of singing organs in scorpions. He procured two large living scorpions; these, when fixed face to face and goaded into fury, at once commenced to beat the air with their palps and simultaneously to emit sounds which were most distinctly audible. It resembled the noise made by scraping a stiff tooth brush with one's fingernails. The singing apparatus is developed on each side of the body, the scraper upon the flat outer face of the basal joint of the palp-fingers, and the rasp on the equally flat and produced inner face of the corresponding joint of the first pair of legs. The former was thickly beset with stout, conical, sharp and curved spinules; the latter studded with minute tubercles shaped like the top of mushrooms. The sounds were produced by these parts being quickly rubbed together, friction in a dead specimen producing the same sound.

THE American export of petroleum has increased wonderfully within the last four years, until, to-day, there is scarcely a civilized spot on the face of the globe to which this cheapest of all illuminators is not shipped. The wells of Pennsylvania and West Virginia have yielded in all about 80,000,000 barrels, which has a value of nearly four hundred million dollars at the seaboard.—*British Trade Journal*

INSTEAD of the time-honored millstones, chilled iron rolls are beginning to be used in England for the purpose of reducing wheat and other kinds of grain.

SELF-WATERING FLOWER POTS.

We illustrate herewith a simple and novel device for moistening flowers and plants by means of the evaporation and condensation of water. Fig. 2 represents the parlor garden form. This is made of sheet metal, terra cotta, or other material, and can be made in any desired shape. The upper portion is pierced with openings after the manner of

Fig. 1.

a stove. In the bottom is a reservoir for water. The earthen flower pots seen in the figure are perforated with numerous holes, and are provided with projecting collars. They fit exactly into the openings of the cover, and the bottoms reach within one or two inches of the water beneath. The top of the pot is covered with segmental covers, provided with openings in the center, through which the stem of the plant protrudes. The natural heat of summer, or the artificial warmth of the room in winter, causes an evaporation of the water in the reservoir. As the exterior casings are water-tight, the water condenses on the sides of the flower pot. The earth contained therein absorbs through the holes the needed moisture, and the rest drips back into the reservoir. The segmental covers prevent the moisture evaporating from above, and in case of too much dampness, one or more of these covers can be raised. The water constantly passes back and forth from the reservoir to the earth, and is thus kept pure and sweet, and very seldom needs renewing. Fig. 1 represents a more ornamental design, constructed on the same principle. Flowers once placed in one of these gardens will, we are informed, remain fresh and green all winter with very little care. For further information address the inventor, C. H. Crater, Owego, N. Y.

IMPROVED CONSTRUCTION OF PORTABLE FRAME BUILDINGS.

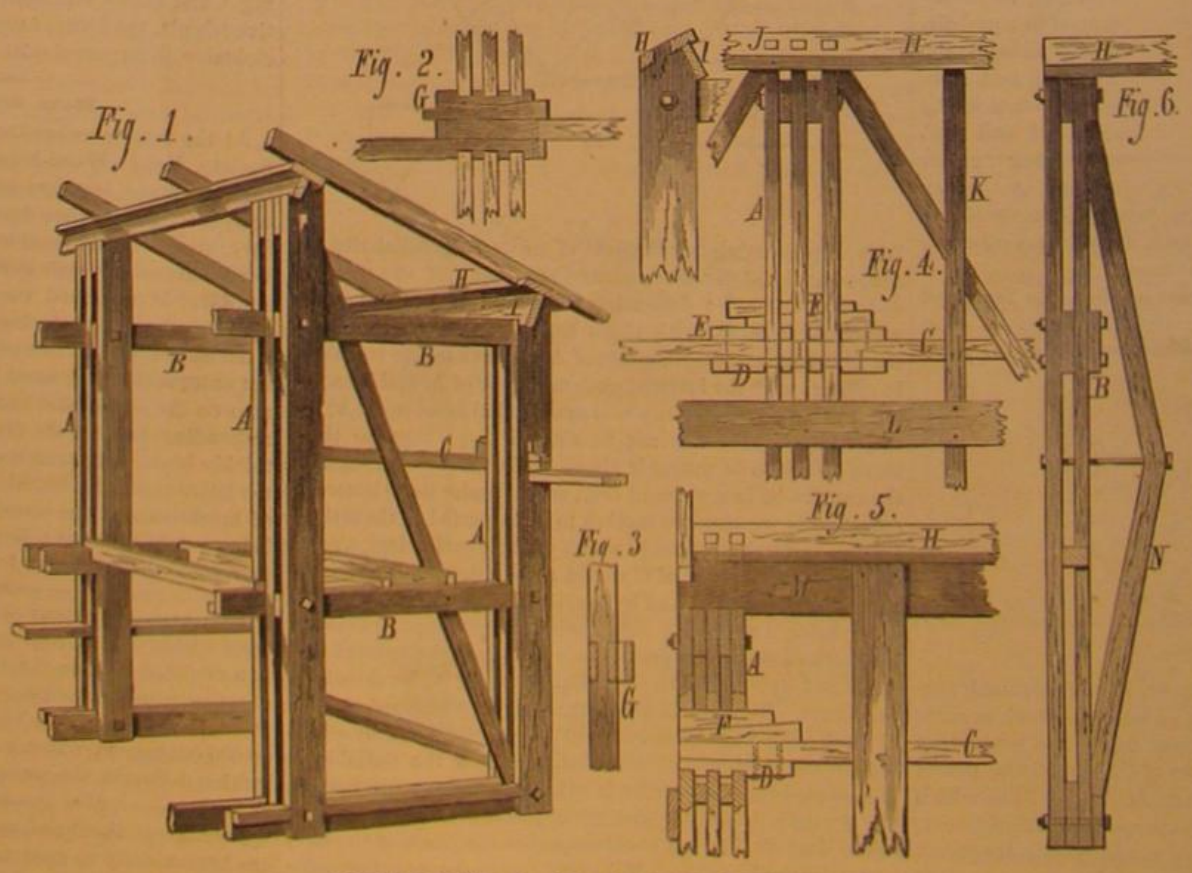
We illustrate herewith an improved method of erecting frame buildings by the use of planks of suitable length, and thickness, from which the posts, beams, joists, etc., are formed, so that the structure may be erected with much saving of timber and by unskilled persons. It also may be taken down and packed in small compass for shipment from place to place.

The supporting posts, A, are made of two or more planks according to the size of the edifice to be erected. The planks are placed at some distance from each other, and are firmly bolted to the beams, B, Fig. 1, which are made of several planks interposed between the post planks, the whole forming a strong and rigid construction. The lateral posts connecting girders, C, are passed through mortises of the plank posts, and are rigidly secured at their meeting ends by a recessed key, D, Figs. 4 and 5, which is first passed through the mortises of the post and then placed in position. The girder ends, after being inserted, are connected by a second recessed top key, E, of less width. Both keys are spiked to the girder ends in order to unite them. The keys and girder joint are finally locked to the mortises of the plank post by two wedge keys, F, introduced at relatively opposite directions.

The girders, C, are also connected to the posts by a similarly recessed key or girder, G, Figs. 2 and 3, that is inserted as above described, bolted, and finally locked by wedge keys.

The rafters are seated by their recessed ends on the rafter-bearing plates, H, Figs. 1 and 4, which are supported by pieces, I, set at right angles to the plates and fitted to the recessed ends of the posts to which they are spiked. The top ends of the posts have tenons, J, Fig. 4, that enter mortises in the rafter plates, H, so as to cause the rigid interlocking of said plates with the posts. Vertical siding strips, K, Fig. 4, are nailed to rafters, girders, etc., so as to receive the horizontal siding boards, L. A horizontal siding strip, M, runs below the rafter plate. In some cases posts are required that are not tied to the building by a girder or beam, in which case the post, constructed as already described, is strengthened by the brace, N, Fig. 6. This brace is made of one piece, and is attached to a central bolt and nut and seated against shoes.

This invention was patented through the Scientific American Patent Agency, December 25, 1876, and September 24, 1877. For further information address the inventors, Messrs. W. R. Morris and Joseph Slanser, LaRue, Marion county, Ohio.



CONSTRUCTION OF FRAME BUILDINGS.

Corrosion of Boilers by Smoke Deposits.

In the *Journal of the Franklin Institute*, Chief Engineer Isherwood, U.S.N., has a paper on the corrosion of steam boiler by the sulphuric acid in the soot deposited from the smoke upon the surfaces, the essay being translated from the French. The conclusions reached are that when smoke deposits on boiler surfaces distant from the furnace are rendered moist by any accidental cause, the sulphurous acid in the gases of combustion determines the attack upon metal by the formation of the sulphate of the oxide of iron.

The attack can take place, while the boiler is in use, on such of its metallic surfaces as may be wetted by leakage from the boiler itself, or by water infiltrated through the masonry, or derived from the condensation of the aqueous vapor in the gases of combustion by contact with surfaces relatively cold. It can also be produced while the boiler is out of use, by means of the humidity of the air in the flues.

These different origins of the corrosive action, point out the precautions to be taken for preventing its destructive effects. They are only those which should be adopted for the preservation of any apparatus, namely, careful construction, thorough cleaning, and maintenance in good repair.

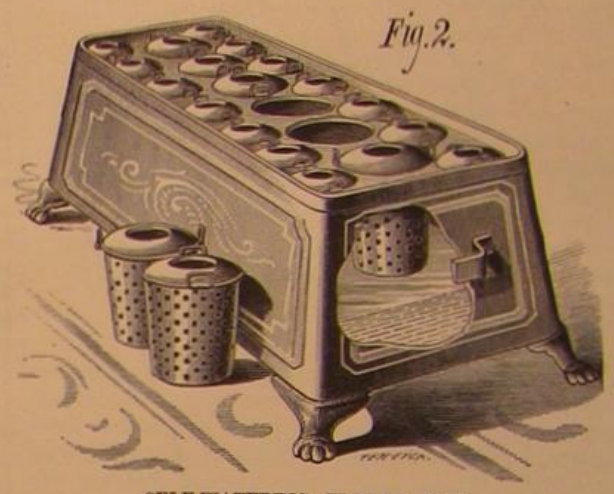
Egg Preservation.

We extract the following from the third report of the National Butter and Cheese Association, giving the method of preserving eggs which is practised by large dealers.

To make the pickle, use stone lime, fine salt and water in the following proportions: One bushel of lime, eight quarts of salt, twenty-five 10 quart pails of water. The lime must be lime that will slake white, fine, and clean. Have the salt clean and the water pure and sweet, free from all vegetable and decomposed matter.

Slake the lime with a portion of the water, then add the balance of the water and the salt. Stir well three or four times at intervals, and then let it stand until well settled and cold. Either dip or draw off the clear pickle into the cask or vat in which it is intended to preserve the eggs. When the cask or vat is filled to a depth of 15 inches or 18 inches begin to put in the eggs, and when they lie, say about 1 foot deep, spread around over them some pickle that is a little milky in appearance, made so by stirring up some of the very light lime particles that settle last, and continue doing this as each lot of eggs is added. The object of this is to have the fine lime particles drawn into the pores of the shells, as they will be by a kind of inductive process, and thereby completely seal the eggs. Care should be taken not to get too much of the lime in—that is, not enough to settle and stick to the shells of the eggs, and render them difficult to clean when taken out. The chief cause of thin, watery whites in limed eggs is that they are not properly sealed in the manner described. Another cause is the putting into the pickle old stale eggs that

Fig. 2.



