played an important part in the formation of the heavenly bodies, conducted us to the present time, where we pass from the darkness of hypothetical views to the brightness of knowledge. In what we have said, however, all that is hopothetical is the assumption of Kant and Laplace, that the masses of our system were once distributed as nebulæ in space.

TINNING SHEET IRON.

Dr. Ure, after giving a brief history of processes formerly in use, says:—"The process of cleaning and tinning at some of the best works now is as follows:—When the sheet iron leaves the plate mill, and after separating the plates, and sprinkling between each plate a little sawdust, the effect of which is to keep them separate, they are immersed, or, as technically termed, "pickled," in dilute sulphuric acid, and after this placed in the annealing pot, and left in the furnace about 24 hours; on coming out, the plates are passed through the cold rolls; after passing through the cold rolls, the plates seem to have too much the character of steel, and are not sufficiently ductile; to remedy this they are again annealed at a low heat, washed in dilute sulphuric acid, to remove any scale of oxide of iron, and scoured with sand and water; the plates in this state require to be perfectly clean and bright, and may be left for months immersed in pure water without rust or injury; but a few minutes' exposure to the air rusts them. With great care to have them perfectly clean they are taken to the stow.

The tinman's pan is full of melted grease; in this the plates are immersed, and left there until all aqueous moisture upon them is evaporated, and they are completely covered with the grease; from this they are taken to the tin pot. and there plunged into a bath of melted tin, which is covered with grease; but as in this first dipping the alloy is imperfect, and the surface not uniformly covered, the plates are removed to the dipping or wash pot; this contains a bath of melted tin covered with grease, and is divided into two compartments. In the larger compartment the plates are plunged, and left sufficiently long to make the alloy complete, and to separate any superfluous tin which may have adhered to the surface; the workman takes the plate and places it on a table, and wipes it on both sides with a brush of hemp; then to take away the marks of the brush, and give a polish to the surface, he dips it in the second compartment of the wash pot. This last always contains the purest tin, and as it becomes alloyed with the iron it is removed on to the first compartment, and after to the tin pot. The plate is now removed to the grease pot; this is filled with melted grease, and requires very skillful management as to the temperature it is to be kept at. The true object is to allow any superfluous tin to run off, and to prevent the alloy on the surface of the iron plate cooling quicker than the iron. If this were neglected the face of the plate would be cracked. The plate is removed to the cold pot; this is filled with tallow, heated to a comparatively low temperature. The use of the grease pots, is the process adopted in practice for annealing the alloyed plates. The list pot is used for the purpose of removing a small wire of tin, which adheres to the lower edge of the plate in all the foregoing processes. It is a small cast iron bath, kept at a sufficiently high temperature, and covered with tin about one-fourth of an inch deep. In this the edges of the plates are dipped, and left until the wire of tin is melted, and then detached by a quick blow on the plate with a stick. The plates are now carefully cleaned with bran to free them from grease. Lastly, they are taken to the sorting room, where every plate is separately examined and classed, and packed in boxes for market.

"The tests of quality for tin plates are—ductility, strength and color. To obtain these the iron must be of the best quality, and the manufacture must be conducted with proportionate skill. This necessity will explain to some extent the cause why nearly all the improvements in working iron during the past century have been either originated or first adopted by the tin-plate makers; and a sketch of the processes used at different times, in working iron for tin plates, will be, in fact, a history of the trade.

A PAIL of water will sometimes stop a squeaking journal when oil is of no avail.

THE LINEN MANUFACTURE IN IRELAND.

Sir Robert Kane, F. R. S., recently read before the Society of Arts a paper from which we take the following extracts:—

"Of all branches of industry, however, that which is of the most importance to Ireland, from the amount of capital it represents, and the number of persons to whom it gives occupation, is the linen trade. I am indebted to the kindness of Mr. M'Il wrath, secretary to the linen trade of Belfast, for much valuable information on that subject, and also to Mr. M Call, of Lisburn, for many interesting particulars, of which I shall endeavor to lay before the Society such general heads as our limited time may allow.

