AMERICAN INDUSTRIES—No. 81.

HEMLOCK SOLE-LEATHER TANNING.

In all the northern counties of Pennsylvania, from Port Jervis almost to Lake Erie, a vast industry is conducted in the manufacture of hemlock sole leather. It is only about twenty years since this region was first largely occupied by tanners, but there are comparatively few sections here now, throughout its whole extent, where tanners have not "prospected," as it were, in looking out favorable locations for their tanneries. Every new railroad, and every minor branch of a road, running through land on which hemlock timber was standing, has added new facilities for reaching the bark supplies necessary for the tanner, and many such roads have been built expressly for this purpose; but the supply is yet abundant, on going back far enough from the thickly settled portions of the country, and probably will continue so for at least a generation yet to come. What we will do then, or rather what our children will do, is a problem which the tanner who has cheap and abundant bark to-day troubles himself very little about.

In the illustrations on the first page of this paper we give a representation of a new tannery, but just well under operation, which is at once one of the largest and most complete establishments of the kind in the world, the "Brunswick" tannery, of Messrs. Hoyt Brothers, of New York. It is situated in Tioga county, Pa., about twenty miles from Blossburg, and forty miles from the New York State line, in the midst of a dense hemlock wilderness, where, for ten miles in every direction from the tannery, it is estimated that the bark on the trees will yield from eight to fifteen cords per acre. The firm, in connection with the Blossburg Coal Co., have built a branch railroad from Arnot to the tannery, and it is expected that this road will give the tannery a large proportion of its supply of bark.

Only those familiar with the tanning business comprehend why it is that in this country the tanneries are thus built way off in the woods. The answer lies on the surface.

It requires about 2,000 pounds of bark to make 150 to 175 lb. of good sole leather, and so, not counting at all the large ground space required by a great tannery, it is cheaper to take the hides to where the bark is than it would be to bring the bark to the seaports where the hides are imported, or the large centers where hides of domestic production are collected. This is not so much a distinctive feature in upper leather and calfskin tanning, where much less bark, proportionately, and a great deal more labor are required, nor is it true in regard to the sole-leather tanning business of any other country, for nowhere else in the world are to be found whole sections of country with such abundant supplies of bark, the growth of the original forests. In England, for instance, where the standard of excellence in sole leather was first made by the "butts" and "bends" so famous in all the markets of the world half a century ago, it is now a rare thing to see a thousand cords of bark on hand at one time at any of the leading tanneries. Very little bark is used in any of the tanning there, its place being taken by gambier, valonia, divi divi, and myrobolans, from the East Indies, the Levant, and tropical sections of South America, and portions of Africa, with the mimosa from Australia. These tanning agents are more concentrated, affording strong tan liquors, and heavy, good-looking leather can be made therewith, but the leather is not as serviceable for wear as that made with bark. The tanners of nearly every other country are, however, compelled to use them because of the scarcity and high price of bark, the price in England now being equal to about $30 per cord. Our sole-leather tanners use bark only, its abundance here making it much the cheapest, as it is acknowledged to be the best tanning material. Its cost, at most of the large tanneries in Pennsylvania, will not exceed from $4 to $5 per cord, and the establishment which forms the subject of our illustrations enjoys exceptionally good facilities for obtaining a cheap and abundant supply, the bark sheds connected with the "Brunswick" being calculated to hold a stock of 10,000 cords.

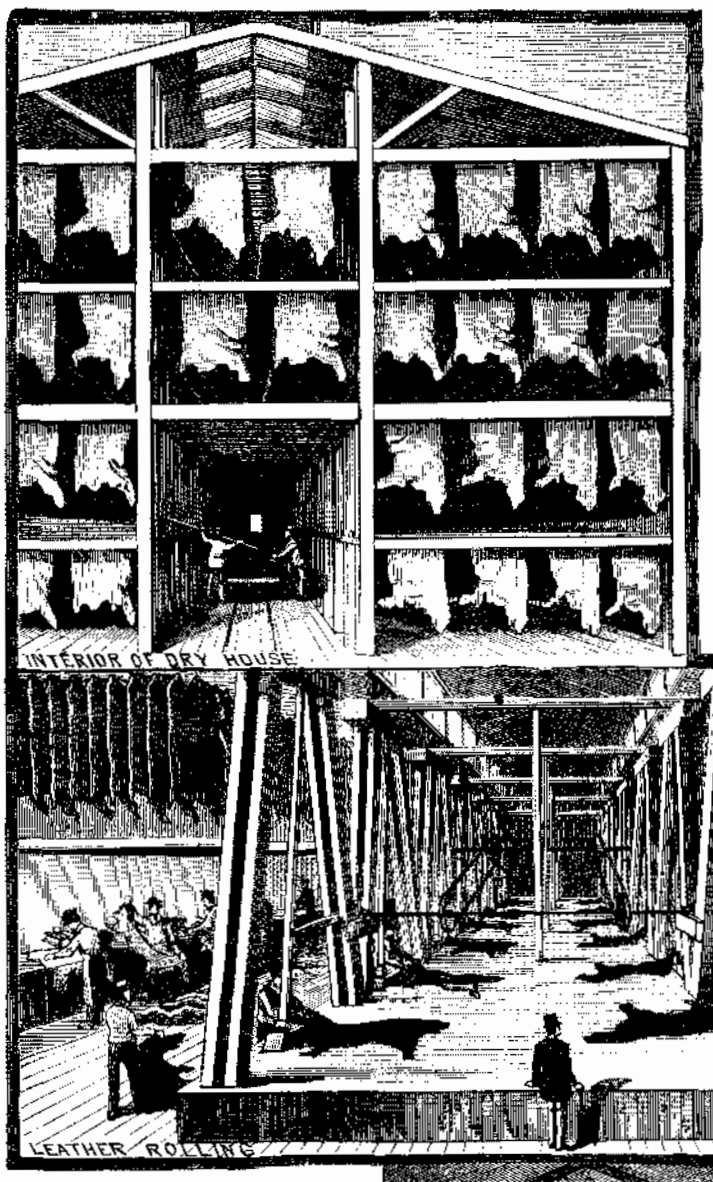
In the view of the location and arrangement of the tannery buildings, shown in the center of the page, but a limited idea of the extent of the business will be conceived unless it is remembered that these buildings extend over nearly thirty acres, and the plan is such that the progress of the stock, from the time it enters as raw hide until it leaves as finished leather, is never backward or over the same ground twice. The building in the foreground represents the shipping house for finished leather, where it is loaded directly upon cars, the tracks for which run through the building. Beyond this, and between the two largest structures on the grounds, may be seen the receiving and storehouse for hides, where they are unloaded direct from the cars. From the hide house the stock is first taken to the soaks in the front end of the great building to the left, which constitutes the yard proper; adjacent to this are the sweat pits, and here are the hide mills and beamsmen, the handling vats coming next, and the lay-away vats extending all down the length of the building. About midway down, and including a passageway to the structure at the right, is the scrubbing department, whence the leather goes to the drying lofts, and thence to the rollers, in the front part of the same structure, where it is very near its place of shipment from the tannery. On the extreme left are the bark sheds; a large building is occupied by the mills for bark grinding, adjoining which is the leach house and a boiler house, another structure being provided in which are large tanks for cooling the tan liquors.

