THE

AMERICAN COTTON SPINNER,

AND

MANAGERS' AND CARDERS' GUIDE:

A PRACTICAL TREATISE

ON

COTTON SPINNING:

GIVING

THE DIMENSIONS AND SPEED OF MACHINERY, DRAUGHT AND TWIST CALCULATIONS, ETC.; WITH NOTICES OF RECENT IMPROVEMENTS.

TOGETHER WITH

RULES AND EXAMPLES FOR MAKING CHANGES IN THE SIZE AND NUMBERS OF ROVING AND YARN.

COMPILED FROM THE PAPERS OF THE LATE

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PREFACE.

The following pages are chiefly the work of the late Robert H. Baird, well known as an expert cotton spinner. But, as the manufacture of cotton is rapidly progressing, and his manuscript was written some few years since, it was found necessary to make such additions to it, as would bring the subject up to the present time. It is not the intention of this treatise, to give a perfect description of cotton machinery, such as is at present in use; the chief object is, to furnish the managers and foremen of cotton factories with a guide, by which to calculate the draught and twist of the various machines, and afford them some assistance in managing the machinery.

But little could be said on the subject of weaving, as it has been already ably treated of in other works of merit; still, a treatise on weaving is very much needed, particularly on plain weaving. But, as this subject, if fully developed, would occupy more space and absorb more means than can be assigned to it in this instance, we hesitated about entering fully upon it at this time, and intend, at some future period, to offer to the public an elaborate work on weaving.

The large amount of capital invested in cotton plantations, in mill-seats, buildings, water-works, steam-engines, and all the machinery required for the manufacture of cotton goods, the number of persons that are employed in perfecting these manufactures, and the value of the articles manufactured, all entitle the cotton manufacture in this country to a claim upon our particular attention.

It is evident that the manufacture of cotton has become a very important branch of our national industry, and that a practical work upon this subject, the first of the kind published in this country, explanatory of the movements of cotton machinery, and of the various processes used in the manufacture of the goods, together with plain and practical rules for ascertaining the best modes of operating the various complicated machines used in this highly important manufacture, cannot fail to be interesting to all the parties engaged therein.

This work is intended for the mutual advantage of employers and operatives; and, as the interests and welfare of both are inseparably identified, the motto, "united we stand, divided we fall," is truly applicable to cotton growers, mill owners, and operative cotton spinners.

PHILADELPHIA, April 1, 1851.

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AMERICAN COTTON SPINNER.

INTRODUCTION.

In a work of this nature, it may not be considered inapplicable to introduce a brief sketch of the rise, progress, and present state of the cotton manufacture in the United States.

The rapid growth and prodigious magnitude of the cotton manufacture in this country, are unparalleled in the history of industry. In 1790, the first cotton mill, with machinery on the Arkwright principle, was erected in Pawtucket, Rhode Island, by the late Samuel Slater. The first spinning machine was, what is called a water frame, containing twenty-four spindles: it was on the throstle principle. This was the humble origin of a system in this country, destined to exercise a mighty and growing influence over the interests of this great Republic.

Since this first machinery was in operation, the advancement and extension of the cotton manufacture is truly astonishing; it has caused hundreds of populous cities, towns, and villages to spring up, as if reared by some magic influence, where, a few years ago, nothing was seen but a barren wilderness. The cotton manufacture continued to spread from this time up to the War of 1812, which gave the manufactures a strong impulse. There were several small mills in Rhode Island in 1807. In this year, the Globe Mills, in Philaladelphia, were erected: a Mr. Davenport was the principal, and Dr. Redman Coxe was connected with it. In 1812, there were in Rhode Island thirty-three cotton factories, containing 30,663 spindles. In Massachusetts there were twenty mills, with 17,371 spindles. An impression, favourable to the protection of domestic manufactures, was everywhere manifested. At the close of the war, in 1815, Mr. Jefferson had changed his views on the subject of manufactures, and expressed himself as follows: "To be independent of others for the comforts of life, we must manufacture, ourselves; we must place the manufacturer by the side of the agriculturist. Experience has taught me that manufactures are as necessary to our independence as to our comfort." But those patriotic sentiments were not the sentiments of the majority in Congress. The importations of 1815 and '16 were carried to a most extravagant extent; the country was completely inundated with foreign manufactures. Mr. Dallas, the Secretary of the Treasury, reported a tariff, the adoption of which would have afforded tolerable protection to the majority of our manufacturers. "The tariff" (says the late venerable and truly patriotic Mathew Carey, in his "Appeal to Common Sense,") "he (Mr. Dallas,) proposed, claimed a high degree of attention, but received very little from Congress, who cut and carved it most unmercifully." The capital invested in manufacturing establishments at that time, amounted to about $60,000,000. The amount of importations during the two years was about $180,000,000. Although the most moving petitions and pathetic appeals were poured into Congress from all the manufacturing districts, portraying in the most vivid colours their sufferings and distress, it was all in vain. Many of the members of Congress zealously contended for the adoption of Mr. Dallas' tariff, but to no effect.

Throughout the years 1817, '18, '19, and '20, ruin and desolation spread among the manufacturers. In 1822, Mr. Baldwin's tariff was brought before Congress; it was bitterly opposed; but, with several modifications, it passed into a law in 1824. The drooping spirits of the manufacturers had been sustained by the anticipation of this result. Although the increase of the duties was not sufficient to prevent the market from being glutted with British goods, the manufactures gradually improved, and even increased.

In the year 1820, Captain John Towers erected the first mill in Manayunk, Pennsylvania; and, in the same year, Isaac Baird rented an apartment in this mill, and spun the first cotton yarn ever manufactured in that place. In 1818 the Canal was in process of construction, and there were only two small cottages on the space now occupied by this thriving manufacturing town.

Astonishing as has been the increase of the various manufacturing towns and villages in the United States, Lowell, in Massachusetts, surpasses everything of the kind that has been witnessed within the memory of man. In the year 1819, Mr. Kirk Boot, of Boston, with a party of friends, visited that place as sportsmen, seeking amusement. Mr. Kirk Boot, being a highly intelligent and quick-sighted gentleman, perceived the advantages it afforded for the location of mill-sites. It was then a poor barren district, containing but a few houses, and inhabitants, who supported themselves principally by fishing in the Concord and Merrimack rivers, which unite at this point. A company of wealthy men was formed in Boston, who purchased the land and water privileges.

The Lowell manufactures represent at present about a mile of mills, filled with machinery. These factories extend from Pawtucket Falls to the Merrimack river, in a continuous line. The first corporation was organized in 1822, under the name of the Merrimack Manufacturing Company, for the manufacture of prints and sheetings: this establishment employed last year 2050 hands. The twelve manufacturing companies of Lowell were incorporated in the following order:—

Merrimack Manufacturing Company, in 1822, with a capital of $2,000,000. There are six mills, exclusive of print works; these mills contain 67,965 spindles, and 1920 looms, which produce 345,000 yards of cotton cloth every week.

Hamilton Manufacturing Company, incorporated in 1825; capital stock, $1,100,000. This Company has four mills and print works, 36,228 spindles, and 1086 looms; which produce 180,000 yards of prints, flannels, and sheetings. They employ 1200 hands.

Appleton Company, incorporated in 1828. Capital stock, $600,000. They have two mills, with 17,920 spindles and 600 looms, producing about 130,000 yards of sheetings and shirtings per week. This Company employs 520 hands.

Lowell Manufacturing Company, incorporated in 1828, capital, $900,000; has two mills, 220 cotton, and 60 carpet power looms, which make 6,500 yards of carpeting, 40 woollen rugs, and 95,000 yards of cotton cloth, weekly; 880 persons are employed.

Middlesex Company. This Company was incorporated in 1830, with a capital of $600,000. They have four mills, and various dye-houses, 16,340 spindles, with 45 looms for broad-cloth, 325 looms for cassimere, and make 18,957 yards of cassimere, and 2334 of broad-cloth per week. This Company employs 1750 hands.

Suffolk Mills; incorporated in 1830. Capital, $600,000. They have 14,448 spindles, 488 looms, make 100,000 yards of drillings per week, and employ 500 operatives.

Tremont Mills. Incorporated in 1830; capital stock, $600,000. This Company owns two mills, containine 14,560 spindles and 517 looms, which produce 120,000 yards of sheetings and shirtings weekly: 500 hands employed.

Lawrence Manufacturing Company. This Company was incorporated in 1830, having a capital of $1,500,000. They have five mills, 44,500 spindles, and 1260 looms, and produce per week 260,000 yards of printing cloth, sheetings and shirtings, on which 1400 hands are engaged.

Boot Cotton Mills, commenced 1835. Capital, $1,200,000. This Company has five mills and a picking house. They run 41,712 spindles and 1338 looms, worked by 1100 hands, which make every week 220,000 yards of drillings, shirtings, and printing cloth.

Massachusetts Cotton Mills; incorporated in 1839. Capital, $1,800,000. Six mills, 45,720 spindles, 1459 looms, 1500 hands; make 475,000 yards of sheetings, shirtings, and drillings every week.

Lowell Bleachery, formed in 1832; $210,000 capital. It employs 220 hands, who bleach 4,000,000 pounds, and dye 2,000,000 yards annually.

The Lowell Machine Shop. An extensive establishment, employing 700 hands.

There are two Savings Banks, in which the principal depositors are the factory operatives. There is a hospital for the sick, under able management. The population of Lowell was, in 1820, 200; it is now swelled to 35,000 inhabitants.

The average wages of females is $2 per week; men receive 80 cents per day, exclusive of their board. Each Company has their own boarding-house, to accommodate their own help. The wages are paid in cash, regularly every month.

Amongst the numerous towns which have sprung into existence, and whose rise can be attributed to the influence of manufactures, may be mentioned Waltham, Patterson, Ware, Fall River, Taunton, Pawtucket, Lawrence, Adams, New Market, Mattewan, Norristown, Pa., and Gloucester, N. J.

In 1840, there were in the United States about 1025 cotton mills, containing about 2,112,000 spindles, of which there were,

In the	State of	Massachusetts,	about	310	cotton	mills.
"	"	New Hampshire,	"	70	"	"
"	"	Vermont,	"	30	"	"
"	"	Rhode Island,	"	130	"	"
"	"	Connecticut,	"	120	"	"
"	"	New York,	"	120	"	"
"	"	Pennsylvania,	"	80	"	"
"	"	New Jersey,	"	55	"	"
"	"	Delaware,	"	17	"	"
"	"	Maryland,	"	30	"	"
"	"	Ohio,	"	10	"	"
"	"	Virginia,	"	10	"	"
"	"	Kentucky,	"	10	"	"

Several of these were small establishments, with not more than 1000 spindles; there were also numerous small factories in the Western and Southern States, which are not included in the above statement.

The power-loom, and the process of printing calico by machinery, are the crowning sequels to the machines used in the manufacture of cotton. These have completed a series of, perhaps, the most perfect inventions ever presented to the world, whether as regards the mechanical excellence of their operations, or the attendant results. Before the introduction of calico printing, the cotton manufacture in the United States was considered to be in such a precarious condition, that no one would venture on the manufacture of the finer fabrics; but since calico printing has been well established, the manufacture of cotton may be said to be built upon a permanent basis. The home consumption of cotton prints is immense; and our domestic prints, of the better kind, as well as our shirtings, sheetings, bed-ticks, jeans, fustians, sail-cloth, &c., are much more durable and substantial than the French or English goods of the same description. The American cotton goods enjoy the preference in South America, China, Siam, the East Indies, &c., and, indeed, wherever they have made their appearance.

In 1840, there were in operation in the United States,

1025 cotton mills, containing	2,112,000 spindles.
Cotton used annually.............	106,000,000 pounds.
Capital invested in cotton manufac...	$80,000,000
Annual value of cotton manufacture .	$60,000,000

In the same year, there were in operation, 29,736 spindles in Maine; 195,173, in New Hampshire; 669,095, in Massachusetts; 518,817, in Rhode Island; 181,319, in Connecticut; making an aggregate of 1,590,140 cotton spindles in those five States.

The number of spindles in operation at the present time, 1850, has been computed at 2,500,000; which shows an increase of twenty per cent. within the last ten years.

The following table, which we take from the Scientific American, shows more distinctly the progress of the cotton manufacture in this country:—

Years.	Male operatives employed.	Female operatives employed.	Wages of Females.	Wages of Males.	Aggregate Wages.
1838	14,000	47,000	$9,287,200	$4,368,000	$13,655,200
1839	15,000	50,000	9,880,000	4,680,000	14,560,000
1840	15,500	52,000	10,275,200	4,836,000	15,111.200
1841	13,800	46,000	9,089,600	4,305,000	13,395,200
1842	16,500	55,000	10,868,000	5,148,000	16,016,000
1843	17,000	69,000	11,658,400	4,304,000	16,962,400
1844	20,000	66,000	13,041,600	6,240,000	19,281,600
1845	22,000	72,000	11,227,200	6,864,000	21,091,200
1846	23,000	75,000	14,820,000	7,176,000	21,996,000
1847	25,000	85,000	16,796,000	7,800,000	24,596,000
1848	27,000	95,000	18,772,000	8,424,000	27,196,000

This shows an immense increase, and, in the mean time, leads to the contemplation of the aptitude of the cotton trade and manufacture.

The general magnitude of the cotton trade may be estimated from the following data.

The importation of raw cotton into England, in the year 1845, was 721,979,953 pounds; of which 626,650,412 pounds were from the United States: 42,916,332 pounds of this was exported to other European States.

In 1846, the value of cotton goods manufactured in England, exclusive of the home consumption, was £25,599,826; £1,016,146 of which was in small wares, £7,882,048 in twist and yarn, and £16,701,632 in other descriptions of goods.

The subjoined statement will give an approximate estimate of the importance and extent of the cotton manufacture throughout the entire civilized world:

The number of spindles employed in the manufacture of cotton in various parts of the world, are 28,985,000. These are distributed as follows:—Great Britain, 17,500,000; France, 4,300,000; United States, 2,500,000; Germany, 815,000; Russia, 700,000; Switzerland, 650,000; Belgium, 420,000; Spain, 300,000; Italy, 300,000. Of the 2,500,000 in the United States, 150,000 are in the Southern States, and 100,000 spindles in the Western States.

The immense amount of capital invested in the growth and manufacture of cotton, and the great number of persons who are thereby furnished with employment, render it a subject of great importance. It must proceed and increase; measures must be adopted to regulate the system consistently with freedom and good morals. We cannot neglect this with impunity; the whole community is interested in the course to be pursued relative to this business. Industry and talent must be called into action for the promotion of the best possible order in manufacturing establishments, such as will be satisfactory to all parties concerned: there should be no variance, no discord, on a subject so intimately connected with the prosperity of all America.

In proportion to the increase of manufactures, and the introduction of improved systems of management in factories, (in which we have hitherto surpassed all other nations,) the prices of manufactured articles will generally depreciate, thus making their products accessible to all. This is strikingly exemplified in the following exhibit, referring to the factories in Lowell, Massachusetts, which we have compiled from the Report of the Secretary of the Treasury. The gradual decline in the prices of cotton goods is thereby rendered very apparent.

In 1835, the Lawrence Company sold stout brown sheetings, 37 inches wide, for 12 cents per yard; in 1849, the same goods were sold at 7 cents per yard. In 1835, the Tremont Company's stout brown sheetings, 37 inches wide, sold at 10½ cents per yard; in 1849, the same description of goods sold at 6 cents per yard. In 1835, the Boot Company sold stout brown drillings, 30 inches wide, for 14 cents per yard; and, in 1849, at 7 cents. In 1835, the Tremont Company's brown shirtings sold at 8 cents per yard; and, in 1849, at 4 cents.

The printed calicoes, manufactured by the Merrimack Company, show the following decrease in price :—

Year.	Cents per Yard.	Year.	Cents per Yard.	Year.	Cents per Yard.
1836	... 17.83	1841	... 13.25	1846	... 10.82
1837	... 17.	1842	... 11.91	1847	... 11.05
1838	... 14.39	1843	... 10.56	1848	... 9.89
1839	... 15.98	1844	... 11.60	1849	... 9.28
1840	... 13.78	1845	... 11.50		

Our factories generally, and the cotton manufactures particularly, are at present much affected by the importation of foreign goods, said to be caused chiefly by too low a tariff on those importations. We do not feel inclined to investigate the truth of these assertions; yet, it is a fact, that the manufacturers in this country suffer to a greater extent than those of England. One consideration, however, may be brought to bear against the policy of a protective tariff, or, in other words, against the prohibition of foreign cotton goods. The United States are producers of raw cotton, as well as of manufactured cotton goods, and are, at the same time, the largest consumers of those goods, whether domestic or foreign. The nett profits on raw cotton, realized by the cotton-growing States, probably amounts at the present time to $40,000,000 per year. The question now arises: whether these profits can be secured to the United States by the exclusion of foreign goods? Whether the manufacturers of cotton goods can secure that sum to the Union by the exportation of their products; or, at least, the above amount, minus the profits on the imported goods? The value of cotton goods imported into the United States, after deducting the amount re-exported, was,

In the year	1844	$13,286,830
" "	1845	13,860,729
" "	1846	12,857,422
" "	1848	17,205,417
" "	1849	15,182,518
" "	1850	19,685,986

The value of the manufactured cotton goods re-exported from this country during the year 1850, was $4,734,424. This proves that the whole actual importation does not amount to much. As long as England, or the other European nations pay a fair price for raw cotton, which is at present the case, good policy would dictate to us to sell it, instead of insisting on manufacturing all that our wants require. The number of mills at present in operation cannot supply the home market, and the organization of new manufacturing corporations tends to the absorption of capital. The question, therefore, is, whether capital pays a higher rate of interest when invested in the production of raw cotton, than it does in the manufacture of cotton goods? Raw cotton seems to be, at present, the most profitable commodity, for,

The exports of raw cotton for	1850	have been	$71,984,616
" " " "	1849	" "	66,596,887
" " " "	1848	" "	61,898,294
" " " "	1847	" "	53,415,848
" " " "	1846	" "	42,787,341

This table exhibits the amount of profit derived from the culture of cotton. If the profits on the crop of 1846 were but $10,000,000, which is a reasonable estimate, the profits on that of 1850 must have amounted to $40,000,000. If our cotton factories, by the exclusion of foreign manufactures, can secure that profit to the Union, it will certainly be good policy to exclude all importations of cotton goods; provided, the factories can furnish the article in the market at the same prices, or lower than those of the foreign article. If we could not find purchasers at reasonable prices for our raw material, we should then act wisely in excluding all foreign goods.

The comparative idleness of our cotton factories is, no doubt, a lamentable prospect; but it would be unjust to charge this result to the General Government and the tariff alone. The advance in the price of the raw material, consequent upon the rapidly-increasing demand, and the partial failure of the crops, has as much a tendency to produce this effect, as the policy of the government: a high tariff would not have prevented the partial stoppage of our factories. The depression of the trade from the above causes is, after all, not so sensibly felt: this may be deduced from the following table, showing the number of spindles in the mills in the New England States, and the proportion of spindles remaining idle.

	No. of Spindles.		No. of Spindles.
Maine........	142,700...	Now idle..	112,500
New Hampshire,	373,000...	" " ..	135,000
Massachusetts..	1,220,000...	" " ..	202,000
Rhode Island..	500,000...	" " ..	212,000
Connecticut...	250,000...	" " ..	53,000
	2,485,700		715,000

This proves about one-third of the whole number of spindles to be idle.

If we compare the foregoing with the following, it will show that the manufactures in the New England States are not in such a bad condition as those of the Southern States, which is certainly owing to a natural cause.

A committee of the Manufacturers' Convention, held recently at Richmond, Va., state in their report, that there are twenty companies engaged in the manufacture of cotton in that State, with an aggregate capital of $1,800,000. These companies run 54,000 spindles when in full operation, all producing coarse yarn, not beyond No. 20. For some time past, these factories have run 22,000 spindles full time, at a reduction of 25 per cent. on the wages; 7000 spindles three-fourths of the time; and 8000 spindles one-third of the time: the remainder of the factories are entirely or partially stopped.

In Maryland, affairs are not much better than in Virginia. Out of 28 mills in that State, but two work full time; 18 work short time, and 8 are entirely idle. The total average product is less than half the capacity of the mills.

A great number of very importunate petitions are daily presented to Congress for an alteration in the existing tariff, which may effect some change favourable to the manufacturers of cotton goods. So far as spinners are concerned, we agree with the writer of an article, published in the "Scientific American" of December 7, 1850, and insert it here, convinced of the correctness of its views on the subject in question.

OUR MANUFACTURES.

"While the sounds of political agitation come floating upon every breeze, there are other objects and other interests which arrest our attention and excite our feelings. There is something sad, yea, even solemn, in beholding the dilapidated mansion, or the ruined homestead; and more than once we have been painfully thrilled at seeing a millstone in some lovely vale, lying silent and broken amid the debris of the once busy mill,—the stream still singing sweet, but no response coming from the laughing hopper or the merry wheel. With such feelings we now hear the reports of factories stopping and closing up their labours. There is no sight which conveys a deeper sensation of 'sadness lone,' than that of a factory, once jocund with the sound of an hundred voices, and the gleesome hurling of throstle and loom, standing, tall, deserted-looking and silent. The once-busy wheel, which gave motion to thousands of spindles, and hundreds of shuttles, stands gloomy and motionless, like a worn-out war-steed. The bell that once clanged cheerily at the evening hour, no more calls out hundreds of gladsome toilers, gushing home through the factory doors, to enjoy the evening's recreation and repose. There are many deserted oriental cities, which have no doubt been depopulated by war, famine, and pestilence; these have their counterparts in our suspended factories and noiseless mills. In them

> "'No more the spindle twirls the slender thread,
> No more the shuttle flies to win the worker's bread.'

"From Rhode Island, that busy cotton cloth-making hive, we learn that about seventy factories have stopped; from Lowell, and our eastern manufacturing villages, we hear the same ominous reports. In Maryland, in the Patapsco Valley, 'silence reigns' and even from the sunny south we hear of depression and suspension of manufacturing operations. From east, west, north, and south, 'the times are bad, the cotton manufacturers say,' and they say so truly. The important question in such a case is, 'What is the cause?' One says, 'a higher tariff is wanted;' another says, it is owing to the high price of cotton; and a few among the great many say, 'it is owing to manufacturing too many coarse goods.' The first question is a political one, and we therefore will not discuss it. The other two are so entwined together that we must and readily can establish their truth or falsity. If the demand for cotton cloth was equal to the supply, the high price of cotton would be paid by the consumer; for, if cloth must be had, it makes no matter whether its price be one shilling or one and sixpence. There is every reason to believe that the supply has been greater than the demand, for the coarse cotton manufactures of Britain have long been in a depressed state, the exports being less for the last two quarters in every kind of cotton manufacture: and taking this into consideration, along with the great number of our factories which have done but little for the past six months, we should have expected some clearance of goods in the markets, and a respectable advance in the prices, to meet the corresponding high price of cotton; but no such appearance of demand for goods is manifested, or rather, the markets are as glut-full of cheap goods as ever. The merchants always like to sell cheap; they care not for the manufacturer's interest, only give them cheap goods to sell. It is a commercial fact, too, that 'when prices are once lowered to a fixed standard for some time, it is almost impossible to elevate them above it, however great the necessity may be for doing so.' It is our opinion, that there have been too many of our factories engaged in making coarse cotton goods. At the North this is self-evident, for coarse goods can be manufactured cheaper at the South, and with the great number of factories now in operation in Georgia, Alabama, Tennessee, South Carolina, and some other States, how can it be expected that our northern manufacturers can long keep the field against them—they cannot do it. Leaving the political question out of sight, there is one remedy which we would suggest, that is, to go into the manufacture of finer fabrics, give your cotton more labour, employ more skill, and spend more for fine machinery. If you do not take our advice, there is a brave chance for you to lose all your machinery, factories and all. Cotton, at 6*d.* per pound, if it requires only the labor of 6*d.* to make it sell for 12*d.*, (the cloth weighing one pound we mean,) if the cotton rises in price to 12*d.*, then the goods would have to be sold for 50 pea cent. more, to meet the rise in the raw material. On the other hand, if cotton at 6*d.* requires 12*d.* labor to sell it for 18*d.*, then if cotton rises to 12*d.*, it requires only the advance of 25 per cent. to make the goods pay. Everybody knows that it is easier to get an advance on high than on low-priced goods; this is the reason, the advance is less in proportion than on the low-priced goods.

"It is difficult to get stockholders of joint-stock companies to make wise and reasonable changes in machinery, &c., even when backed up with urgent requests by able agents of factories; this is the reason why those factories are generally most successful, whose head stockholder has the ability, and is chief manager. We know of a factory, not above sixty miles from New York, the machinery of which has paid for itself over and over again; and although the very first quality of machines are made in the machine shop, for other factories, the old mill displays looms twenty-five years old. This should not be: our manufacturers must adopt some new measures, speedily and decisively. What we have suggested may not, if acted upon, result in a complete remedy for the evils set forth, but our suggestions are certainly of a remedial character; and we have no doubt that, if they were acted upon, many of our factories, with their machinery, spindles, and looms, now gaunt and silent like dry bones, would soon become animate with vitality, health, and prosperity."

REMARKS ON THE PLAN OF A FACTORY BUILDING.

DIMENSIONS OF THE BUILDING.

The dimensions of the building will, of course, depend on the number of spindles, or machinery, it is intended to contain. When this is settled upon, and the number, size, and dimensions of the Willeys, Spreaders, Cards, Drawing Frames, Speeders, Throstles, Mules, Spooling Machines, Warping Mills, and Looms, with the space they will occupy, ascertained, a plan is drawn out on an accurate scale; particular care being taken to arrange all the machinery in proper order, and in such a systematic method, as will prove the most advantageous in facilitating with despatch and convenience the several operations. The various machines must be placed so as to allow the necessary spaces for passages and stands for the hands. When this is done, the walls of the building are drawn on the same scale as the machines, around the machines. By these means, we obtain a correct knowledge of the proper dimensions of the building, together with the places where the shafts and machinery are to be placed, before a stone is laid. If this plan is adopted, it will save a great deal of confusion and trouble, attended with expense and loss of time. A building erected on this plan, will proceed on a sure and regular system; where there will be a place for everything, and everything in its place.