SELF WATERING FLOWER POT.

have thin, weak whites. When the eggs are within 4 inches of the top of the cask or vat, cover them with factory cloth, and spread on 2 inches or 3 inches of the lime that settles in making the pickle, and it is of the greatest importance that the pickle be kept continually up over this lime. A tin basin (holding about six to eight dozen eggs), punched quite full of inch holes, edge muffled with leather, and a suitable handle about 3 feet long attached, will be found convenient for putting the eggs into the pickle. Fill the basin with eggs, put both under the pickle and turn the eggs out; they will go to the botom without breaking.

When the time comes to market the eggs they must be taken out of the pickle, cleaned, dried, and packed. To clean them, secure half of a molasses hogshead, or something like it, filling the same about half full of water. Have a sufficient number of crates of the right size (to hold 20 to 25 dozen eggs), made of laths or other slats, placed about three quarters of an inch apart. Sink one of these crates in the half hogshead, taking the basin used to put the eggs into the pickle, dip the eggs by raising it up and down in the water, and if necessary to properly clean them, set the crate up and douse water over the eggs; then, if any eggs are found when packing that the lime has not been fully removed from, they should be laid out and all the lime cleaned off before packing. When the eggs are carefully washed, they can be set up or out in a suitable place to dry, in the crates. They should dry quickly, and be packed as soon as dry. In packing the same rules should be observed as in packing fresh eggs.

Vats built in a cellar around the walls, with about half their depth below the surface, about 4 feet or 5 feet deep, 6 feet long, and 4 feet wide, are usually considered the best for preserving eggs in, although many use and prefer large tubs made of wood. The place in which the vats are built, or the tubs kept, should be clean and sweet, free from all bad odors, and where a steady, low temperature can be maintained—the lower the better—that is, down to any point above freezing.

CONDENSED forage is supplied to the Russian commissariat on the Danube by three Russian manufacturers, one of whom at St. Petersburgh turns out 30,000 lbs. per diem. The forage is composed of small biscuits of oatmeal, pea flour, rye meal, and ground linseed, and twenty-eight biscuits form a single ration for a horse, containing as much nutriment as 12 lbs. of oats, whilst only one fifth the bulk.

THE CAROLINA MANTIS

BY C. FEW SEISS.

One of the most peculiar of orthopterous insects found in the Southern and Western States is the mantis or "race horse" (*mantis Carolina*, Linnæus). It will easily be recognized among other insects by its large, spiny, raptorial fore legs or arms. With these it captures its prey, which consists entirely of insects. While devouring an insect it holds it firmly between the tibiæ and tarsi of its fore legs, which are strongly toothed or spined on their lower or posterior surfaces. When holding the insect to its mouth while eating, I have often thought it had a half human appearance, like a child devoid of table etiquette, with the end of a turkey's leg in each hand, tearing with its teeth the meat from the femur.

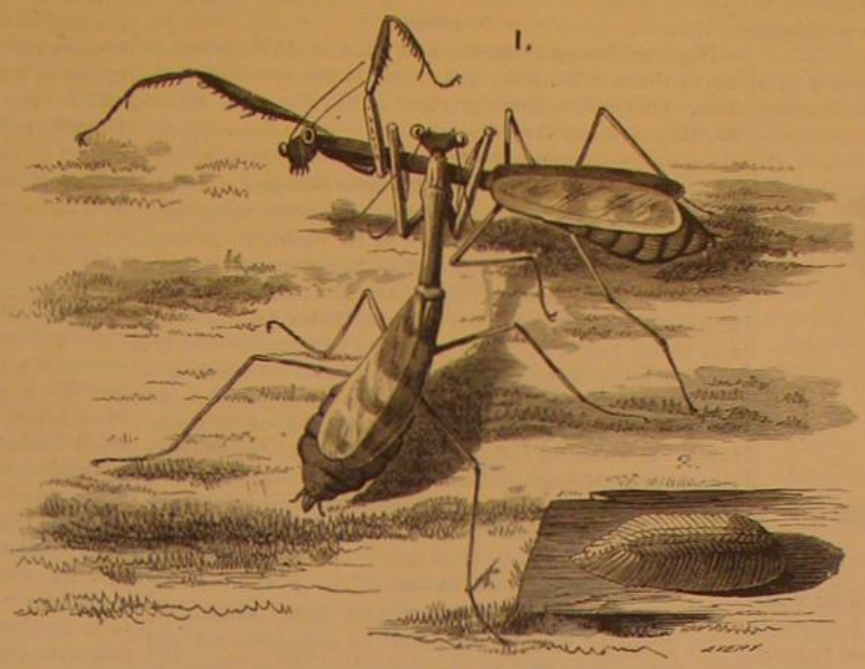
The mantis is savage in its habits, and they often have fierce combats among themselves. They rush to the attack with their raptorial legs elevated and wings expanded; but when the most expert of the two combatants has once firmly seized its adversary, they fold their wings and fight with tooth and claw. I have on two instances witnessed the victorious mantis partially devour the vanquished adversary.

The mantis does not merely "suck the blood" of its prey, as stated by a popular entomologist, but it generally devours blood, internal organs, and shell, especially if the object be a soft bodied insect. In the case of a caterpillar, if it should be a hairy species, the hair and skin are generally rejected.

In September the female attaches a cluster of eggs (Fig. 2) to the limb of a tree, or to the rail of a fence. Here they remain until the following summer, when the young mantes hatch out. I take the following from my journal: April 9, 1877.—The eggs of the *mantis Carolina*, sent me from Baltimore in November last, hatched to-day. The young mantes escape only from the upper, longitudinally, central portion of the convex sub-ovoid egg-cluster. They work themselves out by moving backward and forward and from side to side. Their legs are closely folded to the body when they emerge, giving them the appearance of a large gnat larva, and it requires several minutes before they fully extricate themselves, and are able to walk. In a short time they can run quite briskly, and will throw themselves in an attitude of defence when disturbed. When they quit the egg, they leave a small thin shell behind them, adhering to the egg case. The young mantes, when just hatched, are of a pale brown color; their legs and head pale green, the former with dull brown bands above the joints; their eyes are dark and prominent; their bodies linear; the abdomen but little wider than the thorax; no vestiges of wings visible. They became much darker in color after several hours' exposure to the sun. Each little mantis was about five sixteenths of an inch in length. They drank greedily from drops of water which were sprinkled about the board upon which they were sunning themselves, throwing back their antennæ to prevent them becoming wet.

From sixty to seventy individuals came from each egg-cluster. As the egg packets were kept in a warm room during the winter, their hatching was accelerated, and consequently the coming forth of the young mantes was premature. They lived only a few days, being killed by the coldness of the weather.

The specimens from which I made my drawing, and also the egg packet, were procured in Baltimore, Md., where it is common enough; but I have never met with it in the vicinity of Philadelphia.



THE CAROLINA MANTIS.

THE TRUNCATED PICHICIAGO.

The "truncated pichiciago" is one of the smallest of four-footed animals. It is not more than two inches in length. The shield which covers the entire upper portion of its body is composed of a single piece, and consists of regular, uniform, and smooth scales neatly arranged like mosaic. This coat of mail is truncated vertically at its rear portion. The animal has a curious cut-off appearance owing to the apparent absence of a tail, but in reality due to the position of that member, which is short and closely pressed against the body. All the lower portions, the neck, stomach, sides and legs are covered with long and fine hairs.

The pichiciago is found chiefly in the Cordilleras mountains, in Chili, where it feeds on earth worms, snails, and insects. It uses its long, large, and sharp nails to make burrows, which are often very deep. In these it remains concealed during the greater part of the day, and rarely ventures to wander to any great distance even by night. It can not jump or run swiftly; hence when attacked by an enemy it has no means of escape but by its subterranean gallery; hence, when hard pressed, it seeks safety in digging a new hole, and very often succeeds in thus escaping; but when this resource fails, the animal rolls its head and legs under its stomach, forming a ball like a hedgehog, and thus incased in armor defies the teeth or claws of its adversary. It is sometimes called the chlamyphore. As is the case with the mole and other subterranean animals, the eyes are of minute dimensions, and are hidden under the soft and profuse fur of the face.

THE TRUNCATED PICHICIAGO.

Tinted Paper.

Tinted paper may be prepared in any desirable shade as follows: 1 gm. of any aniline color is dissolved in 30 gms. of strong alcohol, 300 gms. of distilled water are added, and finally a solution of 1½ gms. of tannin in 15 gms. of alcohol. The tannin acts as a mordant. Moderately sized white paper is spread on a marble slab, or other smooth, hard surface, and the coloring liquid is applied in even horizontal lines by means of a small sponge. The paper is then hung up to dry, and may be covered after a few days with a concentrated solution of sodium silicate, to every 100 parts of which 10 parts of glycerin have been added, if it is desired to impart to it a gloss.

DRYER FOR OIL COLORS AND VARNISHES.—Water, 100 parts; gum lac, 12 parts; borax, 4 parts.

Botany of the Rocky Mountains.

Sir Joseph Hooker, a distinguished botanist of London, accompanied Dr. Hayden in the survey of Colorado and Utah. He has given in *Nature* some notes on the botany of the Rocky Mountains, which we copy. The section which he thus visited contained representatives of three very distinct American floras, each characteristic of immense areas of the continent. There are two temperate and two cold or mountain floras, namely, (1) a prairie flora derived from the eastward; (2) a so-called desert and saline flora derived from the west; (3) a sub-alpine, and (4) an alpine flora. Two of the principal American regions are in a broad sense humid; one, that of the Atlantic coast, and which extends west to the Mississippi river, the other, that of the Pacific side, from the Sierra Nevada to the Western Ocean, and two inland, that of the northern part of the continent, extending to the polar regions, and that of the southern part, extending through New Mexico to the Cordillera of Mexico proper. The vegetation of the middle latitudes of the continent resolves itself into three principal meridional floras, incomparably more diverse than those presented by any similar meridians in the Old World, being, in fact, as far as the trees, shrubs, and many genera of herbaceous plants are concerned, absolutely distinct. These are the two humid and the dry intermediate regions above indicated.

Each of these again is subdivisible into three, as follows: (1.) The Atlantic slope *plus* Mississippi region, subdivisible into an Atlantic, a Mississippi valley, and an interposed mountain region with a temperate and sub-alpine flora. (2.) The Pacific slope, subdivisible into a very humid cool forest-clad coast range; the great hot, drier Californian valley, formed by the San Juan river flowing to the north and the Sacramento river flowing south, both into the Bay of San Francisco; and the Sierra Nevada flora, temperate, sub-alpine, and alpine. (3.) The Rocky Mountain region, subdivisible into a prairie flora, a desert or saline flora, a Rocky Mountain proper flora, temperate, sub-alpine, and alpine.

The difference between the floras of the first and second of these regions is absolute; not a pine or oak, maple, elm, plane, or birch of Eastern America extends to Western, and the genera of thirty to fifty species are confined to each. The Rocky Mountain region, though abundantly distinct from both, has a few elements of the eastern region, and still more of the western.

Magnetic Nickel.

