melted together in black lead crucibles and run into plates; these must be annealed and pickled before rolling into strips, in which form, after a part of the hardness imparted to the sheets during the process of rolling is removed, they are sent to market or used in various ways in other parts of the establishments. The mill has the capacity for turning out six thousand pounds of rolled brass daily. The first branch of manufacture which would be likely to engage the visitor's interest, is the mode of making brass tubing. The strips prepared as just stated, are brought from the rolling mill; one end shaped into tube form is placed in the die and the whole strip is forced through the same, whereby a circular, elliptical, star-shaped, or other form of tube results. Several such tubes being placed on a rack, the joint of each is cleaned, a charge of borax and solder placed in it and set by running the whole number simultaneously through a furnace. The oxide raised by the fire is now removed and the tubes are ready for shipment. The number of purposes to which the manufactures of this department are required in every-day use, is much larger than one would suppose; stair rods in a great variety of designs, rails for sliding doors to run upon, lightning rods, are but a few of the multitudinous uses which a little reflection will suggest.

The manufacture of brass kettles by machinery is a branch of industry carried on only at this establishment and by a Waterbury firm. The old English mode of making these culinary indispensables, was by the laborious one of continuously and vigorously hammering upon a sheet of metal until by degrees the required shape was assumed. This process of battering was operated by this company for many years, and furnished the distinctive name by which the company is still called. The plan now in use is known as "Hayden's patent," a patent having been granted for the same, bearing date December 15, 1851. Square blanks of sheet brass are cut into circles of a diameter corresponding to the size of kettle required. After annealing, the metallic disks are brought in contact with cast iron chucks revolving horizontally with great velocity. A small steel friction roller, resembling a button, is then brought in close contiguity to the metal, and, running along the outer surface of the blank, spins it out to the shape of the mold. Four such operations are commonly required before the kettle assumes its finished form, the metal requiring to be annealed after each. The course of the roller is marked by the concentric rings which are found upon most of the brass kettles in market. The processes of wiring, fixing on the ears and bales are all required to make the kettle complete. Sizes range from one half to thirty-two gallons capacity.

Manufacturing burners for kerosene lamps is conducted on a large scale in one department of this shop. The well known "sun burner" is made exclusively by this company, who are the sole proprietors of the patent. Another room in the same building is devoted to making hoopskirt trimmings, apparently a very insignificant industry, but in reality a very thriving one. The pieces are stamped out by the thousands from sheets of copper, tinned, and sold in bulk to the skirt manufactures for fastening the tapes and web to the hoop springs. Harp-hangers for kerosene lamps, clock trimmings, and copper burrs and rivets in almost endless variety are other products of this department. For making the last named, wire is fed into a machine, which cuts it off the proper length, and heads it by two blows. The demand for these articles comes principally from belt, hose, and harness makers. Copper bottoms for kettles, wash basins, and boilers, are stamped out from sheets; annealed and pickled, they are washed on the concave side, first with muricate of zinc, then by a solution of lead and tin; when dried they are ready for the tinners.

In the wire drawing mill, coils of rough imported English wire are drawn by power through dies of varying diameter until reduced to sizes required by the trade. Each drawing necessitates a separate annealing and pickling. The wire is coated with flour or lime to prevent wear on the dies as also to preserve it from oxidation when ready for market. A large amount of wire is called for to supply the pin machines in the neighboring towns of Waterbury and Birmingham, but by far the largest demand the company now have comes from the West, where it is used in enormous quantities for making fences. One of the uses of wire just being introduced, is for making shoe pegs, a Boston notion. The wire for this purpose is made oval or three cornered and a half turn given to the pegs prevents them from drawing out of the boot sole.

Clock making, one of Connecticut's most important industries, is vigorously carried on in Ansonia. The movement and case departments occupy now the same building, pending the construction of a new shop which, on its completion, will be monopolized by the former business. Space would fail to describe the processes of converting the rough stock into attractive and substantial cases, or making the intricate mechanism constituting what is known as the movement, and finally, fitting together the completed whole. ready for a long life of useful service. The shops of this and other companies in the village are open to visitors, and no more instructive summer tour can be undertaken than a trip through the Naugatuck river valley, with a short sojourn at the villages of Birmingham, Ansonia, Waterbury, and Seymour.