PLAN OF BUILDING.

Costly establishments have been erected, without taking the necessary precautions in the first place: they are ever after in a state of disorder and confusion, owing to the improper planning of the house, and injudicious placing of the machinery. It then becomes necessary to make alterations and changes in the position of the machines, or else work them to a great disadvantage; this might all have been prevented, by following the plan here laid down.

It is based upon an error, though a rather common one amongst Factory owners, that it is a saving and an economical measure, to pack as much machinery as possible into a given number of superficial feet, without paying regard to the necessary room or space required to work the machines to proper advantage.

The most convenient plan of making calculations relating to the Cotton manufacture, as to its produce, wages, and profits, and the extent, cost, and dimensions of the building, is by the spindle. The number of spindles in a factory were formerly limited to a small number. Previous to the year 1806, the number of spindles contained in a factory seldom exceeded 1000. In 1838, there were 28 factories in Lowell, containing 150,404 spindles, being a fraction over 5,371 spindles in each factory. At the present time there are two mills in Lowell, containining 17,140 spindles, but capable of accommodating, without looms, at least 28,000.

PICKING DEPARTMENT.

Buildings containing the raw cotton and waste, should be, if possible, detached from the main building: this arrangement decreases the risk arising from fire. It is preferable to place the cards on the first floor, as they will then be more convenient to the picking or spreading department; though it is the opinion of some persons that the throstles should occupy this floor, on account of their great weight, and also to be convenient to the moving power, as they require more power in proportion to the space and number of spindles, than any of the other machines used in a cotton factory, with the exception of the spreading machines. The carding room should be on a level with the picking rooms, on account of the necessity of a constant communication between these two departments. If these rooms are placed at a distance from each other, or not on the same level, a great deal of time must necessarily be wasted in the passage from one to the other. The lap-rollers should be carried directly from the spreading machines to the backs of the cards. Such an arrangement is very convenient for the master-carder, who can then superintend the picking department, without being necessitated to leave his room frequently. It will also prove convenient in clearing the carding room of waste, to be mixed with the cotton in the picking department.

The picking house must be fire-proof, little or no wood being used in its construction. The floors must be made of brick, as well as the ceiling, which must be arched. It is important that every precaution should be taken to prevent the occurrence of fire, which, owing to the rapid motion of the machines in this department, is readily created by the friction, if constant attention is not paid to the lubrication of the machinery.

HOISTING PASSAGE.

An easy and convenient mode should be adopted for conveying the rovings from the carding room to the spinning rooms, so that labour and time may be economised. The proper time for attention to this matter is when drawing out the plan of the factory. Apertures should be left open from the carding room through all the spinning rooms, about the centre of the building, and adjacent to the side wall. These openings may be of the dimensions of three feet six inches by one foot six inches, carefully railed around, to prevent accidents; there should also be clear passages leading to them in each room, to serve for the transportation of the boxes to and from the hoisting machines. The stairs should always be placed on the outside of the building.

It is obvious that the particular arrangements of the various departments, and the order in which the machinery is placed, will have a considerable influence upon the productiveness of large establishments. The advantage of having them arranged in the best manner which practical experience can suggest, is so evident, that it requires no other argument than sound common sense to prove it.

DIMENSIONS OF A BUILDING FOR FIVE THOUSAND SPINDLES.

The following dimensions of a factory building are not intended as a perfect model, because the situation and nature of the ground, and the space occupied by the building, will always have their influence upon the drawing of the plan, or the decision as to the precise form or shape of the edifice. Some of the proportional measurements may, however, be safely relied upon; such as the height of stories, thickness of walls, sizes of girders, joists, windows, doors, &c.

	No.	Feet.	In.
Length of building inside, in the clear....	..	144	
Width of building inside, in the clear.....	..	44	
Floors, including the basement and attic...	6	..	
Windows in the face of each story	16	..	

	No.	Feet.	In.
Windows in the end of each story	4	..	
Width of windows, including sash frames	..	3	4
Width between windows, outside	..	5	6
Height of windows* from sill to lintel	..	5	10
Height of window-seat from the floors	..	2	6
Windows in the four stories	160	..	
Height of cellar story from floor to floor	..	9	1
Height of carding room from floor to floor	..	11	2
Height of throstle room from floor to floor	..	11	
Height of reeling room from floor to floor	..	10	10
Height of mule room from floor to floor	..	10	4
Height of attic, (thirty feet in the centre)	..	10	4
Joists across the building	33	..	
Depth of joists	..		9
Thickness of joists	..		3
Girders† through the house	15	..	
Depth of girders	..	1	2
Width of girders	..	1	
Distance from centre to centre of joists	..	1	3
Distance from centre to centre of girders	..	9	3
Thickness of walls in the cellar	..	3	6
Thickness of walls in the carding room	..	3	
Thickness of walls in throstle room, 3d story	..	2	8
Thickness of walls in reeling room	..	2	4
Thickness of walls in mule room	..	2	
Height of doorways in rooms	..	6	7
Width of doorways in rooms	..	4	
Width of stairs	..	4	4

* Each window contains twenty-four panes, eight inches by ten.

† An upright, nine inches square, or iron column, is required under the centre of the girders in each story.

	No.	Feet.	In.
Breadth of stair steps....................	..	1	
Depth of stair steps....................	..		7
Height of outer door	..	7	
Width of outer door	..	4	1
Height of hoisting doors in each story	..	7	
Width of hoisting doors	..	4	7
Diam. of upright steam pipe used as heater ..	..		8
Diam. of horizontal steam pipe " " ..	..		7
Distance of horizontal pipe from the floors...	..	6	8
Length of boiler	..	10	7
Diameter of boiler......................	..	5	
Length of picking house..................	..	40	
Width of picking house	..	26	
Length of stairs in factory...............	..	21	
Width of stairs	..	4	

REMARKS ON THE MAIN GEARING.

HORIZONTAL SHAFTS.

In putting the horizontal shafts in a factory, single hangers are preferable to double ones, as it is almost impossible to make the latter work true, or the couplings to run well. There is a diversity of opinions amongst mechanics, regarding the advantages of upright shafts as a means of communicating motion to the machinery, compared with large belts.

CONVEYING POWER BY BELTS.

Large belts, passing from a drum on the water-wheel or steam-engine shaft, are preferable to the old system of gearing a mill with vertical shafts. Where there is a ponderous horizontal shaft, passing from the water wheel or steam engine the whole length of the factory, connected at regular intervals with four or six heavy vertical, driving, through all the stories, as many horizontal shafts, a considerable amount of friction and loss of power will ensue. In those establishments which have substituted belts for the ponderous shafts, the change has been found beneficial. Of course their recommendation induced the projectors of new factories to adopt the belt system. But, notwithstanding all that can be urged in their favour, a factory properly geared with an upright shaft, adjusted on correct mechanical principles, is, in many respects, preferable to the belt system.

GEARED BY WHEELS.

In a factory of 150 feet, or upwards, in length, the first joint of the upright shaft, gearing into the water wheel, or the steam engine, will necessarily be about 8 inches in diameter; the second joint, or story, 7 inches in diameter; and decreasing the diameter in this manner 1 inch on each joint, until it reaches the fifth; the diameters will then be, 8, 7, 6, 5, and 4½, respectively. The horizontal shafts in each story, or at least in the carding and throstle rooms, should have the following proportions. The first joint, where the pinion is fixed to work into the crown-wheel, should be made of wrought iron, and be 3 inches in diameter; the two succeeding joints, 2¾ inches each; the two next, 2¼ inches each; and the two last, 2⅛ inches. Where the joints are nine or ten feet in length, and have to carry heavy iron pullies in the middle, they should never be less than two inches in diameter, otherwise they will be liable to spring or vibrate.

COUPLINGS.

The couplings should each have a hold on the shaft, four inches in length, fastened with steel keys, fitting in key-beds. That part of the coupling which connects with the shaft had better be made round, and be cast in one piece; this is preferable to having them divided, or, where one-half the coupling is fastened to one shaft, having them divided into two parts, and put together by four bolts—this makes them clumsy, and they are apt to break at the bolt-holes. Couplings put together by six or eight bolts, are more suitable for the large upright shafts, and are convenient for use on them, on account of their being more readily removed; whereas, the round couplings on the horizontal shafts can be easily uncoupled, by merely withdrawing the keys.

TO DISCONNECT THE GEARING.

It is very necessary that the gearing end of each horizontal shaft which gears into the crown-wheel on the upright shaft, should be so constructed, with its pedestal or bearing, that, having a moveable joint at this end, it may be raised, or dropped out of gear at a moment's notice, in case of the occurrence of any accident to either the belts or shafts, the slipping or breaking of keys or bolts, or in the event of any person being caught in the machinery. This plan affords the means of preventing many serious accidents to individuals and machinery. It is sometimes necessary to run a particular part of the machinery in a factory, and stop the rest, for the purpose of making repairs, otherwise, an accidental break might partially suspend the operations of the factory; a steam engine may be required to start early in the morning for the purpose of pumping water; or, in a severe winter, it may be expedient to run a water wheel all night to prevent its freezing. On any of these occasions, if there is no convenient apparatus for throwing the shafts out of gear, all the main horizontal shafts, counter-shafts, loose pullies and belts will be kept running, subjecting them to wear and tear, and perhaps result in some serious accident to the machinery. Some of the belts in almost every factory have a tendency to run on the fast pulley, and set the machines in motion to which they are attached. Any one who has been employed for even a short time in a cotton factory, can bear evidence to the disorder and confusion of a carding or throstle room in the morning, when the motive power has been used during the night for some necessary purpose. Several cards, drawing-frames, and speeders will be found in a deplorable condition, and perhaps several throstles in motion, the belts of which happened to run on the fast pulley, thereby putting the machines in motion. In this case, all the rollers, both top and bottom, the journals, cranks, &c., become lapped with waste and cotton; several articles are forced out of their places, and perhaps other parts strained or broken. In addition to all this, the waste made, and the consequent loss of time, is considerable. All this trouble, damage, and loss can be easily prevented by a simple dis-connecting and connecting lever, attached to the pedestal of the gearing end of each horizontal shaft. No factory should be without this very necessary and useful apparatus.

Every machine should be composed of as few parts, and those of as simple a character as possible — just sufficient to answer the purpose; not only because it diminishes the cost of making and repairing, but it will be less liable to get out of order, and it is needless to do a thing with many parts when it can be done with a few.

EXAMINATION OF MACHINERY.

Particular attention should be paid by the superintendent in person, or by some trustworthy mechanic, to a careful examination, two or three times each week, of all the gearing, head-stocks, plumber-blocks, bridges, pedestals, stays, braces, keys, bolts, nuts, &c., in short, everything connected with the gearing, to ascertain if anything is out of order, or needs repair. The loosening of a nut or a key has often caused considerable damage and loss of time, by breaking pinions, shafts, couplings, &c., thus stopping a great part, if not all of the works, for several days or weeks, occasioning a great loss to both owners and operatives.

LUBRICATION.

All the journals of the gearing and shafts should be carefully oiled every morning and noon. For this purpose, tallow should be kept on all the journals of the horizontal shafts. A very good lubrication for journals that are liable to heat to such a degree as to endanger ignition, may be compounded of common salt and tallow, well mixed together. Tallow, black-lead, and sulphur, mixed together, is often used for the same purpose; this is a good composition to apply to the teeth or cogs of new gearing and new journals; it reduces the friction, smooths the parts, and makes them run easy. Care should be taken not to apply too much oil or grease, as it will only be a waste of an expensive article, and cause a disagreeable deposit of dirt, which should be as much as possible avoided. All the wheels, hangers, shafts, pullies, &c., should be particularly well cleaned every Saturday; indeed, they should be occasionally cleaned through the week, so that they may be kept, at all times, in good running order.

HEAVY MACHINERY NEAR THE MOVING POWER.

In setting out the gearing of a factory, it should be the object of the engineer to place the heaviest machinery nearest the moving power; as, in the communication of motion to distant machinery, not only the weight of the shafting must be taken into consideration, but also the friction which exists in all the different bearings, and which is greatly increased by any small obstacle placed beyond those bearings. Care should likewise be taken to make as few bearings as possible; still, retaining in view the necessity of preventing the shafts from swagging. If the shaft had nothing to move beyond its own weight, rules might be laid down for the distances of the bearings; but, having to carry various sized pullies, both their weight and that of the pullies at the machinery to be driven, must be estimated, in order to arrive at a correct conclusion: rules, therefore, are out of the question. To have a bearing too many, however, is preferable to allowing the shaft to bend or swag, as it will then be impossible for it to run true in its steps or journals.

SIMPLICITY OF MACHINERY.

In forming couplings, great care should be taken to make them fit well, so that the coupled shaft may move as though of the same piece with the driving-shaft: nor can simplicity be too strongly recommended, so that the coupled shaft may, in case of accident, be instantaneously disengaged; for, the loss of time which is the result of any accident, is a matter of serious importance to the manufacturer. Couplings should be placed near the bearings, as at those places there is the least swag, and the shaft is, of course, always weakest at the couplings.

PULLIES.

The same observation is applicable to the arrangement of wheels and pullies. Pullies have been formed in two halves to facilitate their being placed on the shafts, and where it is difficult to take them down; for instance, putting a pulley on an upright main shaft, to drive the governor, and in other similar cases. But their adoption is by no means general, as there is some difficulty in adjusting them to run true while the shaft is in its place.

BELTS.

Belts to drive shafts in place of wheel-gearing, should be avoided whenever wheels can be substituted, as belts are liable to stretch and break, and do not transmit a regular, steady motion. In fixing the wheels and pullies upon a shaft, it is usually done by driving wedges or keys in the bush of the wheel or pulley.

SHAFTS TO BE TURNED.

In most of the factories now, or of late years, the horizontal shafts are all turned true in a slide lathe, and the hubs of the pullies bored out to fit each particular shaft, with a key-bed, filed or cut through the entire length of the eye or hub, and also the whole length of the shaft.

HOW TO FASTEN PULLIES.

The pulley is made to fit closely, so that it may be moved on the shaft to any place it is wanted, and the key is driven in tight. Sometimes one or two holes are drilled through the hub, and taped with pinch-screws. These screws are fitted in with square heads to suit a wrench, by which the pullies are fastened on the shaft. Either plan of fastening, whether by keys or screws, will answer. The key is preferable where the pulley has to drive machinery requiring considerable power, such as throstles, pickers, spreading machines, or counter-shaft pullies; screws being more liable to give way in such cases. Wheels are usually fastened on with four keys; they should be put on very true, otherwise, they will back-lash, and wear the wheels irregularly.

If the pulley is not true, it will communicate an irregular motion to the belt that runs on it, and will therefore cause an irregular stress upon the shaft on which it works, much to the detriment of the bearings. Shafts and pullies should be circular, and turned smooth and bright; they are then less likely to catch anything, and have a much neater appearance; besides, the pullies can be moved with greater ease and despatch.

CASINGS AROUND WHEELS.

A round form is certainly the best for couplings, for the same reason which assigns a preference to round shafts. The wheels of the gearing should always be enclosed in a casing of wood, sheet-iron, tin, or zinc, to prevent anything from falling into the teeth, or the oil and grease which is applied to the cogs from being scattered about, and to decrease the risk of accident to persons having business about them while in motion. The wheels should be oiled by brushes resting upon their faces, as this method distributes the oil more equally, and keeps it between the teeth. When new wheels are about to be started, some mill-wrights mix up a little fine emery with the tallow or grease, as it imparts a fine, smooth face to the teeth.

REMARKS ON WATER-WHEELS.

EFFECT OF WATER-WHEELS.

Water-wheels are of various kinds: those most in use are over-shot wheels, breast-wheels, under-shot wheels, tub-wheels, and horizontal reaction wheels. The relative merits of these various wheels have long been a matter of dispute among mechanical philosophers; the controversy being as to which wheel a given quantity of water will produce the greatest effect upon. Smeaton and Evans were of the opinion, that the ratio of power derived from a given quantity of water, when applied to the different wheels under similar circumstances, was nearly as follows: for every 100 pounds of water discharged upon an over-shot wheel, a power is derived equal to 68 pounds, or 68 per cent. The same amount, applied to a breast-wheel produces a power equal to 52 per cent.; to an under-shot wheel, 34 per cent.; and to a tub-wheel, 25 per cent. And it has been proved by a series of experiments on some of the horizontal reaction wheels, that they do not convey a power greater than 12 per cent. of the water used; while other wheels of the same description effect as much as 75 per cent.

BREAST-WHEELS.

Where the fall of water is less than eight feet, breast-wheels with open buckets are found to be more powerful than those with close buckets, under an equal force of water. Want of air is no impediment to wheels with open buckets; but wheels having close buckets are always in a greater or less degree affected by it.

SPEED OF WATER-WHEELS.

It is said that a water-wheel will overcome the greatest resistance, with a given quantity of water, when the circumference of the wheel is calculated to move at a velocity of six feet per second. When a water-wheel moves too slow, the least addition to or diminution of the work, by stopping and starting the machinery, creates an irregularity in the movement of the wheel, which is very prejudicial to the machinery propelled by it. A wheel, moving at the above-mentioned speed, would be but slightly affected by the throwing off or on of machinery. With a 12 feet wheel, the speed just mentioned would be equal to 10 revolutions per minute. In this case, it would be better to drive the wheel faster, than slower. It is an established rule with the best mill-wrights, to allow 3 buckets to each foot in the diameter of the wheel. A wheel 12 feet in diameter should contain 36 buckets.

MASTER-WHEEL.

When water-wheels are used as a motive power, the segments of the cog-wheel, or master-wheel, should never be put around the rim, it being the very worst place that could be selected. Such an arrangement causes the journals and axles to give way, loosening and straining all the timbers of the wheel. It also occasions a loss of power. A pit-wheel should be put on the axle, at some distance from the rim of the water-wheel, say about two feet; then it will, if separated by a partition, run dry. A water-wheel of 12 feet diameter, would require a pit-wheel of about 5 feet 6 inches diameter. Mill-wrights have a rule for discovering the true diameter of the pit-wheel, which is in accordance with the diameter of the water-wheel.

REGULATOR OR GOVERNOR.

The regulation of the motion of a water-wheel or steam-engine used in spinning cotton, is of very great importance, particularly in a large mill. Where there is a large number of machines employed, many will frequently happen to be disengaged at the same time. This tends to diminish the resistance to the power of the first mover, which will now run with increased velocity, producing injurious effects on the operations of the machinery. In a factory filled principally with, or containing a large number of mules or power-looms, there will be a continual fluctuation in the velocity of the first mover; it will either work too slow or too quick, if there is no governor to regulate its motion. A very ingenious contrivance has been invented, which, when properly constructed, will counteract the causes of irregularity; and the engine of a large factory, so regulated, will move, with regard to the uniformity of its motion, like clock-work. Regulators or governors are constructed on various principles. Those most commonly in use are made of two balls, which approach and recede from each other by the operation of the centrifugal force. These balls are suspended from an upright shaft, on two iron rods, fastened by a hinge at the upper end to a movable collar. Two other rods are connected from the middle of the ball rods with a movable collar at the bottom of the upright shaft. When by a slow motion the balls contract, the collar, to which a gearing is attached, descends and connects with a gearing attached to the water-gate or steam-valve, and raises the gate or opens the valve. When the motion becomes too rapid, the balls expand and raise the collar, which now performs a contrary movement, lowers the gates or shuts the valves, and restores the velocity to its required uniformity. The governer is driven by a strap from a pulley on the main shaft. No cotton or woollen factory should be without these extremely useful, and, we might say, indispensable articles of machinery.

CALCULATIONS OF HORSE-POWER FOR PROPELLING COTTON-SPINNING MACHINERY.

SPINDLES DRIVEN BY ONE-HORSE POWER.

The following has been proved by numerous experiments, to be the effective result of a one-horse-power, applied to the propulsion of cotton machinery. The standard of Bolton and Watt—32,000 pounds lifted one foot high per minute, although it represents a much greater power than that of an ordinary horse—from having been the first introduced into use, has been generally adopted. It is of great importance to have one determinate rule for the measure of power, that will, under the most unfavourable circumstances, give a result equal to the power of a horse.

A one-horse-power is calculated to drive at an average speed, 100 throstle spindles, on No. 25 cotton-yarn twist, including the necessary preparations.

A one-horse-power will drive 250 mule spindles, with preparation, on No. 25 yarn filling.

A one-horse-power will drive 500 mule spindles, with prepation, on No. 60 yarn filling, and for intermediate numbers in proportion.

A one-horse-power will drive 12 power-looms, with warping, sizing, &c.

HORSE-POWER.

Smeaton states that a strong horse is able to lift, by means of a pump, 250 hogsheads of water, of 63 gallons each, 10 feet high, in one hour at the maximum. Twelve gallons of water weigh 100 pounds. Thus, the actual weight of water lifted, is at the rate of 22,000 pounds raised one foot per minute. The standard of a horse-power, as above stated, is 32,000 pounds, raised one foot high per minute.

WATER-WHEEL AT LOWELL.

At Lowell, Mass., 24 cubic feet of water per second, with a fall of 30 feet, has been found sufficient to operate 4000 spindles, with all the preparatory machinery for spinning cotton yarn, No. 30's, together with the looms necessary for weaving the same. This makes an average of about 100 spindles to each horse-power.

DEAD AND LIVE SPINDLES—DIFFERENCE IN POWER.

The spindles in use at Lowell are all of the description denominated dead spindles, requiring more power to operate them than the common live throstle spindle. The difference of power required for the dead spindle, is as 4000 to 4400. Calling 4000 dead, equal to 4400 live spindles, the power required to operate them, together with the necessary preparatory machinery, will be

Equal to that of	44	horses
144 looms, (at 12 looms to the horse,).	12	"
	56	"

A calculation of the efficient power of the quantity of water used, 24 cubic feet per second, with a fall of 30 feet, is here given, to show that the estimates of the power required to operate an equal amount of machinery, will nearly coincide with that actually imparted by the water-wheels.

CALCULATION OF HORSE-POWER IN WATER-WHEELS.

Twenty-four cubic feet of water per second is equal to 1440 cubic feet per minute. $1440 \times 62\frac{1}{2}$, (the latter is the weight in pounds of each cubic foot of water,) gives in pounds $90,000 \times 30$ feet, the fall of the water; this is $= 2,700,000$ pounds descending one foot per minute; deduct one-third for the loss of power by friction and otherwise, in applying the weight of water to the wheel, &c., and dividing the remainder by 32,000 pounds, (Bolton and Watt's standard,) gives $56\frac{1}{4}$ horse-power. At the Hamilton Mills, in Lowell, where the fall of water is only about 12 feet, the same quantity of machinery is operated by using 60 cubic feet of water per second.

The $56\frac{1}{4}$ horse-power required for one of the above mills, would be sufficient to put in motion 15,600 mule spindles, with preparation for spinning yarn as fine as No. 110, or above 10,000 mule spindles for spinning yarn for twist and filling, as fine as No. 48, together with 400 looms to weave the same.

STEAM-ENGINE IN AN ENGLISH FACTORY.

It is partly in consequence of the great expense of the power necessary to operate throstle spindles, that the throstle twist commands a higher relative price than yarn of the same number spun on mules. One of the most extensive cotton mills in Manchester, England, contains 90,000 mule spindles, employed in spinning yarn, from 200 to 250 hanks to the pound, propelled by two steam-engines, rated at less than 80 horse-power each. Those two engines use from four to five tons of coal per day: good coal for this purpose costs in Manchester about $2 20 per ton. The steam-power, therefore, does not cost much in proportion to the work performed.

STEAM-ENGINE IN AN AMERICAN FACTORY.

One of the mills at Gloucester, New Jersey, opposite to Philadelphia, contains 15,000 mule spindles, and 315 power looms, spinning yarn from No. 26 to 30. The machinery in this factory is driven by a steam-engine made by I. P. Morris & Co., Philadelphia, which consumes four and one-half tons of anthracite coal in twelve working hours. This result is still better than the above. It does as much spinning as the English mill, and runs 315 looms in addition, which is equal to 30 horse-power more than the English engine.

WILLEY, OR PICKING MACHINE.

This machine is used for opening and mixing the cotton and waste, and preparing it for the spreading machine. When well constructed, on a proper plan, they are very useful machines, and of great service in opening, mixing, and cleaning cotton. We shall describe two kinds, constructed on quite different plans.

M'CREDY'S WILLEY.

	Ft.	In.	Teeth.
Length of frame	4		..
Width of frame	3	6	..
Diameter of cylinder	2	8	..
Width of cylinder	2	5½	..
Number of steel teeth set in cylinder			.. 196
Length of teeth*		4¼	..
Square taper part, sunk in cylinder		2	..
Round taper part, that projects and opens the cotton		2¼	..
Thickness of round part at shoulder		½	..

This Machine is driven by the following Wheels.

	Ft.	In.	Teeth.	Rev.
Diam. of pulley on main horizon. shaft,	3		..	.. 82
Driving a counter-shaft by pulley of	1		..	.. 246
Driver-pulley on counter-shaft	1	8	..	.. 246
Diameter of pulley on axle of willey	1		..	.. 410
Diam. of pulley on other end of axle		2½	..	..
Driving a pulley of	1	4	..	..
A pinion attached to this pulley			.. 26	..
Working into a fluted roller wheel of,			.. 120	..
Pinions on fluted roller wheel, each			.. 30	..
Carrier steed, or intermediate wheel			.. 30	..
Pinion on feeding-cloth roller, and length of feed	3	6	.. 28	..