The magnetic properties of pure nickel have been lately investigated by M. Wild, of St. Petersburg, who procured a nickel magnet in the form of a flat pointed bar, made by Wharton, in Philadelphia. The results are as follows: 1. Pure nickel takes, as compared with the behavior of pure soft iron, a considerable quantity of permanent magnetism; but the maximum of this is only a half to a third of the permanent magnetism which may be acquired by hard steel. 2. The magnetism remaining in nickel after cessation of the magnetizing force is less permanent than in well hardened steel; the gradual loss of magnetism in course of time, both in warming and cooling, is in nickel greater than in hard steel, even when, by repeated heating and cooling it has, like steel, been brought to a certain state of permanence. 3. The temperature co-efficient of nickel magnets in the latter state is less than that of well hardened steel. 4. The temporary magnetism which pure nickel acquires is about double its permanent magnetic moment, half of the temporary magnetism which hard steel can acquire, and a fourth of that which soft iron can acquire. In its magnetic behavior, nickel is thus throughout subordinate to steel and iron.

Dangers of Galvanizers' Waste.

Pollution of streams by manufacturers' refuse has been assigned as the cause of more evils than can be fairly brought home to it. A new charge has been brought against it, not only of serious pecuniary waste, but also of great and increasing danger to life and property. It appears that the galvanizers of the Wolverhampton district, England, are in the habit of discharging their waste acid into the sewers. The damage caused by this practice is almost incredible; but it is clearly proved that the sewers themselves are being rapidly destroyed; the irrigation farms which dispose of the sewage are being rendered unproductive; and, most serious of all, the boilers of the surrounding factories, which are fed from the neighboring canals, are rapidly corroded.—*Ironmonger.*

NEW TRAPLESS WATERCLOSET.

Noxious gases issuing from defective closets and sewerage connections are an intolerable nuisance, productive of disease, and always injurious to health.

The watercloset illustrated in the accompanying engraving is designed so as to prevent efflux of these dangerous gases. Fig. 1 represents a sectional view of it, by which its peculiar construction will be easily understood. R is a detachable ring, which holds a porcelain non-corrosive valve seat; O, the overflow; T, overflow trap; W is a socket that can be closed with a cap or used as a connection with a washbasin waste; V is a socket for ventilator.

The feature of novelty in this closet is the absence of a trap between the basin and the soil pipe. It is, however,

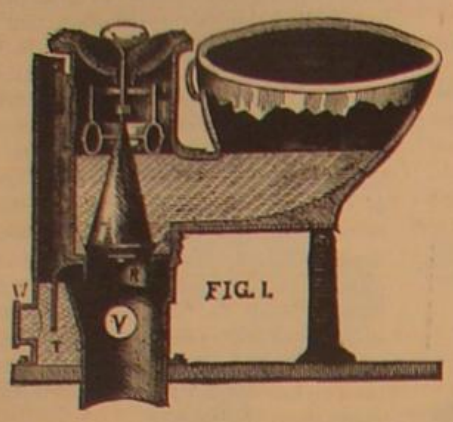


FIG. 1.

doubly protected by the tight seating ball valve and the water seal left in the basin after flushing. The overflow is trapped, as shown in the cut, with a sufficient depth of seal to resist any ordinary pressure, and much more than ever takes place in properly ventilated pipes. The valve of this "trapless" closet is regulated by a float, which makes it automatic and insures an abundant flush when the closet is in use. Cisterns and service boxes are unnecessary, but may be used as safeguards against the possible danger of fouling the service pipe when, from any cause, the head might fall below the closet level. The seat of the solid conical plunger is protected from corrosion by a porcelain non-corrosive coating, and the vent, V, relieves the soil pipe and overflow trap from any pressure of gas or foul air. This should always be provided in watercloset, in addition to the ventilation secured by the soil pipe. This is a feature that should enter into all good plumbing work. There is no complicated mechanism about this closet; it is strong, simple, and, we are informed, efficient and inexpensive. It is the invention of Mr. Jennings, the well known sanitary engineer, of England. Further information can be obtained at the Jennings' Sanitary Depot, conducted by Mr. A. G. Myers, 94 Beekman St., in this city.

ASTRONOMICAL NOTES.

OBSERVATORY OF VASSAR COLLEGE.

The computations of the following notes, which are merely approximate, have been made by students in the Astronomical Department of Vassar College.

Position of Planets for December, 1877.

Mercury.

On December 1, Mercury rises at 8h. 9m. A.M., and sets at 4h. 53m. P.M. On December 31, Mercury rises at 8h. 37m. A. M., and sets at 6 P.M.

Mercury can probably be seen during the last week of December, after the sun has set, a few degrees north of the sunset point.

Venus.

On December 1, Venus rises at 10h. 45m. A.M., and sets at 7h. 43m. P.M. On December 31, Venus rises at 10 A.M., and sets at 8h. 23m. P.M.

Venus will be very brilliant all through the month; it will pass very near the moon, according to the *Nautical Almanac*, as seen at Washington a little south of the moon's limb on December 8.

Venus will be at its greatest eastern elongation on December 11, but will be higher in altitude later in the month.

Mars.

Mars is conspicuous all through the month, but is becoming smaller, and passes the meridian early in the evening.

On December 1, Mars rises at 1h. 10m. P.M., and sets at 0h. 53m. of the next morning. On December 31, Mars rises at 0h. 20m. P.M., and sets at 11h. 44m. P.M.

Jupiter.

Jupiter sets early and is so nearly in range with the sun that its satellites cannot be seen with ordinary glasses.

On December 1 Jupiter sets at 6h. 18m., and on the 31st at about 5 P.M.

Saturn.

Saturn, although it appears so pale and so small contrasted with the ruddiness of Mars and the brilliancy of Venus, is at present the planet of most interest to astronomers. The ring is so situated with regard to the sun and the earth that but little more than the edge is seen, but the numerous satellites which pass around Saturn, at different distances and at different inclinations, give great variety to the configurations. Some of these satellites pass along the edge of the ring, going around in a few days, and others are weeks in their circuit and depart long distances from the central body. Titan, the largest, can be well seen with an ordinary glass. It is now (November 16) on the right of the planet as seen in the telescope, and in seven days it will be on the left, and around again in fifteen days at the right.

On December 1, Saturn comes to meridian at 6h. 20m., and sets at 11h. 50m. P.M. On December 31, Saturn comes to the meridian at 4h. 28m. P.M., and sets at 10h. P.M.

Uranus.

On December 1, Uranus rises at 10h. 37m. P.M., and sets at 0h. 7m. P.M. of the next day. On December 31, Uranus rises at 8h. 37m. P.M., and sets at 10h. 8m. A.M., of the next day.

Neptune.

Neptune rises on December 1 at 2h. 48m. P.M., comes to the meridian at 9h. 30m., and sets the next morning at 4h. 12m. On the 31st, Neptune rises at 0h. 49m., and sets at 2h. 11m. A. M. of the next day.

New Use for Beet Molasses Refuse.

A promising new mode of producing cold has lately been described to the French Academy by M. Vincent. A short time ago he found that, by distilling the residue of molasses of beet, he could prepare large quantities of chlorhydrate, bromhydrate, and iodhydrate of trimethylamine. He has now shown how it is easy to pass from this body to chloride of methyl, and he insists on the applications of which this latter compound is capable: At 33° below zero (C.) it liquefies, and nothing is easier than to keep it liquid in sealed tubes. If it then be caused to evaporate—*e.g.*, by sending a current of air through the mass—a cooling is obtained which goes down to — 55°. Mercury immediately congeals in such a medium. This method of producing a very low temperature is, moreover, a very cheap one.

DORR'S ADJUSTABLE HAT AND COAT RACK.

We illustrate herewith an improved adjustable hat and coat rack, which may be constructed of either wood or metal and in a variety of styles. The hooks, it will be noted, slide upon parallel rods of polished metal, and can be placed either near together or far apart, as desired. The rods are secured in handsome brackets of either metal or wood. Fig. 1 represents the single rack; Fig. 2 is an ornamental form of metal rack; and Fig. 3 has a wooden bracket in the fashionable Eastlake style. Each rack may be easily taken to pieces for convenience in packing or shipping. The device is exceedingly strong and durable, and is a neat and handy substitute for the ordinary large and expensive stand.

Fig. 1.

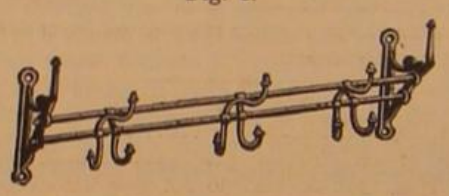


Fig. 2.

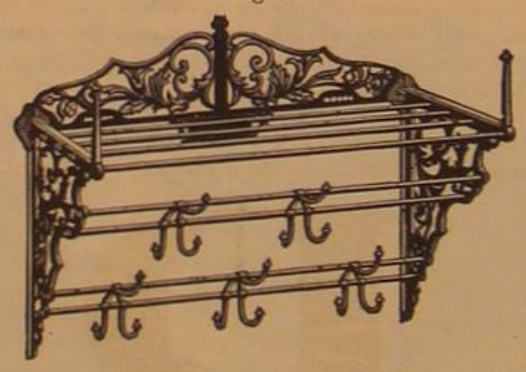
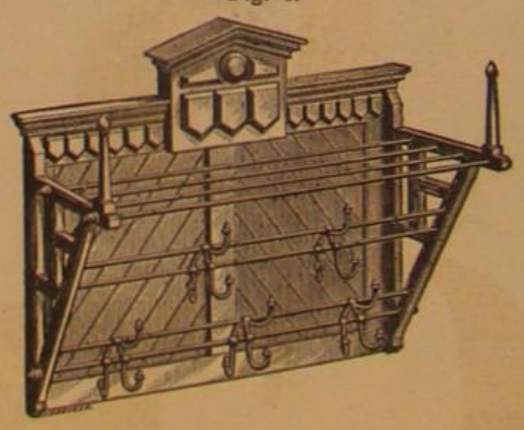


Fig. 3.



For further particulars relative to agencies, rights, etc., address the Dorr Hat and Coat Rack Company, 542 Broadway, Albany, N. Y.

The New Tea Region.

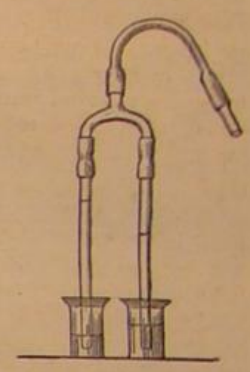
The tea trade is generally considered as being the exclusive business of China and Japan, and tea from other countries is apt to be looked upon with suspicion as a spurious article. Seventeen years ago the first tea plantations were established in Assam, and the growth of tea in India was regarded merely as an experiment. The trade steadily increased until, from 1,300,000 lbs. of tea in 1861, the export from Calcutta advanced to 25,000,000 lbs. in 1875. The cause of the poor quality of China teas of late years lies in hasty preparation, with a view of bringing the teas early to market. Small farmers grow from 50 to 500 lbs. of leaf, and carry it off to a market. If they fail to sell it here they take it to others, and in the meantime the unfired leaf is spoiling fast by exposure to the air. In India the planting, picking, and firing are done more systematically, and consequently a better quality of tea is produced.

A Special Specific Gravity Apparatus.

BY JAMES TAYLOR.

It is often desirable to ascertain approximately the specific gravity of a liquid in cases where the hydrometer and specific gravity bottle are not applicable, or would take up too much time. The following contrivance answers very well for this purpose, is very readily applied, even with tolerably small quantities of liquid, and easily gives results correct to the first decimal place.