"The linen trade of which Belfast has been the long established head quarters in Ireland had been rather falling off in amount, until the interruption of the supply of cotton by the American war called it into immensely increased activity. The contrast in this regard is well shown by the following figures:—In 1859 there were in Ireland 82 flax-spinning mills, containing 651,872 spindles, of which 91,230 were unemployed; whilst in 1864 there were 74 spinning mills with 650,744 spindles, of which but 8,860 were unemployed, whilst 50,638 additional spindles were in May last being set to work. Further, in addition to the above there were employed in 1864, 14,648 spindles occupied in making thread, and five mills were in course of erection to contain 45,000 spindles. In regard to power-loom factories for linen, a similar remarkable increase is shown for the same period. Thus, in 1859, there were 28 factories with 3,633 looms, of which 509 were unemployed; whilst in 1864 there were 42 factories with 8,187 looms, of which but 258 are unemployed; 1,685 additional looms were about being set to work at the date of the return in May last. The introduction of the factory system into the linen trade, and especially the power-loom, is comparatively modern, the first spinning mills for flax in Ireland having been established about 1828, previously to which time cotton spinning was much more extensively carried on in Belfast than it has since been.

The great extension of trade and the benefit to the operative classes which followed this change, may be illustrated by the following fact:—When spinning and weaving were done by hand, the firm of Richardsons, of Lisburn, turned out from 15,000 to 20,000 pieces of goods in twelve months; that firm can now deliver 250,000 pieces of bleached goods in the same time.

As to wages in the old day of spinning on the domestic wheel, the earnings were from 2s. 6d. to 4s. (62 cts. to $1.00) weekly, whilst at present in spinning mills the ordinary work-women make from 3s. 6d. to 6s. (86 cts. to $1 50) per week, and superior hands from 6s. to 8s. ($1 50 to $2). The best hand loom weaver can only make 6s. per week, out of which he has to pay charges which leave him only 5s, ($1 25) whereas an expert girl, who can attend to two power looms, can make 10s. ($2 50) per week clear. Thus the earnings of individuals have been materially increased by the introduction of steam machinery in the linen trade; and in regard to the total amount of employment, there were ten years ago, 17,000 persons employed in this trade in and about Belfast, whereas in the present year the number employed in the mills is 25,000, exclusive of the vast number of outsiders who indirectly derive their subsistence from that branch of manufacture.

Coupled with this development of the linen trade there has taken place a great increase in the quantity of flax cultivated in Ireland. During the Crimean war, when the Baltic trade was subjected to certain impediments, the quantity of land under flax was increased, and amounted, in 1853, to 174,579 acres, but on the restoration of peace, the Baltic trade being resumed, the demand for home grown flax diminished, and the cultivation fell off to 91,646 acres in 1858. Since that time it has progressively increased, and has now assumed proportions entirely unprecedented, the quantity in 1863 having been 214,099 acres, and in the present year having increased to 301,942 acres, which at an average of 35 stone of clean scutched flax to the acre, gives the produce of fiber at 10,557,070 stones, or 66,050 tuns; and at an average price of 7s. 6d. per stone, the total value of the crop of the present year is £3,962,989. This great increase of production is accompanied of course with corresponding increase of the export trade.

THE MANUFACTURE OF STARCH.

The extensive discussion of the manufacture of sirup from the starch contained in Indian corn naturally gives an interest to the methods employed for extracting the starch. It is a maxim among chemists never to employ chemical processes when the result can be reached by a mechanical process. Starch exists in grain and can be separated by simply washing. Any one attempting to make sugar or sirup from corn will doubtless find it best to separate the starch first by approved methods, and then treat this pure starch with sulphuric acid to convert it into sugar. We extract from Ure the method practiced in England for separating starch from wheat, and we take from Appleton's Cyclopaedia some statements in regard to the manufacture of starch in this country from Indian corn:—

In England, wheat crushed between iron rollers is laid to steep in as much water as will wet it thoroughly; in four or five days the mixture ferments, soon afterwards settles, and is ready to be washed out with a quantity of water into the proper fermenting vats. The common time allowed for the steep, is from 14 to 20 days. The next process consists in removing the stuff from the vats into a stout, round basket set across a back below a pump. One or two men keep going round the basket, stirring up the stuff with strong wooden shovels, while another keeps pumping water, till all the farina is completely washed from the bran. Whenever the subjacent back is filled, the liquor is taken out and strained through hair sieves into square frames or cisterns, where it is allowed to settle for 24 hours; after which the water is run off from the deposited starch by plug taps at different levels in the side. The thin stuff called slimes, upon the surface of the starch. is removed by a tray of peculiar form. Fresh water is now introduced, and the whole being well mixed by proper agitation, is then poured upon fine silk sieves. What passes through is allowed to settle for 24 hours; the liquor being withdrawn, and then the slimes, as before, more water is again poured in, with agitation, when the mixture is again thrown upon the silk sieve. The milky liquor is now suffered to rest for several days, four or five, till the starch becomes settled pretty firmly at the bottom of the square cistern. If the starch is to have the blue tint, called Poland, fine salt must be mixed in the liquor of the last sieve, in the proportion of two to three pounds to the cwt. A considerable portion of these slimes may, by good management, be worked up into starch by elutriation and straining.