* These teeth are turned off to a smooth obtuse point; they are placed in the cylinder twill fashion, or zig-zag, thus,

. . . .

. . . .

. . . .

DESCRIPTION OF A WILLEY.

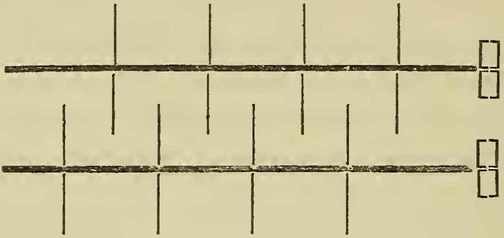
There are thin slips of wood screwed to the cloth, about nine inches apart, and running on the surface of the cloth, across its whole width. These are to keep the cloth in shape, and prevent it running from one side to the other of the feeding frame. The cloth is liable to run, if strips of wood are not fastened on. Squaring the roller, or attaching cords or leather straps to the sides of the cloth, will seldom prevent it from running irregularly. There is a coarse, curved wire grating, or else a grating of tin tubes, half an inch in diameter, fixed under the cylinder, reaching from the fluted rollers to the other end of the frame, at which the cotton comes out: this is at the distance of about two inches from the points of the teeth in the cylinder. This grating is for the purpose of letting seeds, dirt, and sand drop from the cotton, as it passes through into the receiving box. These machines will open and clean properly 2000 pounds of cotton per day, if a proper degree of attention be paid to them.

DESCRIPTION OF A PATENT WILLEY.

This machine is in general use, and seems to have the preference, on account of the small space it occupies, as well as for the simplicity of its construction. With the exception of a pulley on each of the two axles, it has neither wheels, rollers, nor pulleys about it. It is a very compact little machine, of the following dimensions:—

	Ft.	In.	Rev.
Length of framing, or boxing of machine...	3	..	
Width of framing	1	6 ..	
Diameter of pulley on main shaft.........	3	..	100
Diameter of driver-pulley on counter-shaft ..		10 ..	360
Diameter of " " ..	2	4 ..	1680

The working apparatus, enclosed in the oblong square box, stiffened with cast-iron framing, are two stout iron or steel axles, running across the frame or box; they are on a level, and parallel with each other. There are four stout steel teeth in each axle, about ten inches long, five-eighths of an inch thick, and round in the middle. These teeth run through the axles, and form eight teeth in each axle; they are round, and tapered off a little, so as to form an obtuse, smooth point. These teeth are so arranged, as to pass between the spaces of the opposite row, in the manner shown in the annexed figure.



There are also four setts of teeth, thinner than those just alluded to, fixed or screwed into four wooden bars, which run across, and are inside of the casing, parallel to each other, and to the cylinders and axles. These teeth pass between the teeth on the axles, their thin edges facing towards the axles. They assist in holding the cotton, while the running teeth open, loosen, and clear it. Cotton is fed into the cylinder through an aperture in the top of the casing, having a backward slant, 2½ inches wide and 14 inches long. The cotton is driven out by the rapid motion of the cylinders, which both run in the same direction. It is necessary that this machine should be driven at a great speed, or it will not open the cotton and drive it out in a proper manner. They will not operate properly at a less speed than 1600 revolutions per minute.

A grating is placed under the axles, to permit seeds, dirt, and sand to pass from the cotton. This should be made of tin tubes, three-eighths of an inch in diameter, and placed at the distance of about one-fourth of an inch asunder. Smooth, round wooden rods or bars, placed in the same manner, would answer the same purpose on any of these machines; the chief object of this grating being to let as much dirt as possible pass from the raw material. Many of these machines do not work well; this is apparent to any one who has seen the vast quantity of rough, heavy seeds and foreign matter, which is thrown out of the cotton by the beaters of the spreading machine, after it has passed through the patent willey. One of these machines, if properly attended, will clean from 2500 to 3000 pounds of cotton per day.

REMARKS ON WILLEYING COTTON.

These machines should be set level, square, and solid. All the bolts and nuts should be examined, and carefully screwed up, and everything made secure. The box or bin into which the cotton passes on leaving the willey, should have round wooden bars, as thick as the handle of a sweeping-brush, laid on its bottom, and in such a manner fixed to the bin in a movable frame, that they can be raised about three inches from its floor. These bars should be separated about a half, or three-fourths of an inch; and, if not round, should be bevelled off on the top, to prevent the dirt from lodging on them,—they should have a triangular form. It is almost incredible what a vast amount of dirt and sand will be found under this grated floor, when it is removed for the purpose of cleaning out the apartment, which should be done every Saturday.

5*

MIXING RAW COTTON.

If these machines are constructed with feeding-rollers, they should be as near as possible to the teeth of the cylinder, leaving just space sufficient to prevent their coming in contact when the cylinders are running at full speed. From six to eight bales of cotton should be opened at one time, and an equal quantity taken out of each bale; this must then be shaken or spread out on the floor, in alternate layers, one over another, and formed into a pile convenient to the feeder of the willey, care being taken to mix the cotton thoroughly. This plan may be pursued until the bales are emptied, when the same process is renewed.

These remarks have an equal application to those factories in which no willey is used, and in which the cotton is placed on the spreading-machine or the cards, without having passed through the preliminary operation of willeying.

MIXING THE WASTE.

The waste which is made throughout the factory can here be mixed with the raw cotton in the most regular manner, rendering it suitable for the different kinds of yarn spun in the factory. The finer the quality of the yarn, however, the less waste will it bear; and very little is put into fine yarn, unless it be good waste from the fronts of the cards, or some of the best drawing-frame waste, from the first head, because waste has a direct tendency to weaken the yarn.

WASTE WEAKENS THE YARN.

The greater the number of operations the waste has passed through, the more its weakening tendency is increased. The best waste is that of the card-flyings, where there are no screens to the cards, cylinder strippings, and the drawing-frame waste, particularly that made at the first head. The waste from speeders, mule and throstle waste, if soft, and roving waste, should be mixed in with the cotton for coarse yarn or filling. All the waste that is fit for use should be carefully collected each evening, and every particle mixed with the different qualities of cotton, to be used the next day in the manufacture of the various descriptions of yarn. This should be done with the utmost regularity; and a proper attention to this process will be the means of keeping the roving more uniform and regular, which is an essential object. The use of too large a quantity of waste at one time, will make the stuff and yarn finer and weaker, and cause it to spin badly. This subject requires the careful attention of the manager and master-carder, as much as anything else; and it is next in importance to preventing the formation of waste. The person who attends the willey or picker, should take the cotton from top to bottom of the pile, beginning at one end or side of it, so that all the different layers may be cut through, and an equal portion of each taken. In feeding those machines which have feeding-rollers, the attendant should be careful to spread the cotton regularly and evenly on the feeding-cloth; for, if some portions pass in thick lumps, and it is laid on thinly in other places, the lumps have the bad effect of choking the rollers, and the loose parts fly through without being acted upon by the teeth of the cylinder.

GRATING TO BE KEPT CLEAR.

The grating below the cylinder must be kept free from flyings, waste, and dirt, so as to allow a free passage for seeds, sand, and other impurities from the cotton. The mouth of the machine should be carefully kept free and clear of cotton, for if this passage to the box, through any inattention, becomes filled up, the cotton will be carried around and around by the cylinder until it becomes completely spoiled, or strung, as it is termed in the cotton-spinners' phraseology.

STRINGING COTTON.

Stringing renders cotton altogether unfit for carding and for yarn, although it should be thrown into the waste-bag. Great care should therefore be used, to keep this machine and all the journals clean; the journals should be carefully oiled every one or two hours, as occasion requires, all the cotton-waste kept in order, and everything placed snugly in their respective positions.

BETTER NOT TO MIX WASTE WITH COTTON.

The best cotton factories do not mix their waste with the good cotton, for the reason that it always proves to be more or less injurious to the quality of the yarn. In coarse numbers, say from No. 10 to 15, waste may be used; but, in numbers above 20, it should never be mixed in the yarn. In these cases, the waste should be carded, and applied to the spinning of coarse filling. Coarse cards, without flats, are used for carding waste.

SPREADING-MACHINE.

This machine is one of vast importance in the manufacture of cotton, both for the correctness of its operations, and as a labour-saving machine. If, in the performance of manufacturing operations, machinery is superior to manual labour, then the spreading-machine bears off the palm of perfection in mechanism. To produce the best result with a spreading-machine, it is requisite that particular attention should be paid to the proper mode of managing it. The regularity and precision of the work in the various branches of carding, drawing, roving, and spinning, is in a great measure dependent on the careful manner in which the cotton is weighed and spread to this machine.

MACHINES WITH THREE BEATERS.

Spreading-machines constructed with three beaters, on a level with each other, and a rolling wire cylinder placed after each beater to lay down the cotton, may be considered very good machines. They are provided at the first beater with four fluted steel rollers, placed in pairs, thus forming two setts. These setts are placed at a distance of two and a half inches apart, measuring from centre to centre. The draught between these two setts of rollers is in the proportion of 1 to $2\frac{1}{4}$ or $2\frac{1}{2}$; this is added to the draught in the machine. The other two beaters have each one pair of fluted rollers to deliver the cotton to them. At the end of the machine there are two pair of cast-iron calender rollers, three inches in diameter. The two rollers which carry the card-lap roller, are cast-iron cylinders, hollow and fluted, about seven inches in diameter. All the rollers have a heavy pressure on them, by means of strong wire springs. The machine is either built entirely of iron, or of heavy ash framing. Each cylinder consists of an axle and two beaters, and is provided with a wooden cover. The other parts of the machine are made of wrought and cast iron, and must be strong, and well put together.

SPEED OF MACHINE.

A spreading-machine may be driven at a speed of 1675 revolutions per minute, to keep twenty-four cards in lap-rollers. If more cards, say twenty-eight, are required to be fed, the speed of the beaters may be increased to 1900; the feeding being also proportionally increased, to enable the machine to keep the cards running. The speed of the card-feeding rollers must be retarded in proportion to the increased weight of the lap. The speed of the spreader-feeding and calender rollers is often increased at the same time with the speed of the machine; but this is injudicious, as it does not allow of proper time to weigh and feed the cotton as it should be done. Irregularity is always the result of too great a speed. It is better for the machine, if the speed of the beaters does not exceed 1500 or 1600 revolutions per minute, and the other parts in the same proportion. There is a medium in the speed of these machines, to exceed which proves to be injurious to both the machine and the work; this is, however, often done, regardless of the consequences. It is certainly a decided advantage to drive the machine at as great a speed as is consistent with the proper performance of the work; but it is an erroneous idea, to suppose that the true method of deriving profit from these machines is, to overdrive them in such a manner as to make waste, and wear out good machinery in the course of a few years. The contrary effect will result from such a pernicious system.

DIMENSIONS OF A SPREADING MACHINE.

	Ft.	In.		Rev.
Length of a spreading-machine, including			..	
feeding-table	19	6	..	
Width of spreading-machine for 30 in. cards,	3	6	..	
Diam. of driving-pulley on main horizontal			..	
shaft	3	6	..	100
Diameter of driven pulley on top shaft....		10	..	420
Diameter of driving pulley on top shaft ...	1	6	..	420
Diameter of driven pulley on the beaters ..		4	..	1890
Length of feeding-cloth.................	12		..	
Width of feeding-cloth (for 30 inch cards),	2	4	..	
The feeding-cloth is divided into 3 spaces,			..	
by black lines; length of each	4		..	
Pulley on the end of top shaft, which drives			..	
feeding-rollers, rolling wire cylinders, ca-			..	
lenders, rollers, &c.		4	..	

On each marked space on the feeding-cloth a certain weight of cotton is spread, varying according to circumstances from one pound two ounces, to two pounds two ounces.

The pulley which drives the feeding-rollers may be increased in size by nailing leather around it, if it is found advantageous to feed stronger. It drives all the rollers, by means of side, bevel, and spur gearing. By diminishing the size of the pulley, the speed of the rollers will be decreased, and they will feed and deliver slower; an increase of its size will produce a contrary effect.

REMARKS ON SPREADING COTTON.

TIME TO FEED.

The bad effects resulting from over-driving the beaters, and increasing the size of the pulley, have been previously alluded to. An extraordinary speed does not allow the operatives time to weigh and feed the cotton properly; they are too much hurried to do it well, and make good picking of the different weighings. If the boy at the scales takes time to weigh and feed the cotton correctly, the cotton on the feeding-cloth will be run through in the same, or nearly the same time. If a thin place is made on the feeding-cloth, there will be one in the card-lap; for, as a part of the marked space of four feet is run empty or thin, the cotton will be too thick on the remaining portion of the space.

CONSEQUENCES OF BAD FEEDING.

To remedy the improper spreading of the cotton on the feeding-cloth, the person in attendance takes up a handful of cotton at random, puts it on the scales, and throws back into the cotton-box the overplus. It very often happens that all the weighing is crowded on too short a feeding space, when the machine is running very rapidly, without any order or regularity, there not being sufficient time to lay it on properly. It is impossible to make even or fair yarn, when work is done in this manner. The feeding-table should stand next to the cotton-box of the willey; it then prevents the trouble of carrying cotton backwards and forwards, at the risk of dropping it about the floor.

WEIGHING THE COTTON.

The scales should be suspended over a bench, fixed into a part of the cotton-box; and the picking-house should be so arranged as to facilitate the ingress of the cotton bales. All the machines should be placed as conveniently as possible; the calender rollers should also be arranged near a passage for conveying the lap-rollers to the cards. The picking department is a very important branch of a large cotton factory, but is too often overlooked, being regarded by many manufacturers as of very little consequence. Those who have had much experience in superintending cotton factories, know that it is of great moment and utility to have a convenient and systematic arrangement of this kind of machinery.

FEEDING-CLOTH.

The feeding-cloth of this, as well as all other machines, should be always provided with light strips of wood, fastened to, and across the full width of the cloth. These strips may be about three-fourths of an inch wide, and one-fourth of an inch thick in the middle, rounded on the top, and thinned off to the edges; they are put on the surface of the cloth at a distance of ten or twelve inches apart, or close together, with three little wood-screws to each strip. The heads of the screws should be on the under-side of the cloth, and provided with a small leather washer of stout calf-skin, about five-eighths of an inch in diameter. These strips keep the cloth in good order, and prevent it from gathering into folds in the middle, or on either side; which is always otherwise the case, even when leather straps or cords are attached to the sides of the cloth. There is nothing equal to strips of light wood for keeping a feeding-cloth in good working order: many an hour's trouble and vexation may be avoided by it.

ALTERING THE WEIGHT OF THE LAP.

Altering the weight of the lap on the spreader, depends on the changes which are necessary to be made on the cards, drawing-frames, speeders, or in the yarns. It is a bad practice to work with too heavy laps, they are liable to choke the rollers and beaters, and the cotton will not be properly prepared and cleaned; besides, it will cause too heavy carding, which should be avoided by all means.

CAUSES OF DIFFERENCE IN WEIGHT.

The stuff varies sometimes considerably in the carding-room, getting sometimes too light, and at other times too heavy, owing either to a change in cotton, a change in the weather, a diminution or increase of the quantity of waste, or careless weighing, and sometimes it is impossible to account for it by any known data. If the drawing-frame pinions fail to correct any of the above irregularities, a difference of more than one or two ounces should not be made in the lap at one time. As evenness and regularity of the lap is of the utmost importance for producing a good article of yarn, strict attention must be paid to correct weighing and feeding; for, if the cotton is correctly weighed, and evenly spread to the spreading machine, it must produce even work on the cards; provided always, that all things are in good order about the spreader and the cards. It is advisable, therefore, to examine the springs frequently, to see that none of the spring-weights rise out of order, and that no pinions or wheels are missing gear in consequence of broken teeth. Bolts and nuts should be properly screwed up; in short, everything should be kept in perfect running order. The axles of the beaters must be kept free from cotton on the inside, or else it will cause the cotton to run to one side or the other of the lap-roller. Attention must be paid to keeping the machine solid, level, and square.

OILING AND CLEANING.

It is necessary that the machine should be kept as clean as possible, and well and carefully oiled. The beaters should be oiled every hour or two, and the slow-running parts twice each day. Negligence of spreading-machines and pickers in this respect, has often been productive of the most disastrous consequences.

FIRE PRODUCED BY FRICTION.

Fire is produced by friction, caused here by dirt and want of careful and regular oiling. It is a well-known fact, that the majority of the fires which have occurred in cotton factories, had their origin in the picking-rooms. This is not an astonishing thing, when the tremendous velocity of the beaters in some factories is taken into consideration. Cotton may be ignited on the roller of a spreading-machine, if waste be wound around the end of a fluted roller. The meshes of the gauze in the rolling wire cylinders should be cleaned off twice each week, and the whole of the machine cleaned two or three times each day. All the journals must be kept clean, and everything about the machine kept in the best possible order.

SPARE PINIONS.

A good supply of spare pinions and wheels for the spreading machine, should always be kept on hand; particularly of the description used on the fluted rollers, and the carrier-studs belonging to them, as these are most liable to wear out. If a supply of spare pinions is not provided, the employment of the operatives in a large factory may, at any moment, be suspended for want of them. It would be a good plan to have an additional spreading-machine.

CARDING.

Carding is the next operation in a cotton factory. Cards are used to disentangle the fibres of cotton, and lay them lengthwise and parallel with each other. Carding consists in the reversed action of two opposite surfaces, which are studded with angled wire hooks. These hooks must be made of good, hard-drawn iron wire, to render them stiff and elastic. In former years, cards were merely made of small straight boards, studded with sharp wire points, and having handles; these were operated by hand: now, they are encased cylinders, driven by steam or water power. These machines consist of one large, and often of many small cylinders. If the large cylinder is partially surrounded by small cylinders, the card is intended for coarse yarn, or coarse wool or cotton; if it contains but one or two small cylinders, it is used for fine cotton and fine yarn. This machine receives the coil of lap from the spreading-machine, which is as wide as the card, and forms it into a lamina, in which the fibres of cotton are more or less parallel, according to the work. Coarse yarn requires the cotton to be carded but once; but, for fine yarn, it is necessary to repeat the operation.

DIMENSIONS OF CARDS.

THIRTY INCH CARD.

	Ft.	In.	Teeth.	Rev.
Driving-pulley on main shaft	1	4	..	.. 100
Driven pulley on card-axle	1		..	.. 133
Pulley on card-axle, driving crank, likerin, and workers	1	4	..	.. 133
Pulley on crank		7⅜	..	.. 286
Pulley on likerin		9	..	.. 237
Pulley on card-axle driving doffer-shaft		4	..	.. 133
Pulley on doffer-shaft	1		..	.. 44
Pinion on other end of doffer-shaft,			.. 23	.. 44
Driving doffer by large wheel of..			.. 228	.. 4½
Bevel on end of doffer-axle......			.. 42	.. 4½
Driving side-shaft by bevel of....			.. 42	.. 4½
Pinion on lower end of side-shaft.			.. 21	.. 4½
Driving fluted roller by wheel of .			.. 67	.. 137
Diameter of fluted roller		1¼	..	..
Diameter of doffer	1	9	..	..
Diameter of likerin.............		11	..	..
Diameter of main cylinder	3	6	..	..
Width of main cylinder	2	7	..	..
Circumference of main cylinder ..	10	6	..	..
Extreme length of card.........	10	6	..	..
Width of card, including pulleys .	3	6	..	..
Three workers on each card; diam.		6	..	..
Three strippers on each card; diam.		3	..	..

	Ft.	In.	Teeth.	Rev.
Diameter of pulleys on worker and stripper		$6\frac{3}{4}$	..	..
Six flats — 3 next to feed rollers, and 3 next to doffer			..	..

WIDE CARD.

	Ft.	In.	Teeth.	Rev.
Diam. driving-pulleys on main shaft	1	8	..	82
Diam. of driven pulleys on card-axle,	1		..	136
Width of face of pulley		$2\frac{3}{4}$	..	..
Diameter of main cylinder	3	2	..	..
Width of main cylinder	3	$1\frac{3}{4}$	..	..
Diameter of doffer	1	$8\frac{1}{4}$	..	..
Diameter of likerin		10	..	..
Diameter of pulley on likerin		9	..	..
Diameter of workers, (2 of these) ..		$5\frac{3}{4}$	..	..
Diameter of strippers, (2 of these) .		3	..	..
Diameter of worker-pulleys		6	..	..
Diameter of stripper-pulleys		7	..	..
Diam. of pulley on main cylin. axle,		4	..	..
Driving doffer-shaft by pulley of...		9	..	..
Pinion on other end of doffer-shaft.		..	18	..
Driving doffer by wheel of		..	228	..
Bevel on other end of doffer		..	42	..
Bevel on top of side-shaft		..	42	..
Bevel on bottom of side-shaft		..	23	..
Bevel on fluted rollers		..	67	..
Diameter of fluted rollers		$1\frac{3}{8}$	..	..
Pinions on fluted rollers		..	14	..
Carrier-wheel to feeding-roller		..	90	..
Diam. of feeding-roller		$2\frac{1}{2}$	..	..
Pinion on feeding-roller		..	30	..

ANOTHER WIDE CARD.

	Ft.	In.	Teeth.
Diam. of pulley on main cylinder axle, inside the frame, driving crank, likerin, and strippers	1	4¼	..
Diam. of pulley on doffer, driving workers		8	..
Diam. of pulley on crank-shaft, driving heads		3	..
Diam. of pulley on crank		8	..
Diameter of pulley on the front-roller driving-head		3	..
Pinion on front roller of driving-head			.. 18
Pinion on back roller of driving-head			.. 40
Intermediate carrier, between the front and back			.. 30
Diam. of front under roller		1⅛	..
Diam. of back under roller		1	..
Distance of rollers from centre to centre		1½	..
Diam. of pulley on front roller, which drives the calender-rollers		2½	..
Diam. of pulley on calender-roller		3¾	..
Diam. of pulley on calender-roller		1⅞	..
Number of top cards, 10; 5 on each side of the workers and strippers.			..
Extreme length of card	10		..
Extreme width of card	5	4	..
Diam. of different carrying-pulleys		6¼	..

These cards are of an excellent description, and when kept in order work extremely well.

ANOTHER TWENTY-FOUR INCH CARD.

	Ft.	In.	Teeth.	Rev.
Diam. of driving-pulley on m. shaft,	1	8	..	.. 82
Diam. of driven pulley on card-axle,	1		..	.. 136
Diam. of main cylinder....	3	3½	..	..
Width of main cylinder	2	1¾	..	..
Diam. small pulley on end m. cylin.,		2	..	..
Driving doffer-shaft by pulley of...		11¾	..	..
Pinion on other end of axle			.. 28	..
Driving doffer by wheel of			.. 240	..
Diameter of doffer..............	1	8½	..	..
Bevel on other end of doffer......			.. 45	..
Driving side-shaft by bevel on top .			.. 45	..
Bevel on bottom of side-shaft.....			.. 26	..
Driving fluted rollers by bevel of ..			.. 75	..
Diameter of fluted roller.........		1⅛	..	..
Pinions on fluted roller...........			.. 11	..
Carrier-wheel to feeding-rollers			.. 96	..
Pinion on feeding-rollers.........			.. 14	..
Diam. of pinion on feeding-rollers..		5¼	..	..
Diameter of pulley on main cylind., driving crank, likerin and strippers,	1	3	..	..
Diameter of likerin.............		10	..	..
Diameter of pulley of likerin.....		7½	..	..
Diameter of crank-pulley		7½	..	..
Diam. pulley on doffer, drives workers		7	..	..
Diam. of workers, (2 in number,)..		6¼	..	..
Diam. of pulleys on workers, (2,)..		6¼	..	..
Diam. of strippers, (2 in number,).		3¾	..	..
Diam. of pulleys on strippers, (2,) .		7	..	..
Extreme length of card...........	10		..	..
Extreme width of card	4		..	..

There are seven top-cards, or flats, on each card; three next to the feed-rollers, and four next to the doffer.

CALCULATION OF THE DRAUGHT ON THESE CARDS.

Diameter of doffer, including wire, (driven,)	21 inches.
Bevel on end of doffer, (driver,)	45 teeth.
Bevel on top of side-shaft, (driven,)	45
Bevel on bottom of side-shaft, (driver,)	26
Bevel on fluted rollers, (driven,)	75
Diameter of fluted rollers, (driver,)	$1\frac{1}{8}$ inch.

Drivers.	Driven.
45	75
26	45
270	375
90	300
1170	3375
9 = $\frac{9}{8}$ diam. of fluted roller.	189 = $\frac{189}{8}$ diam. of doffer.
10530	30375
	27000
	3375

10530)637875(60.57
63180
60750
52650
81000
73710
7290 remainder.

Draught of the card, 1 into 60.57, or a little over $60\frac{1}{2}$.

REMARKS ON CARDS AND CARDING.

BELTS AND JOURNALS INSIDE THE CARDS.

The cards alluded to have the pulleys and belts inside the framing and covers; this is not a good plan, as the belts are always catching and throwing out flyings, and the journals of the likerins, workers, &c., become choked with the flyings. The belts and journals should be free from flyings, sand, and other matter. The workers and strippers should be placed next to the feeding-rollers, and the top-cards must be placed next to the doffer. Workers and strippers have a tendency to leave the cotton loose and irregular on the main cylinder, and to let all the large motes and dirt pass on to the doffer, and fill up its teeth; whereas, when the top-cards are all next to the doffer, they smooth down the rough and straggling fibres, and perform good service, by seizing upon all motes, and other matter, that should be caught and held fast before it passes to the doffer. Carders and cotton-spinners are divided in opinion as to the merit of the different plans, some say that the flats catch too much of the good cotton which is left loose on the cylinder by the worker and stripper. They prefer to let it go on to the doffer in a loose, furry state. Some carders and managers have had fancies and ticklers placed on the main cylinder, near to the doffer, for this purpose, and pretend that flats keep the cotton too light and loose on the main cylinder, and that, by their improvement, the cards will only require stripping once in each week, instead of four times per day, on cards with flats. They say that the flats should all be placed next to the feeding-rollers, for there they will do the most service.

