[For the Scientific American.]

EFFECTS OF TIDE CURRENTS ON HARBORS.

The effects of running water are very strikingly perceptible on the banks of rapidly flowing rivers. The channels of the Missouri and Mississippi rivers are continually changing ; and the griefs of shipowners and captains, and the shrewd devices of pilots on this account, have been most attractively depicted by Mark Twain. Many a time has a planter retired, with his home and plantation on one side of the river, and awakened in the morning to find that the river had cut a new channel on the other side of his property. The crescent-shaped bayous so common along the south Mississippi, are results of this change of river bed by washing across from one curve to another in a straight line, instead of following the direction of the bend. The work of Captain Eads, now in progress at the mouth of the Mississippi, shows both the effect of water disposition and the ability of man to counteract it by means of jetties which produce scouring action.

That the waves and tides are materially and constantly modifying the physical geography of the sea coast has been long observed. Places which were once on the very edge of the sea are now removed to the distance of miles from the coast line by the agency of tidal deposit ; and others, which were formerly at considerable distance from the water's edge, have since been washed away by tidal erosion. The famous Pass of Thermopylæ, which was, in the time of Herodotus, so narrow that but a small squad of soldiers was necessary to prevent the passage of the whole Persian army, is now separated from the sea by a vast area of marine deposit.

Professor J. E Hilgard, of the United States Coast Survey, has made some interesting observations regarding tidal influence on harbors, and the modifying effects of encroachment to meet the growing necessities of large cities. It is well known that a tidal wave, when uninfluenced by the contour of the coast, is but inconsiderably elevated, and the front slope is about equal in length and similar in form to the rear slope. But as it enters a bay, harbor, or river, the crest of the wave becomes more elevated as the passage for it becomes more constricted, and also the front slope acquires much greater abruptness than the opposite one. Consequently the time occupied by the flood tide is shorter than that occupied by the ebb tide. This phenomenon of tides may be artificially illustrated with a very small amount of water, by dashing a bucketfull horizontally upon some uneven surface, with projecting points and indentations to represent capes and bays. If the water is projected with slow motion, it will be seen to rise but little at the projecting points, and to rise much higher in the indentations or bays, and the slopes of the waves will present the peculiarities already mentioned.

In the Delaware bay and river, the difference between the mean rise and fall at the Delaware Breakwater and at Philadelphia is only 2½ feet, while the difference of luni-tidal interval between the two places is nearly six hours. At the former place, the mean duration of the flood and ebb tides is about the same, showing that the tide wave has here about the same slope on its front and rear sides ; while at Philadelphia, the time of ebb exceeds that of flood tide by about 2¾ hours. At the head of the Bay of Fundy, the mean hight of the tide is 36 feet, and at spring tides, 50 feet or more. And here the tide rises so rapidly—owing to the very abrupt front slope of the tidal wave—that cattle feeding on the shore, and sometimes people, are often overtaken and engulfed or drowned. In the Severn river, England, above Bristol, the whole rise of 18 feet takes place in 1½ hours, and the fall requires 10 hours. As a result of this variation of slope, when a flood tide enters the mouth of a bay—which is usually a comparatively narrow strait—its rapid flow through the strait carries sand and mud with it ; and when the water spreads out in the basin beyond, and thus slackens its velocity, it deposits sediment in extensive flats opposite the entrance. The ebb, being more gradual, only washes little channels which converge from all directions to the outlet, leaving much of the deposit behind. Since the amount of water entering a harbor is about equal to that which leaves it at the next ebb tide, it may seem at first thought that the sediment carried out would just equal that brought in ; but when we remember that the rise of water is more rapid than its descent, we clearly see that this cannot be. While, therefore, the accumulation of sediment in well sheltered harbors cannot well be avoided, there is one thing which is very largely under human control, and affects very materially the value of harbors for commercial purposes. Man has it in his power to make deeper or shallower the channels of entrance and exit to a harbor by modifying the water capacity of the enclosed basin.