Two straight pieces of glass tubing, 5 to 10 m.m. bore and 250 m.m. long, are joined by caoutchouc tubing to two ends of a T-joint which have been bent so as to be parallel. The third end of the T-joint has a piece of caoutchouc tubing of convenient length slipped on, and this is stoppered by means of a bit of glass rod. Two small beakers, a rule, and any convenient stand arranged so as to hold the long tubes vertically, complete the apparatus.



Its application is almost obvious. On pouring a little distilled water into one beaker, and the liquid whose specific gravity is to be determined into the other, bringing the beakers under the two vertical tubes so as to immerse the ends of the latter in the respective liquids, and partially exhausting above, the liquids will rise to heights depending on their relative densities. The plug is now inserted, the lengths of the liquid columns are measured, and the specific gravity required, is obtained by dividing the length of the water column by that of the other.—*Chemical News.*

NEW INVENTIONS.

A new Gasket, patented by Cyrus S. Stoy, of Butler, Ind., consists of two thin annular metallic plates, joined together at their inner edges, having a space between them for a coil of packing. In taking the joint apart, there being no part of the elastic packing in contact with the face of the joint, it may be readily removed without injury, and may be used many years without renewing.

A simple Wire Stretcher, the invention of D. A. Smith, of Marak, K., consists of a forked casting having a squared upper end for receiving a wrench, and perforated ears for receiving a nail that prevents the wire from unwinding after being tightened.

An ingenious Automatic Toy Figure of a Man, invented by John Schwippl, of Brooklyn, N. Y., performs somersaults in an amusing manner. A spring inside the body works a geared shaft, imparting a rotary motion to the arms, which causes the body to roll over and over.

An Iron Fence Post, patented by S. S. Crocker and Albert Wilcox, of Clarence, Iowa, has notches on the front edges of the upper part to receive the fence wires. In the bends and angles of the concave post are holes to receive the hook bolts by which the wires are locked together. By tightening the nut of the bolts the wires are drawn into the hollow of the posts, so that they cannot change their position. This invention will be of great service to farmers.

Cellar Bottoms are generally easily permeated by noxious gases exhaled from the earth, or crack from the pressure of gas beneath. To remedy this difficulty Tobias New, of New York city, has patented a vent for the gases. A narrow channel is constructed at the bottom of each cellar wall under the flooring, from which arises an escape pipe, and thence to the roof of the house. By means of this improvement cellars are freed from noxious gas and are rendered healthy.

A neat Basket, invented by J. J. Cole, of Hillsdale, N. J., consists of a single piece of veneer or similar material cut so that when folded together at the ends it may be fastened at a single point, where a handle is also affixed. It will prove very convenient for carrying berries or small groceries.

Abraham Morris, of New York city, has invented an improved Sofa Bedstead. A swinging seat section is hinged to the lounge frame and a head section is swiveled centrally to the swinging section, and connected at the upper rear corner by a strap with the head section of the lounge frame. The head section has a supporting front foot that fits into recesses of the lounge frame. It is a convenient article to have in the house.

A new Water, Grain, and Earth Elevator, patented by Levi Gallaher, of Businessburg, O., has an endless chain of lifting buckets, which are connected together by open links, a lower drum having scoops affixed to it, and which supply the buckets of the chain with the material to be raised. The upper drum has chutes so arranged as to register with the buckets of the chain and guide the water to the receiver. It promises to be an invention of much advantage.

A new Gas Burner Regulator, patented by Eugene Ginss, of New York city, consists of a hollow cylinder screwed on between the burner and gas fixture. Two conically bored nipples are screwed into the bottom of the cylinder and communicate with the interior of the socket. These nipples direct the head of gas against the side of the cylinder, thus

arresting the solid particles. The passage of gas through the nipples, and its expansion in the cylinder modify the pressure so that a uniform light is secured, blowing avoided, and gas economized.

In a new Process for Tanning and Dyeing Leather, invented by Gonzalio De Cordova and H. N. David, of Brooklyn, and Morris Wise, of New York city, an extract of the leaves of the pimento or allspice tree are used. The tanning is rapid and a rich brown color is produced.

Ira A. Paine, of New York city, the well known shooting expert, has patented a new glass ball for trap shooting. The ball is of the usual kind, but filled with feathers, so that when hit it will produce the same effect as when birds are struck by shot. It also enables a marksman to see the effect of his shot, the smoke having time to disappear before the feathers can possibly reach the ground.

The ordinary Billiard Bridge in common use is deficient in many respects. To obviate these difficulties F. E. Doughty, of New York city, has patented a bridge by which the cue may be supported in any desired position above the bridge by merely turning the handle of the bridge. The bridge has a central vertically sliding and guided cue rest, that is raised or lowered by a pinion connected to the end of the bridge handle, and intermeshing with an interior rack of the sliding rest.

Samuel H. Emanuel, of Gloucester, Mass., has invented an improvement on his Combined Overalls and Jumper. The material forming the front of the garment is entire and without transverse seams. The back is divided across the waist and a flap is formed in the overalls, which is supported by three elastic buttoned straps attached to the inner side of the jumper. A band sewed to the jumper over the waist gives it an appearance of a separate garment. This is a neat and desirable article of clothing for working men.

An improved Watch-case Spring has been invented by D. C. Voss, of New York city. It consists of an ordinary spring, but with the hook end turning on a fixed rivet or pivot of the spring, so that the hook end of the catch may be readily locked to or released from a recess of the watch case. The spring lasts longer and is more easily repaired than the old style.

A Coffee Roaster, the invention of A. R. J. Langer, of Mount Olivet, Ky., consists of a sheet iron cylinder with a shaft extending axially through it, upon which arms or rings are arranged radially at different points. These arms extend nearly to the inner surface of the cylinder, and serve to thoroughly stir the kernels of coffee as the cylinder is rotated, so that the whole mass is equally acted upon by the heat.

A Detachable Cuff, invented by E. K. Betts, of Lansingburg, N. Y., furnishes an ornamental and strong article of wear. It consists of a continuous back part, sectional intermediate layers, and front parts, and of a face strip that connects the intermediate and front sections, and is extended over the end of the cuff and down at the back to form stays for re-enforcing the button holes at the points of greatest strain.

Another Cuff, patented by the same inventor, is made with the back cut narrower than the other parts, so that the cuff may be sewed on both sides, and all the fullness will be taken up by the edges and a superior bead formed on both sides. The back extension is turned inward and thus strengthens the button holes.

A Fence Post, the invention of G. W. Chandler and S. H. Ceering, of Moingona, Iowa, fits into a bell-shaped base of hard clay and is bolted at the bottom. The base is filled with earth to make it secure. It is an inexpensive plan and makes a strong fence.

A Liquor Shaker and Strainer, invented by W. H. Trepus, of Chicago, Ill., will be a great convenience to bartenders. In the cover, with screws on the cup, is formed a strainer, covered with a close fitting cap. In the bottom of the cup are two small holes covered with a valve, the stem of which passes through a hole in the bottom, fitted with a spring and ends in a knob. When the ingredients are shaken up in the cup, the cap of the strainer is turned back, and by pressing the knob of the valve stem, air is admitted and the contents can be poured out.

A Nursing Apparatus, invented by G. F. White, of Middletown, is intended to prevent sore nipples. The mother's milk is drawn off by a simple device into a vacuum bulb, whence it is sucked by the infant while the milk is still warm.

A new Window Shutter has been invented by W. S. Everett, of Hyde Park, Mass., which provides for ventilation while a protection against the sun and storm. It can also be turned into an awning. It consists of an outer and inner shutter frame, the latter so hinged to the upper end of the former as to be thrown outward, while side wings close the the sides. The shutter slats have supplementary slats which are thrown up when the shutter is inclined, thus excluding the sun and admitting ventilation. It is a desirable improvement to a house.

A Broom Rack invented by S. W. Sheldon, of New York city, has three rod-connected disks, the upper having notches, the middle one holes, and the lowest disk a beveled edge. It is easy to use and answers the purpose well.

An Evaporator, patented by J. M. Randolph, of Somerset, O., consists of an evaporating pan, extending around the top, sides, and bottom of a sliding firebox, whose main smokepipe passes the cleansing tub to heat up the liquid therein, preparatory to its being let into the pan. The firebox is open at the front through the evaporator. A second smokepipe registers with the fire through the evaporator. It used up all the heat of the fuel and is thus economical.

In a new Hat Die, invented by R. L. Goddard, of Palmer, Mass., the shell is provided with holes in the top through which steam is admitted. A cross bar is secured detachably to its top by screws, the ends of which overlap. The die is kept from being drawn up too far by a flange formed around its lower edges and which fits into a rabbet in the lower side of the shell. It is a convenient device.

A new Grain Tally has been patented by Phillip Thomas, of North Huron, N. Y. To the forward end of the operating lever of the hopper is pivoted the upper end of a connecting rod, the lower end of which is pivoted to the forward part of the bottom. To the forward edge of the hinged bottom is pivoted the middle part of a bar which passes through the guide keeper, attached to the upper part of the hopper. The measure cannot be removed without operating the register. It is a simple and accurate device.

A Bung Extractor, the invention of W. A. Wiley, of Allegheny, Pa., consists of a spindle carrying at its lower end a a wood screw. To the stand which supports the spindle a forked lever is attached which draws the bung. It is easily and quickly operated.

An improved Spring Seat for wagons has been invented by L. J. Bazzoni, of Newburgh, N. Y. It consists in suspending the bottom of the wagon body from the reach bars of the seat, the bars being supported at their ends upon strings. The bottom and seat are thus elastically connected, and the driver is saved from shocks.

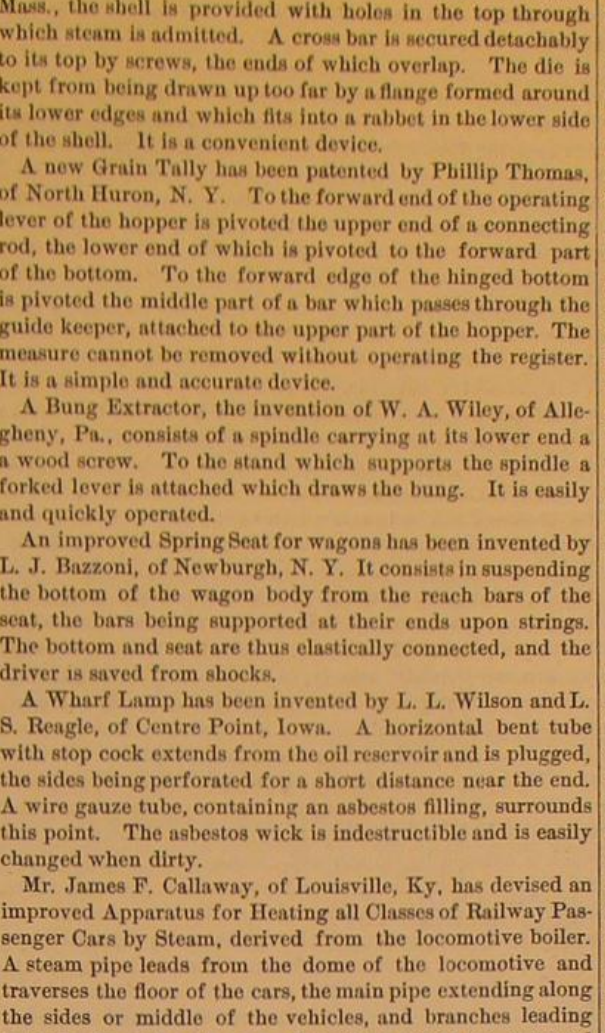
A Wharf Lamp has been invented by L. L. Wilson and L. S. Reagle, of Centre Point, Iowa. A horizontal bent tube with stop cock extends from the oil reservoir and is plugged, the sides being perforated for a short distance near the end. A wire gauze tube, containing an asbestos filling, surrounds this point. The asbestos wick is indestructible and is easily changed when dirty.