USE OF FLATS.

That the flats do the most work when nearest the feeding-rollers, no person will certainly deny; but, that they do good service, is not equally true, as they catch the cotton immediately after it leaves the likerin, before it has passed on to the workers and strippers, which take it from one to the other, carding it properly, and returning it to the main, well finished; while the flats, when placed next to the fluted rollers, soon become filled up, and are of no further service until they are again stripped. Such an arrangement actually has a bad result, as it causes the card to nap, when the teeth of the flats become filled up with cotton; though there may be cards that work very well on either plan. Cards similar to those described, having some flats on each side, when in proper order, make most excellent work, and may be considered as good as any other kind, with the exception of having the journals and belts inside of the framing.

GENERAL REMARKS.

The greatest advantages may be derived from a careful and skilful management of this very important branch of the cotton manufacture. The preliminary basis of good fine yarn must originate in the carding-room. If in any of the various processes through which the cotton necessarily passes in this department, it becomes in the slightest degree injured, no subsequent operation can correct or remedy the evil; the yarn is inevitably spoiled.

Having given the dimensions of different parts of some good plans of cards, and also directions for the attendance and management of the willey and spreading-machine, we shall now proceed to lay down plain practical rules for putting cards in good working order, together with some useful directions and instructions as to the most advantageous system of operating them.

TURNING UP A CARD.

Before turning up a card preparatory to clothing it, always remove previously the heads of the wooden cylinders, and screw up tight all the stave-bolts; also, screw up all the joint-bolts firmly, and see that the frame stands square, level, and perfectly solid. The doffer, likerin, fluted rollers, workers, and strippers, must be made to stand perfectly parallel with the main cylinder. In turning up, all parts of the card that require turning must have a very true, level, and firm rest. A crescent-shaped tool, of good steel, is the best for turning up cards.

SLIDING-REST.

The screw-slide-rests for turning up cards, are the best and most correct. The sliding head in which the tool is set, rests on a stout frame of cast-iron, as long as the width of the card-frame, to which it is screwed fast by clamps. The two parallel bars of this frame are about seven inches apart; the tops of these bars are finished off as slides for the movable head, which is propelled from one side to the other of the card by a screw-shaft, running through the whole length of the rest-frame, with a handle or wheel at each end of the propelling screw. There is also a slide and screw on the movable head in which the cutting-tool is fastened, for regulating the contact of the tool with the cylinder or roller to be turned. This operation is performed with the nicest accuracy. When the rest is placed parallel with the cylinder-axle, and the cutter is in good order, a card-cylinder can be finished with despatch and great exactness. No factory should be without this useful and necessary machine. Many cards have been, and are still injured by miserable, shackling fixtures, used in turning up cylinders. Stands and other fixtures must be attached to the grinding-machine, for turning off the likerins, workers, and strippers, which is done with the same rest and tools.

WOOD FOR CARD-CYLINDERS.

If good care be taken of cards, the frame-work and cylinders may last thirty or forty years. During that time they may require to be turned off ten or fifteen times, according to circumstances, owing to the kind of wood of which the cards are built. If the wood has not been well seasoned, if it is exposed to damp air, or to great heat, accidents, &c., or if there is any considerable quantity of the substance cut away in turning, they will soon be worn down to the bolt-heads; the staves will become so thin that they will be liable to cast or warp, and open in the joints with every change of the atmospheric temperature. Hence the necessity of having a first-rate apparatus for turning card-cylinders to advantage.

IRON DOFFERS.

Cards are now generally constructed with cast-iron doffers. This is an excellent and valuable improvement. Zinc, however, is preferable to iron, as it may be tacked. The doffers and cylinders should have cast-steel axles, and the cylinders should be exactly balanced; for, if they are heavier on one side than on the other, it will produce a considerable vibration when they are run fast. Besides, it has a tendency to wear the journals off at the heavy side, and of course cause the cylinder to run crooked, and thereby spoil the carding on the machines. This will inevitably be the result of a few years use of iron doffers that are incorrectly balanced.

CLOTHING THE CARDS.

Care must be taken, in putting the sheet-cards on the main cylinder, to fasten them on as tight as they will bear without tearing the leather, or pulling the tacks out of the backs of the sheets. Especial attention is required if the cards are made of calf-skin, as this, if not put on very tight, is very apt to stretch and become slack in grinding. These cards will cause a great deal of trouble afterwards, by the leather and teeth rising up in the middle of the sheets, and rubbing against the doffer-teeth. When this occurs, there remains no remedy but to strip off the sheets, turn up the cylinders, and re-cover them with the same sheets. In turning up the cylinders and rollers, be very careful to take as little as possible off the wood, just sufficient to make them true, and no more.

The sheets are put on with good stout eight or ten ounce tacks, driven at the distance of about seven-eighths of an inch apart. Cylinders made of mahogany or bay-wood, the kind most commonly used, may be covered with six ounce tacks; and, for pine cylinders, ten ounce tacks are large enough. The holes in the sheets should be pierced by a tool, having three, four, or five points, each point being separated seven-eighths of an inch from the others. The tacks must be driven in a straight line, at equal distances and opposite to each other in the sheets, so as to form regular rings around the cylinder; this has a neat and workmanlike appearance, and is correct in principle. We can form a comparatively correct opinion of a carder's abilities and skill in arranging and keeping his room in snug order, by observing the manner in which he covers his cards. When covering the doffer, put on the fillet-cards as tight as possible without breaking them. If the doffer be made of cast-iron, it will be advisable to give it two good coats of white lead, not so thick as to prevent it from being laid on very even. A portion of copal varnish should be mixed with the second coat, as it prevents the paint from becoming too hard. The backs of the fillet-teeth will imbed themselves in this coating of paint, and keep the fillets from running slack each time the card is ground, which they are very apt to do on the bare, smooth surface of the metal, causing a great deal of trouble and loss of time.

GRINDING THE CARDS.

In setting the emery rollers to grind the cards, do not set them to bear too hard or too heavy on the wire, for this will heat, soften, or break the wire, if it is not very good and tough. The emery rollers should be seven or eight inches in diameter, and always two or three inches wider than the card-cylinders, so that they may traverse an inch each way on the cylinder, and not leave any of the wire bare. Traversing is effected by means of a waving pulley, about 5½ inches in diameter; the outer rim or edge of the pulley runs in a slot attached to the stand of the roller: or the traversing is produced by a crooked strap, which, fitting between the rims of the pulley, will move the emery roller longitudinally and around at the same time. The traverse motion may be also produced by a waving pulley at the emery roller. The emery roller must be kept on the cylinders until they are ground perfectly true, and until the greater portion of the teeth are ground to a point. The perfect rotundity of the cylinder may be ascertained by the sound it produces on the emery roller as it runs: the sight may also be of service in this respect, either when the cylinder is in motion, or by stopping it, and giving it a careful examination. When the surface of a card-cylinder has been sufficiently ground, it will have a blackish appearance, while those parts that are not ground enough will appear more or less clear and bright. As long as a considerable quantity of white teeth appear, the grinding must be continued. One day will be sufficient to grind up a new card, if the emery is in tolerably good order.

HAND-EMERIES.

When the cylinder has been ground perfectly true, and nearly all the bright teeth have disappeared, the cards are finished off by reducing the teeth to a smooth point, which is done by a wooden hand-emery for the doffer, and a canvas emery for the main cylinder. The emery for the doffer should be made of clean, well-seasoned pine wood, one inch thick, three inches wide, and two or three inches longer than the width of the card-cylinder. For twenty-eight inch cards, the emery should be thirty or thirty-one inches long, and for thirty inch cards, thirty-two or thirty-three inches long, so that, in traversing the emery-board backwards and forwards two or three inches, the wire will be always covered, and no part of it left bare at the end of the cylinders; for, if such be the case, the parts left bare will be higher than those on which the emery was constantly operating. In grinding with the hand-emery, it must be moved perfectly straight and parallel, and not pressed too heavily on the cylinder, as this makes the fillet slack at the right-hand side, and proportionally light on the left-hand side of the doffer. When these hand-emeries are over twenty-six inches in length, they should have a strip of wood attached to the centre of the upper side. This strip or back-bone should be full an inch wide, and 2¼ or 2½ inches deep in the middle, sloping off to each end, and be fastened on by stout screws. This prevents them from warping. If they become warped or crooked, it has the effect of grinding off the card-wire, and destroying the straight, level surface, which must be guarded against by every possible means. Good, well-made canvas emeries are undoubtedly the best for finishing or grinding the main cylinder on ordinary occasions; they are made by attaching a piece of stout, even canvas, twelve inches wide, and seventeen or eighteen inches long, to an iron or wooden frame, one end of which must be made to move with slats, so as to make the canvas slack enough to form a curve like a saddle when applied to the cylinder. On this account it is commonly called saddle-grinder. It is advisable not to make it so slack as to permit the ends where the canvas is fastened to come in contact with the teeth. Those ends, if attached to a flat board, should rise about 2¼ inches, which will allow the canvas 17 or 18 inches to form a sufficient curve without touching the back. There must be a handle on the back of the board to hold it by: two handles are better than one, if reaching from end to end, as the person grinding would then have to use both hands, and could, of course, hold it steadier. If the canvas is on an iron frame, this frame should be made in two parts, with a curved back, and be connected on the back by a slide and two screws.

USING THE HAND-EMERY.

In using the hand-emery, the operator must be careful not to press it upon the wire, but to let it bear its own weight. While moving it backwards and forwards, or rather from side to side, he should also take heed that the grinder dwells a little longer at the ends of the sheets, or the sides of the cards, than in the middle: the reason for this is very obvious, the emery passing over the middle twice for the once that it does over either end; and, without resting a short time at each side, the cylinder would be ground hollow, consequently, on starting the card, it would be found to make bad work. Many cards are injured by learners, or by persons unacquainted with the proper manner of holding or using canvas emeries. Canvas emeries cannot be made the full width of the cylinder—at least they are not made so—it would make them quite too heavy, and they would do more to injure than to benefit the wires of the cards.

GROUND HOLLOW.

If, through ignorance or inattention, it should happen that either of the cylinders or likerins is ground hollow in the middle, if the surface is in any way injured, or if the cylinder is losing its rotundity, it will be impossible, while in this condition, for a card to make good work. One card working badly will spoil the work of twenty cards working in a proper manner, if mixed with it at the drawing-frame. When any of these difficulties occur, the only remedy is to put on the emery roller again, and reduce all the prominent places, making the cylinder as even, true, and round, as it was originally.

STRAIGHT EDGES.

In every carding-room, there should be at least one pair of hard, well-seasoned, wooden straight-edges — cherry will answer very well—of the full width of the cylinder, or as long as the emery roller. These straight-edges should be about three inches broad, and nearly three-fourths of an inch thick. They are used for the purpose of trying the cards, and the manager or carder should frequently apply them to the card-cylinders, likerins, hand-emeries, and rollers. In every large-sized carding-room, there should be a good tape measuring line, fifty or seventy-five feet in length, having the feet and inches correctly marked thereon; also, an accurate spirit-level, two feet long by three inches in width, having both horizontal and perpendicular spirit-glasses inserted in it.

HOW TO EXAMINE A CARD.

Should any of the cards work so badly, after being set carefully, as to create a suspicion of their not being exactly true, all the cylinders of the card should be stripped and brushed out. The straight-edge should then be applied on the surface of the teeth, holding it perfectly parallel, and looking under it against the light. By this means, we may ascertain whether the surface is perfectly straight. It will then be an easy matter to discover whether any of the cylinders are not perfectly round, by examining them while running without any cotton on them. If they are so much out of the proper form as to be the occasion of injury to the work, and it is apparent that a great deal of grinding will be requisite to make them true, the sheets should be taken off, and the cylinders turned up and re-covered. The same must be done with the doffers under similar circumstances. If the cylinders do not require to be divested of their covering, put on an emery roller for a period of three or four hours, or as long as may be required to produce the desired effect. At the same time, it will be necessary to try all the emeries by the straight-edge; for, if they are not straight, it cannot be expected that the cards can be made true by their use.

For spinning yarn from No. 15 to 30, the cards should be ground every two weeks; for fine numbers they must be ground once or twice a week; but no cards should run longer than two weeks without being ground, when either middling or coarse numbers of yarn are being spun. The workers, strippers, and top cards may be ground every four weeks, or once while the card-cylinders are ground twice. The cylinders should be well carded out with an open, thin-set hand-card, applied to the cylinders when they are running in the same manner as when being ground; the main cylinder and likerin revolve in a contrary direction to what they take when carding, but the doffer runs in its usual direction, only much faster. After being carded out, they should be well brushed with a good, thick-set, stiff-bristled brush, which may be again used after the grinding is finished, in cleaning out the emery dust, and taking out any chance particles of emery that may adhere to the sheets. It is much better to grind cards often, than to grind them long at one time, as the teeth are subject to become clogged with particles of waste and seeds, and to become dull and set back, if they are run too long. This is especially the case where there are screens under the cylinders and likerins. The top cards should be carefully examined when they are ground, and all the teeth which may be depressed should be set up by a sharp, thin, tapering, and pointed steel tool, made for the purpose. All dents, bruises,

&c., of the teeth, should be remedied as much as possible every time they are ground. If no attention be paid to this matter, the cards will fall by degrees into a very bad state, and will not last as long as they would under a proper system of management.

The proper and timely grinding of cards calls for the most careful attention on the part of the manager and head carder. The proper performance of this process is so essentially necessary to the production of good work, that we may safely assume that there is more cotton and yarn spoiled by the improper grinding of the cards, running them too long without grinding, or unskilful setting, than from all other causes combined. Some master cotton-spinners, apprehensive lest the teeth of the cards should be cut down, have forbidden their carders to grind their cards oftener than once in four weeks, even when those cards were running at a quick speed, doing heavy carding, and having screens under the cylinders and likerins, at the distance of only three-eighths of an inch from the teeth. It would be equally as correct to forbid a carpenter to file his saw, or whet his plane-irons, chisels, or gouges, lest he should wear them out.

SETTING CARDS.

In setting cards to work Georgia, Tennessee, or Alabama cotton, or any of the common short staple cottons in general use, for low and middling numbers of yarn, set the fluted rollers so that they will run without touching the likerins, workers, strippers, or doffers, as close as possible to the main cylinder without coming in contact with it. Set the strippers sufficiently near to the workers to take the cotton off them. When setting the top cards, raise the front part of them, or the side next to the feeding-rollers, a little higher than the back part, sufficient to cause the back teeth to catch the dirt as well as the front ones. If they do not catch alike over the whole surface of the sheet, they are not properly set. Top cards, when kept in good order, properly set, and regularly stripped, are very useful auxiliaries in carding. Both the eye and ear may be used in setting cards; it sometimes occurring, that in particular situations, the ear may detect an imperfection, where the eye cannot be used advantageously, if at all. A quick eye and a sharp ear are both of great use to carders.

SETTING THE COMB-PLATE.

When setting the comb-plate to clear the cotton from the doffer, turn the sweep of the crank-axle so that it will stand half up and half down, then set the comb-plate so that the teeth, which must be inclined in towards the doffer, will stand parallel with the centre or axle of the doffer, so that in working the comb-teeth, it will rise above the centre of the doffer and sink below it. The sweep of the crank should be about three-fourths of an inch, which will give a stroke of one and one-half inches up and down. The crank should make one revolution for every inch of circumference turned by the doffer.

STRIPPING OF CARDS.

The main cylinder should be well stripped every two, or at least every three hours. The doffer should be stripped twice each day, at noon, and near the stopping time in the evening; the likerin once or twice each day. The top cards should be stripped in regular rotation, without causing any interruption, and not more than one-half of the same card at one time.

For this purpose, a stout boy should be in attendance on each sixteen or eighteen cards. Considerable importance should be attached to the stripping of the top cards; it is more requisite for fine yarn than for coarse, but is undoubtedly beneficial to all numbers of yarn, and makes the cards work better. The persons stripping the top cards should work by the piece, and be paid at the rate of so much per pound; their toppings should be weighed every morning and entered in a book kept for that purpose by the carder. This system of operations will save the manager and carder a great deal of trouble, and is also the means of improving the work, having a tendency to promote the constant and regular topping of the cards by those employed for that purpose.

CARDS SHOULD NOT RUN BARE.

The cards should not be suffered to run bare when a lap-roller is run out; it is so much time lost, and renders the card liable to accidents and injuries, by waste catching about the calender rollers and cranks. The piecings of the rollers should be neatly joined at the cards, and not overlapped or doubled too much, as they will choke the feed-rollers and likerin. The flyings should be taken from under the cylinder once or twice each day, according to the speed of the cards, and the nature of the cotton giving it a greater or less tendency to the production of flyings.

SCREENS.

Where those useful fixtures, screens, are attached to the cards, cleaning twice each week will suffice, on Wednesday evenings, and at noon on Saturdays. If well fitted up, the screens should go round under the likerin, from the fluted rollers, and extend from thence under the main cylinder, and around this cylinder, and between it and the doffer. It can be safely taken thus far without coming in contact with the doffer; here it should be doubled over, and not present a raw edge between the two cylinders. The end, when neatly doubled over, should descend at least five or six inches. The screen must be a full inch distant from the doffer at every point; for, if any waste or cotton catches on it, sticks, and rubs against the doffer, it makes a very ugly appearance in the stuff coming off the doffer.

LENGTH OF SCREEN.

Screens are generally made of zinc, all in one piece, and as wide as the framing of the card. About eighteen inches in length of the space under the cylinder, and four inches under the likerin, the full width must be punched regularly with half-inch holes, at the distance of about half an inch apart, to allow the sand and dirt to fall through. The screen should be placed at the distance of about three-sixteenths of an inch from the card-teeth of the likerin and cylinder, very accurately put up to fit the circumference of the circles, and so firmly fixed that it will not be liable to be easily moved when anything is being done about the cards. The screen should be connected altogether with the frame-work of the card, and not be in any manner attached to the floor.

NUMBER OF HOLES.

For thirty inch cards the screen will require to be about thirty-six inches wide, and should contain forty holes in this width; and in the eighteen inches under the centre, in the direction from the likerin to the doffer, there should be at least twenty holes in the width: this will make 800 holes under the main cylinder. Perhaps one foot would be enough in this last direction. If we put twelve holes in this one foot by three feet, it will make 480 holes; 200 holes are sufficient under the centre of the likerin.

USE OF SCREENS.

There is a diversity of opinion among good cotton-spinners and carders, as to the utility of screens. Experience shows that they have a tendency to make the cards dull in a short time, and to cause seeds and large motes to stick in the teeth, if the cotton is dirty. Notwithstanding this, screens effect a great saving of cotton and labour. A card, thirty inches wide, turning off about sixty-two pounds of cotton per day, will, without a screen, produce flyings amounting to not less than twelve pounds per week, and, if an inferior kind of cotton be used, it will amount to nearly eighteen pounds. At any rate, if we consider the cotton to be fair, it will amount to twelve pounds. It is true that a considerable portion of this cotton would be fit to mix into filling, coarse yarn, &c.; but then what a waste of time and labour in picking, sorting, and mixing, what dirt and confusion is occasioned in the card-room, taking out these flyings twice every day from under all the cards, in addition to other inconveniences. But when screens are used, and well fixed, a card will not make more than three pounds of flyings per week, instead of twelve pounds, which, in twenty-eight cards, amounts to 336 pounds of cotton. By the screen system, the loss would be eighty-four pounds. There are thus 252 pounds of good cotton saved per week, on twenty-eight cards. These are positive practical facts. The last waste may be packed into a bag without any further trouble, and will be worth from two to three cents per pound. The amount of 252 pounds per week in favour of the screens will amount to 13,104 pounds per annum, which, at 12½ cents per pound, would be worth the sum of $1633. So much in favour of the screens, which should be a conclusive recommendation of them.

ADVANTAGES OF SCREENS.

Some persons object to the screens, and say that they make the yarn dirty and weak. But if the cylinders and top cards are kept properly stripped and ground, the screens will work well. The advantage of the screens is, that the greater part of the fibres, which would, otherwise, fly off the cylinders and lodge under the cards, are wrought up into yarn. This part of the cotton is quite as long and strong in the staple as the best of the stuff, and the shorter parts pass in by such a regular and imperceptible process, that the yarn is not weakened or injured by it. In the cards previously alluded to, the pulleys and crank-straps run inside of the frame and covers, and cause considerable quantities of cotton and waste to be thrown on the floor; this can be remedied by putting the straps on the outside.

When the screens do not give satisfaction, it is owing to their improper construction. The expense of fitting them up is very trifling, when compared with the benefits to be derived from them. Everything which effects a saving of labour and material, should be brought into use in these days of foreign competition and rivalry, if it proves to be worthy of a trial.

TO CONNECT CARDS BY RAILROAD.

Railroads, as they are called, are in front of the cards; by these the slivers from six or twelve cards are all run along in a trough on a strap, and pass in the mean time through a series of rollers, placed together in the same manner as in a drawing-head. This improvement saves the labour of changing cans, is a saving of them, and also a saving of the floor at the same time. The whole of those ten or twelve card-slivers pass into one can, which is generally convenient to the drawing-heads. These railroads have also a tendency to improve the work, so far as doubling together a number of ends is concerned, and thereby partly remedying any defects in the feeding, or irregularity of any single card. The fixtures and machinery of this improvement are of a complicated nature, and consequently liable to become deranged in some of its numerous parts, and prove troublesome. This may and does form a serious drawback to the advantages they possess.

As the principal use of these railroads is, to collect all the stuff produced by a number of cards into one can, they are certainly capable of being very much simplified. They are generally so constructed, that the stuff comes through the calender-rollers of the railroad at one end, and is of the same thickness when two or three of the cards are stopped, as if they were all in motion. To produce this desirable and very necessary effect, such a quantity of gearing, levers, cones, and clock-work machinery is required, as renders the whole system liable to get out of order. Any derangement of course materially affects the regularity of the stuff. When anything happens to any of the cards of the system, it causes a stoppage for the time being of all the cards attached to it, thereby stopping one-half or more of the machinery in a large room.

It is a wrong principle to have machinery of such a flimsy nature dependent on the watchfulness of a thoughtless, giddy boy or girl. If a piece of waste catches around a journal on two of the cards in such a system, it will stop six or twelve cards, with all the other machinery dependent on them, for a considerable length of time.

These railroads have now, however, arrived at such perfection, that nothing is wanting to bring them into general use, but care and attention on the part of the head carder. If he keeps the cards in good order, no difficulty will ever occur in the operations of the railroad. The improvement in the drawing-head which Jenks has patented, is perfectly secure. It admits of the stoppage of one, two or three cards, without disturbing the running cards, or the thickness of the laminæ. As twelve cards are never usually connected in one system, nine may be set down as the highest number which should ever be so connected by railroad.

FACING CARDS.

The great improvements in card-grinding, introduced within the last twenty-five years, have abolished the destructive process of facing new cards, or old ones either; that is, by grinding them for several days against the teeth with a fast grinder. This has ceased to be a practice, and has been superseded by skill and practical knowledge. Many thousands of setts of good card covering have formerly been spoiled or greatly injured by this erroneous system of grinding, which was once deemed necessary to level the teeth, and bring them to an even surface. Formerly, before machinery was brought to such perfection as to cut and stick card-teeth in the leather, the points or surfaces of the teeth were not of such a uniform regularity as they now are. This ruinous plan of cutting down the wire to one-fourth of its original length, may break out one-fourth or one-third of them close to the leather, and cause injury to the remainder by softening the wire. In those times, cards actually underwent more wear and tear in one grinding, than three years' fair work would have done, and now does.

Cards should be faced in the following manner. When a new card is to be faced up, apply a light hand-emery gently to the teeth, against their set, for about one or two minutes on each cylinder; this is done for the express purpose of setting all the teeth up before the roller is put on. The carder should attend to this personally, or some careful, practised individual on whom he can depend. No ignorant, careless person should be entrusted with the grinding of cards, unless it is intended to have them spoiled, and the work spoiled also.

CLOTHING CARDS—DIRECTION OF THE WIRE.

When clothing cards with workers and strippers, put the fillet on the likerin from left to right; on the workers from right to left; on the strippers from left to right. The teeth of the likerin and strippers stand in a different direction from those of the main cylinder, and also run contrary. Those on the workers stand the same way as on the main cylinder, but run in a contrary direction. The fillet on the doffer is put on from left to right, and the teeth stand the same way as on the main cylinder, but it runs in a contrary direction. The teeth on the top cards stand in a different direction to those on the main cylinder.

KIND OF WIRE USED IN CARDS.

For flletting on the likerins, 2 inches wide, use No. 30 wire.

For filletting on the workers and strippers, $1\frac{1}{2}$ inches wide, use No. 30 or 31.

For filletting on doffers, 2 inches wide, use No. 34 or 35.

For main cylinder, length to suit, 4 inches wide, use No. 33 or 34.

For sheets of top card, length to suit, $1\frac{3}{4}$ or 2 inches wide, use No. 31 or 32.

REGULATIONS IN THE CARDING-ROOM.