Professor Hilgard affirms that the depth of the channels "will depend, in a great degree, on the proportion of the area of the basin to the outlet, or, in other terms, on the difference of level which will be reached during the ebb between the basin and the ocean, which determines the greatest velocity and transporting power reached by the ebb stream." And even the flats, which are bare at low water, form an element of importance in fixing the depth of the channel. These flats furnish space for the excess of water at flood tide, and also, by their friction, retard the water in its outward flow. The velocity of water, and hence its scouring effect, is due to the hight of the water column rather than to its area ; but while the rapidity of scour is due to its hight, the continuation of its effect must of course depend upon the amount of water. From this we obtain an idea of the risk to harbor navigation which must necessarily attend any encroachment upon the water capacity of a harbor. To emphasize the important lesson he aims to impress, Mr. Hilgard offers as illustrations the two harbors of New York and Charleston.

Of the two entrances to New York harbor, the channel through the Sound is subject to but little natural modification. But it is widely different at the Sandy Hook entrance. In the place where the beacon on the end of Sandy Hook now stands, there was 40 feet of water 15 years before it was built. The cause of this accumulation is attributed to a northward current along both sides of the Hook. This invasion of Sandy Hook upon the best entrance to New York harbor is not a matter to be lightly considered. The depth of this channel, at mean low water, is 22 feet, and is maintained by the water (1) in Raritan Bay and east of Staten Island, (2) in Newark Bay and on Jersey flats, (3) lower waters of the North river, and (4) the Sound tide flowing through Hell Gate. The effect of the last of these is chiefly due to the fact that the Sandy Hook tide wave reaches the docks at New York before that from the Sound, the two meeting at Hell Gate; and the conditions of this tidal circulation are such that, if at the point of meeting a partition were placed, the water on one side would be sometimes 5 feet higher, and at other times 5 feet lower than on the other side. Even in the absence of such a partition, in the most contracted part of the passage the water is often a foot above its level only 100 feet distant. Hilgard estimates that the closing of Hell Gate would cause a loss of not less than 3 feet in the depth of Sandy Hook channel. The effect on this channel of the first three divisions is dependent upon the amount of water and its distance from the bar. The direct and necessary effect of diminishing the area of the tidal basin is to diminish proportionally the depth of the channel. He ventures the assertion that the proposed enterprise of occupying the Jersey flats with docks and wharves " would occasion a loss of not less than 1 foot in the depth of the bar off Sandy Hook, and certainly not more than 2 feet." And he very significantly adds the following remarks, which should not go unheeded: " When we yield to the demands of commerce any portion of the tidal territory, to be used for its wharves and docks, we must do so with full cognizance of the sacrifice we are about to make in the depth of water over the bar ; and in order to form any well founded judgment in regard to the effect of such encroachments, it is necessary to be in possession of the fullest knowledge of all the physical facts involved in the problem, and no measure of encroachment should be determined upon except in pursuance of the advice of scientific experts."

Professor Hilgard seems to attribute the cutting-out of harbor channels to the slow ebb scour entirely, and not at all to the more rapid flood tides. The latter would seem to us most likely to produce the greatest scouring effect. And this would be consistent with the two facts stated by him: that sand accumulates at the bar by being thrown up by waves of the sea ; and that the inflowing tide carries the sand and mud with which it is charged into the inner basin, and there deposits it, gradually filling up the harbor. In either case, the amount of scour would seem to depend equally upon the capacity of the tidal basin. But it is probable that much of the sediment is washed down the rivers which flow into the harbors, and settles to the bottom, while the river water is backed up in the harbors by the incoming tide.

During the rebellion, a stone fleet was sunk in the channel at the entrance of Charleston harbor, where the channel was 12 feet deep at low water. The submerged fleet caused a shoal to form, so the water here is now only 7 feet deep ; but each side of this, a narrow channel has been scoured out, one 12 and the other 14 feet deep. Furthermore, 4 miles south of this point was formerly a much frequented passage for southern traffic ; but since the fleet was sunk, this channel, at first 9 feet deep in low water, has become so filled up that it is now only 3 feet deep, very seriously to the disadvantage of easy communication with southern ports. From this, says Professor Hilgard, " we are warned how carefully all the conditions of the hydraulic system of a harbor must be investigated before undertaking to make any change in its natural conditions, lest totally unlooked-for results be produced at points not taken into consideration." S. H. T,

Naval Items.