Mr. James F. Callaway, of Louisville, Ky, has devised an improved Apparatus for Heating all Classes of Railway Passenger Cars by Steam, derived from the locomotive boiler. A steam pipe leads from the dome of the locomotive and traverses the floor of the cars, the main pipe extending along the sides or middle of the vehicles, and branches leading laterally beneath each seat. Ingenious valves are arranged for allowing escape of water of condensation and controlling admission of the steam

Tests for Vision.

Dr. B. Joy Jeffries, 15 Chestnut street, Boston, Mass., is desirous of ascertaining what proportion of people with normal eyes, that is, who do not wear glasses for distant objects, and also of those who have their focus perfectly corrected for distant objects by glasses, are gifted with a visual power above what is now considered good average vision, called vision *one*.

The following letters are selected as nearest in size to the test letters used by oculists all over the world. The letters should be hung up in a good light; and those of our readers who are able to see them distinctly, further off than



the number of feet marked against each (which would be normal vision), are kindly requested by Dr. Jeffries to send him as above this information on a postal card, simply stating which letters were read and at what distance. From this he hopes to compile and publish some important data.

German Coal.

Hamburg has been the scene of a rather novel exhibition, that of German coal, which we are told, has excited much interest among German patriots and commercial men.

The idea that Germany should endeavor to emancipate herself from the English market and produce her own coal has, it appears, acquired a powerful hold upon the national imagination, and hence the promotion and development of the German coal trade has come to be looked upon as a matter of patriotism. It is also alleged that Westphalian coal is superior in heating power to English, and Senator Godeffroy, in his address on the occasion of the opening of the exhibition, even made it appear that Germany is in possession of coal fields incomparably larger than any that England can show. The Westphalian coal basin alone, said M. Godeffroy, is capable of producing for seven centuries to come the same quantity of best coal annually that all England now yields, and beyond this, the basin is not yet fully explored, and is probably capable of material extension. With all these supposed advantages Germany has not yet been able to beat England out of the field on her own ground. The city of Hamburg imported in 1876 about 1,500,000 tons of coal, of which about six sevenths were the produce of England, and only one seventh of home production.

Wooden Money.

Advocates of inconvertible paper currency may perhaps derive some satisfaction and encouragement from the fact that from the reign of Henry I. down to the period of the establishment of the Bank of England the legal tender money of England was fabricated out of wood. This instrument was called an exchange tally, and by virtue of it the holder was entitled to receive from the Crown the value inscribed thereon. It really consisted of one half of a four sided rod or staff, on which, when in its entire state, the sum it purported to represent was carved in transverse notches, varying in width for thousands, hundreds, scores, pounds, shillings, and pence. These signs were for the unlearned; for the advantage of those who could read, the sum was written in ink on two opposite sides of the staff, and, finally, with a knife and mallet the staff itself was split in two longitudinally. One half, called the tally or check, was given to the person for whose service it was intended; the other half, called the counter tally, was laid up in safe keeping until its corresponding tally should be brought in by the person who had last given value for it. Its intrinsic value was, of course, only that of the wood on which it was composed, but by representation it denoted large sums. It was a current token of real money, and served actually to distribute it from man to man by this exchange. From this primitive tally was derived the Exchequer Bill, first introduced in 1696 by Mr. Montague, the Chancellor of the Exchequer. The word "bill," too, was no doubt obtained from the Norman French word, *bille*, which means a staff. Bank post bills and bills of exchange in our own day came from the same wooden base, and soldiers are said at this hour to be "billeted," because formerly they tendered wooden "billes" or tallies to the victuallers upon whom they were quartered. In olden times officers of the army who were taken into the king's own pay were said to be put on the staff, that is, they were paid with exchequer tallies, or wooden money.

An Unknown Narcotic Plant.

I am tempted to notice a plant that grows here of such strong narcotic powers that, in the hands of a skillful practitioner, it will produce coma of any intensity or duration, or even death itself when so intended. The knowledge of this plant is confined to a few families, who transmit the secret as an heirloom from generation to generation, and the heritage is highly prized, confirming it is thought the power of miracle workers and priests. For the plant is in many ways used in aid of solemn imposture, superstition, and even crime. The power thus exercised is called "wanga," a word that inspires the African with awe and dread. The wanga priest can throw into a death-like coma, and knowing the moment of returning consciousness, he will make a show of recalling to life. If a burglary is to be committed, he can, by means of his art, cast a deep sleep on all indoors; and one may understand how he can attain other forbidden ends in the same way. An experienced botanist could not fail to discover this plant, which, as an anæsthetic, would no doubt prove a valuable acquisition to medical science.—*Major R. Stuart, Port au Prince.*

Bullet Making.

The manufacture of bullets is not so simple as it used to be. At Woolwich, England, the melted metal is poured into a receiver, and as soon as it solidifies, but before it is cold, it is forced by hydraulic pressure through cylindrical holes in the form of long strings. This process is to prevent the formation of air bubbles in the bullet, which would cause it, when fired, to swerve from its course. The leaden strings are thence carried to the bullet moulding department, where they are cut into lengths and roughed; then shaped in one machine, and finished in another. They have now to be plugged. These plugs were formerly made of wood, but are now prepared from a special powder, which solidifies after being pressed into form.—*Ironmonger.*

INK stains in cotton or linen can be removed by washing in salt and water. This should be done before the fabric is washed with soap.

New Agricultural Inventions.

A new Butter Mould has been devised by Mr. Augustus W. Faris, of Red Sulphur Springs, West Va., which presses out the milk and water from the butter and forms it into neat packages of uniform size, so that it can readily be stowed in boxes for transportation, and for the retailer.

Mr. Philip Leitz, of Baton Rouge, La., has patented a Machine for Cutting Sugar Cane, or Corn, Cotton Stalks, and Stubble. As the apparatus is drawn forward, upper knives first meet the cane and cut off the tops, and then a lower set of knives cut off the bottoms. These knives may be adjusted to work higher or lower, with reference to the ground. The new features consist mainly in the mechanical construction.

A novel Ditching Machine, devised by Mr. Peter N. Fowler, of Smith's Mills, Ky., embodies seven new devices. In rear of the machine is a large wheel having a wide smooth-faced rim. Around this passes an endless chain of buckets formed of sharp edged steel bars. As these begin to rise at the lower side of the wheel, the soil within them is separated from the ground by the edge of the plate, which retains the material in the buckets as they pass upward.

Mr. John J. Smith, of Unionville, Mo., has patented a new Sulky Harrow, which adapts itself to the surface of the ground, however uneven said surface may be. Its parts may be separately or simultaneously raised from the ground in passing from place to place or to clear obstructions.

A new Grain Separator for Thrashing Machines, invented by Mr. James M. H. F. Shepler, has an improved straw carrier by which all the grain that passes over or through the separator is saved and returned to the grain elevator of the thrasher. Another device prevents the choking of the riddle and keeps the same perfectly clean around and below the stacker.

Mr. John F. F. Porter, of Booneville, Miss., has patented a new Fastener for Colters and Plow Standards. It may be applied to any kind of a plow, is not liable to break or get out of order, and holds the colter or standard firmly in place. The colter may be raised or lowered as desired.

Mr. Royal W. Barnard, of Fayette, Iowa, has devised a new Butter Worker. It is made in the shape of a foot, one portion of which is made flat for packing, and the other portion has flanged edges to scrape down the butter from the sides of the tank, and also to prevent the grinding of the grain of the butter by not permitting washing or rubbing of the same.

New Mechanical Inventions.

Messrs. Nimrod Gooder and Bernard Lavin, of Kansasville, Wis., have devised an improved Machine for Punching and Shearing, which enables cold punching, shearing, and similar work to be conveniently and efficiently performed. The new feature resides in the combination of a vertically guided and interchangeable tool with a pivoted actuating cam lever, and interchangeable equalizing plate acting on the top of the tool and with a pivoted spring engaging the lower part of the tool. By retracting the spring the tool may be easily changed.

An Improved Rock Drill has been invented by Mr. W. W. Gaines, of AuSable Forks, N. Y. Ordinarily the serpentine groove which gives motion to the slide valve in these machines is formed of a single segment of a cylinder made of hardened steel. In the present instance it is made of two separate pieces of metal. This is claimed to obviate the danger of the segments cracking and admits of their easy removal from the piston head when they wear out.

A new Car Coupling, devised by Mr. Christmas P. Byrd, of North Cambridge, Mass., has a releasing lever which extends down to the drawhead and throws back, by the concussion of the latter, trigger mechanism so as to release a sliding pin and drop the coupling pin into the drawhead and link for coupling. The coupling link is held in the required position for entering the opposite drawhead by a crank screw and head adjusted from below the drawhead.

A curious and novel device is a new system of Buoyant Propeller Wheels for Vessels invented by Mr. Laurence Brown, of Chatham, New Brunswick. A number of airtight polygonal drums are arranged to turn in bearings on a supporting frame, upon which frame the saloons, etc., are erected. By suitable machinery these drums are revolved and cause the propulsion of the entire structure, on the principle of an airtight float or box which, when upset or turned, will change position and move over to the side towards which it falls.

Mr. Ezekiel Delano, of Greenwich, Conn., has devised a new Addressing Machine, wherein devices are embodied for addressing papers and packages rapidly without the sticking of the label strip so as to clog the machine, and also for removing the papers or wrappers. The construction is very ingenious and well calculated to save time and labor.

Mr. Henry D. Rodgers, of New York city, is the inventor of the latest machine for making car conductors honest. It is a Fare Register, shaped something like a large watch and containing a bell and a moving strip of paper, which last passes from one spool upon another. On the paper are marked numbers indicating the number of fares received, each number being greater than that preceding by the sum of one fare. When the conductor pushes down a follower, the bell is sounded and the paper moved to the second spool. At the same time one of the numbers marked on it is perforated by a needle. The last number found punctured represents the total of fares taken. The device is of exceptional ingenuity, and is well calculated to check the thieving proclivities of even the most conscienceless of conductors.

Those of our readers who may desire further information concerning any of the above described inventions, can obtain the same by communicating with the inventors at the addresses named.

A New Dyestuff from Anthracene.