The cards, and everything about them, should be kept in nice, clean order, as well as all the machinery connected with them. All cotton and waste must be kept off the floor and out of the windows. The cards must be regularly and carefully oiled; the main cylinder, cranks, likerins, and strippers, twice each day; or, the likerins and strippers may be picked off and oiled each time the main cylinder is stripped, which is every two or three hours: all the other journals, which run at a slower speed than those mentioned, must be oiled every morning. The flyings must be taken out twice every day; but if there are screens to the cards, twice each week will be sufficient, namely, every Wednesday and Saturday. All the cards should be well brushed off every one or two hours, as well as the side-frames, top-covers, and fronts. Waste must not be allowed to accumulate on the comb-plate and the ends of the doffers, on both of which places it is liable to catch. The surface of the covers of the top cards, worker, and likerin, should be rubbed off twice each day with hard waste; this may be done near dinner-time, and near the stopping-time in the evening. Do not allow the boys, or any other person, to cut, bruise, or disfigure the machinery, walls, window-sills, or seats, in any manner whatever. Nothing has a worse appearance, independent of the damage occasioned by it; it indicates a careless indifference on the part of the superintendent of the room, and is the fault of the manager.

It may be proper to repeat, that if the cards are badly set or ground, or suffered to run too long without grinding, they will spoil the roving, and consequently the yarn, by rendering it nappy, rough, and weak. The subsequent operation of drawing and doubling cannot correct this fault; no machine can make good marketable yarn from such carding. These things cannot be too strongly impressed on the minds of the carder and manager, as they are subjects of the utmost importance to those who wish to make good yarn.

SPEED OF PARTS OF THE CARD.

It was the impression at one time, that the likerins would make the best work when driven at a rapid speed; this was discovered to be a mistake. A card is found to work to the best advantage, when the relative speed of the main cylinder and likerin is so calculated, that the main cylinder will display double the amount of surface that the likerin will display in the same time. On reference to the sizes of the different parts of the cards, we find that the main cylinder displays about 1355 feet of surface per minute, and the likerin 660 feet; the main cylinder displaying double the surface of the likerin in a given time.

The yield of well-constructed cards is about three pounds in ten hours for every inch in width; so that a card thirty inches wide will furnish ninety pounds of sliver in ten hours. This is the calculation for coarse numbers, from No. 6 to 20; the cards must be entirely covered by workers and strippers, and one carding will be sufficient. For finer numbers a double carding will be required, and the cards must consist partly of workers and partly of flats. These cards do less work, and make but one and three-fourth pounds of sliver in ten hours, for each inch of their width; so that a thirty inch card will produce fifty-two and a half pounds in one day.

COVERING EMERY ROLLERS AND EMERIES.

KIND OF EMERY.

The emery used for grinding cards, is of various sizes and qualities, and may be had of the principal druggists. Numbers 3 and 4 are good sizes, and are preferable to the finer kinds. It must be perfectly free from rotten or pounded stone, and all ingredients not belonging to it. Emery may be tested by laying some of it on a flat piece of iron, and attempting to bruise it with a flat-faced hammer; if it is good and hard, it will resist the hammer; if it is soft, or mixed with any improper matter, such as broken porter-bottles, rotten rock, or pounded stone, it will yield easily to the hammer, and must consequently be rejected. Coarse emery cuts and grinds quicker than fine emery, and also sinks in among the points of the teeth, cleans them, and cuts off any roughness, barbs, or hooks that may be on them, and prevents them from rubbing on each other. If the emery is too coarse, it causes rings or grooves and ridges around the cylinders.

CLEANING EMERY.

Emery, when brought from the druggists', is generally found to contain more or less dirt, such as chips, dust, &c., which prevent the glue from holding the emery, as it will become filled up with the dust. To prevent this, some carders wash the emery in warm water, when the light dust and chips will rise to the surface, and may be washed off. After this, the emery may be spread on a cloth, and dried in the sun, by a stove, in the steam-engine room, or in any other dry place. This is an excellent plan, as by it the emery may be thoroughly cleaned.

Another plan is, to have a box made of wood, about four inches deep, its length and width to correspond with the size of a sheet of tin, which is pierced full of holes, sufficiently large to allow the grains of emery to pass through them; this tin sieve must be nailed on the box frame. The emery must be taken to a door, window, or some other place where the advantages of a good breeze can be obtained; sift the emery through this sieve, holding it up at a distance of three or four feet from the ground, exposing the sifted emery to the breeze, and letting it fall on a piece of cloth spread on the ground, large enough to receive all the emery as it falls. It may be necessary to repeat this process in order to clean the emery properly from dust and chips. It is advisable, if there is a large quantity on hand, to clean it all at one time, cover it up snugly in a keg or box, and put it away carefully, so that it may be always ready for use when wanted.

MAKING EMERY ROLLERS.

Have the rollers turned perfectly true and straight, and two or three pots full of good glue, ready melted. This glue must be of a medium consistency; if it is too thin it will not hold the emery, and if too thick, it will not adhere to, or spread evenly on the rollers. It will require one person to turn the rollers or the cylinders slowly, while two others apply the glue by means of large paint or sash brushes; or, one of them might use a half-worn white-wash brush, while the other passed over after him, and finished them off with the sash brush. The glue-kettles should be placed quite convenient to the rollers. The glue must be brushed around the rollers as soon as possible, particular care being taken not to miss any part, especially the ends, as it is there they first begin to give way. As soon as the roller is covered with glue, two persons must strew on the emery, letting it fall from a height of two feet, to make it stick, while a third turns the roller. The emery must be laid around the ends of the rollers by hand, in order to make it adhere to those places. As the roller is turned slowly around, the loose emery will fall off, and a sufficient coat will adhere to it.

These rollers should be allowed to dry during the night, and the next day they should receive a second coat, exactly in the same manner as the first, with the exception that the glue may be somewhat thinner. They should again be left to dry during the night, and the next day all the glue and waste emery adhering to the ends should be scraped off. The rollers should then be tried by a correct straight-edge, the emery rubbed off the high places, and the whole made as level and true as possible. Then, a wash, composed of about 2½ ounces of glue and 1 pint of water, may be applied to all the rollers, canvas, and hand-emeries, with one of the sash brushes. This is a very necessary process, as it prevents the emery from flying off into the cans, and thereby spoiling the top rollers when grinding; this wash unites all the coats firmly together, and does not prevent the emery from cutting equally as fast; this operation should never be dispensed with, as it is of great practical utility. When this wash is applied to the rollers or emery cylinders, some person should keep them constantly revolving, to prevent the wash from running to the lowest side, and dripping off. This would spoil them; therefore, they must be kept in motion for three or four hours, or until the glue hardens to such an extent as to remove any apprehensions of its running. It will be necessary, when covering the rollers with emery, to have a piece of stout muslin or canvas tacked around the frame, under the roller or cylinder, to receive the emery which does not adhere, and prevent it from encumbering the floor. When covering the canvas for emeries, it must be tacked to a smooth, level board, on which it must remain until it has received both coats, as well as the finishing wash.

MAKING HAND-EMERIES.

In putting the emery on the canvas and wooden hand-emeries, it is advisable to strew it on pretty thickly, level it off by drawing a straight-edge lightly over it, and then pass a straight wooden or iron roller over it two or three times. After this has been done, lift them up and give the ends a gentle tap on the floor, which has been previously covered with a cloth or paper, and collect all the loose particles of emery. The hand-emeries should receive two coats, and previously to their undergoing the washing process, they must be tried by a correct straight-edge, to ascertain whether they are perfectly true, as it is of the utmost consequence in grinding cards, that they should be so. If they are not exactly true, they may be made so by rubbing the high parts over with another emery. Two or three small hand-emeries, nine or ten inches long, three inches wide, and a full inch thick, are a very necessary article in every carding-room: they are covered on both sides with a coat of emery and a wash, and will be found very serviceable in setting up the teeth which may be bruised or dented in any part of the cards, by accident or negligence, and also for levelling the surfaces of the other emeries.

After the application of the wash to the canvas, and other emeries, they should be carefully put away in a level position, with the side on which the emery has been spread, uppermost, so that the surface may dry evenly.

There are many different modes of covering rollers and hand-emeries, which it is unnecessary to describe here, as the methods alluded to are equal, if not superior, to any other plan of making them. It was formerly a prevalent opinion amongst carders, that an emery roller or cylinder could not be so covered as to make a good job, without the application of an iron friction-roller. When this was the practice, as soon as the emery was put on the roller, it was kept turning at a smart speed for ten or fifteen minutes, with the friction-roller pressed tightly against it.

PRESSING EMERIES WITH ROLLERS.

Pressing-rollers answer very well to roll over hand or canvas emeries, where there is a layer of emery a half or three-fourths of an inch thick; but the rollers are much better without their action. Rollers are not only made more true and round without the aid of the pressing-roller, but they are left rougher and sharper; the projecting grains then sink between the points of the card-teeth, make them clean and smooth, and produce well-shaped points, free from hooks; objects which are very desirable.

TO FIND THE DRAUGHT OF A CARD.

THE DIMENSIONS OF THE PARTS OF A CARD.

Diameter of doffer, including wire, (driver,)	21 inches.
Bevel on doffer-axle, (driven,)	42 teeth.
Driving side-shaft by bevel of, (driver,)	42 "
Pinion on lower end of side-shaft, (driven,)	21 "
Driving fluted rollers by bevel of, (driven,).....	67 "
Diameter of fluted rollers, (driver,)...........	$1\frac{1}{4}$ in.

RULE.

Multiply the dimensions of the drivers together, and that product by the diameter of the fluted rollers. Then multiply the dimensions of the driven wheels together, and that product by the diameter of the doffer. Divide the greater number by the lesser, and the quotient will be the answer, giving the draught of the card between the doffer and the feeding-rollers.

When the cards have drawing-heads attached to them, find the draught of this head, and multiply the quotient just found by the sum of this draught; the product will be the total draught of the card.

EXAMPLE.

Drivers		Driven.	
42		67	
21		42	
42		134	
84		268	
882		2814	
5 =	{ 1¼ in. diam. of fluted rollers, reduced to quarters.	84 =	21 in. diam. of doffer.
			4
4410		11256	
		22512	84 reduced to ¼ inches.

4410)236376(53.60 = draught of card between f. rol. & dof.
22050
15876
13230
26460
26460

DRAUGHT OF A DRAWING-HEAD.

There are drawing-heads to these cards, of the following dimensions :—

	In.	Teeth.
Diameter of front roller, (driven,)............	$1\frac{1}{8}$	..
Diameter of back roller, (driver,)............	1	..
Pinion on front roller, (driver,)...............	..	20
Pinion on back roller, (driven,)	..	40
Intermediate wheel	..	30

There are only two rollers in the card-head; it receives its motion from a small pulley on the crank-shaft, which is but a poor contrivance, as the straps are liable to slip when the card is started. Where there are a great number of cards in a room, this causes a great deal of trouble, and makes too much waste, besides a loss of time. It would be much better if these heads received their motion from the doffer by gearing.

TO FIND THE DRAUGHT OF THE DRAWING-HEAD.

EXAMPLE.

Driver pinion on front roller.	Driven pinion on back roller.
20 teeth.	40
8 = diam. back roller.	9 = $1\frac{1}{8}$ in. diam. front roller.
160 = 1 inch = $\frac{8}{8}$.	160)360($2\frac{1}{4}$, or 2.25, draught of
	320 drawing-head at cards.
	$40)\frac{40}{160}(\frac{1}{4}$

Draught of card = 53.60
Do. of d. head = 2.25
26800
10720
10720
120.60,00 = total draught of card, 120.60.

That is, one foot of a lap, running up at the feeding-rollers, comes out in front of the calender rollers a trifle over $120\frac{1}{2}$ feet in length. There are cards with a draught of nearly 200 to 1.

The draught between the feed-rollers and cards, in this instance, was 1 into 79, and the draught of the drawing-head was 1 into $2\frac{1}{2}$. Total draught, $197\frac{1}{2}$.

This is carding for fine yarn, No. 150.

79
$2\frac{1}{2}$
158
$39\frac{1}{2}$
$197\frac{1}{2}$

TO FIND THE LENGTH OF A FILLET.

To find the length of a fillet, two inches in width, (it should never be narrower than this, either for doffer or likerins,) to cover a doffer 21 inches in diameter, and 30 inches in width, use the following rule. The diameter bears to the circumference about the same (or near enough for our purpose,) proportion as 7 does to 22. Multiply the number of inches in the circumference of the doffer by the amount of inches in its width, and divide the product by 2; the quotient will be the length in inches, which, divided by 12, will give the correct length in feet; the remainder, if any, will be inches.

EXAMPLE.

To find the circumference, if

```
Diam. Cir.
  7 : 22 : : 21 : to circum. of doffer.
      21
      ——
      22
     44
    ————
   7)462
    ————
Circumference of doffer=66 inches.
       Width of doffer= 30   "
                      ————
    Width of fillet=2)1980
                     ————
  Inches in a foot=12)990
                      ———
                      82.6=len. of fillet, 82 f. 6 in.
```

To be on the safe side, get the fillet long enough; for, sometimes they fall short, which occasions a great deal of trouble. For iron doffers, particularly, it is essentially necessary that the fillets should be long enough to reach from the plug-holes on one side to those on the opposite side. All cylinders are about one inch wider than the sheets are made. In order to be certain, let the calculation be made at 31 inches instead of 30; for it is much better to have some to spare than to have the fillet too short. The length of the fillet will then be

Circumference of doffer = 66 inches.
Width of doffer = 31

```
    66
   198
  ----
 2)2046
  -----
12)1023
  -----
   85.3 = 85 feet.
```

Or, 84 feet would be amply sufficient.

SIZE OF FILLETS.

Fillets for likerins should be as wide as those of the doffers, when the diameter of the likerin is eight inches or more. If the diameter is less than this, a fillet two inches wide would assume too much of a spiral form when lapping on the likerin, and would present the sides of the teeth to the cotton, instead of the fronts and points. This is the reason why narrow fillets are put on workers and strippers. Narrow fillets are too weak for likerins, which have so much more labour to perform in pulling the raw cotton from between the feeding-rollers. By the straining which it receives, and by grinding it, the fillet is often drawn to such a degree of tensity as to break suddenly when the card is performing only its regular work, thereby damaging the other cylinders, or their clothing, to the amount of forty or fifty dollars, besides the vexation and loss of time which such an accident occasions. Sad devastation may be occasioned about a card by the fillet on a doffer or likerin giving way when the card is at work. If the fillet should catch on the main cylinder, when it is revolving at its greatest speed, which is nearly 140 times per minute, it will, in an incredibly short space of time, tear everything to pieces, and make the workers, strippers, and top cards fly about in every direction; and, before it will be possible to stop the card, great damage will be caused. The breaking of a fillet may be said to be one of the miseries of cotton-spinning; the only possible remedies for which are, the use of strong fillets, and the exercise of the utmost care on the part of those who are employed to superintend the operations of this portion of the machinery.

Fillets on likerins of the narrow kind, say 1½ inches wide, may be strengthened by driving two or three rows of small 2½ or 3 ounce tacks, in equi-distant rows, around the circumference, and the full width of the likerin. If this is neatly and carefully done, it will be of considerable use in preventing it from breaking, and will also keep it from running slack at the right-hand side when grinding.

TO FIND THE LENGTH OF THE FILLET FOR A LIKERIN.

When the diameter of the likerin is 11 inches, and its width is 31 inches.

EXAMPLES.

$$7 : 22 :: 11 : 34\tfrac{1}{2} \text{ inches} = \text{circum. of likerin.}$$

$$\begin{array}{r} 34\frac{1}{2} \\ 31 \quad \text{"} \quad = \text{width of likerin.} \\ \hline 34 \\ 102 \\ 15\frac{1}{2} \\ \hline 2)1069\frac{1}{2} \\ \hline 12)534\frac{3}{4} \\ \hline 44.6 \end{array}$$

Ans. 44 feet 6 inches of 2 inch fillet.

The length of a 1½ inch fillet for the same likerin, will be,

Inches.		Feet.		Inches.		
2	:	44½	: :	1½	:	Ans.
2		4		2		
4		3)178		3		
		59.3				

Ans. 59 feet 3 inches of 1½ inch fillet.

TO FIND THE LENGTH OF THE FILLET FOR A WORKER.

When the worker is 6 inches in diameter, and 31 inches wide, to find the length of 1½ inch fillet which will be required to cover it.

EXAMPLE.

```
     31 inches.
     19   "     circum. of worker, nearly.
    ---
    279
    31
    ---
    589
      2 halves.
    ---
  3)1178
  -------
 12)392 2/3 inches.
  -------
    32.8
```

Ans. 32 feet 8 inches, length of fillet.

LENGTH OF FILLET TO COVER A STRIPPER.

To find the length of a fillet, $1\frac{1}{2}$ inches wide, to cover a stripper 3 inches in diameter, and 31 inches long

EXAMPLE.

```
      31
       9 1/2
    -----
     279
      15 1/2
    -----
     294 1/2
       2
    -----
   3)589
   ------
  12)196 1/3
   ------
      16.4
```

Ans. 16 feet 4 inches, length of fillet.

NUMBER OF TEETH TO THE SQUARE INCH OF EACH NUMBER OF CARD-WIRE.

The number of card-teeth or points set in a square inch or a square foot of leather, depends upon the size of the wire which is used, ranging from No. 28 to 36. The wire in the likerin is generally coarse, and thinly set. In the top cards, also, it is set thinner than in other parts of the card. Subjoined, we give the proportion, and the numbers of the wire.

No. 28	wire,	275	points to the sq. in.	=	39,600	to the sq. ft.
29	"	300	" "	=	43,200	"
30	"	325	" "	=	46,800	"
31	"	350	" "	=	50,400	"
32	"	400	" "	=	57,600	"
33–34		450	" "	=	64,800	"
35–36		475	" "	=	67,400	"

If 450 or 475 points of No. 35 or 36 wire are put in a square inch, it will be quite sufficient; especially as the spinning in this country is generally done on the heavy system, for which a fine wire would not answer so well. The proper sizes of wire for clothing the different parts of the card, are:

Filletting on likerin, 2 inches wide, No. 30 wire: 325 points to the square inch.

Filletting for workers and strippers, 1½ inches wide, No. 31 or 32 wire: 325 points to the square inch.

Filletting for doffers, 2 inches wide, No. 34 or 35 wire: 450 or 475 points to the square inch.

Sheets on main cylinder, 4 inches wide, No. 33, 34, or 35 wire: 425 or 450 points to the square inch.

Top cards, $1\frac{3}{4}$ inches wide, No. 31 or 32 wire: 325 points to the square inch.

Some manufacturers prefer using No. 28 or 29 wire for likerins; but it is too coarse and harsh.

It makes but little difference whether the teeth are set in the leather in the form of a twill, or inserted in plain rows.

THE DRAWING-FRAME.

DRAWING or doubling is the next operation through which the cotton has to pass after it has been carded. The ends, bands, or slivers, as they come from the card, are exceedingly tender and loose, the fibres of cotton not being yet arranged in the parallel form requisite for good spinning. Before any twist is given to the bands, the fibres should be in a proper position for the manufacture of smooth yarn. The doubling and drawing out of the bands, which accomplishes this perfectly, is done on the drawing-frame. Some drawing-frames are constructed with three pair of rollers, and some with four pair; the latter having the advantage of doing more work in the same time. The rollers in a drawing-frame are generally so adjusted, that the drawing is done between the first and third roller, the middle roller having but little influence on the result, so far as the stretching is concerned. Where there are three or four rollers, the drawing is performed twice;

each pair of rollers draws a certain amount. The distance between the rollers is so adjusted, that the longest fibre of the cotton does not reach from the centre of one roller to the centre of the other; this prevents the rollers from tearing the fibres, because the first pair of rollers pulls the fibres, while the second holds them fast. If, on the other hand, the distance between the rollers is too great, the filaments of cotton separate in unequal thicknesses, and the result is unequal yarn. It is more preferable to have the rollers too close together, than to have them too far apart, provided they are always so far distant as not to injure the staple. The principal object to be attained in drawing the bands is, to reduce their thickness after they have been doubled. Doubling and drawing effects the two-fold purpose of stretching the fibres of cotton, and equalising the bands. The more a band is doubled and eliminated, the more perfect should be the yarn spun from it; but this process of drawing can, nevertheless, be carried too far. Excessive drawing, as well as excessive picking and carding, tends to weaken the fibre, and finally renders it brittle and rotten. Still, if the machinery is kept in such perfect order as not to injure the cotton, it may be considered impossible to eliminate the fibres to too great an extent. The sliver from the last drawing-head should be of a silky lustre, and its component fibres should lie perfectly parallel with the band and with each other. But little cotton is wasted in this operation; the waste consists principally of those parts which have to be broken off in consequence of their running singly, or when the attendant, through negligence or inadvertence, misses a can, and gets behind-hand with the rollers.

SIZES OF DRAWING-FRAMES.

	Ft.	In.		Rev.
Diameter of pulley on horizontal main driving-shaft	1	8½	..	82
Diameter of driven pulley on counter-shaft ..		9¼	..	177
Diameter of driving pulley on counter-shaft ..	1	¼	..	177
Diameter of frame-shaft—driver	1		..	180
Diameter of driving-pulley on frame-shaft	1	2	..	180
Driving first, second, and third heads by pulleys of the diameter of		6	..	420
Driving the last head by a pulley of		4½	..	560

DRAUGHT CALCULATIONS OF THESE HEADS.

FIRST HEAD.

	Teeth.
Pinion on front roller—driver	24
Driving carrier-stud of—driven	48
Change-pinion attached to carrier-stud—driver	40
Driving middle roller by pinion of—driven	48
Pinion on other end of middle roller—driver	24
Pinion on back roller—driven	40
Intermediate carrier-stud between the back and middle roller pinions	40

The whole four heads have exactly the same pinions, with the exception of the change or draught pinions, which bear the following relative proportions.

	In.	Teeth.	Rev.
First head, change pinion, and speed of front and back rollers	..	40	.. 420

	In.	Teeth.	Rev.
Second head, change pinion, and speed of front and back rollers		36	420
Third head, change pinion, and speed of front and back rollers		32	420
Fourth head, change pinion, and speed of front and back rollers		28	560
Diameter of back and middle rollers	1		
Diameter of front rollers	$1\frac{1}{4}$		

DRAWING-FRAME OF ANOTHER SIZE.

	Ft.	In.	Rev.
Diameter of pulley on main shaft	1	10	100
Diameter of driven pulley on counter-shaft		10	220
Diameter of driving-pulley on counter-shaft	1	$2\frac{3}{4}$	220
Diameter of driven pulley on frame-shaft	1		270
Diameter of driving-pulley on frame-shaft	1	2	270
Diameter of driven pulley on first head, front roller		4	890
Diameter of driven pulley on second and last heads		6	629

There are only three heads to these frames, and all the gearing and pinions are the same, with the exception of the change pinions on each head, which are as follows:—

	Teeth.
Change pinion on first head	36
Change pinion on second head	32
Change pinion on third and last head from 27 to 30	28

The last head is used when alterations are made in the size of the stuff. It requires sometimes the use of a smaller pinion and sometimes of a larger, according to circumstances.

DRAUGHT CALCULATIONS OF FIRST HEAD.

	In.	Teeth.
Pinion on front roller—driver	..	24
Driving carrier-stud of—driven	..	48
Change pinion attached thereto—driver	..	36
Driving middle roller by pinion—driven	..	48
Pinion on the other end of middle roller—driver,	..	24
Driving carrier-stud of	..	40
Driving back roller by pinion of—driven	..	40
Diameter of front under roller—driven	$1\frac{1}{4}$	.
Diameter of back under roller—driver	1	.

DRAWING-FRAME OF ANOTHER FORM.

	Ft.	In.	Rev.
Diameter of pulley on main lying shaft	1	9	82
Driving counter-shaft by pulley of	1	1	132
Driving pulley on counter-shaft	1	4	132
Driving frame-shaft by pulley of		10	211
Diameter of driving-pulleys on frame shaft,	1	2	211
Driving 1st, 2d, and 3d heads by pulleys of		6	492
Diameter of pulley on fourth and last head,		5	590
Length of under rollers from stand to stand,	2	8	..
Width of bosses, four under each roller		$5\frac{1}{4}$	..
Diameter of vent in the tube at the last head of the calender-roller		$\frac{3}{16}$	..
Extreme length of frame—four heads	17	1	..
Extreme width, including cans	5		..
Distance from centre to centre of front and middle rollers		$1\frac{1}{2}$	..
Length of the longest staple of upland cotton		$1\frac{3}{16}$	..

The front under rollers of this frame are cast-steel. As all the front rollers of drawing-frames and speeders should be made of steel, the front under rollers of a spinning-machine are also much better if made of the same material. Steel front under rollers which have run for twelve years, are not near so much worn in the flutes and journals, as those made of iron, which have only been in use about three years. This is a proof of the great superiority of steel over iron rollers. In addition to this advantage, they work better, being free from the flaws, cracks, and other imperfections, which often cause other rollers to lap.

DRAUGHT CALCULATIONS OF THE FIRST HEAD.

	Teeth.	In
Pinion on end of first roller—driver............	30	..
Driving head-shaft by pinion of—driven.........	60	..
Pinion attached to the head-shaft—driver........	36	..
Driving middle roller by pinion of—driven	48	..
Change-pinion on other end of head-shaft—driver,	36	..
Driving back roller by pinion of—driven	60	..
Diameter of front under roller—driven	..	$1\frac{1}{4}$
Diameter of back and middle rollers—driver	..	1

Drivers.	Driven.
36	60
30	60
1080	3600
4 = $\frac{4}{4}$ diam. back roller.	5 = $\frac{5}{4}$ diam. front roller.
4320	

```
4320)18000(4.16      Draught 1
     17280           into 4.16.
     -----
       7200
       4320
       -----
       28800
       25920
       -----
        2880 remainder.
```

1st head, front roller pinion 30;	change pin. 36;	draught	4.16
2d " " " 28;	" " 34;	"	4.72
3d " " " 27;	" " 32;	"	5.36
4th " " " 26;	" " 30;	"	5.76

The draught on these frames is altered both by pinions on the front roller, and by change pinions on the head-shaft. This is the most convenient plan of a drawing-frame for making changes. In calculating the draught, the pinion on the head-shaft, which drives the middle roller, should be omitted; as also the pinion on the middle roller, because they do not operate

TO FIND THE DRAUGHT OF ANY MACHINE WITH THREE ROLLERS.