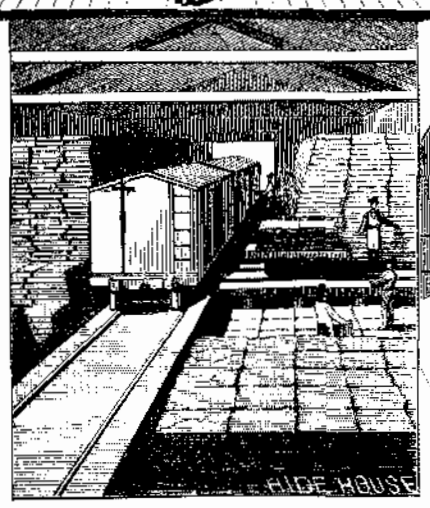
The first operation upon the hide entering the tanning process is the soaking. This is always necessary, whether green, salted, or dry hides are worked, to soften and clean them, but in this tannery dry hides are used exclusively which are principally imported from South and Central America, or received from Texas and California, the best grade of dry hides generally coming from Buenos Ayres and Montevideo. The hide, as taken from the animal, contains so much moisture that the weight of a sixty pound hide, if dried quickly in the sun or otherwise, to prevent putrefaction, will be reduced to about twenty pounds when dry. The freshly taken-off hide or skin needs comparatively little soaking, but only sufficient washing to clean it from blood and impurities; the dry hide, however, must be soaked until it is thoroughly softened, or brought back as nearly as possible to the condition it was in when first taken from the animal. For this purpose from three or four days to a week is usually required, and sometimes longer, dependent upon the condition of the hide, the time of year, the water, etc.

An abundant supply of pure water is one of the prime necessities of a large tannery, and it is important that it should not be what is commonly known as "hard" water. There is very little natural spring or river water, of average freedom from soluble impurities, which is not suitable for tanners' uses, but a large creek, flowing from the hills and through the woods which surround the tannery, affords an ample supply of comparatively soft water.

After the soaking, which is effected at the end of the yard where the hides are first received, and where the hide mills and beamsmen are located, the hides go first to the sweat pits, in an adjoining building, whose sides appear sunken below the earth, only the roof being seen, but the floor of which is, in reality, on a level with that of the rest of the tanyard. The hides are taken here, as in fact they are moved from one portion of the tannery to the other all through the process, on light cars, easily pushed over tracks laid for this purpose. Two views of the sweat pits may be seen on the sides at the top of the page, one showing the arrangement by which they are all reached in the common entrance from the tanyard, and the other giving an interior view of one of them, as the hides are hung in "sweating." The sweat pits, or vaults as they more properly appear here, have double doors, and are made so that, when the hides are hung up therein, they will be as much as possible removed from any effect of outside air. When the wet hides are hung up here in a close atmosphere, kept at a uniform temperature, their natural tendency to decay is likely to quickly manifest itself, and an incipient putrefactive fermentation soon becomes apparent in the strong smell of ammonia they give off. The hide swells as this proceeds, and the cells at the roots of the hair become enlarged, until the hair will readily "slip" when the hide has been sufficiently long in the sweat. During this process, however, extreme care and the best of judgment are necessary; only hides of about the same weight, character, and condition should be started together, and then frequent examinations must be made by the workman in charge, so that if any of them seem to have been sweated sufficiently before they have all arrived at that stage, the most forward ones may be immediately removed, as a very short delay here would be highly injurious to the leather. Concerning the temperature which should be maintained in these sweat pits tanners differ widely in practice Formerly it was considered necessary to keep it down as low as 50° Fah., whence came the designation of this process as the American "cold-sweating" system, but now the temperature varies with different tanners, all the way from 60° to 75° Fah., the operation proceeding slower or more rapidly accordingly, although a still lower temperature may be advisable when there is danger from the condition of the hide. The hides themselves may be so managed that the heat they give off will keep up a proper temperature during the greater part of the year, with the necessary washing of the floors and sides of the pits, and the use of a little steam in winter, the ventilators being opened to allow of the escape of ammonia, which comes off freely when the putrefactive fermentation is set up. Abundance of moisture in the atmosphere is also requisite in the sweat pit, but the pores of the hide, as hung up, being filled with water, will keep the surrounding air always damp. About a week is ordinarily taken for the sweating of heavy hides, though sometimes only three or four days are necessary, and, exceptionally, even less than that. As the hides come from the sweats the hair has been so loosened that the greater portion of it will readily come off in a brief working in the hide mill. One of the views shows the operation of these mills, which are in principle nothing more or less than the old-fashioned fulling stocks, intended to pound and tumble over the hides without breaking or in any way injuring the surface. A stream of water is kept running on the hides as they are subjected to this operation, and a good part of the hair is thus with little trouble removed. The hides, after being soaked, are milled before being put into the sweat pits, and if not sufficiently soft are thrown back into the soaks until they are.

The "beam-work" of a tannery is well illustrated in the main view at the top of the page. Each hide is taken separately over a tanner's beam, and the hairs not before removed are worked off, while the extraneous flesh on the other side is cleaned down to the true skin. This not only allows the tan liquors to more readily penetrate the pores of the hide, but, where the fleshing is well done, it makes a more solid,





HEMLOCK SOLE-LEATHER TANNING.

sightly, and serviceable leather. Thirty hands are here employed at work over the beam, and great care is given to this department, for much attention has been called to the proper "fleshing" since we began to be large exporters of sole leather. The best European tanners flesh their sole leather very closely, and the custom of most English tanners is to give the flesh side a smooth and clean appearance by a kind of pasty covering, which certainly does not add to the value of the leather, although considerable increase in its weight is thus made. Without going to the extreme of close fleshing, which some European customers have desired, there has been great improvement among our tanners in this direction within a few years past, while nowhere is it a practice to put on any extraneous substance to cover up cuts or defects in the flesh, or add to the weight.