The United States Steamer Saco has been in commission ten years, and now returns to Mare Island, Cal., to be put out of service. Though the hull is quite rotten, and the boilers worn out, the engine is reported as being as good as on the day it was finished. She has steamed about 150,000 miles.

NAVAL ENGINEER CORPS GAZETTE.

July 20. Chief Engineer J. W. Whittaker and Passed Assistant Engineer J. S. Ogden were detached from the U.S.S. Congress and placed on waiting orders.

July 21. Chief Engineer William J. Lamdin was placed on sick leave, having been condemned by a medical survey, and detached from the Pensacola flagship of the North Pacific station.

July 21. The leave of absence of Passed Assistant Engineer L. W. Robinson, who is assistant to Chief Engineer John S. Albert, U.S.N., Chief of the Bureau of Machinery at the Centennial Exhibition, has been extended six months from the 1st of August next.

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THE longer Portland cement is in setting, the better it will be. At the end of a year, 1 part of cement to 1 part of sand is about ¾ the strength of neat cement. Strong cement is heavy, bluegrey in color, and sets slowly. The less water used in mixing cement, the better.

Japanese Paper.

In Japan, paper finds a very wide field of usefulness, outside of the commoner but perhaps more important applications, for writing, printing, wrapping, and wall paper. The peculiar strength and toughness of Japanese paper fit it for many uses which would hardly be anticipated. Japanese paper handkerchiefs, with which we are all familiar, are quite soft, and pleasant to use, and at the same time nearly as tough as cloth; and from twisted strips of paper torn from these, an excellent string may be temporized, really quite strong and serviceable.

In Japanese houses, paper not only covers the walls and ceilings, but is used on light sliding doors which divide one room from another, and on the folding screens which protect from the too abundant drafts. Light wooden frames, on which a single thickness of paper is stretched, form the windows, admitting light but not sunshine, and air in plenty but not wind. These paper *shoji*, however, as might be expected, fail completely against rain, and must be supplemented by sliding-to or outside wooden storm doors.

Made waterproof with oil, paper serves for umbrella covers and rain coats, and in large sheets is used to protect baggage and merchandise.

In the form of an admirable artificial leather, it is used for pocket books, boxes, etc.

An inferior pasteboard is also made from paper, which is sometimes used for boxes. Thin sheets of wood, however, cut by hand with a large plane, being both cheaper and better, usually replace this material.

Articles of *papier maché* are common, but are usually disguised by lacquer, and can hardly be distinguished from ordinary wooden lacquer ware.

Japanese paper is usually made from the inner bark of the paper mulberry (*Broussonetia papyrifera*), which is grown and cultivated for the purpose. The bark of the *passerina Gampi*, and of the *Edgeworthia papyrifera*, are also said to be used.

Japanese paper is always made by hand, and is therefore of necessity made in small sheets ; the more common size, known as *kanshi*, being about nine and a half by twelve and a half inches, though both larger and smaller sizes are used to a limited extent.

The paper as generally sold is unsized, the thick india ink used for writing rendering size unnecessary; but there is special paper called *ro-biki*, or *bidoragami*, very thin and translucent, used for blank books, etc., which forms an exception to this rule. The size used in the manufacture of this paper is said to be made from the bark of a species of hydrangea (*h. paniculata*).

Japanese paper is never bleached, and has usually a faint yellowish or greenish tinge. Its texture is rather loose, and very fibrous. Generally the fibers lie parallel to the shorter edge of the sheet, and in this direction the paper tears easily, while in any other line it tears with difficulty. In certain kinds of paper, made for rain coats, wrapping paper, etc., the fibers seem to cross each other, so that it is difficult to tear the sheet in any direction.

The paper mulberry shrubs, which supply the raw material for papermaking, are grown by the farmers in the vicinity of their villages, on the borders of their rice fields, or on the narrow ridges of earth which divide one rice field from another, and very rarely on ground specially devoted to the purpose.