MANUFACTURE OF INDIGO CARMINE.

A recipe for a green color for confectioners' use, published in No. 10, current volume, has called forth inquiry as to the nature of indigo carmine, and its method of manufacture The following description will be found a complete answer to these inquiries:

In the first place, the choice of the indigo on which to operate is not without importance. Its price is generally in proportion to the quantity of pure indigotine which it contains, and it is most advantageous to employ the finest qualities, in order to avoid, in manufacturing a fine quality of indigo carmine, a number of purifications, washings, etc., which soon become costly operations. The manufacturer must not allow himself to be entirely guided by the external appearance of the indigo, the best qualities of which are porous, light, clear, etc., but he should ascertain by one of the known methods the quantity of pure indigotine it contains.

Indigo carmine consists of a perfectly uniform paste of a fine copper color, without any granulations. Spread upon a sheet of glass, and viewed by transparency, it should give a pure blue color with a slight tint of violet.

In the manufacture of indigo carmine, the first operation is the pulverization of the indigo. The author places some 13 lbs. at a time in a wooden drum, properly closed, and in which have been previously placed three cannon balls of 6 lbs. weight each. This drum is fixed to a wooden case, which catches any of the powder that may happen to escape during the pulverization. The drum is turned on its axis by means of a handle, and in about three hours the above quantity is completely pulverized. It is then withdrawn, and passed through a silken sieve containing 100 threads to the square inch. Whatever remains on the sieve is put aside, and replaced in the drum in a future operation.

The powder thus obtained must be completely dried, otherwise, when placed in contact with the sulphuric acid in the next operation, it would give rise to a degree of heat which would injure the product. The desiccation is operated at a temperature of 60° to 70° C.

When the pulverized indigo is dry and has cooled, its dissolution in the acid is proceeded with, and as this part of the process determines the result of the manufacture, it is impossible to operate with too much care. The author recommends that small quantities should be operated on at a time, for the work is thus facilitated, and if an accident happens the loss is comparatively slight.

It is best to add the acid to the indigo, rather than the indigo to the acid; the temperature rises less high, less sulphurous acid is produced, and dissolution is more complete. As to the quality of the sulphuric acid employed, it must contain no nitric acid; for complete safety it is best to add a little sulphate of ammonia, to neutralize the effects of any nitric acid that might be present. The concentration of the acid is another point of great importance. Acid at 66° did not yield good results; the stronger the acid, the more perfect the dissolution. It is best to use a mixture of 4½ parts of fuming sulphuric acid and 1 part of acid at 66° Baumé. The weaker the acid the more violet will be the indigo carmine produced when viewed by transparency.

The following is the method adopted by Herr Roesler:

One pound weight of the pulverized indigo is placed in earthenware dishes kept cool by water, and upon it is poured 2¾ lbs. of the mixture of acids above quoted, previously cooled. The mass is stirred with a thick glass rod, slowly at first, then more rapidly, so as to prevent the indigo from agglomerating. In the course of about half an hour the whole forms a dark smooth paste, almost black; it is stirred rather slowly, while a second quantity of acid, equal to that already mentioned, is added. When the mixture froths considerably and evolves much sulphurous acid gas, it is a bad sign; on the contrary, the operation may be considered successful when, after the mixture is completed, the thick foam of little bubbles of gas forms upon the surface while the mass gradually thickens.

It is true that this manner of dissolving indigo is somewhat slow, since one workman can scarcely operate upon a hundred-weight per diem, but the results are always good.

The operation is not yet complete, however; the transformation of the indigo into sulphindigotic acid is not entirely effected, and if the process is immediately continued at this point, a bad result can alone ensue. The earthenware vessels must now be covered to protect them from dust, and their contents allowed to remain in this state for about a fortnight, care being taken to stir up the mixture now and then during that interval, and to warm the vessels a little on the last few days. The whole product is thus transformed into a thick mass, covered by a thinner or more liquid layer.