The starch is now fit for boxing, by shoveling the cleaned deposit into wooden chests, about four feet long, twelve inches broad, and six inches deep, perforated throughout, and lined with canvass. When it is drained and dried into a perfect mass, it is turned out by inverting the chests upon a clean table, where it is broken into pieces four or five inches square, by laying a ruler underneath the cake, and giving its surface a cut with a knife, after which the slightest pressure with the hand will make the fracture. These pieces are set upon half burned bricks, which by their porous capillarity imbibe the moisture of the starch, so that its under surface may not become hard and horny. When sufficiently dried upon the bricks, it is put into a stove (which resembles that of a sugar refinery,) and left there till tolerably dry. It is now removed to a table, when all the sides are carefully scraped with a knife; it is next packed up in the papers in which it is sold; these packages are returned into the stove, and subjected to a gentle heat during some days; a point which requires to be skilfully regulated.

In the United States Indian corn and potatoes are most commonly used for starch. The application of the former to this use was patented by James Colman, in 1841, and was successfully practised by Thomas Kingsford, of Oswego, N. Y., in 1842. In 1849 he had a large factory at that place, which is still in successful operation under the direction of Messrs. T. Kingsford and Son, having up to the end of the year 1860 made nearly 30,000 tuns of starch. Its annual production for five years was as follows:—1856, 6,328,453 lbs.; 1857, 8,018,778 lbs.; 1858, 8,686,516 lbs.; 1859, 6,747,586 lbs.; 1860, 8,500,000 lbs.; far exceeding that of any other starch factory in the world for the same time. The total consumption of raw material in the twelve years from Jan. 1, 1849, was 2,476,000 bushels of Indian corn and 164,448 bushels of wheat, besides some damaged flour. The boxes for packing the starch have required 15,000,000 feet of bass-wood, supplied chiefly by the farmers in the neighborhood. The building has a front of 510 feet, and extends back over the Oswego river 250 feet. Its flooring covers 250,600 feet, or nearly six acres. For grinding the corn there are fifteen pairs of buhr-stones, and six pairs of large, heavy iron rollers. The river furnishes the power to drive the machinery, and a steam engine of 140 horse power is provided to make up any deficiency in very dry seasons. The vats employed in purifying the starch have a capacity of 2,200,000 gallons, and the length of gutters for conveying and distributing the starch waters is over three miles. A similar factory, almost or quite similar to this in capacity, commenced operations at Glen Cove, on Long Island, in 1858. This also uses Indian corn, which is more cheaply transported from the western states than the starch from it would be. The product of each bushel is about 23 lbs., and the boxes of the starch, on account of their bulk and the extra care they require, make more expensive freight than the raw material. Potato starch factories are more numerous but not so

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extensive. In the town of Stowe, Vt., there are five of them, each one of which consumes from 16,000 to 20,000 bushels of potatoes yearly, and produces about 8 lbs. of starch to the bushel.

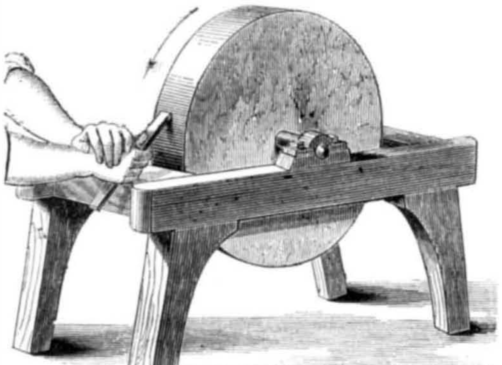
The corn used for starch is the white flint kind. Received at the factory, it is hoisted to the top of the building, winnowed to remove foreign substances, and then transferred to vats, where it is long soaked before grinding. It is run through troughs with water to the mills, and when ground the mixed meal and water is conveyed in a similar manner to the tubs in which the separation of the starch is effected. The gluten fluid that flows from these has a musty and disagreeable odor and appearance in the troughs, and the substance lacks when concentrated the consistency of wheat gluten, not "rising" like it in fermentation by the expansive action of the carbonic acid gas generated in this process. Its only value is for feeding horses, cattle and swine. The starch fluid is conveyed through troughs to great vats in the basement of the building, where the water is partially removed, and then it flows into smaller wooden vessels from which a portion of the surplus water drains away through a cloth laid in the bottom of each. The mass of starch, then tolerably solid, is placed upon shelves made of loose bricks, when more moisture escapes by absorption and evaporation. Kiln drying finishes the process and the starch is obtained in prismatic forms ready to be put up in papers or boxes for the market.