When the hide comes out of the soaks it is cut in halves along the back from the head to the tail, and these two parts are thereafter known as sides. This is the only "trim" usually made in hemlock sole leather before it is sold to the manufacturer, although in oak leather, and in the mixed tannage of oak and hemlock known as "union," it is common to cut off, and sometimes tan separately, the bellies, or pate, bellies and flanks, the leather being then known as "crops" and "backs" respectively—the latter being nearly the trim of what is known as English "bend" leather, while the "butts" would represent the hides thus trimmed of all the lighter or more spongy portions, but not cut down through the back. All of the American boot and shoe manufacturers, however, and most of our foreign customers, since they have become accustomed to the use of "side" leather, prefer it in that way, as they can use the inferior portions for inner soles, heel lifts, stiffenings, etc., and the thickest portions for outsoles, with greater latitude in their selections as to quality and kind of stock required for each.

Of the "handling," which is the first operation of the tanning proper, our artist has given a single illustration, showing the manner of proceeding, as also with the "laying away;" but both these operations are likewise represented in the larger view at the bottom of the page, the first process running into the second, taking up nearly all the room of the principal building. The hides, as they come clean and white from the beamsman, are thrown first into a vat containing weak tan liquor, of just sufficient strength to color the grain or hair side, and partially strike through the grain. It is the combination of the tannic acid of the bark with the gelatine of the hide which alone makes true leather. It is also necessary, if possible, to somewhat distend or "plump" the hide.

And here we come to one of the great questions in the tanning business, about which the doctors in the trade have long disagreed, namely, the proper method of plumping and the feeding of the hide with tan liquor in its early stages. The hide, as it comes from the sweat pit, where the incipient putrefactive fermentation has been sufficient to loosen the hair, must have prompt treatment with some counteracting agent, or it will "run," so as to lose gelatin, and thus lessen the weight of the leather, or damage the grain, or make "black rot"—risks which have to be carefully looked out for in all the early stages. The handler liquors should be of sufficient strength to at once stop this tendency, and they should be such as will also open the pores of the hide. In hemlock sole leather there are two general classes in the market, commonly known as "acid" and "non-acid," according to the plan followed at this stage of the process. The first takes its name from the fact that sulphuric acid, though diluted to about the strength of a weak vinegar, is used in the handlers to plump the stock and assist to stop decay, while the non-acid leather is so called because only the liquors derived from the bark are employed. In the latter case, however, a tan liquor which is not only weak, but which has become sour or oxidized from exposure to the air, is found most efficient, both to stop decay and plump the leather. The "acid" or vitriol plumped leather always has a thin grain and a dark streak under the grain, which is very objectionable to manufacturers, who buff off the surface of this grain to make a clear, fair, even-colored bottom; "acid" leather has, also, a tendency to be harsh and brittle, though this is not always the case, some of the most solid leather for heavy work being of this class. In the non acid leather, also, if the liquors used in the handlers be too old and sour, the grain will not be light-colored, though it will not have that distinctive dark streak. There is a nice mean to be sought here, which has been successfully attained by our best practical tanners only. The "Brunswick" tannery is a non-acid yard, and the firm who built and are operating it have made for themselves a wide reputation, wherever hemlock sole leather is used, for the excellence of their product in this line of manufacture. Their leather has been solid and of good substance, fine-textured, excellent in grain and clear in color, just such as is required by the first-class boot and shoe manufacturers, making a handsome looking and good wearing bottom.

The process of handling in the tannery occupies from two to four weeks according to the kind and condition of hide and the state of the liquors. The strength of the liquors is gradually increased as this department of the work proceeds, so that, while the first handlers have a strength or weight of sour tan liquor of four to six degrees, the last ones will have a sweet tan liquor weighing from twelve to sixteen degrees. The weight or strength of liquors is usually tested by what tanners call a "barkometer," but which is really nothing more nor less than a hydrometer, so arranged as to be best adapted for tanners' use, with a scale which marks, for the strength of liquors that can be ordinarily leached from hemlock or oak bark, without evaporation, about thirty-five to forty degrees, although, of course, with any artificial abstraction of their moisture, or the further adding of extraneous matters which would be held in solution, the weight would be correspondingly increased. In the bark extract manufacture, which is now a considerable industry in this country, tan liquors are evaporated down to about two hundred degrees, according to a similarly proportioned scale.

Next we come to the lay-aways, where, the grain having been thoroughly colored and "struck through" with the tan liquors, the sides are "laid away." One of the views shows the manner in which this is done, a workman standing by and throwing one or two shovelfuls of ground bark on each side as it is laid down, and, after the pile reaches the top of the vat, enough tan liquor is run in to cover the whole. Each lot of hides, in going through, receives five lay-aways, except in case of very heavy ones, which may receive the sixth, the time occupied in the first ones being from five to ten days, and in the last ones from three to six weeks. With each change, however, the sides are given a stronger liquor than was the preceding one, until, in the last lay-away, the strength of liquor reaches from thirty-two to thirty six degrees, or as much as any leaching process will get out of the bark. The time usually occupied in the tanning is about six months, including the drying and rolling, although somewhat longer is frequently consumed, especially with heavy hides, it being considered quite advantageous to let the leather lie as long as possible in the heavy liquors of the last lay-aways.

The preparation of the bark liquors properly commences with the grinding shown in one of the views. The bark is peeled in the woods in the spring, and is piled and allowed to season for a few months, or until the following winter, most of the tanners having their bark hauled in the winter, when the snow is on the ground. All of the bark coming from any considerable distance will be brought in by rail, and all is unloaded from the cars or vehicles bringing it directly opposite the bark mills, except the quantity they will keep ahead in stock, their usual policy being for the present, while the supply is so abundant, to have it brought in only about as needed, and thus save the extra handling. The mills at the top have something the appearance of iron hoppers, about twenty-four inches in diameter, over the edges of which the attendant roughly breaks and feeds in the bark. There are many different styles of bark mills, but the great point necessary in a good mill is that it grind evenly, and of sufficient fineness, without also making dust, while it will at the same time do the work with sufficient speed, without being unduly liable to break or get out of repair. The mills here grind very evenly, reducing the bark to about the average size of grains of wheat, and in their fitting up no pains have been spared to provide ample power and use every precaution against possible break-downs. The gearing running these mills is below the floor, and is shown in a special view on this page. Perhaps the most noticeable feature of this department, however, is the entire absence of bark dust, with which the air is generally filled and all surrounding objects covered everywhere in the neighborhood of the bark grinding in most tanneries.