The next operation is that of precipitation. The contents of five of the earthenware vessels are emptied into a large vat and 237½ pints of pure cold water are added, and then, gradually, a concentrated solution of common salt (1·17 sp. gr.), until the whole of the coloring matter is precipitated. The author formerly used carbonate of soda instead of salt, but the cost is greater and loss of time ensues on account of the violent effervescence.

By the use of common salt a large amount of hydrochloric acid is generated, which attacks the ordinary suspended filters hitherto used. The filtration is therefore effected in cases provided with false bottoms pierced with holes, over which the well-soaked filtering material lies. The first portions which pass must be passed again through the apparatus until the liquid filters clear. The clear solution which filters through is of a blackish green tint. When salt has been used, the clear liquid is afterwards evaporated to crystallize; when chloride of potassium is used, instead of salt, sulphindigotate of potassa is obtained, but this product is not so soluble as the soda compound, and is therefore less esteemed.

When the filtration is finished, the filter is doubled upon itself, and the product submitted to a careful pressure. The cakes of indigo carmine thus obtained are fit for certain purposes; but when it is desirable to furnish a product capable of giving very pure tints, this first yield must be submitted to a few more operations.

The precipitate yielded by 5 pounds of indigo, is mixed with 210 pints of boiling water, and 5 pounds of monohydrated sulphuric acid are added, while the whole is well stirred with large wooden spatules.

Although this quantity of acid is not sufficient to dissolve all the product, it is enough to bring it to a very fine state of division, and to keep in solution all the impurities during the subsequent precipitation. The latter is then operated with 5 pounds of a solution of soda at 90°, and an equal quantity of common salt for every 2 pounds of indigo. The mixture is carefully stirred, allowed to cool, and filtered on cloths about two square yards in size, stretched on wooden supports. The mother water has a dirty green tint. The filtered product is washed until the water which passes has a clear blue tint.

With impure qualities of indigo it is advantageous to repeat the latter operation to obtain a perfectly pure product.

The indigo carmine collected on linen filters is pressed, and finally a little glycerin is added to preserve a proper degree of moisture in the mass.

One pound of indigo yields about ten pounds of indigo carmine.

Do Animals Think or Reason?

The theory that animals think and reason, and their mental manifestations differ from those of mankind only in degree, has found a new advocate in Ernest Mensalt. Here are some of the stories which he narrates to establish the claims of fleas, fishes, and bugs. He also claims for these inferior creatures the affections of parental love, and an emotional nature, capable of gratitude for kind treatment.

There were industrious fleas before our time. Baron Walckenaer (who died in 1852), saw with his own eyes, for sixpence, in the Place de la Bourse, Paris, four learned fleas perform the manual exercise, standing upright on their hind legs, with a splinter of wood to serve for a pike. Two other fleas dragged a golden carriage, with a third flea holding a whip on the box for coachman. Another pair dragged a cannon. The flea horses were harnessed by a golden chain fastened to their hind legs, which was never taken off. They had lived this way two years and a half, without any mortality among them when Walckenaer saw them. They took their meals on their keeper's arm. Their feats were performed on a plate of polished glass. When they were sulky and refused to work, the man, instead of whipping them, held a bit of lighted charcoal over their backs, which very soon brought them to their senses.

But of what use is cleverness without a heart? The flea has strong maternal affections. She lays her eggs in the crannies of floors, in the bedding of animals, and on babies' night clothes. When the helpless, transparent larvae appear, the mother flea feeds them, as the dove does its young, by discharging into their mouths the contents of her stomach. Grudge her not, therefore, one small drop of blood. For you it is nothing but a flea bite; for her it is the life of her beloved offspring.