TURNING TOOLS.

PART SIXTH.—THE END.

As grinding a tool and keeping the edge in proper condition is very essential to success, it will not be amiss to state a few facts of importance in regard to it. Inexperienced turners always go on the wrong side of the stone to grind; that is, when it runs from them. Every tool, no matter what its character, should be ground with the stone running toward the workman, as in Fig. 28—the direction of motion be-

Fig. 28.



ing shown by the arrow. The reason for this is apparent to any one who thinks for a moment. It is this—viewed through a magnifying glass the edge of every tool presents a serrated or saw-tooth appearance.

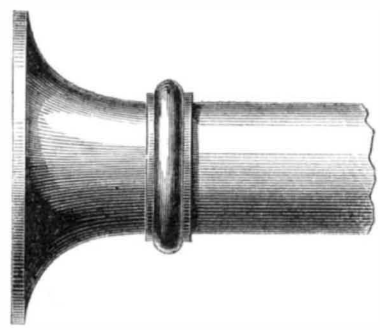
When the tool is ground with the stone running from the operator, all these fine threads, or filaments of steel, are drawn off toward the outside or upper edge, so that it forms what is known as a wire edge; the first application to the work breaks these off, and in a little while the tool is as dull as before it was ground. If, on the contrary, the tool be held against the face of the stone on the running side, as shown previously, the metal will be cut downwards, and a keen sharp edge produced, which will last much longer than when ground on the other side; it only requires an oil stone rubbed over it to remove the asperities and render the edge uniform. As the tool comes from the grindstone it is invariably rough, however smooth it may appear to the naked eye, and it is a good practice to touch up the edge preparatory to putting it in the tool post. It is this rubbing with the oilstone that gives that incomparable finish to wrought iron when the tool is sharp. Such a polish is more durable than any that can be imparted with emery or oil, superior in appearance and cheaper to produce; cardinal points in favor of using a sharp turning tool.

There are many tools which cannot be ground upon the stone without destroying the shape. Tools for forming beads or moldings are of this class, but as they are generally used on cast iron; they are intended to scrape rather than cut, and the faces can therefore be ground flat. It is generally easier to file the tool to the required shape and grind it when dull.

Tools that are filed have two disadvantages which make them inferior to those tempered and ground subsequently. When a tool is tempered, the smith dresses the edge by repeated blows, and compacts the metal at that point very closely, thus making it tougher and finer in grain, The hardening process is also an advantage, for the edge is less apt to be wiry than when the metal is fibrous; which is the case with annealed steel. A tool that is to be filed into shape must necessarily be soft previously, and though the workman may be an adept, he is very likely to slur the fine edge over in forming it, and make it rough and dull, instead of sharp. When the edge of a filed tool is tempered it is apt to crumble, and is, in many other respects, inferior to one that is ground.

For turning a molding or bead on a side pipe, or cylinder head, such as the one shown in this figure,

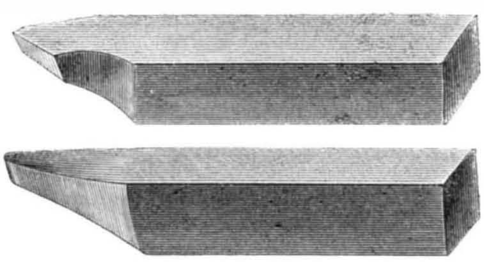
Fig. 29.



it will be found convenient to make the beading tool on the spring plan, illustrated in Fig 18, current volume. By this method it is less likely to chatter or leave ridges or cut roughly.

Of tools other than those used for cutting wrought and cast iron, there are few which are materially different in external appearance. To this statement there is one exception. Brass cannot be cut by the same tools that are used for iron. Below, in Fig. 30,

Fig. 30.



we give examples of tools for turning brass. It will be seen that they are perfectly straight on the upper faces, and have no lips or acute edges. It is not possible to cut brass with a drill, or any other tool, that has a cleaving edge. Such edges draw in to the metal and throw it out of the lathe or else jam and break off. There are compositions of copper and tin, zinc and copper, and others, which can be cut by common tools, but these are not brass, which consists of specific portions of certain metals. One of these tools—the round nose—is used for light cuts, and the other where larger amounts of metal have to be taken off at once.