A mixture of glycerin and concentrated sulphuric acid reacts upon the dyestuffs derived from anthracene and produces new compounds, which likewise possess coloring properties. As yet only alizarine and mono-nitro-alizarine have been tested in this respect. By heating a mixture of 1 part of alizarine paste, 2 parts of white glycerin, and 2 parts sulphuric acid of 66° B., the liquid becomes rapidly dark brown, and a large quantity of gas is evolved containing sulphurous acid and acroleine. The temperature is kept for some time at 200° C. (392° Fah.), in order to accomplish a perfect conversion of all the alizarine. It is then allowed to cool, the product poured in a large quantity of water and filtered. The dark yellow, insoluble residue is washed several times with hot water, then taken up cold by a mixture of equal parts alcohol and water, in which the new dyestuffs dissolve. The shades of red and pink which they yield in dyeing are more yellowish than those of alizarine, the violets are more bluish, and the browns more reddish, while the blacks are also finer than with alizarine. With ammonia and carbonate of soda it yields an orange-red solution, while alizarine with alkali dyes purple. If alcohol is added to these solutions they become dicroitic, namely, in transmitted light red and by reflected light green. It reacts toward alum the same as alizarine, and also resembles it in its other physical properties, such as its reaction toward soap, acid liquids, chlorine, etc. With like treatment the mono-nitro-alizarine produces peculiar results. On treating the washing water with caustic soda, a dark indigo blue precipitate is thrown down, which is reduced by tin salt and caustic soda solution to a pink liquid, which becomes covered with a greenish blue lustre. The precipitate collected upon the filter consists of two different substances, which may be easily separated by a cold mixture of alcohol and water. The substance, easily soluble in this, dyes violet with alum mordants, bluish-black with strong iron mordant and a mixture of iron and alumina, and bluish grey with weak iron mordant. The other and less soluble substance dyes quite a fine black, a grey violet, and instead of red a pink, and for brown a catechu brown without any red admixture. Both dyes resist soap well, chlorine not so well, and are destroyed by strong acids.

Dyestuffs of the anthracene series are known already which produce a violet with alum mordant. One of these is obtained by the action of ammonia upon anthrapurpurine in closed vessels, and has been found by Perkin in crude alizarine. It seems to be identical with the purpuramid of Stenhouse. The other was put into the market about a year ago by Gauhe & Co., of Barmen, under the name of "anthraviolet," but possesses no special interest from an industrial point of view. According to N. Potier's investigations (*Soc. Ind. de Rouen*, Sept. and Oct., 1876), this anthraviolet dyes uneven and with difficulty, and the colors produced do not withstand either soap or chlorine

A dyestuff which yields a series of colors similar to those given by Campeachy wood, and which can replace them, specially by the very fugitive steam dyes, would be of special interest. Both of the dyes obtained from nitro-alizarine by the author seem to satisfy these conditions. As regards the constitution of these substances, the author thinks that in their production the molecule of glycerin takes part in the reaction, and therefore they may perhaps be regarded as glycerides. He reserves to himself the right to subject the other dyestuffs of the anthracene series, such as purpurine, isopurpurine, etc., as well as the non-dyeing members of the series, anthrachinone and nitro-anthrachinone, to the same treatment.—*Bulletin Société Chimique.*

Poison in the Oven.

Sixty-six persons living in the neighborhood of the Parc Monceau, Paris, were almost simultaneously seized with symptoms of lead poisoning. The attention of a sanitary association was directed to the epidemic and a long investigation was then undertaken as to the cause of so many disasters. The water, wine, and groceries used by the sufferers were found to be unimpeachable. It was discovered however that, with two exceptions, all the patients had bought their bread from the same baker, and as to the two exceptions they had unwittingly consumed bread in an eating house which was supplied by this baker. The baker himself and his assistants were more severely poisoned than the majority of their customers. This led to an examination of the stove, and the places that would come in contact with the outside of the bread, and it was then finally revealed that the baker burnt wood brought from old houses recently destroyed. It had constituted the wainscoating of the house and was covered with several layers of paint, which the heat converted into pulverized oxide of lead, and which naturally adhered to the moist surface of the loaves. In consequence of this discovery a regulation has been issued by the Prefecture of Police forbidding bakers to heat their ovens with wood derived from old houses.

Roumanian Amber.

One of the natural products of the Danubian Principalities is amber, which, however, differs totally from the German product found on the shores of the Baltic Sea. Both are the fossil resins of antediluvian trees, and agree in chemical composition, but differ in color. German amber is found only of light colors—yellow, white, and pink—while Roumanian amber is red, pink, brown, blue, green, and black. These colors are frequently found mixed in a single piece, and we also have lumps with silver colored veins and gold specks. On account of this variety of colors, the Roumanian amber is highly esteemed, and darker and more beautiful pieces are more costly than yellow amber, especially as they are more rare.

The Flight of Partridges.

To the Editor of the Scientific American:

Why is it that a covey of partridges cannot fly across the Mississippi river? At this point the river, during low water, is 1,200 yards wide, and 50½ feet above tide water. I have seen whole coveys go down into the water at 600 yards; though in hunting I have seen single birds go nearly as far to windward, until they rose to the height of 40 feet, and then follow the wind to cover. A covey started from immediately below Natchez, Miss. (an altitude of 260 feet) to fly across the river (at that point the river is 1,000 yards wide). They came "like shot," almost describing a "bee line" from the altitude to the bed. They were unable to perch, and what were not killed by striking the houses, were picked up exhausted (October, 1871). They hatch here during May. Frequently the nests are broken up in April; they then continue to lay and hatch and bring their broods out during August. In the case cited at Natchez, Miss., they were old birds, or rather of the May brood. I have seen coveys, during the first quarter, fly from drift pile to drift pile, and accomplish their migrations in that manner. Drift does not generally run in the Mississippi river, only from November to June. Their migrations are always westward.

Bartlett's Bayou, La. C. F. S.

Testing Wool by Entomological Knowledge.

A practical example of the value of a knowledge of entomology in connection with commercial transactions is afforded by M. Viret's suggestion in the *Journal de l' Agriculture*, of a simple method of detecting the admixture of inferior foreign wools with fleeces purporting to be of superior quality. In certain cases the identification of wool is easy, Russian and Buenos Ayres wool, for example, being readily distinguished from all others by the presence in the fleece of wild oats in the one instance and a peculiar variety of small thistle in the other. But in German, Spanish, Australian, and Morocco wools no such test is applicable. To distinguish between these, M. Viret recommends us to have recourse to entomology. The fleeces from each of these countries will be found to contain coleopterous insects peculiar to it, and by an examination of these the real source of a wool in fleece may be indisputably determined by whatever name a dishonest stapler may have placed it on the market.

BLACK FINISH FOR BRASS.—Optical and philosophical instruments made in France often have all their brass surfaces of a fine dead black color, very permanent and difficult to imitate. The following, obtained from a foreign source, is the process used by the French artisans: Make a strong solution of nitrate of silver in one dish and of nitrate of copper in another. Mix the two together and plunge the brass into it. Remove and heat the brass evenly until the required degree of dead blackness is obtained.

"IS THIS a foreign country?" asks an American journal. "Russian leather is made in Connecticut, Bordeaux wine is manufactured in California, French lace is woven in New York, Italian marble is dug in Kentucky, Marseilles linen is produced in Massachusetts, English cassimere is made in New Hampshire, Parian art work comes from a shop in Boston, Spanish mackerel are caught on the New Jersey coast, and Havana cigars are rolled out by the million in Chicago."

A MODE of producing tissues printed in relief, imitating gold, silver, and silk embroidery, has been patented by M. Coffin, in France. The pattern is printed on satin by means of engraved plates and with gilders' fatty mordant, and, afterwards, the fine parts of the design are printed with the same vehicle with the addition of gold or silver in powder.

THE quantity of herrings caught this year on the Danish coasts is said to be enormous, and it is hoped that these fish, which suddenly deserted the Danish waters about three hundred years ago, after having for centuries represented the chief source of revenue to the country, may now again direct their migrations to the Danish coast.

THE *Atlantic Monthly* does honor to one of its old contributors by issuing a life-size likeness of the Quaker poet, John Greenleaf Whittier, in commemoration of the anniversary of the poet's seventieth birthday. The lithograph was executed by Mr. J. E. Baker and is in the highest style of the art. It can be obtained from the publishers, H. O. Houghton & Co., Boston, on remitting the price, $1.00.

THE depositors in the savings banks of New York city are mostly poor working people, who are allowed five per cent interest; but they are required to deliver up a little more than half of their interest money in the shape of personal taxes to the extravagant Tammany Ring who run the city government, and have run up the annual personal tax, on savings bank deposits, to 2.65 per cent.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion.

Notes & Queries

(1) J. H. asks: Can you give us a rule to measure the height of a tree or other standing object near enough for practical purposes? A. Place a small mirror in a level position on the ground, at a little distance from the tree, and then step backward until you see the top of the tree reflected in the center of the mirror. Height of tree =

$$\frac{\text{Your height} \times \text{distance of tree from mirror.}}{\text{Your distance from mirror.}}$$

(2) F. C. H. says: 1. I have a boiler that has 22 square feet of heating surface, contains 20 gallons water up to water gauge, will evaporate 20 gallons of water per hour, with ordinary firing. What horse power is it? A. As we have frequently explained, there is no standard for measuring the power of the boiler, that is generally accepted. 2. I have seen men working in a foundry pass their finger through the melted iron as it ran from the cupola without receiving any burn whatever. Can you explain the philosophy of this experiment? A. The moisture on the skin is converted into vapor, which forms a protective covering. 3. How can the ordinary bars of cast iron (pig iron) be broken so as to be melted in a crucible or small cupola? How are very heavy masses of cast iron broken, such as cannons, heavy machinery, etc., to be remelted? A. Cast iron can be broken with blows from a heavy hammer. Dynamite has sometimes been used for large masses.

(3) J. A. M. asks: What is the method of setting the valves of the Corliss engine, and regulating the cut-off? A. Advance the eccentric until the valve has the proper lead, and then adjust the tripping arrangement by trial.

(4) A. W. asks: What is the best thing for making a person grow? A. Good food and good habits.

(5) L. M. C. asks: 1. What is steam packing? How is it constructed and used in the pistons of steam engines? A. It ordinarily consists of metallic rings, which are set out by the pressure of steam. 2. What course would you advise a young man twenty years of age to pursue in order to learn to be a competent steam engineer? A. He should pursue a course of instruction such as is given in our best technical schools.

(6) J. W. S. asks: 1. How much advantage has the best automatic governor cut-off engines over the best throttling engines? A. You will find some notes on the subject on p. 321, vol. 30, of the SCIENTIFIC AMERICAN. 2. Is a valve which cuts off and admits the steam better than two valves for doing the same, one riding on the back of the other? A. Generally the clearance will be somewhat less in the case of the former arrangement, and there will be less mechanism and fewer wearing parts.

(7) P. G. asks: Is there any tool giving the exact length of a circle, in drawing that circle? Would such a tool be of any practical use? A. We do not know of any such instrument. It would be of some use if simple and cheap.

(8) T. J. R. asks: 1. Would it not be a better plan if, in reducing the area of grate bars in burning screenings with a blower, instead of bricking up the sides of the furnace to reduce the center over the grate bars? A. This idea is practically carried out in the dead plates or coking plates that are usually fitted. 2. What is the rule for finding the flow of steam through a pipe into the atmosphere? A. You will find rules in the SCIENTIFIC AMERICAN, p. 113, vol. 29.

(9) A. G. says: I have a 5 horse power engine and a horizontal boiler about 4½ feet long. The boiler does not make steam fast enough. I want to burn coal dust to save fuel. Please tell me what is best to increase the draught, a blower, or shall I turn the exhaust in the firebox above the flues? Also what is best to keep the boiler from rusting? A. T.y exhausting into the stack. Paint your boiler to prevent rusting. There is a black varnish made from mineral oil that is largely used.