While pleading, however, for the flea, we cannot do as much for the bug, though he is gifted with fuller developed intelligence. An inquisitive gentleman, wishing to know how the bug became aware of human presence, tried the following experiment: He got into a bed suspended from the ceiling, without any tester, in the middle of an unfurnished room. He then placed on the floor a bug, which, guided probably by smell, pondered the means of reaching the bed. After deep reflection, it climbed up the wall, traveled straight across the ceiling to the spot immediately over the bed, and then dropped plump on the observer's nose. Was this, or was it not an act of intelligence?

The Fish belongs to the great Flathead family. The same sort of platitude which you see in his person doubtless extends to the whole of his character. You have met him somewhere in human shape—one of those pale-faced wishy-washy gentlemen, whose passions have extinguished all heart and feeling. You often find them in diplomatic regions, and can't tell whether they are fish or flesh. But if their mental powers are less developed, their term of existence is more extended. They gain in longevity what they lose in warmth of temperament.

Nevertheless, the skill with which the stickle-back constructs his nest is now a matter of natural history. Other fishes display an address which we acquire only by long and constant practice. One fellow, with a muzzle prolonged into a narrow tube (which he uses as a popgun), prowls about the banks of tidal rivers. On spying a fly on the water weeds, he slyly swims up until he gets within five or six feet of it. He then shoots it with water from his proboscis, never failing to bring down his game. A Governor of the Hospital at Batavia, doubting the fact, though attested by credible witnesses, procured some of these fish to witness their pranks. He stuck a fly on a pin at the end of a stick, and placed it so as to attract their notice. To his great delight, they shot it with their water guns, for which he rewarded them with a treat of insects.

The pike has proved himself not only intelligent, but even capable—disbelieving it who will—of gratitude.

"While living at Durham," says Dr. Warwick, "I took a walk one evening at Lord Stamford's park. On reaching a pond in which fish were kept ready for use, I observed a fine pike of some six pounds weight. At my approach he darted away like an arrow. In his hurry he knocked his head against an iron hook fixed in a post in the water, fracturing his skull and injuring the optic nerve on one side of his head. He appeared to suffer terrible pain; he plunged into the mud, floundered hither and thither, and at last leaping out of the water, fell on the bank. On examination, a portion of the brain was seen protruding through the fractured skull.

"This I carefully restored to its place, making use of a small silver toothpick to raise the splinters of broken bone.

The fish remained quiet during the operation; when it was over he plunged into the pond. At first his sufferings appeared to be relieved, but in the course of a few minutes he began rushing right and left, until he again leaped out of the water.

"I called the keeper, and with his assistance applied a bandage to the fracture. That done, we restored him to the pond and left him to his fate. Next morning, as soon as I reached the water's edge, the pike swam to meet me quite close to the bank, and laid his head upon my feet. I thought this an extraordinary proceeding. Without further delay I examined the wound, and found it was healing nicely. I then strolled for some time by the side of the pond. The fish swam after me, following my steps and turning as I turned.

"The following day I brought a few young friends with me to see the fish. He came toward me as before. Little by little he became so tame as to come to my whistle, and eat out of my hand. With other persons, on the contrary, he continued as shy and wild as ever."

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents

Concentration, Transmission, and Transportation of Motive Power.

MESSRS. EDITORS:—In the late work of John Bourne, entitled "Recent Improvements in the Steam Engine," in speaking of researches in thermo-dynamics, made by Joule, he says: "It has long been known that heat may be made to produce power, and that power may be made to produce heat. But Mr. Joule has shown by elaborate experiments that the heat produced by friction is the mechanical equivalent of the power expended in maintaining friction; and that the power represented by the descent of a pound weight through 772 feet, or 772 pounds through one foot, would, if expended in friction, produce as much heat as would raise the temperature of a pound of water one degree Fahrenheit. If we had a perfect engine for extracting the power from heat, we ought to be able to recover from the heat generated by friction the exact amount of power expended in generating the heat. But in the best existing steam engines it is found that only about *one tenth* of the value of the heat it obtained as power, the residue being wholly wasted; so that if a steam engine were employed to generate heat by friction, only one tenth of the power would be obtained that would have to be consumed in the production and maintenance of the friction. The steam engine, indeed, has now been found to be a very wasteful machine; and the cause of the waste is traceable to the fact that it deals with extremes of temperature but little removed from one another, instead of with extremes of temperature as far removed from one another as possible."