In turning wrought iron very many turners make their tools quite hard and cut the metal dry or without water; preferring to absorb power rather than soil the lathe with sloppy combinations of iron and water. With proper care but little "muss" will be made, while the gain in time, by using water, is very apparent. Not less important is the power required to drive a given number of lathes. Those which run dry require more than tools used with water, for the simple reason that the friction is greater. Any one can test this to his entire satisfaction by putting a tool in a lathe, starting the cut, and driving the machine by hand. It will be found that when the chip is of such a size that the arm can hardly turn the lathe dry, the addition of water will free it immediately, and the lathe can be driven with ease. If the shears be well oiled previous to beginning a job, the water can be wiped off without injury to them, even though the work be days in progress.

This article concludes the series on this subject. The skilled turner will perceive many cases not laid down in the several papers under this head which might have been alluded to, but it is obviously impossible in the limits of a newspaper to detail every minute manipulation a lathe is capable of. Special instruction on particular points has not been aimed at, but a general and familiar treatise on the tools used in turning.

SEASONING AND DRYING LUMBER AND TIMBER.

[For the Scientific American.]

A COMPARISON OF SUPERHEATED STEAM WITH OTHER MODES OF SEASONING, AS IT REGARDS SPEED, THOROUGH WORK AND CHEAPNESS.

It seems to be a great mystery to the uninitiated how lumber, and other substances, can be dried while in direct contact with steam.

All understand that steamed lumber will dry in the open air, more rapidly after, than before, it is steamed —though all do not understand why it does it. They notice that the lumber comes from the steam in a very wet and soaked state, and the general impression would be, that it would require a longer time to dry than before it was thus soaked.

The fact however that it does dry more rapidly, has induced many to adopt this mode, when they were in haste for some dry lumber, even though practical tests have shown that such steaming injures its beauty of finish, as well as the strength and durability of the lumber and timber. The reason for this will be seen.

This steaming and soaking process extracts the albumen, which if properly coagulated and retained, is a preservative to the lumber. It also expands the pores of the lumber, so that they never shrink again to their smallest size, and do not often return as tubes, but shrink into angles; thus injuring the strength as well as beauty of finish. If these improperly shrunk tubes were placed under a powerful microscope, they would look like hills and valleys and very high ones.

This albumen is somewhat difficult to dry in the pores of the lumber, by air drying, for it does not part with its moisture readily, and when dried in the outside pores of the lumber, it nearly hermetically seals the inside, as it becomes nearly impervious to moisture.

Many attempts have been made to get rid of this albuminous substance in the lumber, for even after it has been once dried, it will ferment, if water be added, and this fermentation produces eramacausis or dry rot, which destroys millions of dollars' worth of railroad timbers, ties, and bridges, per year, as well as timber in buildings, ships, &c.

Kyanizing, paynizing, burnetizing, and other similar processes, are only modes used to coagulate or chemically change this albumen, by using the various kinds of salts, such as corrosive sublimate, zinc, copperas, &c. Many of these modes have been found to be valuable for preserving the timber from the dry rot. But since these processes are usually performed by soaking or steeping the lumber in a solution of these salts, much of the albumen passes out, to the injury of the lumber; for when all of the strength and beauty of finish is desirable, the albumen should be coagulated and retained in the pores of the lumber. Of course the lumber comes from all these processes as well as in steaming, boiling, or soaking in water— in a wet and soaked state, and must therefore be used in the wet state, or afterwards dried by the air, either naturally or artificially. In either case, the outside of the timber is dried first, and forms an enamel, which will not further shrink, as the drying progresses, and therefore the timber cannot be brought to its smallest size, even though the drying process be continued forever.

Air drying we must remember always commences on the outside of the lumber, and its tendency is to close up its own way, and check materially its own progress, forming an enamel with dried albumen, and by closing the pores of the lumber on the outside first. The further therefore the drying extends into the lumber by this process the slower must be the future drying, for the passage of the moisture from the inside is the more strongly resisted, the thicker this enamel becomes. Is it any wonder, therefore, that the center of thick lumber is rarely ever dried. Comparatively small sticks of oak timber have been used for a fire piece for at least sixty years.

Many millions of dollars have been expended in experiments to season and dry lumber. The result has generally proved to be drying without seasoning, and seasoning without drying. But when both seasoning and drying have been attained by subjecting the lumber first to one process and then to the other, the result has usually been a sacrifice of the strength and

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