The explanation is found in the fact that the bark, as it leaves the teeth of the grinders, is received into a thin, slow-moving stream of water, and is in this way conveyed to the leaches.

The leach house is a large building, shown in one of our views, the leaches themselves being not unlike the vats or handlers in which the leather is tanned. Into these leaches, by a system of covered troughs which enables the current from the bark mills to be floated into every part of the leach house, the water carrying the ground bark flows according to a regular system, which can be changed to meet each day's requirements. They are then warmed up by steam pipes running into them, but not heated sufficiently to extract the resinous and coloring matters of the bark, which would be the case if the temperature was raised to the boiling point. There is a great difference of opinion among tanners as to what degree of heat should be used in this process, but the best test of the excellence of any method is to be found in the quality and color of the leather. After the liquor has thus stood a sufficient time to mainly exhaust the strength of the bark, it is drawn off and another liquor put on, with a similar process, the bark being thus "washed," as it were, three or four times, until its strength is exhausted, and the liquors are pumped into the large coolers adjacent to the yard. It is necessary, however, in order to make the strong liquors required in the later stages, to put the same solution several times through different leaches, each one raising the strength, until the practical limit is attained in a weight of about thirty-five degrees.

At the sides of the leaches, with low supports in the passage way, run long, slow moving endless chains, with slats at frequent intervals, on which is pitched the wet spent tan from the leaches, after it has been thoroughly exhausted of its tannin. These belts carry the spent tan to the furnace room and automatically dump it over the feed holes of the great wet tan ovens, in such way that only mere nominal attention is required at any time to see that the fires are well kept, during all the working hours of the day at least, from one month's end to another. These ovens are built according to what is everywhere known in the trade as the "Hoyt system," a designation for them which was accepted by Judge Blatchford, in the famous Thompson wet tan suit, about ten years ago. The decision of the court in this case was widely commented upon as maintaining the validity of a patent which, to some extent at least, set up the advantages of water itself in fuel, and claimed that it was actually and advantageously dissociated in a certain described system of ovens, operated in a specified way. The "Hoyt" ovens, however, which were not considered as coming under this patent, are simply structures with high grate bars and good smokestacks, to insure strong draught, with ample grate surface and a high arch, to insure plenty of room for a large body of fire, beside an unusual proportion of wet and charred fuel constantly coming into condition for actual combustion. They are set in front of the boilers, and, for, convenience, are automatically fed from the top as described. The fire once thoroughly started and the walls heated, there is no difficulty with these ovens in getting plenty of steam at any sole-leather tannery, provided the ovens have been properly built and made large enough. They require more fuel than they would if the tan were dry, but spent tan is a drug at all the great sole-leather tanneries, and some of the tanners have put in much larger ovens than they need, as the readiest means of getting rid of their spent tan. In one instance, at least, within the writer's knowledge, complaint was made of a tannery at a certain town in Maryland for blowing off steam so much of the time, which was caused in this way.

From the nature of the case, therefore, there is no reason why a sole-leather tannery should be wanting in any facilities which an abundant supply of power and steam for heating will supply, and the new "Brunswick" tannery is exceptionally well fitted up in this particular. It has ten boilers, thirty-eight inches in diameter by thirty-six feet long each, to make steam for heating the buildings, heating and pumping liquors and water, and running a half dozen different engines in the various parts of the tannery, for there is no part of work in which power can be advantageously used where it is not supplied in abundance.

After the leather has come from the final lay-aways, and been allowed to drain as piled up for a little time, it is taken to the scrubbing department. Here are large drums, with doors in their ends, for putting in and taking out the leather, these drums being formed of open work of heavy slats, and sunk in vats where a stream of water is kept constantly running. The leather is revolved in these drums until the bloom, stains, gum, and sediment which may have accumulated on it during its stay in the vats are washed away, after which it is piled up on one side to drain. A rough coating of cod oil is then brushed over each side, and the leather is moved on to the drying loft, a building nine hundred and fifty feet long, with ample ventilators at the top. Four tiers of sides are hung here, one above the other, the steam pipes with which the room is abundantly supplied insuring a constant circulation of warm dry air. An illustration on this page gives a sectional view of this department.

The only operation now required before the sole leather will be ready for market is the rolling, conducted in a building which constitutes a forward extension of the drying lofts. Before rolling the leather is again slightly dampened and oiled, the object being to bring it into what tanners call a properly "sammied" condition, or very similar to the "temper" which shoemakers give it before hammering to shape it over the bottom of the last. Especial care is necessary not to have the leather rolled too hard, which would hurt its quality in the eyes of many manufacturers. The beds of the rollers are brass-faced, narrow, and about twenty inches long, concave, in which swings a roller on an arm, with a sort of pendulum motion, a treadle allowing the workman to put on any desired pressure, and the table affording ample room for moving the side about in bringing its different parts under the roller. In this way the two surfaces are made firm and smooth, and a high polish given to the grain side.

The working facilities at this tannery exceed probably those of any other tannery in this country, and it is certainly now working in a greater number and weight of hides than was ever before done in one establishment. It was intended to tan 500 hides, or 1,000 sides of leather, per day—all standard, full weight sole leather, and this number has actually been worked in now continuously for several weeks. America could years ago boast of the largest sole leather tannery in the world, but there were several establishments here which, though larger than those of any other country, were so nearly equal in capacity that it seemed almost invidious to place one above the other in such a comparison. The "Brunswick" has now settled this question with a production which excites wonder among our own tanners, and will, no doubt, provoke many expressions of incredulity abroad.

Of the firm who illustrate their business enterprise in an undertaking of this magnitude, words would be superfluous among New York merchants, or almost anywhere in the world where there is any considerable market for sole leather.

Their warehouses are at Nos. 72 and 74 Gold street, New York, and they also have a store at No. 132 Summer street, Boston.

Growth of Chemical Manufactures in the United States.

In a recent communication the Secretary of the Manufacturing Chemists' Association of the United States gives incidentally some figures which strikingly exhibit the importance of chemical manufactures in this country. The capital invested is $85,000,000; the annual production is worth $118,000,000; the number of manufacturing establishments is 1,346, using 600,000 tons of coal, and employing 30,000 working people, whose wages amount to $12,000,000.

The Use of Plaster of Paris in Fractures.