In view of the facts that such a waste is as far as can be foreseen an inevitable concomitant of the use of steam as a motor, and that as the coal supplies in different parts of the world must eventually fail, and also that the time is not far distant, comparatively speaking, when in many locations the price of coal must advance so as to increase the expense of steam, why steam is the only motor except water power which is to any great extent available becomes a pertinent inquiry.

Although future discoveries may yet render electricity available as a motor, there is no immediate prospect of its becoming so. Heated air is gradually coming more into use for light service, but with this there must be always more or less loss of heat, from the same causes which occasion loss in steam production. There remains the strength of animals; yet with these as motors of machinery, no economy over steam can be obtained. For although a pound of meat, or butter, or honey, or a bushel of corn, will be converted into power with far less waste in the animal economy than similar quantities of coal can be in the furnace of a steam boiler, the preparation of the animal fuel, the conversion of carbon and hydrogen into butter or corn, is an expensive process, and so increases its cost, that, even with a loss of nine tenths, coal could more than compete with it, even though the cost of the latter should far exceed what it is at present.

As all the forms of motion may be traced back to the sun, the great prime mover of our system, it seems singular that the power it is constantly generating should not be employed directly as a motor without having recourse to power stored up in coal beds or wood. This power is constantly raising immense volumes of water to enormous hights, which in their descent would, if utilized, drive a million times more machinery than the world will ever require; but the unequal distribution and irregular precipitation of the water from the clouds, and the level surfaces of many localities, are practical difficulties which obstruct a more general use of water power as a motor.

It is not intended in this communication to place before the public a method for the direct utilization of the sun's heat, which can be said to be free from practical difficulties. It is freely confessed that there are many obstacles to success. But to leave altogether out of consideration a mechanical possibility, because of its attendant difficulties, is, to say the least, not a philosophical method of thought.

Let us see what is the essential nature of these difficulties, and appreciate them to their fullest extent. Suppose it were proposed to utilize the heat of the sun by the expansion of solids, and a method of doing this were required, it might be done as follows: An inclined plane or railroad, having placed thereon a heavily loaded car, with pawls attached, playing in ratchets by the sides of the rails, so that it should be prevented from descent; also, having a long bar of iron or other metal fixed to the lower end of the car with a movable joint, so that the lower extremity of the bar should lie upon a central ratchet lying parallel to and between the rails, would operate thus: The long bar would expand by the heat of the sun, and, being prevented by the central ratchet from downward motion, would push the car up the inclined plane. The side panels and ratchets would hold it there, so that upon subsequent cooling the bar would be drawn up, and, taking a new hold upon the central ratchet, would, when heated again, push up the car. In this way, step by step, through successive days and nights, the car would be lifted to the top of the inclined plane, precisely as a tin roof sometimes crawls out of its place by contraction and expansion. An enormous weight might thus be elevated, which, in its descent, could be made to supply power for mechanical work; but here comes in the practical difficulty. It will have taken days to have thus stored up the force, which, though it might be enormous, would be so concentrated that, to apply it, great multiplication of its motion would be necessary. This would lead to complication of parts, and loss from friction. This description has only been introduced to illustrate the fact that the direct application of the sun's heat to motion can only be practically made by great concentration, through a long period, of the force generated by it, and that the chief practical difficulty lies in the distribution of the force to work after it has been so concentrated.

The inclined planes do not need to be artificial. Nature has provided for that; and the sun, as we have seen, is constantly putting vast weights of water upon their summits. It would be difficult to find a place where power is required in large measure that has not a range of hills within two hundred miles of it, where powerful wheels might be placed. But how transmit the power, or how transport it? This is the question to which the age demands an answer, and to the solution of which mechanical genius should be at once applied. Some suggestions upon the means of so doing must be reserved for a future occasion. A.