The scraped and dry bark, in quantities of about 33 lbs., is boiled with a strong lye for about two hours, or until the mass becomes sufficiently tender. It is then put into bags or baskets and submitted to the action of running water, in a stream or irrigation ditch, for twenty-four hours, or until the last trace of alkali has been washed out. The lye used for this treatment is made by lixiviating wood ashes, the ash of the common artemisia being employed. According to Zappe, the ash of buckwheat chaff is also used ; and in case the fiber does not readily soften, a small quantity of quicklime is added, though the color of the paper is likely to suffer thereby.

To convert the bark thus treated into pulp, it is next beaten, two or three pounds at a time, on a solid slab of oak or cherry, with short heavy sticks, being frequently turned during the operation, so that the fibers may be broken in every direction. This beating is continued vigorously by two persons for about fifteen minutes : at the end of which time, the few pounds operated on have been pretty thoroughly reduced to pulp.

For the manufacture of paper, this pulp must be mixed with a certain quantity of *tororo* or of rice paste.

Four *kan* (33 lbs.) of bark, scraped and dry, yield two *kan* of finished paper: and will make about three thousand to thirty-six hundred sheets of ordinary size and thickness.

Paper of ordinary weight is usually sold by the *jo*, of ten sheets, and the *so*, of two hundred. With some kind of paper the *jo* is twenty sheets, in others forty-eight. Thick paper is always sold by weight.

The Japanese make numerous varieties of fancy paper, one of the prettiest being known as devil paper. This is a thin tissue paper on which lace-like patterns are printed in opaque white ink, producing the effect of a most elaborate water marking. This paper is used for fancy lanterns, and sometimes for covering *shoji* or window frames, though it is rather thin for this last purpose. Pasted on glass, it makes a very good imitation of ground or etched glass.

Japanese fans, paper for poems, and wall paper are often very beautifully decorated by painting or printing. The patterns are always artistic, consisting generally of leaves, vines, flowers, shoots of bamboo, etc., very naturally arranged. The wall paper in general use is perfectly white, with a pattern printed in a white opaque ink with a pearly luster. Colored wall papers are rarely used, except for halls and vestibules. This wall paper, like other Japanese papers, is made only in small sheets.

The imitation leather, or leather paper, is made of a special kind of paper, *tozasenka-gami*, of which several layers are employed to give the requisite strength. The inner layers are saturated with oil, *ye-no-abura*, from the fruit of the *Celtis Wildenowiana*, giving the material softness and flexibility. The morocco-like surface is obtained by pressure from an engraved wooden block, and finally the whole is covered with a varnish of lacquer.

"Herr Von Brandt, formerly German Minister to Japan, in a paper* read before the German Asiatic Society, gives a very minute and interesting account of the method of making crape paper, from which I condense the following description: The paper to be craped, ordinary Japanese paper, with some colored design printed upon it, is dampened and spread in a pile on a large slab of wood, in such a way that the edges of no two sheets shall be parallel. Alternating with these sheets are pieces of ordinary white paper, placed between the colored sides of two printed sheets, and sheets of *takanaga* paper. The whole pile is then tightly rolled on a smooth stick, and covered with a long band of dampened linen, rolled diagonally and tightly over the whole. The stick with its roll of paper and cloth is then pressed longitudinally in a rude lever press. The arms of this press are provided with holes through which the ends of the round stick may pass, so that the roll of paper alone receives the pressure. The *takanaga* sheets are made of strong paper, composed of several thicknesses of ordinary paper fastened together with rice paste, which have been previously creased in regular parallel corrugations by a similar process, and which serves to impart the desired regular creasing to the colored sheets when they are together compressed as described. After the first compression, the paper is unrolled from the sticks, and the sheets are separated. The *takanaga* paper is smoothed out, and the pile made up as before, but in such a way that the creasing may come at an angle to the former fold of each sheet. The process is thus repeated seven times, and the sheets finally dried. The paper thus treated resembles crape very closely both in texture and in elasticity.