Plaster, either in the form of a bandage enveloping the fractured part, or in the form of a distinct splint, is used quite extensively in the various hospitals of this city. In fact, all other things being equal, it is given the preference over other forms of apparatus usually employed in such injuries. Particularly is this the case with fractures of the leg, which are treated now almost exclusively by this bandage. The fracture box is rarely used, and only in exceptional cases, where there is great swelling, and under conditions of extensive injury of the skin, in which it is necessary for the parts to be exposed during treatment. Generally this open method is only employed until such time as it is safe to apply the plaster of Paris bandage, as shown by the disappearance of the swelling and the healing of the abrasions. No time is lost in so doing, as generally the parts are made fit for the immovable apparatus before the bony union commences. In compound fracture the limb is generally placed at once in the plaster apparatus, openings being made in the latter corresponding with the injuries of the soft parts, for the purpose of establishing thorough drainage. As a rule, and when, of course, there is no special contraindication in the shape of undue swelling, etc., all fractures in which plaster of Paris is to be employed are "put up" at once. A general description of the method of procedure may apply to that to be employed in any case of fracture in any region of the body. The part is enveloped in a thin layer of cotton, and the bandages, immersed in water sufficiently long to be permeated, are applied directly over the cotton, care being taken to exert slight and uniform pressure. Each layer of bandage is carefully moulded to the inequalities of the surface, and made perfectly smooth before the next layer is applied. If the bandages are properly prepared, without sizing, and have been kept in a dry place, the plaster will commence to "set" before the second bandage is applied. Generally three layers of bandage are sufficient for a fracture where ordinary support is required. Four, with suitable re-enforcements, may be required in other cases. After the dressing is complete, it is exposed to the air, and hardens sufficiently in two or three hours to allow the limb to be moved.

The plaster apparatus is generally kept in position during the whole period of treatment. If undue swelling occurs, the envelope is slit in the long axis of the limb by a Hays saw, or by scissors for the purpose, and thus a splint is formed which is kept in position by outside bandages.

Some surgeons prefer to dispense with cotton altogether, and use a well-fitted silk or gauze stocking or jacket as the foundation for the plaster. There is, however, greater care and skill required in this method, as any undue pressure at any one point would be more apt to produce swelling in the parts beyond. Yet still, when properly applied, this makes the most comfortable and lightest dressing that can be used, and gives the perfection of support and greatest accuracy of adjustment to the injured parts.—*Med. Record.*

Morning Work.

Perhaps, on the whole, moderately early rising is now a commoner practice in cities than it was forty years ago. It seems strange that the habit of lying in bed hours after the sun is up should ever have obtained a hold on the multitude of brain-workers, as undoubtedly it had in times past. Hour for hour, the intellectual work done in the early morning, when the atmosphere is as yet unpoisoned by the breath of myriads of actively moving creatures, must be, and, as a matter of experience, is incomparably better than that done at night. The habit of writing and reading late in the day and far into the night, "for the sake of quiet," is one of the most mischievous to which a man of mind can addict himself. When the body is jaded the spirit may seem to be at rest, and not so easily distracted by the surroundings which we think less obtrusive than in the day; but this *seeming* is a snare. When the body is weary, the brain, which is an integral part of the body, and the mind, which is simply brain function, are weary too. If we persist in working one part of the system because some other part is too tired to trouble us, that cannot be wise management of self. The feeling of tranquillity which comes over the busy and active man about 10:30 or 11 o'clock ought not to be regarded as an incentive to work. It is, in fact, the effect of a lowering of vitality consequent on the exhaustion of the physical sense. Nature wants and calls for physiological rest. Instead of complying with her reasonable demand, the night-worker hails the "feeling" of mental quiescence, mistakes it for clearness and acuteness, and whips the jaded organism with the will until it goes on working. What is the result? Immediately, the accomplishment of a task fairly well, but not half so well as if it had been performed with the vigor of a refreshed brain working in health from proper sleep. Remotely, or later on, comes the penalty to be paid for unnatural exertion—that is, energy wrung from exhausted or weary nerve centers under pressure. This penalty takes the form of "nervousness," perhaps sleeplessness, almost certainly some loss or depreciation of function in one or more of the great organs concerned in nutrition. To relieve these maladies—springing from this unsuspected cause—the brain-worker very likely has recourse to the use of stimulants, possibly alcoholic, or it may be simply tea or coffee. The sequel need not be followed. Night work during student life and in after years is the fruitful cause of much unexplained, though by no means inexplicable suffering, for which it is difficult, if not impossible, to find a remedy. Surely morning is *the* time for work, when the whole body is rested, the brain relieved from its tension, and mind power at its best.—*Lancet.*

The Space Occupied by Coal.

Few persons have an idea as to the amount of coal that can be stowed in a given space. Manufacturers think they have not enough room, even though they may be offered a bargain. We, therefore, give an example of the manner in which it may be figured up. A shed or room, 15 feet high, 18 feet wide, and 30 feet long, will hold 200 tons of anthracite coal, and perhaps 10 tons less of Cumberland. Thus, 15 x 18 x 30 = 8,100 × 40 = 202½.

The average number of cubic feet required to stow a ton of coal is as follows:

BITUMINOUS.	
Cumberland, maximum	42·3
" minimum	41·2
Duffruyn, Welsh	42·99
Cannel, Lancashire	46·37
Blossburg, Pa.	42·2
Hartley, Newcastle	44
Pictou, Nova Scotia	45
Pittsburg, Pa.	47·08
Sydney, Cape Breton	47·02
Clover Hill, Va.	49·02
Cannelton, Indiana	47
Scotch	43·08
Richmond, Va. (Midlothian)	41·04
ANTHRACITE.	
Peach Mountain	41·06
Forest Improvement	41·07
Beaver Meadow, No. 5	39 08
Lackawanna	45·08
Lehigh Co.'s	40 05
Beaver Meadow, No. 3	40 07
COKE.	
Natural of Virginia	48·03
Pittsburg	70·09
Charcoal	104

It is usually stated that a ton of coal "in the hill" measures about a cubic yard, or 27 cubic feet.

A prominent retail dealer in Philadelphia informs us that from many years' experience he finds the cubic contents of 2,240 pounds of hard Lehigh coal to be a little over 36 feet; an average Schuylkill W. A., 37 to 38 feet; Shamokin, 38 to 39 feet; Miller, Greafff & Co., Lorberry, nearly 41.

According to measurements made with Wilkesbarre anthracite coal from the Wyoming Valley, it requires 32·2 cubic feet of lump, 33·9 cubic feet of broken, 34·5 cubic feet of egg, 34·8 cubic feet of stove, 35·7 cubic feet of chestnut, and 36·7 cubic feet of pea, to make one ton of coal of 2,240 pounds; while it requires 28·8 cubic feet of lump, 30·3 cubic feet of broken, 30·8 cubic feet of egg, 31·1 cubic feet of stove, 31·9 cubic feet of chestnut, and 32 8 cubic feet of pea, to make one ton of 2,000 pounds.