A Patent in 1655.

MESSRS. EDITORS:—In the records of the Colony of Massachusetts Bay I find the following passage relating to a patent granted to Joseph Jencks, Sen., for an engine for the more speedy cutting of grass:

"In ansr to the moccon of Joseph Jencks, Señ., itt is ordered that Joseph Jencks, Señ, and his assignes only, shall have libertje graunted to them to make that engine the said Jencks hath proposed to this Court, for the more speedy cutting of grasse, for seven Yeares, and that no inhabitant, or other person wthin this Jurisdiccon, during that tjme shall make or use any of that kind of engine wthout license first obtajned from the sajd Joseph Jencks, on the pœnalty of five pounds for every such engine so made or vsed, to be recoured at any Court in this jurisdiccon by the said Joseph Jencks' Señ., or his assignes."

Can you inform me what sort of engines were made in those days? H. B. HARRISON.

[In "those days" all machines driven by any power except hand labor were called engines. The engine referred to, invented by Joseph Jencks, Senior, mentioned in the colonial records from which the above extract is taken, was one of a series of inventions made by him for the making of scythes and other edged tools with greater speed and perfection than had previously been accomplished. It was not an engine directly applicable to cutting grass, as the quaint language of the record might seem to imply. It was merely a machine, driven by water power, to manufacture scythes upon a new principle of construction, which gave greater length and thinness to the blade, the requisite strength being given to it by welding a rib of iron to the back of it, now done by rolling instead of welding. This was a great improvement upon the short, thick, and clumsy English scythes used at that period. Although many improvements have since been made in modes of manufacturing scythes, no radical change in their form has taken place.

Joseph Jencks, Senior, was one of the most skilled mechanics and inventors of his time. He was the first founder of brass and iron on the Western Continent. In 1652 he was employed by the Colonial Government, to make dies for the silver coins issued to supply the deficiency of specie which at that time embarrassed financial operations. The issue consisted of shillings, for which there were at least sixteen different dies, sixpences, threepences, and twopences. The coins were of very fine metal, but they were worth by weight two pence less in the shilling than the English coin. Mr. Jencks was the maker of the first fire engine ever used in America, anticipating their use in France nearly fifty years.—EDS.

How to Become an Engineer.

MESSRS. EDITORS:—I am not a machinist, but am a natural mechanic—can do a good job at nearly anything with a little instruction. I wish to learn to be a marine engineer (a good one—I mean a competent one). How had I better commence? Is it necessary to learn the machinist business; or had I better try to get a job helping about some marine engine? (I have put up engines—stationary—and run them with good success.) What books had I better commence studying on engineering? I have been a reader of the SCIENTIFIC AMERICAN for sixteen years; it has benefited me very much in a mechanical way. Please give me a little advice to commence with. C. C. R.

Avon, Ill.

["Line upon line, precept upon precept," seems as necessary a rule now as in the time of Solomon. We have published our advice on these matters repeatedly, have replied by mail to many such letters, and not a week passes that we are not called upon personally for our opinion on these subjects. Our advice is always founded on our personal experience as a practical mechanic and on observation, and cannot be more valuable than that of any intelligent mechanic.

There is no royal road to success in mechanics; there are no books published which will make a "natural mechanic" a practical mechanic, and the sooner our young men appreciate the fact the better for their welfare and the credit of the noble army of wealth producers. To be a marine engineer one should understand every part and piece of the engine and all its connections. He should be competent to do or direct in case of accident or repair. How can he best acquire that knowledge? Evidently by practice, and practice must begin in the shop. Jobbing about a marine or any other engine never made an engineer—it may enable one to *run* an engine when everything goes right. But an engineer—"a good one, a competent one"—such as our correspondent evidently desires to be, must begin at the beginning, go into the shop and *work*. In his leisure hours study "Bourne's Hand Book," "Russell's Steam and Steam Navigation," "Main and Brown on the Marine Engine," and other authorities. Still, books are but an aid, an accompaniment to his daily labor and daily experience, and in no case to take the place of that labor or that experience. To ascend a ladder one must begin at the first rung, however much his natural taste may enable him to see through the ladder.—EDS.