By the draught of a machine, is understood the difference between the length of the cotton coming from between the calender rollers, or front drawing-rollers, and that which is passing in at the back rollers of the machine.

RULE.

Multiply the number of teeth (say 36,) contained in the change-pinion attached to the third carrier, by the number (say 24,) in the pinion on the front roller. The product must be multiplied by 4, for the diameter of the back roller, which is 1 inch, or 4 fourths of an inch. Then multiply the stud carrier, of 48, by the pinion of 48 on the middle roller, and that product by the diameter of the front rollers, which, if $1\frac{1}{4}$ inches in diameter, makes $\frac{5}{4}$, or 5.

EXAMPLE.

Drivers.	Driven.
36	48
24	48
144	384
72	192
864	2304
4	5
3456	3456)11520(3.33 = draught of the head.

```
3456)11520(3.33 = draught of the head.
     10368
     -----
      11520
      10368
      -----
       11520
       10368
       -----
        1152 remainder.
```

When taking the draught of a head, the middle roller is not included in the calculation, because the motion is imparted to the back roller; but, had the motion been communicated to the middle roller, then the back roller would have been omitted.

SIMPLE METHOD OF TAKING THE DRAUGHT.

There is an easy mode of taking the draught of drawing-heads and speeders, without going to the trouble of counting the teeth of the various pinions, or taking the diameter of the rollers. Break off the ends from the first can close to the calender rollers; then, by a foot rule, laid to the stuff at the back rollers, close to their bite, measure off six inches;

roll the sliver at the end of the six inches with your finger and thumb, and make a mark. The measure taken at one end of the back roller will be sufficient; there is no necessity for measuring along the whole head. Turn the head slowly, until the six inches measured off have been fairly run through up to the mark. Break off the sliver that has run through, close to the calender rollers, being very careful, at the same time, not to stretch it. Lay it on a smooth board, or a clean part of the floor, where its length may be measured in inches, which, when divided by six, will give the draught of the frame. If there should be a draught between the front and calender rollers, they should be altered, as it has a bad effect.

If the sliver measures 28 inches, 6)28(4$\frac{2}{3}$; that is, 1 drawn into 4$\frac{2}{3}$. If 30, thus, 6)30(5; that is, a draught of 1 into 5: any remainder is a fractional part of the divisor. This is a plain and easy way, and answers the purpose very well, particularly, if it is desirable to know the draught of a frame, and there is not sufficient time to count the wheels. Too great a draught in any one head has an injurious effect on the staple of the cotton. In another portion of this work, we shall lay down the rules for taking the draught at the different machines, in a correct and proper manner.

TRYING THE STUFF.

The last head of a drawing-frame is the best place for trying the stuff. If anything goes wrong, it can here soon be detected, and a proper remedy immediately applied. The old plan was, to try it from the stretcher or the roving-frame, and if it was found to be too light or too heavy, the weight of the lap was altered at the cards. This is not the proper place to make temporary changes, and to regulate the stuff; it is by far too distant from the roving-frame, and several hundred-weight of rovings may be spoiled by this method in the course of a month, by being run through either too light or too heavy. There is already too much work done between the spreading-machine and the speeders, and there is no possibility of checking it; to prevent mischief, try the stuff at the last heads, and make slight temporary alterations there. The mode of doing this is as follows:—

Break off all the cans at the front of the last heads, close to the calender rollers, and run the head so that the ends just touch the floor, or the surface of the rotary pulleys on which the receiving-cans belonging to the last head revolve. Repeat this twice, and put all the ends together. The distance from the calender-rollers to the surface of the pulleys is about 3 feet 4½ inches; the double of this will make 6 feet 9 inches, or, if there are four heads, 27 feet in all. When a proper standard has been fixed upon, the weight of the stuff in grains should be ascertained by the use of a pair of small but correct scales. If it becomes too light or too heavy, owing to a change of cotton or a change of weather, for both these causes will produce the like effect, from bad mixing, careless and incorrect weighing or spreading in the picking-room, or from a defect at the drawing-heads, put on a pinion one tooth larger to increase its weight six or seven grains, if it is required, or one containing a tooth less to decrease the weight that much. This change will depend, in a greater or less degree, on the standard fixed upon, the size of the roving, and the numbers of the yarn that is being spun.

The stuff can be tried equally as well on the yarn quadrant, if there is one in the factory. The proper system is, to try the stuff regularly every two or three hours; if any change has been made in the weight of the lap, or in the card-pinions, it will be well to try it repeatedly, until it again becomes right. In a trial of the stuff made on the last-described drawing-frames, by the yarn quadrant, the 27 feet would weigh from 32 to 34; this would make, on the small scales, from 210 to 214 grains, and would make, in roving, 2.42, or nearly 2½ hank roving. The yarn spun from it will average from 18 to 25 hanks to the pound.

CHANGE-PINIONS.

There should always be a plentiful supply of change-pinions for the drawing-heads, containing from 24 to 40 teeth, and also an ample supply of pinions for speeders and cards, to be ready for the accomplishment of any desired change, or to meet any emergency which may arise.

DRAWING AND DOUBLING.

When drawing-heads are on the cards, their draught, and that of the four heads of the drawing-frame, should be regulated as follows. Drawing-head at the cards, 1 into 2¼ or 2½: first head of drawing-frame, 1 to 3½; second head, 4½; third head, 5½; fourth head, 6½; and the speeder, 6½ or 7. It will not do much harm to the heads to draw less, but if the draught was increased it would prove hurtful. A great deal of yarn is spoiled by being overdrawn at the speeders; the fibre of the cotton becomes broken and weakened, and cannot be made to produce good yarn. If the draught at the spinning-frames does not exceed 1 into 8 or 9, it will not spoil the yarn: this proportion is, however, often exceeded, for the purpose of keeping as large a number of spindles running with as few preparatory machines as possible. These are practical errors, as the yarn will not be so good, where the draught is too strong. Where there are drawing-heads to the cards, the stuff will come light from them, and if there is no doubler, 12 ends can be brought up to the back of the first head.

Thus,	12	ends run into 1 can at first head.
	6	at second head.
	72	
	6	at third head.
	432	
	3	at fourth and last head.
	1296	

There it is doubled 1296 times.

DRAWING WITH DOUBLERS

In the drawing-frames with three heads, the cotton is only doubled 216 times, which is too little for twist or chain. Frames with three heads are much better if they have a doubler attached to them. Five cans may run up at this doubler; where the cards have a drawing-head to each card, and no railroads, four cans from the doubler run up to the first head instead of twelve. These four cans would be equal to twenty cards running into one can. These four cans at the second head, running into one, would be equal to eighty double; two cans running into one at the third head, would be equal to 160. If the doubling is continued through four heads on this plan, with only four cans at the back of each head, or one can to every roller-boss, all running into one can in front, the doubling would be 320; or, if the stuff would admit of two cans running up to each roller-boss at the fourth head, without increasing the draught more than 1 into 6½, the doubling may be carried to 640. If a doubler is used on the stuff, previous to putting it up to the first head, it is an excellent plan for preventing the stuff from running single, and is a saving of waste, by using four cans at the back of all the heads instead of twelve. By the last system of working there is always more or less single running, whereas, if there were only four ends running up, it would be impossible for the stuff to run through single without being noticed, and the head stopped. Where such a number of ends run up, this single running may occur without detection. Large cans should be used, especially in front of the doublers, and at the back of the first heads. By this means, two hands can attend to six heads with as much ease as they could attend to three, with a greater number of cans. A saving of cans will also be effected, and the first head may be driven considerably slower than usual, which will be of great advantage. The front roller then requires but 534 revolutions per minute, instead of 890; which decrease of speed is very favourable for this frame, as the rollers will not heat then, and cause them to lick up the cotton and lap, thereby making waste and losing time. This plan of doubling is an old one, although it has, of late years, been adopted with advantage at some mills.

JENKS' DRAWING-FRAME.

One of the most perfect drawing-frames is that patented by Jenks, having four rollers. It has three heads, each working four coilers, which makes an aggregate of twelve coilers to the frame. The rollers are all made of the best cast steel, and the first one makes 800 revolutions per minute. This machine yields 1000 pounds of first quality sliver in ten hours.

SLIVER FROM THE RAILROAD.

Where there is a railroad, on which the cans run for twelve cards, each twenty-four inches wide, the stuff will be doubled as follows. Three cans from the railroad head run up at the doublers, which consist simply of two rollers, the top one having a weight attached; this is equal to thirty-six card cans. Four of these cans run up at the first head, and fall into one can. This is continued through all the heads, with the exception of the fourth and last, at which the stuff is not doubled. By this system, the stuff, including that from the twelve cards, doubles 2304 times before it reaches the fourth head, which draws but does not double.

CHANGING THE DRAUGHT.

A change in the roving for the purpose of making finer yarn, where it would be improper to add to the draught of the spinning-machine, may be done in the following manner. If No. 20 yarn is being spun, and it is desirable to alter the roving so that No. 25 yarn can be made, and the stuff from the last head weighs 214 grains, how much must its weight be to produce the yarn required?

EXAMPLE.

No.		Grains.			No.		
20	:	214	:	:	25	:	Ans.
		20					

25)4280

171.2 or $171\frac{1}{5}$

It appears from this, that to alter it five numbers, the stuff must be made 43 grains lighter.

If there is a pinion containing twenty-eight teeth, on the last head, what sized pinion would it require to make the change?

EXAMPLE.

```
Grains.  Pins.    Grains.
 214  :  28  : :  171  : Ans.
                   28
                 ----
                 1368
                 342
                -----
           214)4788(22 teeth, or not quite 6
                428        of an alteration.
                ---
                 508
                 428
                 ---
                  80 remainder.
```

We perceive that it would require less than six teeth of an alteration to produce this change. This would be too great a change to make on any one head; but a difference of two teeth may safely be made on the first heads, and three on the last, if necessary. When a change of this kind is made, all the cans should be run out of the frames.

CHANGING THE SIZE OF THE ROVING.

If the roving was sufficient before, there will be no necessity of doing such heavy carding. A smaller pinion might be put on the bottom of the side-shaft, and a part of the alteration may be effected by a change of two or three teeth on the card-pinions. If the feeding at the spreading-machine is too heavy to do justice to the cotton, the weight of the lap may be altered, which will effect the desired change at once, and without any further trouble. If the weight of the lap is two pounds, and No. 20 yarn is being spun, how much must it be reduced to make it suitable for No. 25 yarn?

EXAMPLE.

No. Grains. No.
20 : 32 : : 25 : Ans.
20

25)640(25$\frac{3}{5}$ ounces.
50

140
125

5)$\frac{15}{25}$($\frac{3}{5}$

Ans. 1 pound 10$\frac{1}{2}$ ounce, and a trifle over.

If the whole change is made in the lap, it will require the weight of the lap to be reduced nearly 5$\frac{1}{2}$ ounces. When changes of this kind, or, in fact, any changes of consequence become necessary, the manager and carder should consult together regarding them. Changes of this nature can be made with the greatest advantage to the work; but the place where it can be done with the least trouble should not be selected for that purpose, when by doing so, a part of these advantages may be sacrificed.

If the stuff from the last head proves to be 220 grains, and the speeders are making a 2$\frac{1}{4}$ hank roving, what should be the weight of the stuff to make a 2$\frac{1}{2}$ hank roving?

EXAMPLE.

$$
\begin{array}{cccccccc}
\text{Hanks.} & & \text{Grains.} & & \text{Hanks.} & & \\
2\frac{1}{4} & : & 220 & :: & 2\frac{1}{2} & : & \text{Ans.} \\
\hline
9 & : & 220 & :: & 10 & & \\
 & & 9 & & & & \\
\hline
 & & 198,0 & = & 198 \text{ grains.} & &
\end{array}
$$

If, with the weight of the stuff at 198 grains, 2½ hank roving is being made, and it is desirable to make three hank roving without altering the speeder, what should be the weight of the stuff from the last head to effect this object?

EXAMPLE.

$$
\begin{array}{cccccccc}
\text{Hanks.} & & \text{Grains.} & & \text{Hanks.} & & \\
2\frac{1}{2} & : & 198 & :: & 3 & : & \text{Ans.} \\
2 & & 5 & & 2 & & \\
\hline
5 & & 6)990 & & 6 & & \\
\hline
 & & 165 \text{ Ans.} & & & &
\end{array}
$$

Thus, we find that it requires a weight of 165 grains to make three hank roving. This alteration must be made in the lap on the spreading-machine, on the cards, or on the drawing-frames, according to circumstances.

If, with a lap weighing 1 lb. 12 oz., the cards are working with a pinion containing 23 teeth on the bottom of the side-shaft, and it is found to be necessary, in order to keep the cards in rollers, to feed thicker or heavier at the spreading-machine, and to increase the weight of the lap to 2 pounds, and still keep the carding at its previous size, what sized pinion will be required on the bottom of the side-shaft?

EXAMPLE.

Ounces.	Pinion.	Ounces.	
28 :	23 : :	32 :	Ans.

```
 28
 23
 ——
 84
56
———
32)644(20  Ans.
   64
   ——
   004  remainder.
```

A pinion of twenty teeth at the bottom of the side-shaft will answer the purpose.

If 2 hank roving is being made, with the weight of the lap at 2 pounds, and it is desirable to make $2\frac{1}{2}$ hank roving without altering the draught of the cards, frames, or speeders, what must be the weight of the lap to produce this result?

EXAMPLE.

Hanks.	Ounces.	Hanks.	
2 :	32 : :	$2\frac{1}{2}$:	Ans.
2	4	2	
4	5)128	5	
	$25\frac{3}{5}$ ounces.		

The lap must weigh a little over $25\frac{1}{2}$ ounces.

If 2 hank roving is being made, with a 28 tooth change-pinion on the last head of the drawing-frame, and a necessity arises for its alteration to $2\frac{1}{2}$ hank roving, what must be the size of the pinion used on the last head?

EXAMPLE.

Hanks.		Pinion.		Hanks.		
2	:	28	: :	$2\frac{1}{2}$	:	Ans.
2		4		2		
4		5)112		5		
		$22\frac{2}{5}$		Ans. $22\frac{2}{5}$ teeth in pinion.		

Here would be a change of five or six teeth to be made on the last head, which would, perhaps, increase the draught too much; there might, also, be no pinions of the required size; and, even if they could be obtained, their use might cause the back rollers to run too slow, and prevent them from keeping up the cans from the next head. It would be better to alter two teeth on each of the three heads, or alter two or three teeth at the bottom of the side-shaft, or make the lap lighter on the spreading-machine. Any alteration at the speeders, having a tendency to increase their draught, is not advisable, unless the draught is less than 1 into 6. Better work, however, is done by the speeders, when their draught does not exceed 1 into 5. When any material change is contemplated, endeavour to ascertain by examination the most advantageous place for making the alteration. No certain rule can be laid down for making these changes, owing to the variety of controlling circumstances, which can only be known to the manager and carder of the factory. If they understand their business properly, they will make such alterations to the best advantage; quantity and quality being duly estimated. It frequently happens, in changing from one number to another, owing to an error in overdrawing the stuff on some one of the machines, that the operation is attended with bad consequences. When any important alteration is being made in the draught of the machines, long-established rules and approved principles should not be departed from, for the sake of making experiments or trying new plans. Without being thoroughly acquainted with the nature and quality of the material, and the principle upon which the machinery in use is constructed, no one can be fully warranted in making new experiments. It is true that discoveries cannot be made, or inventions perfected, without trials and experiments; but the capacity to invent and perfect machinery is a talent which is not in the possession of every individual.

ROVING.

The fifth operation through which the cotton has to pass, is the roving, or first spinning process; it is performed on the roving-frames, such as the slubbin, fly-frame, belt-speeder, tube-frame, and numerous other machines of the same construction. The elongated slivers become, by the time they reach this portion of the machinery, so thin and tender, that they would not hold together, if they were not slightly twisted, or held together by a pressure imparted to them. If the system of twisting is adopted, it should never be carried further than is necessary to make the roving strong enough to withstand the winding and unwinding of the bobbins, as too great a twist injures the quality of the yarn. The operation of roving is, in many cases, frequently repeated, according to the degree of fineness required in the yarn. Coarse yarn, or yarn under No. 20, may be spun of a good quality by receiving but one twist, or none at all, as on the speeders. Fine numbers require repeated twisting on various machines.

A preliminary spinning process, in which some twist is given to the sliver, is frequently performed at the drawing-heads, by making the cans revolve. This is a very good plan, and is more generally performed now than formerly, especially in new factories; but more than one twist should not be given to each 2½ or 3½ inches of sliver. A coarse band requires more twist than a fine one. The revolving cans are placed for this purpose on a horizontal revolving wheel, which is so arranged as to be flush with the floor of the factory. From these cans the sliver passes to the fly-frame or speeder, if it is required for coarse numbers; if fine yarn is wanted, the roving must first pass to the slubbin, and from thence to the fly-frame.

The operations of the slubbin and fly-frames are considered more beneficial to the quality of the yarn than those of the speeders; but the expensive character of these machines is an obstacle to their general adoption. Warp of every kind and number should be spun from roving made on these frames, the increased expense attending their use being amply repaid by the facility with which it is woven. Filling may be spun from the roving of the speeders, as a little roughness in the yarn used for filling is a matter of no consequence. The yarn made from the roving of these frames may be considered, when on the loom, to be from five to ten per cent. more valuable than that made from the same cotton by the operations of the speeders.

SPEEDERS.

DIMENSIONS OF BELT-SPEEDERS.

	Ft.	In.	Teeth.	Rev.
Diameter of pulley on main horizontal shaft	1	10	..	100
Diameter of driven pulley on counter-shaft		11	..	200
Diameter of driving-pulley on counter-shaft	1	10	..	200
Diameter of pulley on front roller of speeder		5¾	..	765
Diameter of pulley on the other end of the front roller		2½	..	..
Driving small parallel shaft by a sliding pulley		6	..	..
Bevel wheel on other end of this shaft,			30	..
Driving condensing-shaft by bevel of,			30	..
Diameter of the pulley on the other end of this shaft		5	..	..
Driving condensing-strap or twist-belt, the width of which is		1¾	..	..
Driving pinion on speeder f. roller			28	..
Driving carrier-stud of			74	..
Change-pinion attached to carrier-stud,			31	..
Driving back-roller by wheel of			60	..
Pinion on other end of back roller			28	..
Intermediate carrier-stud			40	..
Pinion on middle roller			24	..
Diameter of front under roller		1¼	..	..
Diameter of back and middle rollers,		1	..	..
Wheel on front roller, driving calender rollers			30	..

	Ft.	In.	Teeth.
Wheel on front roller, driving bobbin-rollers,		..	76
Diameter of bobbin-rollers		$3\frac{1}{2}$	..
Extreme length of speeder with 12 ends ..	11	10	..
Width of speeder, including cans	2	10	..

DRAUGHT OF THIS SPEEDER.

EXAMPLE.

```
Drivers                        Driven.
 31                             74
 28                             60
 ---                           ----
248                            4440
 62                               5 diameter of front roller.
----                          -----
868                   3472)22200(6.3
  4 diam. b. roller.    20832
----                    -----
3472                     1368 remainder.
```

Ans. Draught 1 into 6.3, nearly.

BELTS ON SPEEDERS.

The belt of this speeder must neither be kept too slack nor too tight, for it will produce bad effects on the roving in either case. If it is too tight it will condense too hard, rendering it a matter of impossibility to draw the roving evenly in the spinning-rollers. If the belt is too slack, the roving will be so soft as to break readily, and will not run off the bobbin cleanly.

Speeders are generally driven much faster than there is any necessity for, usually making 900 revolutions per minute.

This great speed causes the top rollers to jump, if there happens to be the least inequality in their covering, thereby cutting and spoiling the roving. This evil is aggravated, if the water-wheel or steam-engine runs faster at one time than at another, owing to the stoppage of part of the machinery. If the speed is reduced to 770 or 765 revolutions, these machines will do more work and do it better. The hank roving is nearly 2½ or 2.45; this is spun by the mules into yarn ranging from No. 18 to 24, or on an average, No. 22½. Eight speeders, having each twelve ends, or ninety-six ends in all, will turn off a sufficient quantity of roving to run 8064 mule spindles, producing 8320 pounds of No. 22½ yarn per week, if full time is made; being an average of nearly four hanks to the spindle. There are, therefore, 1008 mule spindles to each speeder.

The untwisted roving, made on machines of this description, will not make, on the spinning-machines manufactured at the present day, as good yarn as that which is twisted. The back and middle rollers should be close together, and there should not be a greater distance between the centres of the back and middle rollers, than there is between the centres of the middle and front rollers. If there is a great distance between the rollers, which have also a considerable amount of draught, and the roving has not sufficient strength to hold it together, it will draw apart in an irregular manner; for, when the roving yields to the draught between the back and middle rollers, a large portion of it is drawn out of a thin place, and passes through in the same state to be formed into yarn. Both the light and heavy parts of the roving are equally reduced in size, by which the thin roving will suffer, as a matter of course.

These machines perform a large amount of work with a very small attendant expense, and therefore make cheap roving, but not of a superior quality. This has induced the owners of numerous cotton mills to bring it into use, much to the injury of their yarn. If it were possible to impart a permanent twist to the rovings made on this description of speeders, they would be very valuable machines. The speeders which give the twist to the rovings are the spindle and the fly, which move so slowly that the front rollers cannot be driven at more than one-third of the speed of the belt-speeder, owing to the vibration of the spindle and the fly. This last description of speeders is certainly preferable for making good yarn on the spinning-machines now in use.

The roving made on the counter-twist speeders is faulty, on account of its being first twisted hard and then untwisted. The end passes through so rapidly from the guide to the bobbin, its speed being at the rate of 200 feet per minute, and the twisting and untwisting is performed at such short intervals, that it laps the outer fibres of the cotton around the body of the roving, and prevents it from drawing freely, and from making a uniform thread. That part of the roving around which the fibres are twisted, will not yield to the draught in a regular manner, but comes through the rollers in a thick mass, and the part which follows it will be much too thin. Any person taking the trouble to examine the roving made on these speeders through a magnifying-glass, will find an ample proof of the manner in which the fibres are wound around the roving. This is the great fault in the roving made on these machines; if a remedy could be devised for it, it would be a great improvement.

ECLIPSE SPEEDER.

The condensing-strap, or twist-belt principle, is borrowed from the eclipse speeder. It makes roving very much like the latter, but many cotton-spinners say it is better, because the fibres of the cotton are not wound around the roving like they are in the other machine. There is, however, but little difference. Be this as it may, the eclipse speeders are frequently preferred on account of the small amount of space required for their accommodation, not occupying more than a common-sized bureau, and the quantity of roving they produce compared with the small quantity of room and power they require. The bobbins stand or rather lay across the carriage, at right angles with the rollers. This plan requires a roller but a trifle longer than a common throstle roller. These speeders may be driven at a rapid speed without causing the rollers to jump in the manner those of the belt-speeders do, which are full twice their length. The front rollers of the eclipse speeder may be driven at a speed of from 900 to 1200 revolutions per minute, and ten spindles or ends will keep 1200 mule-spindles supplied with $2\frac{3}{4}$ hank roving, spinning No. 24 or 25 yarn. This is a great amount of work, to be accomplished by a small speeder, with but ten ends. They are now constructed with two roller-beams and a double draught, so that the stuff can be run up double behind them, or two cans run into one end, which improves the roving considerably, and helps to correct any defects which may occur in a single end. These machines are very profitable to mill-owners; but some practice is necessary to enable any person to work them to advantage; which, however, may be said with propriety of all other machines. Any person who has been accustomed to the operations of cotton machinery, and will take pains to study the principles upon which these machines are constructed, will soon be able to work them to the greatest advantage.

HOW TO BECOME ACQUAINTED WITH MACHINERY.

There is no better method of gaining a thorough knowledge of the principles which regulate the movements of a machine, than to take it apart and re-construct it. This will give any person a thorough knowledge of all the parts of a machine, and make him its master; so that, if any accident should happen, he will be able to discover what is the matter, and how to put it in good running order again.

SPEEDER-BOBBINS AND SKEWERS.

All these machines should stand firm, level, and square, and each speeder should be provided with two setts of skewers, so that one set of bobbins may be filling, while another is in course of preparation. The full bobbins, made on the speeders which do not twist the roving, must be handled very carefully, and laid in boxes, in nice, regular order, the moment they are doffed. If properly made on the speeders, and not rubbed or spoiled by rough and careless handling, the bobbins will run well in the mule-creels. The mule-skewers should have well-formed wire points, not so sharp, however, as to cut the creel steps, but slightly rounded; glass steps are the best for use. The creel should stand near the roller-beam, but at a distance from the levers, and the skewers should be as nearly in a perpendicular position as possible. Some spinners prefer those speeders, the bobbins of which run on wires instead of skewers. It is true, they save the trouble of skewering at both the speeders and mules; but they require long, awkward, moving stands, which cause the speeders to take up more room, and the wires are liable to become bent and out of order. Taking everything into consideration, the skewer speeders are preferable to the latter. The heavy iron skewers act as weights in place of the folding stands. If wire bobbins could be so constructed as to run in the stands, or a plan could be adopted by which small rollers or pullies, running on the ends of the wires, like the old tube bobbins, could be brought into use, they would answer very well. Skewering takes up a great deal of time.

It is necessary that speeder-bobbins should run very true, for if they do not they will jump on the calender-rollers, which would cause the roving to be laid on the bobbins irregularly instead of smoothly, and, as a necessary consequence, be the cause of the roving breaking while running off the bobbins. A large number of full bobbins are spoiled in this manner. Imperfect bobbins should be thrown aside when empty, and either not used at all, or turned off true.