(10) F. C. J. says: I have a boat 16 feet long and 4 feet beam with an engine which has a 4 inch stroke and 2 inch bore. What sized boiler will I require and how many tubes? What is the greatest rate of speed I can make? A. Boiler 2 feet in diameter, 3 feet high, with from 50 to 60 square feet of heating surface. Probable speed, 5 miles an hour in smooth water.

(11) R. C. says: I have a 5 foot wheel that runs on the end of a shaft that is 18 inches long and 1⅛ thick; it runs a belt over a 10 inch pulley. I run the large wheel by hand. Can I gain speed and save labor by putting a small cogwheel on the shaft with a larger one over it with a crank to run it? What will be the size of cogwheels that I will have to have? A. We think the present arrangement is likely to be more effective than the one proposed. If you wish to have greater speed change the pulleys.

(12) E. I. O. Co. says: We have a 11 inch high pressure engine with about 2 feet stroke. In winter time we have great trouble in separating the sand, being so mixed up with the frost. If we could get warm water in our hutches it would be a great benefit to us? Can we condense the steam of the engine in our hutches and will it interfere with the power of the engine, and to what extent? A. By carrying the exhaust pipe into the water, and letting the steam escape through numerous small perforations, you can heat the water without producing back pressure, that is, if there is constant circulation. You can put the pipe as far down as you please by arranging the discharge as indicated.

(13) R. R. R. asks: How is the Atlantic cable repaired when broken in mid ocean, and how do they find the place where the break occurs? A. The calculation is based on the principle that a current of electricity, having two or more courses open to it, will divide itself; and the current on each course will be in exact proportion to the resistance of that course as compared with the others. When the cable is laid, the resistance of the entire length is measured, and from this is calculated the average resistance per mile. Now if a break occurs, the current will escape through the water, and the resistance of the cable will be again measured and compared with its previous resistance; this gives the figures of a proportion from which the distance, in miles, is calculated; this calculation is made at Newfoundland, and at "Heart's Content," and a mean of the two results is taken. Two vessels furnished with grapples sail over the place indicated until the two ends are found, when they are drawn up and well spliced.

(14) S. H. K. says: I have found a vegetable color for the hair which makes a very natural brown or black. As I have it, it is not a fast color. When applied to the hair it can be washed off, but will not rub off. What can be combined with it to make it a fast color, or what could be applied to the hair, after the color is on, to set it? A. This can only be determined by experiment. You may try solution of chloride of tin, tannin, sumac decoction, acetate of iron, and alumina, cream of tartar, etc., applied before or after, or mixed with the dyestuff.

(15) W. J. C. says: I have a telegraph line ½ mile long, stovepipe wire, with ground plates 30x36 inches; one in a well and the other buried in moist earth with its upper edge flush with the surface. How many cells gravity, 4½ x 4½ inches, will give a fair sound, using two common office sounders? A. Your ground connection is not sufficient, and will require about ten cup cells, unless the magnet wire on your sounders is very fine. Connect your ground wire at each end with the gas or water pipes.

(16) L. H. McF. says: I have seen bottles of oil and phosphorus prepared in such a way that when the cork is removed, admitting air, the contents of the bottle become luminous. Please inform me what kind of oil and phosphorus, and how to incorporate them to use? A. Heat the oil (olive oil) to about the temperature of boiling water (212° Fah.) and drop in the phosphorus in small pellets. Ordinary stick phosphorus is used—it dissolves in the hot oil.

(17) M. R. asks: What fulminating material is used in small cartridges? A. The fulminate of mercury is generally used. To prepare it, 1 oz. of mercury is dissolved by a gentle heat in 8¼ measured ozs. of nitric acid (of specific gravity 1·4), and the solution is poured into 10 measured ozs. of alcohol (specific gravity ·830); action soon ensues with the evolution of copious white fumes, and the fulminate is deposited in white crystalline grains, which are washed with cold water, and dried at a gentle heat. It explodes at a temperature of 390° Fah. by friction, percussion, and by contact with strong acids. For percussion caps and cartridge a little chlorate of potash, or more commonly niter, is added to the fulminate.

(18) I. F. D. asks: What metal will heat and cool the quickest? A. Pure cobalt, nickel and iron have the lowest specific heats.

Will ammonia act corrosively on copper or iron? A. On copper, yes; on iron, no.

Will a fluid continue to increase in pressure if confined in a vessel and kept at a degree or two above the boiling point? A. The pressure will remain constant as long as a uniform temperature is maintained.

(19) J. R. S. says: In order to remove sulphurous acid from an aqueous solution of gum, I find nothing available but carb. baryta, which is expensive. What is the cheapest method of removing the sulphurous acid from the solution? A. Use marble dust, as free as possible from magnesia carbonate.

(20) F. C. says: I have a pump in my well with lead pipe 16 feet long. Sometimes the water has a sweet metallic taste. How can I test the water in the well as to whether the lead is poisoning it? Will cistern water drawn through lead pipe be affected by the pipe? A. The water is very probably contaminated. To test this pass sulphuretted hydrogen gas through a sample of the recently drawn water for some time, and observe if a black precipitate is formed; if so, lead is present, and the water should not be used for drinking or cooking purposes. To make the sulphuretted hydrogen, place in a large bottle a few small pieces of protosulphide of iron, and cover them with sulphuric acid previously diluted with two parts of water. Perforate the stopper with a bent glass tube to conduct the gas as it is formed. Lead pipe is not suitable for the conduits of well or cistern water—tubes of wood or enameled iron pipes may be used instead.

(21) W. B. S. asks how to clean iron rust off window glass? A. Mix muriatic acid with an equal quantity of water, and apply this with a small cloth cushion to the spots.

(22) C. F. P. asks how to make and apply a black japan to small iron castings that will dry soon and become very hard and durable at a small cost? A. Apply a ground of asphaltum, 3 ozs.; boiled oil, 4 quarts; burnt umber, 3 ozs. Mix by heat and when cooling thin with turpentine. Lay on three coats, and between each dry the article in an oven heated from 250° to 300°. Lay on several coats of varnish, drying in an oven between each, then polish with powdered pumice and rub with oil.

How many and what numbers of SCIENTIFIC AMERICAN SUPPLEMENT contain the lessons on mechanical drawing? A. Professor MacCord's lessons on mechanical drawing are now published in collected book form. Price $2.50 in paper covers. Sent postpaid by Munn & Co.

(23) H. K. O. asks: What is the varnish composed of which is used upon brasswork to prevent its tarnishing? A. Mix equal quantities of Canada balsam with very clear spirits of turpentine until the whole is of the consistence of ordinary varnish. Apply in the usual way.

(24) W. G. asks for (1) a recipe for gilding brass by dipping in acids? A. The gold bath is composed of distilled water, 17 pints; pyrophosphate of soda, 28 ozs.; hydrocyanic acid of ¼ prussic acid, ½ of an oz.; crystallized perchloride of gold, ½ oz. The pyrophosphate is dissolved in 16 pints of water, heated, filtered, and cooled. The filtered solution of the gold chloride is added, and then the hydrocyanic acid, when the whole is raised nearly to the boiling point for use. Before entering the bath the articles should be passed through a solution of water 2½ gallons; nitrate of binoxide of mercury, ½ oz.; sulphuric acid, ½ oz. 2. And for the best lye in which to soak brass articles before dipping? A. Caustic potash dissolved in 10 times its weight of water.

(25) M. V. asks for a process of nickel plating without a battery? A. Into the plating vessel place a concentrated solution of zinc chloride. Dilute it with from 1 to 2 volumes of water and heat to boiling. Redissolve any precipitate with a few drops of hydrochloric acid. As much powdered zinc as can be taken on the point of a knife is then thrown in. Add nickel salt (chloride or sulphate) until the liquid is distinctly green. Then put in the articles previously well cleaned with some zinc fragments. Boil for 15 minutes when the nickel coating is finished.

(26) J. B. U. asks for a rule for calculating the number of bricks that it will take to construct a wall? A. Allow 7½ bricks per square foot to every 4 inches of thickness of wall. Thus a 14 inch thick wall will require 26¼ bricks per square foot.

(27) P. S. asks for the proper composition of fusible plugs, attached to crown sheets of steam boilers. Working pressure 70 lbs. per square inch. A. Equal parts of antimony, tin, and bismuth, melted and well mixed, make a very good safety plug. The melting point of this proportion is about 300° Fah., and this is about the temperature of steam at 70 lbs. per square inch. If you wish to carry a higher pressure, increase the proportion of tin.

(28) J. T. asks for a durable black ink to be made with nutgalls and copperas? A. Bruise 12 lbs. Aleppo nutgalls, boil in 6 gallons of soft water for 1 hour, adding water to replace that evaporated. Strain and boil the galls again in 4 gallons of water for ½ hour; strain and boil with 2½ gallons more water. Strain and mix the liquors. Add 4½ lbs. coarsely powdered copperas and 4 lbs. gum arabic in small pieces. Agitate until dissolved and filter through hair sieve. This will give about 12 gallons of fine durable ink.

(29) J. R. M., Jr., asks how gold and silver bronze powders are made? A. Gold bronze powder is made by melting together in a crucible over a clear fire equal parts of sulphur and white oxide of tin. Stir until they become a yellow flaky powder. Silver bronze powder is made by melting together 2 lbs. each of tin and bismuth, and adding 1 lb. of quicksilver. Pound all together into a powder.

(30) C. W. P. asks how to granulate copper in fine grain? A. Ladle the refined copper from the furnace into cold water.

(31) M. G. L. asks: How can I harden a wooden pulley? A. Boil for about 8 minutes in olive oil and allow it to dry.

(32) E. G. asks (1) for a silver bronze powder? A. Melt together 1 oz. each of bismuth and tin, then add 1 oz. quicksilver, cool and powder. 2. How can I make blue bronze on copper? A. Clean the metal, polish, and cover the surface with a fluid obtained by dissolving vermilion in a warm solution of soda, to which some caustic potash has been added.

(33) F. T. C. asks: What is the so-called "flash" used for coloring spirits? A. It consists of burnt sugar caramel, to which is added enough capsicum extract or essence of cayenne to give the liquor a fiery taste. It is commonly used in flavoring vile whiskey.

(34) M. T. L. asks for a recipe for liquid glue? A. Dissolve (with heat) 2 lbs. of glue in 1 quart of water, add 7 ozs. of nitric acid, and when cold, bottle. This is an excellent preparation to sell.

(35) E. P. asks for a varnish to smooth moulding patterns? A. Alcohol, 1 gallon; shellac, 1 lb., lamp or ivory black sufficient to color it.

(36) F. G. inquires how to make japanner's gold size? A. Melt 1 lb. of gum ammoniac, add 8 ozs. of boiled oil, and then 12 ozs. spirits of turpentine.

(37) P. T. asks for a good sizing for linen? A. Crystallized carbonate of soda, 1 part; white wax, 4 to 6 parts; stearine, 4 to 6 parts; pure white soap, 4 to 6 parts; Paris white, 20 parts; potato starch, 40 parts; wheat starch, 160 parts. Boil with sufficient water to form 1,600 parts altogether, adding if desired some ultramarine to counteract the yellow tint of the linen.