To Find the Number of Teeth in the Gears Used on the Spindle and the Leading Screw.

MESSRS. EDITORS:—I send a copy of my rules for screw cutting on engine lathes:

RULE. Take the number of threads in any convenient distance on the leading screw, for the number of teeth on the gear on the spindle, and the number of threads in the same distance on the screw to be cut, for the number of teeth on the gear on the leading screw.

EXAMPLE. The leading screw of a lathe being 5 threads to the inch, required the gears to cut 8 threads.

In 4 inches of the leading screw there are 20 threads which gear put on the spindle, and in 4 inches on the screw to be cut there are 32 threads, which gear put on the leading screw. But suppose you have no 32 tooth gear; take some other distance, say 6 inches, and the gears required will have 30 and 48 teeth. So any distance may be taken.

Again, suppose the leading screw to be 4 threads to the inch; required the gears for cutting 6 threads.

In eight inches of the leading screw there are 32 threads, and in 8 inches of a 6 thread screw there are 48 threads; then 32 and 48 are the gears wanted.

In cutting the same number of threads as the leading screw, the gears should both have the same number of teeth, no matter what that number is.

From the foregoing it will be seen that any gears, having the same ratio to each other as the number of threads given and required, may be used with the same result.

The pitch of a screw is the distance gained, in the direction of its axis, by one revolution of the screw, and is usually expressed by a fraction.

The denominator of the fraction denoting the pitch of a screw, is the number of threads in the number of inches denoted by the numerator.

EXAMPLES. 1-5th of an inch pitch is 5 threads in 1 inch; 3-16ths of an inch pitch is 16 threads in 3 inches; 1 5-8ths pitch is (1 5-8ths = 13-8ths) 8 threads in 13 inches; 11-30ths of an inch pitch is 30 threads in 11 inches; 15 22ds pitch is 22 threads in 15 inches.

In the last two cases suppose the leading screw to be 5 threads to the inch; required the gears.

In 11 inches of the leading screw there are 55 threads, and in 11 inches of the screw to be cut there are 30 threads. Put 55 gear on the spindle, and 30 gear on the leading screw. Again, in 15 inches of the leading screw there are 75 threads, and in 15 inches of the screw to be cut there are 22 threads; but suppose there is no 22 gear at hand, or if it is at hand it is too small to be driven without crowding; double the numbers already found, and use 150 gear on the spindle, and 44 on the leading screw.

TO FIND THE PITCH OF A SCREW.

Lay a rule on the screw, in the direction of its axis, and note where the threads correspond with the inch marks on the rule; make the number of threads the denominator and the number of inches the numerator of a fraction, which fraction will denote the pitch in its lowest terms. If the fraction be an improper one reduce it to a mixed number. If the fraction is a proper one the number of threads to the inch may be found by dividing the denominator by the numerator.

EXAMPLES. 3-16ths pitch is (16÷3=5 1-3) 5 1-3 threads to the inch. 11-30ths of an inch pitch is (30÷11=2 8-11) 2 8-11ths to the inch.

In counting a square thread screw be careful to count a thread and a space also.

In two or three thread screws the pitch should be taken at twice and three times, and the number of threads at one half or one third that of a single thread screw.

Intermediate gears are used only to transmit motion, and the number of their teeth does not affect their work, but it sometimes happens that the pitch of the screw to be cut, is so much greater or less than that of the leading screw, that one gear is too large or the other too small. In that case the speed of the leading screw may be increased or reduced by two gears fixed together on the same stud, one being half the size of the other.

EXAMPLE. The leading screw being twelve threads per inch, required the gears for cutting 2 threads per inch.

Take the number of threads in 10 inches, which will be 20 and 120 on the spindle and 20 on the leading screw, but so small a gear on the leading screw will crowd and drive hard So double the number of teeth on the small gear, and put 40