Silvering of Large Telescopic Mirrors.

At a recent meeting of the Royal Astronomical Society, Mr. Common read a paper on "Silvering Large Mirrors." He said that the chief difficulty in silvering large mirrors was due to their weight and the difficulty of handling them and turning them face downwards into the silvering solution. His own mirror was 37 inches in diameter and 4½ inches thick, and weighed over 400 pounds. It was difficult to handle such a heavy mass of glass, and turn it over without doing some damage with the tackling and pulleys that were necessary to move it. The plan which he had adopted was to make use of a large sucker to hold the mirror. The atmospheric pressure was partly removed, and the sucker could then be attached to pulleys, and carried the mirror along with it. The sucker consisted of a shallow cylindrical iron box, which rested upon an India-rubber ring at the back of the mirror. The atmospheric pressure was removed by means of an air pump, and a mercury gauge attached to the box showed the amount of exhaustion. He found that a difference of four inches of mercury between the atmospheric pressure and the pressure within the box was amply sufficient to lift the weight of the mirror. For silvering solution he made use of glucose and water and nitrate of silver, and got a very good film in about forty minutes, so that if the flat became dewed while he was observing, he had no hesitation in removing the film, and could resilver it and have it back in its place within the hour.

When the mirror was first silvered, in the autumn of 1879, he devoted it principally to observations of the satellites of Mars. They were not good test objects to give an idea of what a mirror would do, but he thought he had a better film with that process than he had before. He observed Saturn last year, and during 1879, and got a few observations of Mimas when near to the end of the ring. And on the first of December he turned the instrument on Mars, and saw Deimos pretty plainly.

A Notable Bridge.

An iron bridge now building across Murderer's Creek, near Newburg, N. Y., for the New York, Ontario, and Western Railroad, will be one of the notable bridges of the country. It will be 1,206 feet long, and 150 feet high, or 680 feet longer than the Niagara Suspension Bridge, and 232 feet longer than the new London Bridge over the Thames. Its height exceeds that of the New York and Brooklyn Bridge by 16 feet, and that of High Bridge, over the Harlem River, by about 25 feet.

Fatal Electric Light Accident.

A fatal accident recently occurred at Hatfield House, the residence of the Marquis of Salisbury, to a laborer named William Dimmock, 22 years of age, in consequence of coming in contact with the wires conveying the electric current for lighting the mansion. Hatfield House is lighted with 117 lights on the Brush system, worked by an engine of 16-horse power, placed in the sawmills some distance from the house; two electric wires and a telephone wire connect the sawmills with the house; for some distance they are carried on poles, but to save the unsightly appearance of the poles near the house, the wires are run along the garden wall, three feet from the ground, and for some distance are not protected. The deceased was at work in the garden, assisting to lay a telephone wire, and was sent to ease the wire at the corner of the brickwork to prevent it getting cut. While he was absent the linesman heard the wires shake, and on locking round saw the deceased lying on his back, and on going up to him found he was dead. The machine was at work at the time, some of the Brush Company's men being down from London repairing it, and it is supposed that the deceased slipped, caught hold of the electric wires to save himself, and was immediately killed by the shock. The medical evidence showed that death arose from shock to the system, causing paralysis of the heart. At the inquest the jury returned a verdict that the deceased died through touching the electric wire, and appended a recommendation that there should be a stated time for working the current, and that notice should be given of it to all persons working near the wires.

It was stated that, to avoid similar accidents in future, the wires would all be conveyed either under ground or on poles out of reach.

Explosion of Aqua Ammoniæ.

The *Pharmaceutical Journal* records a recent case of an explosion of ordinary liquor ammoniæ followed by serious results. A Belfast woman, subject to headache, sent her daughter to the druggist to purchase a small quantity of "head salts," for which he gave her liquor ammoniæ, or "spirit of hartshorn," instead of the salt, carbonate of ammonia. The vial was put on a shelf and not used for a few days. Having a headache, the woman lifted the remedy to apply it, and had it in her hand for a few minutes only when the vial suddenly exploded, scattering the contents over her face. Her eye was destroyed, and her mouth and throat burned, the skin of both having been torn off. The vial had been put on the mantelpiece previous to the time it was used, and when about to apply the contents the woman was sitting near the fire.

Malarial Organisms in the Blood.

In the blood of patients suffering from malarial poisoning, M. A. Laveran has found parasitic organisms, very definite in form and most remarkable in character. Some were cylindrical curved bodies, pointed at the extremities, with a delicate outline and a transparent body, colorless except for a blackish spot in the middle, due to pigment granules; on the concave side a fine line could often be traced, which seemed to unite the extremities of the crescent. These bodies presented no movement. Spherical organisms were also seen, transparent, of about the diameter of a red blood corpuscle, containing pigment grains which, in a state of rest, were often arranged in a definite circle, but sometimes presented rapid movements, and then lost their regular arrangement. On the borders of the spherules very fine filaments could often be perceived in rapid movement. These filaments were in length three or four times the diameter of a red corpuscle. Their number varied. Sometimes three or four were seen around a spherule, to which they communicated an oscillatory movement, displacing the adjacent red corpuscles. The free extremities of the filaments were slightly reflexed. When at rest the filaments were invisible on account of their tenuity and perfect transparence. These mobile filaments appeared finally by becoming detached from the pigmented spherules, continuing, however, to move freely amidst the corpuscles. There were also bodies of spherical or irregular form, transparent or finely granular, about the hundredth of a micro-millimeter in diameter, containing dark red, rounded pigment grains, either regularly arranged at the periphery, or aggregated at some part of the spherule. The bodies and granules were both motionless. These appear to be the ultimate or "cadaveric" stage of those last described. They have no nuclei, and do not tint with carmine, a distinction from the pigmented leucocytes with which they have hitherto been confounded. Lastly, spherical elements were met with similar to those already described, but much smaller in size, and apparently representing a stage in their development. The animated nature of the mobile pigmented spherule, furnished with filaments, appears indisputable. M. Laveran regards it as a form of animalcule, which exists at first in an encysted state, and in the perfect condition becomes free in the form of mobile filaments, a mode of development not uncommon among the lower organisms. Besides these organisms, the blood of patients suffering from malarial fever contain (1) red corpuscles, which appear to be vacuolated at one or two spots, and contain pigment granules; (2) pigmented leucocytes; (3) free pigment granules, possibly proceeding from the destruction of the parasitical organisms.