(38) J. A. B. asks: 1. What kind of a preparation do watch repairers use to give that fine polished appearance to the brass movements of a watch? A. For brass, Spanish whiting is mixed with clear rain water in the proportion of 2 lbs. to the gallon. Stir and let stand for a few minutes to allow the gritty portion to settle; decant off the water into another vessel and again allow it to stand. The settlings in the second vessel are mixed with jeweller's rouge and used for polishing. 2. What kind to the steel portions? A. Take a flat burnishing file, warm it and coat it lightly with beeswax. When cold wipe off as much of the wax as can readily be removed, and with the file polish the metal. This is said to be equal to the finest buff polish.

(39) C. J. A. asks for a recipe for a lacquer for polished or burnished copper, that will prevent it from tarnishing when handled? A. 1 gallon methylated spirits of wine, 5 ozs. of shellac, 4 ozs. of gum sandarac, and 1 oz. of gum elemi. Mix in a tin flask and expose to a gentle heat for a day or two, then strain off

and add ½ gallon of the spirit to the sediment and treat as before.

(40) J. S. M. says: I wish to paint on porcelain or earthenware. Shall I use water colors or oil? Also by what method is the finish obtained that causes it to withstand washing, etc.? A. The colors used are enamels mixed with turpentine. The china is glazed first and the enamel is burnt in, in a muffle. Prepared colors for painting on china can be purchased of large paint dealers. The burning in must be done by an experienced potter.

(41) J. H. M. asks how to make a gold solution for battery gilding, such as is used by carriage platers? A. You had better gild in the hot bath. The composition is crystallized phosphate of soda, 21 ozs.; bisulphite of soda, 3½ ozs.; pure cyanide of potassium, ½ oz.; pure gold, transformed into chloride, ½ oz.; distilled water, 2½ gallons. This is good for silver, bronze, and copper alloys. For wrought iron and steel the bath consists of distilled water, 2½ gallons, phosphate of soda, 17½ ozs.; bisulphate of soda, 4½ ozs.; pure cyanide of potassium, ½ oz.; gold (chloride) ½ oz. It is not necessary to mind the weight of the chloride so long as the proper amount of gold is dissolved in aqua regia.

(42) S. B. H. asks: 1. Are north, south, east, and west relative or absolute terms? A. Relative. 2. State the greatest distance that could be traveled in any direction. A. You might go around the world an indefinite number of times, always traveling in the same direction according to the compass.

(43) J. E. S. asks how bright crimson writing fluid is made? A. Powdered cochineal, 1 oz.; hot water, ½ pint. Digest, and when quite cold add ammonia 1 oz., diluted with 3 or 4 ozs. of water. Macerate for a few days and decant when clear.

(44) G. M. W. asks how to make a good article of yellow soap? A. Tallow and sal soda of each 1½ lbs.; resin, 56 lbs.; stone lime, 28 lbs.; palm oil, 8 ozs.; soft water, 28 gallons. Put soda lime and water into a kettle and boil, stirring well; then let it settle and pour off the lye. In another kettle melt the tallow, rosin, and palm oil, having it hot, the lye being also boiling hot. Mix altogether, stirring well, and the work is done.

(45) K. H. R. asks what laundrymen use use besides starch to give a smooth glossy appearance to starched goods? A. One tablespoonful of strong gum arabic solution to each pint of starch.

(46) C. S. R. says: 1. If I bore a piece of 2 inch round bar iron 7 inches long, lengthways through the center, with ¾ inch drill, and previously plug the ends of bore, what internal pressure will the tube resist? A. About 30,000 lbs. per square inch. 2. If I fill the tube with water before closing the ends, to what degree of temperature can it safely be heated without exploding? A. A very slight rise of temperature only would be required. 3. How can the odor of petroleum and kerosene be destroyed? A. There are several patented processes, one of which consists in the use of superheated steam.

(47) C. B. L. says: I have two flywheels, each 1,000 lbs., running at the rate of 50 revolutions per minute; one is 10 feet in diameter and the other is 20 feet in diameter. Which would exert the most controlling influence on an engine, and why? A. The larger wheel would be the most effective, because its actual energy depends on the angular velocity and moment of inertia, both of which increase when the radius is increased, other things being equal.

(48) E. C. H. says: 1. Of two engines less than 2 horse power, running at 300 revolutions, and steam pressure 80 lbs., one engine having stroke the same as diameter of cylinder, and the other having a stroke twice the diameter of cylinder, which uses steam most economically, both engines cutting off at ¾ stroke? If there is a difference, please explain. A. The long stroke engine would ordinarily be the more economical of the two, on account of the higher piston speed and the less percentage of clearance in general. 2. What should be the size of engine ports of a 4 x 4 engine running 300 revolutions, steam pressure 80 lbs., cutting off at ⅛ stroke? A. Port area ½ square inch at least.

(49) J. D. W. asks: What is the heating surface of a boiler 28 feet long, 42 inches in diameter, with five 8 inch flues? A. If the tubes are the whole length of the boiler, the heating surface is about 297 square feet.

(50) I. L. L. asks: What sized boat would be required for an engine 2 inch bore, 6 inch stroke, with an upright boiler 4 feet high and 2 feet in diameter and what sized screw? A. Boat 18 to 20 feet long, 5 feet beam. Propeller, 18 to 20 inches diameter, 3 feet pitch.

(51) E. A. B. asks: 1. What are ocean steam boilers made of? A. Wrought iron. 2. Are they upright and tubular? A. Horizontal tubular. 3. Are the driving engines horizontal or upright? A. Vertical generally, in merchant steamers.

(52) F. H. R. asks: Is the pressure of a steam gauge diminished if it be located 20 feet from the boiler, the boiler being three horse capacity? A. Ordinarily, no, if properly located.

(53) F. H. says: 1. Can you give me a rule to find out how much packing is necessary to cover a pipe 105 feet long, diameter of pipe 3 inches, with a covering 3 inches thick; the material weighing 4 lbs. to the square foot? A. Let d = diameter of pipe, in feet. D = diameter of packing, outside, in feet. L = length of pipe in feet. W = weight of packing per square foot. Total weight required = $3{\cdot}1416 \times \frac{d+D}{2} \times L \times W$.

What is meant by cold short iron? A. Iron that is brittle when cold.

(54) H. A. P. asks: 1. How can I ascertain the horse power of a punching machine, to which steam cannot be applied for the purpose? A. Some form of transmitting dynamometer must be employed. 2. What is the relative toughness of cast steel and the best of "charcoal" iron castings? A. If you refer to tensile strength, the steel is to cast iron about as 5 to 1. 3. What kind of iron is the toughest for heavy machine castings? A. Cast iron toughened by the admixture of wrought iron scrap.

(55) J. C. wants to know how to drive several tilt hammers off the same driving shafts at varying speeds? Each hammer must be independent of the others, and the speed easily and immediately alterable to suit the heat being worked. Hammer heads are about 4½ cwt. weight, so any suitable arrangement must be of a substantial character. Also what are the best kinds of bits and anvils, the present ones of chilled metal get soft in a very short time? A. Friction wheels or clutches will enable you to vary the speed at pleasure. The same thing can be accomplished by using a pair of continuous cones connected by a belt. Steel facings may be used for your anvils.

(56) W. T. B. asks: Are there any schools teaching mechanical engineering, and if so, where is the best one, considering expenses? A. There are so many schools of this character that we do not feel inclined to make a comparison. We give a partial list: Lehigh University, University of Pennsylvania, Rensselaer Polytechnic Institute, Massachusetts Institute of Technology, Yale College, Harvard University, Worcester Institute, Stevens Institute of Technology, University of Illinois.

(57) N. W. H. asks: Which of the two engines below noted will develop the greatest power? One is 8 inch cylinder, 12 inch stroke, 100 revolutions with 30 lbs. boiler pressure. The other is 4 inch cylinder, 6 inch stroke, 175 revolutions, with 60 lbs. boiler pressure. Both are the common slide valve type, and both cut off at ¾ stroke. A. Probably the first would develop about twice as much power as the second.

(58) A. C. asks: What power can be got from a current wheel? The channel is 50 feet wide and 24 inches deep, with a fall of 24 inches in forty rods. I think of making a wheel 10 feet in diameter and 20 feet long, with 16 paddles. A. With a well designed wheel you may realize about 40 per cent of the effect of the water. This effect in foot lbs. per second = [lbs. of water passing the wheel per second × (velocity of water in feet per second)²] ÷ 64·4.

(59) W. F. S. asks if moonshine has the same effect on fish to spoil them as sunshine? A. The influence of the moon is restricted to lovers, dogs, and the tides.

In our last week's issue the answer to No. 22 of the inquiry column, 3,300 should be 33,000.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

M. S.—It is zinc blende, and of good quality. Judging from the sample, this ore should yield 40 per cent of zinc. It contains cadmium.—E. A. S.—The substance cannot economically be purified as suggested. If finely ground and weathered for some time, it may answer some of the purposes of whiting. This could best be determined by comparative tests.—A. B. F.—No. 1 is principally carbonate of lead. No. 2 contains much more mineral impurities than No. 1; but both contain enough lead to poison the sugar if, as we understand you, they remain together. This should be known at once.

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 Tides. By U. H.
On Petroleum. By W. S. R.
On a New Galvanic Battery. By E. G. A.
On Matter. By W. B.
On Mica Bronze. By R. S. V.

HINTS TO CORRESPONDENTS.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Inquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

WANTS AND BUSINESS INQUIRIES.

Almost any desired information, and that of a business nature especially, can be expeditiously obtained by advertising in the column of "Business and Personal," which is set apart for that purpose subject to the charge mentioned at its head.

We have received this week the following inquiries, particulars, etc., regarding which can probably be elicited from the writers by the insertion of a small advertisement in the column specified, by parties able to supply the wants:

Who makes Hyatt's patent sidewalk tiling?
Who sells grape sugar?
Who makes tile machinery?

OFFICIAL.

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

October 30, 1877,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

Advertising device, A. H. Dean 196,639
Animal trap, J. C. Ambrose 196,549
Annunciator, automatic time table, L. Dart 196,637
Arithmetic, teaching, R. W. Kavanaugh 196,583
Baby-walker, J. P. Wisk 196,560
Bale tie, J. W. Petty 196,699
Barrel hoop, L. Reed (r) 7,932
Bed bottom, Read & Howell 196,701
Bed bottom, spring, J. P. Allison 196,618
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Windmill, Gray & Knox 196,524
Window screen, J. S. Wilson 196,543

DESIGNS PATENTED.

10,286 and 10,287.—CASSIMERES.—A. Carmichel, Westerly R. I.
10,288.—ORNAMENTAL SCROLL WORK FOR JEWELRY.—L. Heckmann, Plainville, Mass.
10,289.—ORNAMENTAL CHAIN LINKS.—K. F. Heckmann, Wrentham, Mass.

[A copy of any of the above patents may be had by remitting one dollar to MUNN & Co., 37 Park Row, New York city.]

TORPEDO VESSELS. BY MR. DONALDSON. A valuable paper, lately read before the United Service Institute. Being a full exposition of the Torpedo-boat system, from the earliest efforts to the present time. Giving dimensions and performances of the several sizes built by Thornycroft Bros. for the various governments, highly interesting trials of these boats, and experiences in war, and a description of the torpedoes used. 1 illustration. Contained in SCIENTIFIC AMERICAN SUPPLEMENT NO. 79. Price 10 cents. To be had at this office and of all newsdealers.

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