"The Japanese paper, excellent as it is, does not supply all the wants of the people; and this account would be imperfect did I not allude to the manufacture of paper from rags, after foreign methods, which is now being conducted on a large scale in several parts of Japan. In Tokio alone there are three or more papermills, fitted with the most approved American and English† machinery, and capable of turning out large quantities of paper. The government consumes large amounts of foreign writing paper; the newspapers use foreign printing paper; and the educational institutions require, in addition to these, drawing paper, book paper, etc. All of these are now made in Japan; and it seems likely that the rude and expensive process of making paper by hand, which I have described in these pages, is soon destined to disappear before the power of machinery, which makes a better paper, at less cost, from inferior and less expensive material.—*Henry S. Munroe, E.M., in American Chemist.*

Correspondence.

The Centennial Excursion by the Pennsylvania Railroad.

To the Editor of the Scientific American:

President Thomas A. Scott recently extended to the Centennial judges and many of the foreign commissioners an invitation for a trip over the Pennsylvania Railroad and some of its branches, so planning the same that it should combine, with a practical examination of the line and its auxiliaries and resources, all the features of a pleasure trip as well. By the courtesy of other roads the train ran into New York State to see Watkins Glen, Genesee Falls, and Niagara.

This excursion, occupying five days, was made by about 175 gentlemen, representing the various nationalities of the world, and was in every respect a most delightful affair. The party was conveyed by special train, ample in its accommodations, and represented the convenience of modern travel, including the luxury of elegant lunches while running at fifty miles per hour. The company had provided accommodations along the route at the best hotels, and each evening brought a banquet to crown a pleasant day. While traversing the superb roadway of the main line, occasional stops were made to allow an inspection of some of the fine iron bridges designed by Mr. Wilson, the engineer in charge of these structures. At Altoona the extensive shops of the company were visited; the various methods in the transforming of raw materials into engines, cars, and the various items pertaining to the outfit of a railway were examined with great interest. There was much careful note-taking by the foreign visitors; and indeed a fair field for observation is presented here, as operations are on the largest scale, and the assemblage of mechanical appliances is something marvelous, from the giant derrick that picks up a whole locomotive as if it were a baby, and moves it tenderly to any desired point, to the delicate scroll saw that cuts dainty designs in birdseye maple. The testing of axles was very interesting, as showing the extreme care exercised by the company; one could hardly witness it without an increased feeling of security.

One hundred axles are made from a given melting, and from that number, five are selected promiscuously, as fairly representing the quality of the metal. These are separately laid between heavy blocks which support the extreme ends, and a wedge-shaped iron, weighing 1,640 lbs., is dropped upon the middle, from hights varying from 25 to 40 feet. If they break, the whole one hundred are returned to the furnace; if not, the ninety-five are used; only the five are remelted, these having, of course, been strained by the severe test. Several were thus tried before the visitors, not one breaking. The great steel works of the Cambria and Pennsylvania Companies were also visited, and afforded much valuable information as to the improved method of manipulating iron. On the grounds of the last named, a steam hammer, striking blows of 200 tuns weight, was seen in operation.

At Williamsport, an opportunity was afforded to see one of the largest lumber mills of the country, a huge monster that drags up the helpless logs from the river and, with a roar and a rush, turns them into a million and a quarter of marketable boards per week, feeding itself on the sawdust which is led automatically under the boiler. Rather monotonous food, though it be "fine board," as some one remarked.

The visit to the oil regions was a very interesting feature of the trip, this industry being so peculiarly American. The sight of derricks innumerable, scattered over a strip of country 150 miles long, some working, others silent and abandoned, was suggestive of the singular history of this most singular traffic. It is now conducted upon a methodical and paying system. Thorough investigation was made of the processes by which the petroleum is pumped from depths of 1,400 feet to the tanks of the different owners, whence, after being gaged, it is drawn by union pipe lines, as they are called, and sent through iron veins, nine miles or more, to the railway station, where, loaded into iron cars, it is dispatched on its mission of lighting the world, and reducing the price of gas. During the visit to this strange region, an incident, not in the programme, occurred; a tank containing a million gallons oil was struck by lightning and burnt, causing a scene very impressive, though not without special pleasure to a gas director. The latest decision of Science is that petroleum is not a distillation from coal but from immense masses of coraline deposit. Fossil coral is found overlying the spongy sandstone in which the oil occurs.