SLUBBING AND FLY-FRAMES.

It is beyond the limits of this work to furnish a description of the slubbing and the fly-frame. These machines are so complicated, that it would be almost impossible to describe their mode of operation without the assistance of accurate drawings, which we have not the facility of obtaining at present, and we shall therefore be under the necessity of postponing a full description of them until some future opportunity. The first roller on both a slubbing and a fly-frame never moves as fast as those on the speeders which do not twist, because the length of the spindles will not allow of it.

A new kind of spindles have lately been put in operation, which promise a greater degree of speed, but the experiment has been made too recently to afford a result sufficient to be depended upon. This spindle is held in three places, at the bottom, in the middle, and at the top; the lower part of it is square, and the bobbins are drawn from below.

THE SLUBBING-FRAME.

The common slubbing-frame is generally very well known; it receives the sliver from the drawing-frames, either twisted or untwisted, and converts it into coarse roving, which is again doubled at the fly-frame. Slubbers are made of from twenty-four to forty-eight spindles. The large machines are very disadvantageous, if not particularly well built; small machines may be driven at a greater speed than those of a larger size. One spindle of a slubber will keep six spindles of a fly-frame supplied with roving; that is, forty-eight spindles on the slubbing-frame will do a sufficient amount of work to keep 300 spindles in operation on the fly-frame.

THE FLY-FRAME.

The fly-frame is generally supplied with sixty spindles, but sometimes it has as many as 100. Many manufacturers prefer the small machine, on account of its greater speed, and the small amount of noise which it makes comparatively with the larger one. Where many fly-frames are in operation it may be of advantage to have them of a small size; still, there are machines running 100 spindles which work admirably. A fly-frame of 100 spindles will make 250 pounds of 2 hank roving, and 200 pounds of $2\frac{1}{2}$ hank; finer roving will be produced in a smaller proportion. The front roller of a slubber may be driven at a speed of 100 or 120 revolutions per minute; that of a fly-frame, 250 to 300 revolutions: this, however, depends entirely upon the spindles and the execution of the machinery. Good spindles may be driven fast, while those of an imperfect character must necessarily be driven at a slow rate. The spindles and rollers of these machines must be made of good steel; when constructed of iron or a mixture of iron and steel, they make inferior work. The bobbins are usually formed of wood, the barrels being light and hollow, and the heads made of thin veneers, glued together. When the spring-finger is applied to the fly, the bobbins are wound much harder, and require a great deal more roving than when this finger is not used; but when it is used, the bobbins with heads can be dispensed with, if the motion of the rail is so arranged as to wind each layer shorter. The bobbins used will then be of the same form as those which are in use on the belt-speeder, with ends like cones, and requiring no heads. In this case, the bobbins being simply of the light barrel pattern, are made light, and the roving is not liable to be pressed in at the heads, and to break at that place on the spinning-machines.

The fly-frame is the last machine used in the preparatory department of a cotton-mill; it is from this that the rovings or spongy cords are carried to the spinning-machines. When yarn as fine as No. 60 is spun, the roving is finished on mules, for the reason that the fly-frames are not well suited to the production of rovings finer than six hanks, and fine numbers require a perfect machine to accomplish the object. The fine qualities of yarn, ranging from No. 50, upwards, are not manufactured to such an extent as to require any particular mention of them.

GENERAL REMARKS ON DRAWING AND ROVING.

THE drawing-frame is a very necessary machine in the preparation of cotton for the process of spinning. It is a beautiful mechanical contrivance for extending and refining the sliver, and at the same time laying the fibres of the cotton straight, parallel, and smooth. This process reflects the highest credit on the inventor of both the drawing and roving-frame. The drawing-frame requires the particular attention of the master-carder, as well as of the hands attending it, as it is necessary, if fine yarn is to be made, that every operation performed upon this machine should be closely scrutinized. So much dependence did the inventor place upon it, that, upon the appearance of bad yarn in any of his cotton-mills, he told his carders to pay more attention to their drawing-frames, being convinced that if they were working properly, all the rest of the machinery would operate well.

IMPORTANCE OF DOUBLING.

In most of the factories but little attention is paid to the operation of doubling at the drawing-frames. If the cotton has been previously well cleaned and carded, no operation is so well calculated to produce good yarn, as a considerable amount of doubling on the drawing-frame and the roving-machines.

AMOUNT OF DOUBLING.

Stuff may be doubled 8000 times before it leaves the can, or goes to the roving-frame. It may then be doubled again on the stretcher bobbins, and spun with double rovings at the mules, which will be doubling it 32,000 times. This is done for yarn numbering from 150 to 200 hanks to the pound, but there will be no harm in doing it for other yarn. Good yarn may be made, however, without so much doubling, for very good yarn is made, ranging from No. 20 to No. 40, with the twenty-fifth part of this doubling. No. 20 or 25 yarn-twist should be doubled not less than 1200 or 2000 times.

SPEED OF DRAWING-FRAMES.

The speed of the drawing-frames depends on that of the cards, as well as the draught of the cards, and the number of them running. The number of card-ends which pass up at the back of the first head of the drawing-frame is also regulated by these circumstances. One drawing-frame, with three or four heads, requires ten, eleven, or twelve cards, if they have no drawing-heads, and five, six, or even seven cards, with drawing-heads, to keep it in operation.

When the number of cards to each drawing-frame has been decided upon, calculate the length of sliver they will deliver per minute; then regulate the draught of the first head at the proportion of about 1 into $3\frac{1}{3}$, or 1 into $3\frac{1}{2}$. Calculate at what speed the front roller must be driven, with eight or twelve cans running up, to take up the sliver of the back roller as fast as the cards deliver it. A drawing-frame, working for ten or eleven cards, having no drawing-heads, and the frame having a draught of 1 into 3 on the first head, with twelve cans running up, would require the front roller to run at a speed of 450 revolutions per minute, to use all the sliver. The front roller of a frame working for six cards, with drawing-heads in front, the draught of the card-heads being $2\frac{1}{4}$, and the draught of the first head of the drawing-frame, $3\frac{1}{3}$, with twelve ends running up at the back, should run at a speed of 760 revolutions per minute; with seven cards, the speed should be increased to 890 revolutions per minute. If a doubler be used to run up four card-cans, and four of these are at the first head, a speed of 670 revolutions will be sufficient; and with five card-ends running up at the doubler, a speed of 536 revolutions per minute will be sufficient for the front roller. This reduction of speed is of great general advantage to both the frame and the work.

Cards with drawing heads will usually deliver about 670 inches per minute. The first head of the drawing-frame must be able to take it up faster than this, as it is often necessary to stop it. From this calculation, it appears that seven cards will deliver about 4690 inches of sliver per minute. The back roller should run at a speed of 200 revolutions per minute, which, at a diameter of 1 inch, or a circumference of $3\frac{1}{7}$ inches, takes up 629 inches of one end, and when twelve ends are in use, 7548 inches. By this it would appear that these heads might run slower, and yet keep up with the cards; but such is not the case.

TOP ROLLERS.

Too much care cannot be taken at the drawing-frames and speeders, to make good piecing; no lumps or single strands should be allowed to pass through the rollers, if it can be avoided. If any impurities pass through, or any disorders occur here, have every inch of cotton that is spoiled taken back or cut out. Bad piecing, and even little bits of single, are productive of great injury, being the cause of bad spinning and irregular yarn. Particular attention should be paid to the top rollers; it is necessary that they should be perfectly level and true, and every precaution should be used to prevent them from cutting the stuff. Cutting may be owing to several causes, such as light weights, or their being improperly hung, the stirrup being on one side of the saddle, the stirrup-hook being wrong on the lever, waste collecting around the journals or the middle of the rollers, or the saddles on the pivots wanting oil. It sometimes happens that, owing to negligence in covering the top roller, one end of it becomes smaller in diameter than the other, which will unfit it for the production of good work. Every carder should have a small pair of callipers, with which to test the accuracy of the top rollers.

CUTTING AT THE DRAWING-FRAMES.

It is advisable to let the front top rollers have two thicknesses of cloth under the leather, as it makes them more elastic, and they draw better and last longer. Sometimes the cloth will become loose and rise into ridges; if this happens to any of the top rollers, it will make the head cut. It sometimes happens that the heads are cut by either the bottom or top rollers, which get out of a parallel position, owing to the screws working loose, or caused by the tremor of the pinions, or other circumstances. Accidents of this nature are of frequent occurrence in the best regulated establishments; and therefore the manager or master-carder cannot be too attentive to those portions of the machinery which are liable to be deranged. The carder should frequently examine all the fixtures, and the movements of the various machines under his charge, with the most minute and careful scrutiny, to see that nothing is out of order, or in such a condition as to make irregular drawing or bad roving. Sometimes the stuff will become so heavy that it will not draw clear; this must be particularly watched. Drawing-frame or speeder top rollers should not be weighted heavier than is necessary to make them draw the sliver fair and clear; if the weights are too heavy, they cause the roller to heat, and make the fibres of the cotton catch. Heavy weights soon wear out the leather and cloth, by pressing the top roller too hard upon the flutes, which stretch and finally cut the leather.

REVOLVING OF CANS.

The receiving cans at the calender-rollers of the last heads of drawing-frames should all have a slow rotary motion. The sliver being here fine and light, falls into the centre, or on one side of the can, until it accumulates in a little heap, which falls over in such a manner as usually to bring the upper part below; this causes it to break when it is running up at the back of the speeders. The rotary motion of the cans causes the sliver to be deposited in regular, even layers, and it runs out without any strain or trouble. It would be a great advantage to have these rotary movements at the fronts of all the drawing-heads, as well as at all the cards. The pressing of the sliver into the can is now in many cases done by machinery. A tin or iron tube hangs over the centre of the can, and when it is nearly full, presses the sliver down. This can only be done at the heads with coarse sliver, such as the drawing-heads on railroads, or a doubler, or the first head of the frame. The pulleys upon which the cans are placed, and on which they revolve, should be even with the floor of the factory, as it saves a great amount of handling and lifting; the cans may then be made larger, and are more durable, because they are exposed to less ill-usage.

SIZES OF CANS AND ROVING-BOXES.

Card-cans, 33 inches deep, by 11 inches in diameter.
Drawing-frame cans, 36 inches deep, by 9 inches in diameter.
Speeder-cans, 33 inches deep, by 8 inches in diameter.
Roving-boxes, 30 inches long by 10 inches wide in the clear, and 13 inches deep.

This is a convenient size for a box to carry either full or empty bobbins in; it will hold from sixty to seventy bobbins, made on the condensing-strap, or eclipse speeders. The cans mentioned above are of a convenient size, and generally have a tin hoop and ring around the mouth. A stout iron hoop, well tinned, is laid around the bottom, and a stout wire ring is soldered around the outside angle, formed by the junction of the sides and bottom. The heaviest plate tin should be used in the construction of cans.

WASTE.

The hands should be particular in keeping all their frames and rollers very nice and clean, and attending to the oiling of them at regular intervals. The front top roller should be oiled three or four times each day. As little waste as possible should be made; this is, however, dependent in a great measure upon circumstances beyond our control. If the frames are kept clean and in good order, with good rollers, good cans of the proper size, and the top rollers covered with varnish, to prevent them from lapping, there will be no occasion to make much waste. If, with the machinery in this condition, an undue proportion of waste is made, it must be owing to the neglect and carelessness of the hands, and for want of proper management. All the waste should be collected every evening with strict regularity, and mixed with the cotton in the picking-room on the following day. If too much waste is mixed with the cotton at one time, it makes the stuff light, weakens the yarn, and makes it spin badly; it also causes the stuff to break down at the back of the frames and speeders, which has a direct tendency to increase the waste and the number of single strands, and cause a great loss of time. An average of from ten to twelve pounds of waste is sufficient to mix with 100 pounds of cotton at one time. The waste made is of less value than the unwrought cotton; even that made at the drawing-frames, which is next in value to the card-front waste. The fibres of the waste have been deprived of their adhesive properties, and have no affinity for each other; it is almost impossible to work it by itself to any advantage. A very good plan for diminishing the amount of waste is, to limit the amount of waste which each person shall make, and allow none of the attendants at the drawing-frames to make more than from twelve to sixteen ounces per day, and at the speeders from eight to twelve ounces; but this, in many instances, is of no avail, as roguish or cunning hands, rather than incur the risk of being reprimanded, will find means to secrete their waste, either by throwing it into the cans, having it conveyed slily into the picking-house, or disposing of it in some other manner. When the manager or carder is very strict as to the quantity of waste made, some careless hands will allow single strands or lumps to run up, without saying anything about it, in order to save appearances, thus making what was already bad much worse. Good, careful hands, having a desire to give satisfaction by doing good work, will take time, and endeavour to work up their single strands at the back of the heads. If, however, they have many ends to mind, and the heads run rapidly, while they are engaged in untangling, splicing, and doubling at one head, everything will be going wrong on the other heads; so that the remedy is actually worse than the evil. A head-carder who understands the duties of his situation, will adopt such rules and measures as are necessary under the circumstances, and best calculated to attain the object in view, the suppression of the extravagant formation of waste. The waste made upon mules and throstles, both the roving and soft waste, is less valuable than carding-room waste, and has a greater tendency to weaken the yarn than any other kind. The hands at those machines, therefore, should not be allowed to make any waste, by pulling roving off the bobbins, or in any other way. Evil-disposed persons have been known, when a plan has been adopted for lessening the amount of waste, to carry out quantities of it, and throw it in various places out of doors. When there is much waste made in a cotton factory, especially after the material has had a great deal of labour bestowed upon it, it constitutes a great drawback upon the profits of the establishment. It is certainly a matter of great importance to all persons interested, that the quantity of waste made in any department of a factory should not exceed that which the nature of the operations requires. Many costly establishments have become losing concerns, instead of profitable enterprises, merely by the waste of valuable material, made through careless or unskilful management.

SWEEPING THE ROOMS.

Make it a rule to have the floors kept clean and free from waste and cotton, as a great deal of both is apt to be trodden under foot in this way and destroyed. Every establishment making any pretensions to good management, should keep one or more careful women employed, whose duty it should be to pick up all the particles of waste and cotton, and keep the floors swept clean. In those factories which do not employ a woman for this purpose, the girls are necessitated to sweep at least three or four times each day around their frames and speeders; and, while their time and attention is taken up with sweeping, their machines are apt to be neglected, and the work to suffer by their absence. It is a mistaken notion, that money is saved by dispensing with the services of two women in a factory to keep it in good, clean order; manufacturers are more likely to lose by such a system of false economy, as they must then take the hands from their frames for that purpose, from which they should not be spared a moment. In those factories in which the work is done on the hot-bed system of rapid driving, and turning off a large quantity of work from each machine, and where the amount of good waste and cotton trampled into the dirt is very great, the sweepings and dirty waste from the picking-room should be carried out of the factory every evening, and what is not worth keeping should be sold to the paper-makers, or to the manufacturers of coarse yarn for carpet filling. Let it be carefully packed away in bags, in a building separated from the factory, and let every bag be weighed when it is full, and the weight plainly marked upon it. By the adoption of this system, they will always be ready for sale or delivery at a moment's notice.

SCOURING, BRUSHES, AND CLEARERS.

The drawing-frames should all be well cleaned every Saturday, by taking the heads apart, and cleaning and scouring the under rollers well with a piece of old sheet-card. All the studs and journals should be carefully oiled when put up again. The top clearers should be kept clean, and the cloth in good order. The under brushes should be cleaned out several times in the course of a day, for they receive a considerable amount of dirt, which, if allowed to accumulate, will run through with the sliver, and cause the formation of waste, as well as a loss of time in separating the waste from the sliver. The under brushes should not be set up against the rollers too tight or too hard, as it heats the rollers, and wears both the rollers and the brushes; and, for the same reason, the staples of the brushes should not be too short or too stiff,—they may be about $1\frac{1}{8}$ or $1\frac{1}{4}$ inches long. Brushes are preferable for this purpose to cloth attached to triangular-shaped pieces of wood; the spring of the bristles in the brush will clean motes and dirt out of the flutings, while the wood and cloth will force them in tighter; the cloth will also soon wear out. Cloth may do very well under slow-running card-head rollers, where brushes would be in the way, and under clearers, made of cloth, are kept up to the rollers by a gentle spring. The cloth should not be glued fast to the whole surface of the wood, but should have a space beneath it; the wood should be hollowed out in such a manner, that the cloth will only touch the two edges, and leave a space of one-fourth or three-eighths of an inch in the centre. Brushes for drawing-frame rollers do not generally extend to the back under rollers; it would be very useful to extend them thus far, as these rollers often lap in consequence of dirt lodging in their flutes.

Particular attention should be paid to keeping the speeders clean and carefully oiled, on account of the rapid speed at which they run. It is customary in well-regulated rooms to clean both the drawing-frames and speeders several times per day; and smart, active girls take pride in keeping these machines in nice, handsome, clean order, without receiving a hint from the foreman; others require very broad hints on the subject. It is essentially necessary for the proper working of these machines, and, in fact, all other cotton machinery, that they be kept clean, and regularly oiled. These matters are of great importance in the management of cotton mills.

The speeders might be taken apart, and their under rollers scoured, once every four weeks. The top rollers should be examined very frequently, particularly the front ones, as they are very liable to become untrue, and cut and spoil the roving. There should be a plentiful supply of spare rollers in every factory, ready covered, to be put into any machine in place of those which do not work well.

VARNISH ON TOP ROLLERS.

It is also necessary that some kind of varnish should be used on drawing-frame and speeder top rollers, to prevent them from lapping or licking up the cotton. Almost every carder has some favourite composition, which he thinks preferable to all others; but perhaps this is all right. Some use the whites of eggs and glue; others, simply glue, or glue and venetian-red: some use gum tragacanth, with venetian-red or gamboge, and others employ copal varnish mixed with coloring matter, vinegar and black lead, and a great variety of other mixtures. As may be expected, all these compounds are more or less imperfect. As much benefit may be derived from a mixture of gum arabic and New England rum, in the proportion of about six or seven ounces of the former to a pint of the latter, as from any other mixture. The rollers must always be well cleaned with moist waste, and rubbed dry with a piece of muslin, before the varnish is applied; on dirty rollers it will always crack and scale off. What mostly recommends this last varnish, is the ease with which it may be made, and the fact of a roller being fit for use in three or four minutes after it has been varnished. If properly made, and applied at a medium thickness, it will last a long time, and will answer the purpose as well as any other varnish. Where frames run very fast, and are heavily weighted, no varnish will last long, especially if the rollers become heated.

DRAUGHT OF CALENDER-ROLLERS.

It often happens in drawing-frames, that there is too much draught between the calender and fluted front rollers; this must be altered, for it has a very bad effect upon the stuff, and is the cause of more injury to the yarn, than managers and carders are aware of. It is a very easy matter to ascertain at any time whether the calender-rollers draw, by applying the hand to the top calender-roller, and holding it back a little, so that the stuff may run slack between the front and calender-rollers; if, upon removing the hand, it is found that the calender-rollers soon tighten up the stuff again, then they have too much draught, and must be altered. Sometimes it is caused by the want of oil on the front top roller, or by too light a weight; if it does not arise from either of these causes, there must be something wrong in the calculation of the wheels. If it is necessary to lay aside the gearing-wheels between the front and calender-rollers, then substitute a small belt to run on the pinions of those rollers, instead of the pulleys, first turning a little off the circumference of the wheel of the front roller, to lessen the draught between it and the calender-roller. This is preferable, in many cases, to the wheel-gearing, because it can be so regulated, that the draught may be altered with very little trouble, by turning a little off either wheel, or by applying a coarse file to them when running. These wheels are very apt to catch the hands, fingers, or some part of the dress of the attendants.

TO PROVE ROVINGS BY GRAINS AND SCALES.

Reel forty threads or a half cut in a careful manner on a correct reel, so as not to stretch the roving. Forty threads are the fourteenth part of one hank, or 560 threads; and 500 grains are the fourteenth part of one pound avoirdupois, or 7000 grains. Whatever number of grains the forty threads weigh, that number will form a divisor to the dividend 500, and the quotient will be the hank roving.

EXAMPLES.

Suppose 40 threads, or a half cut, weighs 250 grains, what hank roving is it?

```
250)500(2    Ans. 2 hank roving.
    500
    ---
```

Suppose 40 threads weigh 222 grains, what hank roving is it?

```
222)500(2.25    Ans. 2¼ hank roving.
    444
    ----
     560
     444
     ----
     1160
     1110
     ----
       50 remainder.
```

Suppose 40 threads weigh 200 grains, what hank roving is it?

```
200)500(2.5   Ans. 2½ hank roving.
    400
    ----
    1000
    1000
    ----
```

Suppose 40 threads weigh 166 grains, what hank roving is it?

```
166)500(3   Ans. 3 hank roving.
    498
    ---
      2 remainder.
```

TO TRY ROVINGS BY THE QUADRANT.

Put forty threads or a half cut in a quadrant balance, and whatever they size, divided by 2, will give the number of cuts, and that product, divided by 7, will give the number of hanks; the remainder will be so many cuts.

EXAMPLES.

Suppose 40 threads size 24 on the quadrant, what hank roving is it?

```
2)24
----
7)12(1.71   Ans. 1¾ hank, nearly.
----
   7
  --
   50
   49
   --
    10
     7
    --
     3 remainder.
```

Or thus, forty threads being the fourteenth part of one hank, or 560 threads, whatever number that sizes on the quadrant, divided by fourteen, will give the hank roving.

EXAMPLES.

Suppose 40 threads size 24, what hank roving is it?

```
14)24(1.71   Ans. 1¾ hank, nearly.
   14
   ——
   100
    98
    ——
     20
     14
     ——
      6 remainder.
```

Suppose 40 threads size 28 on the quadrant, what hank roving is that?

```
14)28(2   Ans. 2 hank roving.
   28
   ——
```

Suppose forty threads size 32½, what hank roving is it?

```
14)31½(2.25   Ans. 2¼ hank roving.
   28
   ——
    35
    28
    ——
     70
     70
     ——
```

If 40 threads size 35, what hank roving will they make?

```
14)35(2½    Ans. 2½ hank roving.
   28
   --
 7)7/14(½
```

Suppose 40 threads size 25, what hank roving will that make?

```
14)25(1.78    Ans. 1¾ hank roving.
   14
   --
   110
    98
   ---
    120
    112
    ---
      8 remainder.
```

Suppose 40 threads size 42, what hank roving will that make?

```
14)42(3    Ans. 3 hank roving.
   42
   --
```

A TABLE,

SHOWING THE SIZE OF ROVINGS, FROM A QUARTER HANK TO FIVE HANKS IN THE POUND, BY SCALES AND GRAINS, WITH FORTY THREADS, OR A HALF CUT.

Threads.	Grains.	Hank roving.
40	2000	$\frac{1}{4}$
"	1333	$\frac{3}{8}$
"	1000	$\frac{1}{2}$
"	800	$\frac{5}{8}$
"	666	$\frac{3}{4}$
"	571	$\frac{7}{8}$
"	500	1
"	444	$1\frac{1}{8}$
"	400	$1\frac{1}{4}$
"	363	$1\frac{3}{8}$
"	333	$1\frac{1}{2}$
"	307	$1\frac{5}{8}$
"	285	$1\frac{3}{4}$
"	266	$1\frac{7}{8}$
"	250	2
"	235	$2\frac{1}{8}$
"	222	$2\frac{1}{4}$
"	210	$2\frac{3}{8}$
"	198	$2\frac{1}{2}$
"	190	$2\frac{5}{8}$
40	181	$2\frac{3}{4}$
"	171	$2\frac{7}{8}$
"	166	3
"	160	$3\frac{1}{8}$
"	153	$3\frac{1}{4}$
"	148	$3\frac{3}{8}$
"	142	$3\frac{1}{2}$
"	137	$3\frac{5}{8}$
"	133	$3\frac{3}{4}$
"	129	$3\frac{7}{8}$
"	125	4
"	120	$4\frac{1}{8}$
"	117	$4\frac{1}{4}$
"	114	$4\frac{3}{8}$
"	111	$4\frac{1}{2}$
"	108	$4\frac{5}{8}$
"	105	$4\frac{3}{4}$
"	102	$4\frac{7}{8}$
"	100	5

Twenty-four grains make one pennyweight; eighteen pennyweights and five and a half grains make one ounce avoirdupois; twenty pennyweights make one ounce, troy weight.

A TABLE,

SHOWING THE SIZE OF ROVING BY THE YARN QUADRANT, FROM HALF HANK TO SIX HANK ROVING, BY FORTY THREADS, OR A HALF CUT.

Threads.	Size.	Hank roving.	Threads.	Size.	Hank roving.
40	7	½	40	49	3½
"	10½	¾	"	52½	3¾
"	14	1	"	56	4
"	17½	1¼	"	59½	4¼
" ...	21	1½	"	63	4½
"	24½	1¾	"	66½	4¾
"	28	2	"	70	5
"	31½	2¼	"	73½	5¼
"	35 ...	2½	"	77	5½
"	38½	2¾	"	80½	5¾
"	42	3	"	84	6
"	45½	3¼			

The two preceding tables will be found to be very useful to every manager and carder when trying their roving. Every carder should have a small pair of scales, accurately adjusted, and a set of weights, ranging from one grain up to 2000 or 3000 grains, or to any number that may be wanted. The weights can be very readily manufactured out of sheet brass or sheet copper.

THROSTLES,

The finishing machines in a cotton mill, which spin the cohesive yarn, are essentially of two kinds: the throstle, or water-twist frame, by which the twisting and winding are performed simultaneously upon the roving as it progresses through it; and the mule, which draws out and stretches the threads, without giving them much twist, to the length of about five feet or more, when it gives the full twist to the thread, and winds the finished yarn immediately upon the spindles in the form of coils.