These elements were first discovered by M. Laveran a

year ago, and since then he has examined the blood in 192 patients affected with various symptoms of malarial poisoning, intermittent and continued fever, and palustral cachexia, and found the organisms in 180. The disease had been contracted for the most part in different regions of Algeria and Tunis. He convinced himself, by numerous and repeated observations, that these organisms are not to be found in the blood of persons suffering from diseases that are not of malarial origin. In most of the cases of malaria in which the examination yielded a negative result the patient had undergone a course of treatment with quinine, and to this fact the absence of the organisms from the blood was probably due. The addition of a minute quantity of a dilute solution of sulphate of quinine to a drop of blood was found at once to destroy the organisms. In all the examinations great care was taken to preclude the entrance of any extraneous objects into the drop of blood examined. In general the parasitic bodies were found in the blood only at certain times: a little before, and at the moment of, the accession of the fever. In some very obstinate cases the organisms were always present in the blood. They rapidly disappeared under the influence of a quinine treatment. It is conjectured that in the apyrexial intervals the organisms probably sojourn in internal organs, especially the spleen and the liver. After death from malarial disease pigment granules are found in great numbers in the blood, and especially in the small vessels of the spleen and liver; and they may be, in the most severe cases, so abundant that not only the spleen and liver, but the marrow of bone, and even the gray substance of the brain, are darkened by their presence. These pigment granules, which may obstruct the capillary vessels, appear to be derived from the parasitic elements, which perish after death, and become then unrecognizable. —*Lancet.*

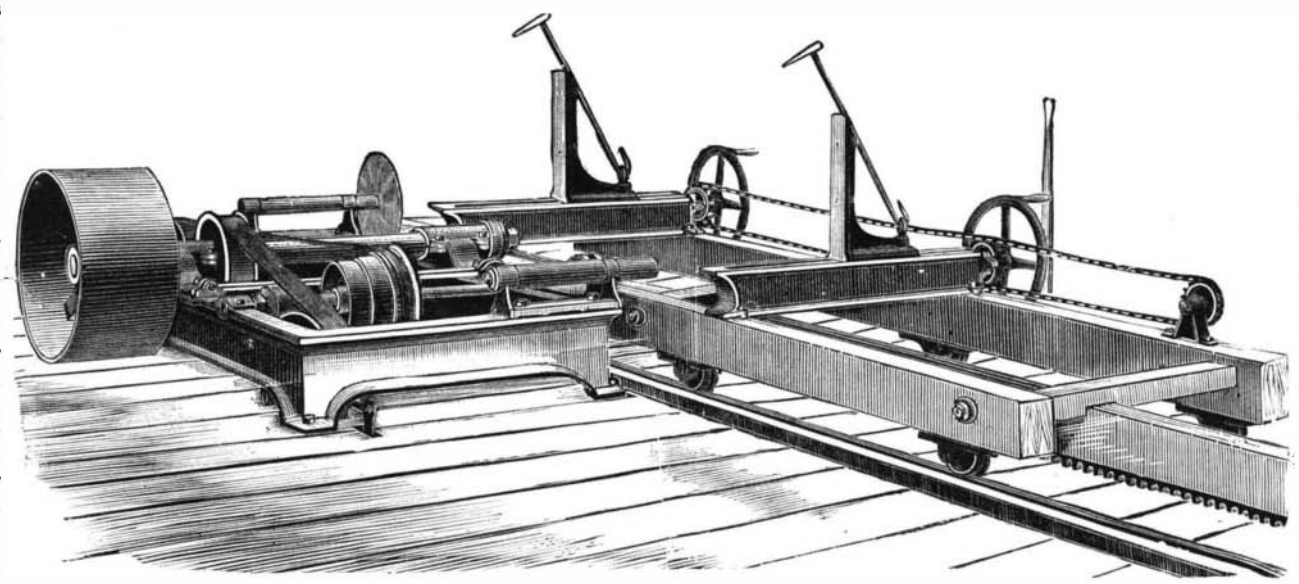
IMPROVED CIRCULAR SAWMILL.

The circular sawmill shown in the annexed engraving is made at the works of Alexander, Bradley & Dunning, Syracuse, N. Y. The frame is iron, and cast in one piece. The saw mandrel is made of steel, and runs in self-oiling boxes, which are cast in a solid yoke extending across the frame, and is adjusted by means of set screws to line the saw. The main pulley is placed outside of the frame, in order to relieve the bearing next to the saw from the strain of the main belt, and give more room between the saw and belt, greatly increasing convenience and safety in handling the lumber. This mill has an improved friction feed, which may be varied at any point to feed slowly while passing through a knot by pressing with less force upon the feed lever, or the carriage may be instantly stopped by throwing the feed lever over. The sawyer sets the log and operates the carriage, thus saving one man over the old style of mill. These machines are furnished with Carley's improved head blocks with screw or lever set as preferred. The screw set has a patent chain connection and taper attachment, as shown in the engraving, by means of which the screws are operated independently or simultaneously, with perfect exactness, enabling the sawyer to set to any required thickness, with great accuracy, and to advance one or both ends of the log at pleasure, without removing from his place.

When only two head blocks are employed an idle chain wheel and stand is attached to the tail end of the carriage, as shown in the engraving. This enables the sawyer to adjust the second block for long or short logs without detaching the chain; when three blocks are used the third block takes the place of the idle wheel.

An improved simultaneous ratchet set head blocks, with rod connection, can be supplied if desired. They are very simple in construction, and much approved by those who prefer the lever set. The connecting rod is made large to avoid torsion, and is 12 feet long for 18 feet of carriage; 16 feet long for 24 feet of carriage, and 20 feet long for 30 feet of carriage.

Three sizes of this mill are made, namely, Nos. 1 2, and 3. The No. 1 mill is strong and well made, and runs very light. It is designed for use principally as a portable, in connection with the farm engine for neighborhood use. It is also used in connection with water wheels in localities where water power is limited, and where there is not enough sawing to do to justify the use of a large and more expensive mill. No. 2 is a strong, durable mill, designed to meet the wants of a large class for a good, cheap mill, of larger capacity than No. 1, and is used as a portable or stationary mill. No 3 (shown in the engraving) is used principally as a stationary mill. It has extra heavy iron frame, 3 inch steel saw mandrel with standard collar, and carries a 60 inch or smaller saw. The main pulley is 26 inches in diameter and 14 inch face, and the head blocks open 36 inches; capacity from 10,000 to 15,000 feet per day.