The scenery through the diversified valleys of New York and Pennsylvania was greatly admired; while the romance of Watkins Glen and the grandeur of Niagara each contributed their peculiar enjoyment to the party, and the distinguished gentlemen returned to Philadelphia, enthusiastic over the trip. Colonel Scott was unable to accompany them, but was happily represented by his subordinates, who not only illustrate, in the highest sense, the rare abilities necessary to the best type of modern railway management, but are thorough gentlemen, understanding how to exercise republican hospitality with a grace which called forth the admiration of the foreign and the pride of the native born guests. It is not too much to say that their courteous consideration put hunger, thirst, and discomfort out of the question, and rendered the trip, from beginning to end, a continual holiday.

One very delightful fruit of the excursion was the evident fraternal feeling produced among the gentlemen of different nationalities, brought together under circumstances so favorable to the development of pleasant sentiment. Its expression was frequent and earnest; and when, after a superb dinner at the Cataract House, Niagara, they joined voices in singing with the band each others' national airs, it seemed as if one of the noblest results to go out from our Centennial observance was already in part realized, the quickening of the sentiment of universal brotherhood. Honor to Colonel Scott for conceiving and carrying out so delightful and so useful a scheme. G. S. D.

Aerotherapy.

To the Editor of the Scientific American:

In your issue of July 29, it is stated anomously, that aerotherapy in medical treatment by compressed air is new. I saw it in 1857 at Benn Rhydding, in Yorkshire, England, at a great hydropathic establishment, where there was an apartment of iron, very handsomely fitted up, for the purpose. And in 1875 I saw another, which had been in operation for many years at the Townsend House, the spacious and elegant establishment of Dr. Grindrod, at Malvern, Herefordshire, England.

Portland, Me. NEAL DOW.

Logwood Inks.

Logwood inks have been much employed for several years on account of their cheapness and the beauty of their tint; the greater part of the so-called copying inks are prepared at the present time from this coloring matter. Both the rasped logwood and the commercial extract are subject to falsifications; it is well, therefore, to make use of the whole logwood, and rasp or grind it as required; it is necessary, also, to consider the presence of an excess of moisture and of foreign substances, which may be used to adulterate it, as insoluble substances, cutch, etc.

The inks prepared from logwood are of four classes: 1. Inks with logwood and chrome; 2, inks with logwood and alum; 3, inks with logwood and copper; 4, inks with logwood and iron

Runge, in 1848, discovered that a dilute solution of the coloring matter of logwood, to which had been added a small quantity of neutral chromate of potassium, produces a deep black liquid, which remains clear, does not deposit, and may be employed as an ink. Perfectly neutral litmus paper is not affected by it; it does not attack pens; it is very cheap, and so easily penetrates writing paper that it cannot be removed by washing even with a sponge—in a word, it has all the properties of an excellent ink. On exposure to the air in the inkstand, it sometimes decomposes very rapidly, its coloring matter being deposited in the form of large black flakes, which leave a colorless liquid above them. This gelatinization is a great defect in this ink, particularly as one does not know the precise conditions which determine it. Different means have been proposed to prevent this action; the best seems to be that of the addition of carbonate of sodium recommended by Böttger.

The author has used an ink prepared in this manner for upwards of two years, and has not observed any decomposition, although this may to a considerable extent be due to the fact that the inkstand employed was one which allowed but little exposure to the air.

To prepare this ink, take extract of logwood, 15 parts; water, 1,000 parts; crystallized carbonate of sodium, 4 parts; neutral chromate of potassium, 1 part.

Dissolve the extract of logwood in 900 parts of water, allow it to deposit, decant, heat to ebullition, and add the carbonate of soda; lastly, add, drop by drop, with constant stirring, a solution of the neutral chromate in 100 parts of water. The ink thus obtained has a fine bluish black color; it flows well from the pen and dries readily. The chrome ink powder of Platzer and the acid ink of Poncelet are imitations of the original ink of Runge.

An ink obtained from a decoction of logwood and chrome alum is not to be recommended; the characters written with it have little depth of color, and are of a somewhat greyish shade.

Decoctions of logwood to which alum has been added give a reddish or violet color, which darkens slowly, particularly with ink prepared from the wood and not the extract. Such inks prepared with alum alone are costly, because to obtain a sufficiently deep tint one is obliged to employ decoctions or solutions of the extract in a very concentrated condition. It is otherwise when a metallic salt is added along with the alum. Alum produces a reddish purple color in decoctions of logwood, while metallic salts produce in the oxidized solution of the coloring matter a precipitate of a black or bluish black color. These inks are analogous to the so-called alizarine inks; the ink is colored by the tint produced by the alum. Under the influence of air there is produced between the metallic salts and the coloring matter a reaction which determines the formation of a bluish black precipitate. To prevent as much as possible this action of the air upon the ink before it is applied to the paper, there is added, as in the case of alizarine inks, a trace of sulphuric acid, designed to dissolve the precipitate which may be produced. This acidity of the ink has several disadvantages; it attacks the pens used for writing with it unless they are either of gold, platinum, or gutta percha. Sulphate of copper or sulphate of iron may be the metallic salt used in such inks—the former is preferable. One of the best formulas for this kind of ink is the following, given in proportions for a manufacturing scale: 20 parts, by weight, of extract of logwood are dissolved in 200 parts of water, and the solution clarified by subsidence and decantation. A yellowish brown liquid is thus obtained. In another vessel, 10 parts of ammonia alum are dissolved in 20 parts of boiling water; the two solutions are mixed, there being also added $\frac{1}{5}$ part of sulphuric acid, and finally $1\frac{1}{2}$ parts of sulphate of copper. The ink should be exposed to the air for a few days to give a good color, after which it should be stored in well corked bottles.

Böttger gives the following formula: 30 parts of extract of logwood are dissolved in 250 parts of water; 8 parts of crystallized carbonate of soda and 30 parts of glycerin of density 1·25 are added; and lastly, 1 part of yellow chromate of potassium and 8 parts of gum arabic, reduced to a powder and dissolved in several parts of water. This ink does not attack pens, does not mold, and is very black.—*E. U. Viedt.*

Facts and Simple Formulæ for Mechanics, Farmers, and Engineers.

Two hundred and seventy cubic feet of new meadow hay and 216 and 243 feet from large or red stacks will weigh a tun; 297 to 324 cubic feet of dry clover will weigh a tun.

Laths are $1\frac{1}{4}$ to $1\frac{1}{2}$ inches by 4 feet in length, are usually set $\frac{1}{4}$ of an inch apart, and a bundle contains 100.

A tarred rope is about one fourth weaker than untarred white rope. Tarred hemp and manilla ropes are of about equal strength. Wire rope of the same strength as new hemp rope will run on the same sized sheaves; but the greater the diameter of the latter, the longer it will wear. One wire rope will usually outlast three hemp ropes. Running wire rope needs no protection; standing rigging should be kept well painted or tarred.

The coefficient of friction of leather belts over wooden drums is 0·47 of the pressure, and over turned cast iron pulleys 0·28 of the pressure.

A mixture of 9 parts phosphate of soda, 6 parts nitrate of ammonia, and 4 parts dilute nitric acid is a freezing compound which will cause a fall in temperature of 71° Fah.

Three fourths of a cubic foot of water evaporated per hour will produce 1 horse power.

Cold blast iron is stronger than hot blast. Annealing cast-iron diminishes its tensile strength.

The safe load in tuns which an iron chain will withstand equals the square of the diameter divided by 9.

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* "Die Aufertigung des Krepp papiers, Tshirimeng mi," Mitthiellungen des Deutsches Gesellschaft, 5tes Heft, Juli, 1874, s. 5.

† See Engineering, vol. XXI. pp, 400, 422.