CARLEY'S IMPROVED CIRCULAR SAWMILL.

NEW AUTOMATIC PENCIL.

The engraving represents a pencil of entirely new construction and of convenient size for the vest pocket. It is handsome in design, well made, strong, and durable. It carries a lead three and three-quarter inches long and three thirty-seconds of an inch in diameter. Leads of this size, black, indelible, or copying, are sold by all stationers, so that the pencil may be readily fitted with leads. The exterior of the instrument is of finely nickel-plated metal and hard rubber, plain or ornamented in various artistic designs. No spiral or other variable spring is used. Unlike other automatic pencils, it has a firm and immovable grasp on the lead that does not cut or mar the lead in the least, and maintains the gripe as long as desired.

LIVERMORE'S NEW AUTOMATIC PENCIL.

When needed for use the lead is advanced by the pressure of the forefinger on the top section; and, when no longer needed, is retired, for protection, by a perpendicular pressure of the pencil on the paper or desk, or by a back-pull of the top section.

When the lead, from wear, requires resetting for a longer point, a quarter turn to the left of the top section releases the gripe, the movable parts are drawn back by the top section, the pencil is then placed, point downward, on the finger or desk, and, while the movable parts are held back, the top section is turned to the right till the gripe is renewed. This automatic operation, requiring but an instant, sets the lead the proper length for use without the aid of the eye.

This instrument is manufactured by the Stylographic Pen Company, and was patented September 13, 1881. It is also covered by Letters Patent in foreign countries, and may be purchased for fifty cents at any of the following offices of the company: 173 Broadway, New York; 290 Washington street, Boston; 38 Madison street, Chicago.

The Marlboro Sea Serpent.

There was lately discovered in a marl pit in Monmouth County, New Jersey, a notable addition to the known fauna of the ancient sea which overlay that region in cretaceous times. According to Professor Lockwood, the monster was between seventy and eighty feet in length, about one-third of his longitude being a broad, flattish tail constructed of chevron-shaped bones so as to make it a valuable engine of propulsion when used as a scull. The data furnished by the relics would imply that between the tip of his muzzle and the back of his head was a distance of four or five feet. It is possible that the specimen belongs to some undescribed species, but perhaps the remains are too imperfect to decide this. It is certain, however, that it belongs to the genus clidastes, many species of which have been determined, and which have been abundantly found in the West. Clidastes was an own cousin to the mosasaurus, or the great lizard of the River Meuse, described by Cuvier. The European reptile, however, was of a more chunky build, with shorter head and neck and stronger jaws. Both belonged to the order of pythonomorphs or snake-like saurians, which were the genuine sea serpents of the period.

MECHANICAL INVENTIONS.

Mr. Jacob Burkhart, of Lock Haven, Pa., has patented an improved saw set. This is an improved implement by which the teeth of fine as well as coarse saws may be accurately set, and one which is adapted also to hold and set the teeth of narrow scroll saws. The invention consists principally of an adjustable and slotted rest or support for the saw, of a horizontally adjustable stop or guide in combination with a spring-supported hammer.

Ordinarily pitman bars or rods are connected with the shaft by means of a crank at the end of the shaft, or to cranks formed by bending the shaft. By this arrangement the whole body of the pitman bar is carried with the crank, causing a considerable loss of power and an undesirable jarring or shaking effect, due to the centrifugal force of the pitman bar, and when running at high rates of speed, the centrifugal force of the pitman becomes injurious, causing the whole shaft to vibrate. Mr. George P. Conant, of Geneva Lake, Wis., has patented a pitman bar intended to overcome this difficulty, and also to provide a pitman connection which may be attached to a straight shaft at any point in its length. The invention consists of a pitman head formed with cross slots, in combination with a crank adapted to be secured upon the shaft, the crank pin of which is adapted to move in one of the slots of the pitman head, the other slot thereof being to accommodate the backward-and-forward movement of the pitman and pitman head in a right line upon the shaft, the crank pin being provided with a sliding block, so that the pin will pass the slot for the shaft.

An improved boot-brushing machine has been patented by Mr. Alfred S. Clark, of Chatawa, Miss. The invention consists of a series of brushes attached horizontally and vertically to a frame loosely mounted on a vertical rod and combined with suitable devices for revolving it. The vertical rod is fastened in a base provided with foot-rests, upon which the feet may be placed if the boots or shoes are to be brushed.

An improvement in knitting machines has been patented by Mr. Freeman A. Calley, of New York city. The object of this invention is to facilitate the adjustment of the length of the stitch; to facilitate running a series of needles out of operation, and, finally, to prevent breaking the vertical ribs of the stationary needle-carrying cylinder. These ends are attained by an ingenious combination of mechanism which cannot be clearly described without engravings.

Mr. Henry G. Dennis, of New Bedford, Mass., has patented an improved bell joint for coupling pipes which consists in a beveled or bell-shaped collar provided in the inner surface with a groove or rabbet a short distance from each mouth of the collar. The latter is mounted on the enlarged or swaged end of a pipe, which receives the contracted end of another pipe. The rabbets of the collar are then filled with molten lead or other suitable filling and thoroughly driven.

An improved spring, particularly adapted for side bar buggies, has been patented by Mr. James H. Howe, of Conneaut, O. These springs are long, yet they occupy small compass in the buggy, thus making the buggy very easy riding, and a buggy provided with these springs will carry one or more persons with equal ease and comfort.

Mr. Parsons Shaw, of Manchester, County of Lancaster, England, has patented an improvement in dental engines. The main object of the invention is to improve the universal joint employed in dental engines by a hinge movement which will allow the swinging arm to play freely in any direction without straining the spiral transmitter or causing it to bind or buckle. This is accomplished by using bifurcations on the bearings and bending their ends at right angles to the bearings, then connecting these ends by pivots.

In the manufacture of cotton goods the marks called "cut marks," which indicate "pieces" or "cuts" of forty, fifty, sixty, or more yards, are put upon the warp in the process of dressing or sizing the same, usually by means of a roller (which has interchangeable large and small gear wheels) placed in the slasher near the measuring wheel, which roller carries a block from a trough or box containing coloring material slowly upward to a point where, at the proper time, it rolls against the warp, leaving the cut-mark, and from thence falls back into the color box. Mr. Orrin M. Rolfe, of Lowell, Mass., has patented a cut-marker for slashers which will deliver the mark suddenly, as by a blow, and then cause the brush to move down into the color box with