The throstle is called a water-twist frame, and the yarn spun on it, water-twist yarn, because it accidentally happened that the first machines of this description were driven by water-power. A vast amount of ingenuity and skill is displayed in the mechanical arrangements of the various parts of a throstle which are necessary to produce the variety of forms which the material assumes in its passage through it; the whole tending to improve the quality of the product. As far as the motions and structure are concerned, however, there is no essential difference in these machines, but there is a difference in the form of the spindles, which regulates the quality of the machines.

LIVE SPINDLES.

The live spindle, as it is called, is the oldest form of spindle, and is still a favourite with many cotton-spinners, on account of the superior quality of yarn which it produces; but it runs very slowly, when compared with other spindles, and from that cause it is gradually going out of use. If this spindle performs 3600 or 4000 revolutions per minute, it may be considered as very good work, and a fair average of its speed.

DEAD SPINDLES.

The dead spindle is an essential modification of the live spindle, and is better adapted for the attainment of a great speed. It is objectionable, however, on account of the poor quality of the yarn which it produces; as many cotton-spinners assert that it does not make such good yarn as the live spindle.

RING SPINDLE.

The ring spindle, or ring frame of Alfred Jenks', appears to have superseded both of the above mentioned spindles, and to be rapidly gaining the favour of those engaged in the manufacture of cotton. This spindle has no fly, and is simply a steel cylinder, upon which the bobbin moves; a small steel ring, called a traveller, which is nearly one-fourth of an inch in diameter, and having an open cut in it, is the means by which the thread is wound. This ring revolves around the bobbin, and is held in its place by an iron ring, which fits in the open groove. The iron ring is fastened upon the traversing rail, and is sufficiently large to allow the head of the bobbin, as well as the traveller, to pass through without touching. This spindle has many and great advantages over every other description of spindles; it may be driven at a speed of 8000 revolutions per minute, with perfect security, when making coarse yarn, and when operating upon the finer numbers 10,000 revolutions per minute is not an extraordinary speed to be attained. When used in manufacturing warp, it gives it a strong wiry twist; the same machine may be used for filling, with but a trifling amount of alteration.

The little steel rings, or travellers, run at such a tremendous speed, that they are liable to wear out in a short time; they do not usually last much longer than three or four weeks, and must then be replaced by new ones. As these rings cost but little, their wear does not furnish a well-founded objection to this spindle. Throstles, with such spindles, are now made to work without bobbins; a thin tube, made of sheet-iron, fitting closely upon the spindle, is substituted for the wooden bobbin. This tube is filled with the yarn in the same manner as the barrels of the speeders, that is, the coil is wound so as to taper to both ends. When wooden tubes or bobbins are used, they should have but one head, so that they may be used either in making warp, or for the shuttle. If the cops are intended for use in the shuttle, the traversing motion should be regulated accordingly; they may then be filled in the same manner as a shuttle cop.

Annexed, will be found the dimensions of the different parts of throstles, to run with live spindles, as well as those of other patterns; also directions as to the proper management of these machines, a careful attention to which is an important matter in every orderly and well-regulated cotton mill.

DIMENSIONS OF A LIVE-SPINDLE THROSTLE.

	Ft.	In.	Teeth.	Rev.
Diameter of driving-pulley on main lying shaft	2	1		82
Driving counter-shaft by pulley of .	1	3		136
Driving pulley on counter-shaft....	2	1		136
Pulleys on throstle cylinder		7½		456
Diameter of throstle cylinder		8½		456
Diameter of warve of spindle		⅞		4429
Diameter of pulley on the other end cylinder, driving fly		7¾		456
Driving fly-wheel of	1	6		196
Change-twist pinion on fly-axle....			26	196
Intermediate carrier wheels, one on each side	1	½	124	
Wheel on front roller...........			78	65
Draught-pinion on front roller			20	
Driving carrier-stud of			74	
Change-pinion attached to carrier-stud.....................			30	
Working into middle roller.......			68	
On the other end of middle roller..			20	
Intermediate carrier			54	
Pinion on end of back roller......			21	
Diameter of front rollers		1		
Diameter of back and middle rollers,		⅞		
Distance from centre to centre of front and middle rollers.........		$1\frac{3}{16}$		
Length of the longest staple of upland cotton.....................		$1\frac{3}{16}$		
Length of under rollers from centre to centre of stands	1	5¼		

	Ft.	In.
Length of spindle	1	5
Length of spindle above the collar		$5\frac{3}{4}$
Length of bearing on collar		$1\frac{1}{2}$
Distance of warve from under side of collar		$1\frac{1}{4}$
Thickness of spindle collar		$\frac{5}{16}$
Thickness of spindle where the bobbin runs, fully		$\frac{1}{4}$
Thickness of spindle from collar to step, nearly		$\frac{9}{16}$
Extreme length of bobbin		$2\frac{5}{8}$
Length of bobbin barrel in the clear		2
Width of the face of the pulleys		3
Width of the face of the large pulleys on the counter-shaft		7
Extreme length of throstle of 132 spindles	17	8
Extreme width of throstle	3	6
Width of passage for hands from one step-rail to the other	3	4

SPEED OF SPINDLES, AND PRODUCT OF THROSTLE.

Sixty-eight revolutions of the spindle to one of the front roller, is a rapid speed for live-spindle throstles, when spinning No. 23 or 24 yarn. This is nearly twenty-three turns of the spindle to each inch of yarn. It may be considered good twist, or throstle chain, for this number.

With this speed, the throstles will yield 4.85 hanks per spindle, in twelve running hours, if nothing wrong occurs. Ends being down, as well as stoppages, will reduce this yield to about 4.50 hanks in twelve hours. If the front roller runs at a speed of about 60 revolutions per minute, it will make about $4\frac{1}{4}$ hanks to the spindle every twelve hours.

CAP-SPINDLE THROSTLE.

	Ft.	In.	Teeth.	Rev.
Diameter of driving-pulley on main horizontal shaft	2	6	..	100
Driving counter-shaft by pulley of		11	..	272
Driving pulley on counter-shaft	2	6	..	272
Driving throstle cylinder by pulley of,		6	..	1193
Pulley on the other end of the cylinder, driving fly-wheel		4	..	1193
Diameter of fly-wheel	1	6	..	265
Twist or change-pinion on fly-axle		..	30	265
Driving front roller by wheel of		..	78	101
Diameter of cylinder		6	..	1193
Diameter of spindle warve		1	..	7158
Pinion on front roller		..	20	..
Stud carrier		..	80	..
Change-pinion attached thereto		..	34	..
Driving back roller by pinion of		..	68	..
Pinion on other end of back roller		..	23	..
Pinion on middle roller		..	21	..
Diameter of front roller		1	..	..
Diameter of back and middle rollers		$\frac{7}{8}$	..	..

DRAUGHT OF THESE THROSTLES.

The draught of throstles is frequently 1 into 9.96; this, with $2\frac{1}{2}$ hank roving, would make the yarn No. 24. If the preparation of the material would admit of it, it would be better to use 3 hank roving, and have less draught. With a draught of 1 into 8, better work could be done if 3 hank roving were used.

DRAUGHT CALCULATION.

Drivers.		Driven.	
34		80	
20		68	
680		640	
7	= diam. back roller.	480	
4760		5440	
		8	= diam. of front roller.

```
4760)43520(9.14
     42840
      6800
      4760
     20400
     19040
       360 remainder.
```

Draught = 9.14
If the machine works $2\frac{1}{2}$ hank roving.

```
18.28
 4.57
22.85
```

Ans. No. 23, nearly, by the draught calculation.

At this speed, these throstles will average about $7\frac{1}{2}$ hanks to the spindle in twelve hours, if no accidents occur, and the ends are kept up; but it is necessary to stop them twelve or fifteen minutes each day, in order to clean off the flyings from the spindles and caps, and oil the metal tubes that form a part of the warve, and which run on the fast spindle at its great speed of 7158 revolutions per minute. These calculations show nearly 71 revolutions of the spindle to one of the front roller, or 22.61 twists to the inch of yarn No. 23 and 24, or so many hanks to the pound.

These throstles generally contain 120 spindles, and are better calculated for spinning filling than twist, as the drag on the thread is very slight, and there are no means of increasing it or regulating it, as on the spindle and the flier. Ends may be spun on this spindle until the bobbin becomes full, and the yarn has not received half the twist that it should have, owing to slack bands. These machines do not suit well for twist, such as No. 20 to No. 26.

REMARKS ON THROSTLES.

THROSTLE SPINDLES.

THERE are a great variety of throstles, but the difference consists chiefly in the spindles. Reasoning from experience, we may say that there are no spindles superior to the live spindle and flier, provided it is well made and kept in good order. We have particular allusion to the making of strong, wiry yarn for chain, and the coarser kinds of goods, say from No. 10 to 30. It would lead us too far to state all the objections which may be made against the various kinds of spindles; but one objection, and a principal one, is, that on most of the new spindles, there is but little drag on the thread, which is essentially necessary for making good, clean thread.

BREWSTER'S SPINDLES.

There is no possible way of increasing or diminishing the draught by washers, by lapping the end around the arms of the flier, or, as the hands term it, by tempering the bobbin, except it be on the Brewster throstle. This, as well as the awkward manner in which the ends have to be mended, the throstle being stopped, and the full bobbins doffed, is a great drawback upon the spindles. Six and a half or seven hanks to the spindle, is a great product, but the machinery will not long bear such rapid driving; it may do for a short time, but will eventually lead to bad results. There is also a great deal of trouble with the bands in consequence of rapid driving, as they create a great deal of waste; the yarn being inferior as twist. If the spindles are driven by a long band, which is slackened or tightened by a sliding pulley and weight, they require a great amount of power.

VARIOUS SPINDLES.

The short bands, or one band to each spindle, do not answer very well on any other description of throstle but the cap spindle. The warve traverses on the spindle about four inches, or the length of the bobbin, and, as it approaches or recedes from the centre of the cylinder, the bands slacken or tighten, and cause inequalities in the twist. If the long band is used, it makes the throstle very heavy, and, if this band happens to break, which it very often does, it laps around the cylinders, and creates a great deal of trouble and loss of time in putting on a new band. These spindles suit better for spinning filling than twist, as it would not then be necessary to drive the rollers at the same speed, say 101 revolutions;

and the spindles would not then require to be driven at a greater speed than 4260 revolutions per minute to make No. 22 filling, or 4841 for No. 25, instead of more than 7000 revolutions, which are required for the same numbers of twist.

TRAVERSE MOTION.

Particular care must be taken of all the parts of the traverse motion; the rails and levers on the traverse-shaft must be placed perfectly square with it, and parallel with each other, and should all range exactly with the lever which bears on the heart. The stud which bears on the heart-wheel must be fastened in such a manner, that the levers will not traverse over too long or too short a space, but lay the yarn on the barrels of the bobbins evenly from bottom to top. There is a slit in the lever, in which the heart-stud is inserted; if this stud is moved back, a little nearer to the lever-shaft or centre, it will cause the levers to traverse over a greater space, and by bringing it out a little nearer to the point of the lever, it will shorten the traverse motion of the lever. The different sections of the bobbin-rail can be adjusted and regulated by the screws on the lower part of each of the upright lifters, which reach from the points of the levers to the bobbins. These screws must be set in such a manner as to prevent the yarn from running over either the bottom or the top of the bobbins, as this is productive of a great deal of waste, which is a dead loss. Bobbins which do not receive the yarn in a proper manner, owing to the spindles being sunk in the step, or the arms of the flier being too short or too long, must be regulated by placing cloth washers under the bobbins if the yarn inclines to the top; if the inclination is towards the bottom, take one or two of the washers off. When the spindle-step is placed in the step-rail, and fastened by a pinch or set screw, the spindle may be raised and lowered a little according to circumstances. Both the steps and the collars should be fastened in this manner by steel set screws. The brasses of the collars and steps should fit very exactly into the holes of the collar and step-rails, otherwise the set screw will give them an inclination to one side, and throw the spindle out of a perpendicular position. Great care should be taken not to obstruct the traverse motion in any way; it should move freely in all the slides, which, as well as the other portions, must be kept in a clean condition and well oiled. If any thing adheres to the traverse lever, or obstructs its motion, the yarn will form a lump or ridge on the bobbin, which will continue until the obstruction is removed. Attention should be paid to the set screws, which fasten the levers on the long shaft, for, if any of them slip, which they frequently do, the levers get out of range, and wind the yarn in an irregular manner. The proper position of the levers is of so much importance, that they should be fastened both with keys and screws.

REGULATING THE DRAG OF THE BOBBIN.

The common live spindles should be cleaned at least once every week; the other kinds will need cleaning much oftener. The part on which the bobbin runs should be kept free from waste and dirt, as this would prevent the bobbin from drawing freely; the bobbin would revolve too fast, causing the thread to gather in knots by being too slack. Good bands should be kept upon the spindles; they must neither be too slack nor too tight, as they have a bad effect in either case. If a band is too slack, the yarn does not receive the proper amount of twisting; and if it is too tight, it causes the spindle to jump and vibrate. Waste, dirt, and bad knots, or many of them upon the barrels, will produce the same effect. Strips of cloth, with holes cut in them to suit the spindles, may be put along the bobbin-rail, under the bobbins, and cloth washers, about the size of, or a little larger than the bottoms of the bobbins, may also be put on to make them build level, and to regulate the drag. When the washers wear glazy or smooth, they do not produce the necessary friction on the bobbins to make them draw properly, and must be changed. When they produce too much friction, the attendants should temper the drag by lapping the ends once or twice around the arms of the flier. Leather washers are sometimes used under the bobbins to increase the friction, particularly when coarse, strong yarn, ranging from No. 7 to 12, is being spun. When filling or fine yarn is being spun, small washers, made of paper or cloth, with a small hole in them, are used to lessen the drag. The cap throstle may be more advantageously used for the last mentioned yarns than any other spindle, and several spinners use the throstle filling frame; still, the mule is the best machine to use for this purpose. If, in spinning chain, there is not a sufficient drag on the throstle-bobbin to keep the thread at a proper degree of tension, the yarn will become knotty, and of course is spoiled, as this renders it quite brittle and weak. It is not good to lap the end too often around the arms of the flier; for this, wide-bore bobbins, bad washers, and too much twist, all have a tendency to the production of knotty yarn. Particular attention should be given to the thread-wires, or that part on which the thread bears, to have it set fairly above the centre of the spindle; if it is not, it has a bad effect upon the spinning.

CLEANING AND OILING.

The roller-leathers and journal must be kept clean and free from waste; have the leathers of the rollers brushed off frequently with a brush similar to a shoe-brush. The attendants should be very careful that no dirt or waste cotton catches on the yarn, as this is particularly injurious to twist; and they should use every endeavour to make good, fair spinning. The spindle-steps and collars should be oiled every morning, and the collars again at noon. The cylinder journals should be oiled every morning and noon; top front rollers and studs every morning; the under front rollers every other day; the middle and back rollers, and top and under rollers every Monday morning; and the journals of all the gearing-shafts in the room every morning. The throstles should be taken down, and well cleaned and scoured, and the roller couplings oiled, whenever they require it. If they are kept clean, and in good order, once in every eight weeks will be sufficient; in some factories they clean one every day, or every other day, so as to make the circuit of the whole of them in four, six, or eight weeks. This is an excellent plan; for when only one machine is taken down at one time, the superintendent has an opportunity of examining every part of it minutely, which he cannot do when they are all taken apart at the same time. Although it is customary to wait for some stoppage, arising from accidental causes, such as back-water, or something of the same nature, to clean and scour all the machines at the same time, it is, nevertheless, a very bad practice, and one which should be abolished.

SPINDLES.

Work should not be done with broken fliers on the spindles, as they cause the spindle to vibrate so much that it prevents the end from spinning well, or taking up on the bobbin; besides, they wear the collar or bearing of the spindle so as to make it untrue, and also wear out the brass collar in which the spindle runs. It is very necessary to the proper working of the machine, that the fliers should be of an equal length, and the arms of a uniform weight; they should be very accurately balanced, to insure that steady, smooth motion of the spindle, which is so important in spinning. Strict attention should be paid to the state of the top rollers; examine them frequently, to be certain that they are working properly, and are not cutting or spoiling the yarn. The roving guides should always be made to traverse about five-eighths of an inch behind the roller, in order to wear the surface of the top rollers equally, otherwise they will be worn into gutters by the hard places in the roving, so that it will be impossible for them to make even and fair yarn.

DRAUGHT.

When twist is being spun on throstles, it is advisable not to have a draught greater than 1 into 8 for No. 24. Nos. 25, 26, 27, and 28, may be spun from the same roving; for No. 28, the draught should be 1 into 9½. A greater draught than this would prove injurious to these numbers.

WASTE.

The hands who attend to the throstles should keep their threads and hard ends separate from the soft and roving waste, which should be collected regularly every morning, and carried to the picking-room, there to be mixed with the cotton used for filling. Waste and bobbins should be kept off the floor, and should not be allowed to lay about the reels, or behind the rollers.

It is necessary to have a smart, active boy, to oil the machinery, tie ends, lift waste, and do other work. The reelers and spoolers should leave their empty bobbins free from waste and yarn; dirty bobbins give a great deal of trouble to the spinner, by the ends catching on the fliers. Spinners should never break or tangle ends upon the bobbins.

BOBBIN-BOARDS.

The best way of preserving bobbins, both full and empty, from injury and abuse, is to have a supply of bobbin-boards, containing as many wire pins as will be sufficient to hold bobbins for one side of a throstle running 60 or 66 spindles; the pins must be so arranged as to admit a full set of bobbins, without their being too much crowded. The cost of the boards is soon realized from the saving effected by it in the yarn and the bobbins.

POWER REQUIRED FOR THROSTLES.

Yarn can never be spun upon throstles of as fine a quality as that made upon mules, and therefore they are seldom used for yarn finer than No. 32. Throstle twist is usually used for the warp of heavy goods, such as fustians, stout sheetings, shirtings, and checks. They require considerably more power than mules; and a throstle of 120 spindles will require more motive power than a mule containing twice the number of spindles, supposing both to be spinning the same kind of yarn. Where steam or water-power is expensive, this will make a considerable difference in the cost of production.

BOBBINS.

As good yarn-bobbins are very necessary to the proper working of throstles, they should be made of good, hard, well-seasoned wood; dog-wood is the best that can be used for this purpose; and they should be turned very true. The bottom part of the bobbins intended for live spindles should be made of a convex form, having a rise of three-sixteenths of an inch from the circumference to the centre; they drag more regularly, and do better spinning, when constructed in this manner.

MULE-SPINNING.

MULES.

The principle upon which mule-spinning depends, has been stated in the previous chapter. It derives its name from the circumstance of its being a combination of the old spinning-jenny and the water-frame. Mules generally contain from 180 to 200 spindles, and upwards. One portion of the machine is stationary, and contains the drawing-rollers and the rovings; the other part is movable, and has the spindles mounted upon it. The first is generally called the roller-beam, and the latter the carriage; the roller-beam contains the principal portion of the machinery, and the carriage just a sufficient quantity to furnish the spindles with the requisite motive power.

The spinning operations of the mule are very ingenious, and involve a perfectly correct principle in the formation

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of a uniform thread. On its passage from the first fluted roller, the thinner portions of the roving are gently twisted by the spindle, and when the carriage is withdrawn from the roller the thick places in the roving receive less twist than the thinner portions. The thick places are therefore liable to be stretched, while the thinner, being twisted harder, will not stretch at all. After the carriage has been drawn nearly to its proper distance, the rollers stop, and the speed of the spindle is generally increased; in the mean time the carriage is drawn a few inches farther out, which equalizes the yarn still more, and prevents the formation of knots.

The winding wires are an important part of the mule, and the sagacity of a spinner is observable in the order in which he keeps his winding wires. The upper wire, or faller, leads the thread, and forms the cap; the lower, or counter-faller, stiffens the thread, and assists the operations of the first. This winding or copping wire may be moved by the hand of the spinner; but at present it is usually moved by machinery. In the latter case the cops are better than those made by the most experienced spinners.

Where the mules are partially driven by either steam or water-power, one person generally attends two mules, which stand opposite to each other. These machines are going out of use very fast, and are replaced by self-acting mules, which perform all the complicated motions of the mule with great precision. Among the self-acting mules, we may mention those made by Mason & Co., of Taunton, Mass., as very perfect machines. Self-acting mules require only children to attend them; piecing, supplying the machine with roving, and removing the full cops, is the whole amount of the labour to be performed.

The quantity of yarn spun by a mule depends partly on the number of spindles in use, the number of the yarn spun, and the quality of the cotton spun, and the machinery that is used. A greater quantity of coarse yarn can be spun than of fine, and more of filling than warp; a good machine will also produce more yarn than a bad one. While three stretches per minute can be made on filling, but two and a half can be made on warp, two stretches on No. 100, and only one in spinning No. 300. Bad spindles, and machinery but imperfectly made, will never yield well, and it would be more profitable to throw such machinery aside, and erect better in its place. A temperature of 65° is found to be the most advantageous in a mule-room; at a lower heat the mules will not work well, and a greater heat is injurious to the yarn.

Self-acting mules are of great advantage where the same description of raw material is uniformly used, and nearly the same number of yarn spun; where either of these is changed frequently, the self-acting mules are not so profitable, and the hand-mule has the preference. There are at present, probably more than 1,000,000 spindles in operation upon self-acting mules, throughout the United States.

DIMENSIONS OF MULES FOR TWIST.

	Ft.	In.	Teeth.	Rev.
Diameter of driving-pulley on main horizontal shaft	1	10	..	100
Diameter of pulley on mule axle	1		..	183⅓
Diameter of fly-wheel	3		..	183
Diameter of rim-band pulley	1	8	..	329
Diameter of drum-band pulley	1	2	..	329
Diameter of groove on the drum where the band runs		10	..	460

	Ft. In.	Teeth.	Rev.
Diameter of drum where spindle runs,	10		460
Diameter of spindle warve	1		4606
Face-wheel bevel on fly-axle........		52	183
Bevel on top of long shaft.........		42	226
Bevel on bottom of long shaft......		28	226
Bevel on front roller		70	90
Pinion on front roller.............		20	
Driving carrier-stud of		74	
Change-pinion attached thereto......		32	
Driving back roller by wheel of		68	
Pinion on other end of back roller...		24	
Diameter of middle roller..........		22	
Diameter of front roller	1		
Diameter of back roller............	$\frac{7}{8}$		

DRAUGHT AND TWIST.

The draught of this mule is about 1 into 9. With the roving at 2.45 hanks to the pound, No. 22 twist yarn can be spun, and the twists are about eighteen turns to the inch. This is rather too little twist, the yarn would be improved by giving it twenty or twenty-one turns to the inch. Another defect in these mules is, there is no stretch on the yarn after the gearing on the rollers has been dropped.

HEAD TWIST.

It is the stretching operation, performed by the carriage receding a few inches from the rollers after they stop, and the spindles continuing to run, which gives to the yarn what is called head twist. This adds to the fineness and regularity of mule twist. If this operation is dispensed with, and the yarn receives all the twist while the rollers are running, and no stretch is given to the yarn, the article produced will be inferior to that made on mules where the stretching head-twist is given. It is true, there is some little time lost at each draw or stretch, by giving about eighteen turns of the fly, or 450 of the spindle; but if all the twist is given when the carriage is coming out, the spindles must be driven at a speed which will injure both the machinery and the yarn. If the proper twist is given after the yarn has been stretched, the superior quality of the yarn, and the diminished wear of the spindles and collar brasses, which is the result of a lower rate of speed, will amply compensate for the very little time required in putting sixteen or twenty times the amount of head twist on the mule.

DIMENSIONS OF A FILLING MULE.

	Ft.	In.	Teeth.	Rev.
Face wheel on fly axle			52	183
Bevel on top of long shaft			38	250½
Bevel on bottom of long shaft			30	250½
Bevel on front roller			70	107
Diameter of fly-wheel	3		..	183
Diameter of rim-band pulley	1	8	..	329
Diameter of drum band or twist pulley	1	2	..	329
Diameter of warve of spindle		1	..	4606
Length of spindle	1	4½	..	..

DRAUGHT AND TWIST OF FILLING MULE.

The draught of filling mules is the same in all respects as in the twist mules, that is, a little more than 1 into 9, and the yarn is then about No. 22. The turns are 13.71, or nearly fourteen twists to the inch. This is rather softer than filling is generally made; the best is given fourteen or fifteen turns to the inch; though this depends in a great measure on the kind of goods the filling is to be used for.

GREATEST SPEED OF A MULE.

	Ft.	In.	Teeth.	Rev.
Upright shaft performs per minute...			..	.. 26
Crown wheel, containing...........			.. 75	.. 26
Pinion on horizontal shaft..........			.. 25	.. 78
Wheel on horizontal shaft, driving the			..	..
counter-shaft			.. 36	.. 78
Pinion on counter-shaft.............			.. 26	.. 108
Diameter of driving-pulley on counter-			..	..
shaft	1	9¾	..	.. 108
Diameter of pulley on fly-wheel axle.	1	1½	..	.. 174
Face or breast-wheel on fly-wheel axle,			.. 60	.. 178
Bevel on top of tumbling shaft......			.. 40	.. 261
Bevel on bottom of tumbling shaft...			.. 31	.. 261
Bevel on front roller...............			.. 96	.. 84⅓

SPEED OF ANOTHER MULE.

	Ft.	In.	Rev.
Diameter of pulley on cross-geared shaft	1	6	.. 78
Driving counter-shaft by pulley of..........	1		.. 117
Driving pulley on counter-shaft	1	6	.. 117
Diameter of pulley on mule axle	1		.. 175½

The bevel gearing on this mule is the same as on the one described above. The front roller makes nearly eighty-five revolutions per minute.

GENERAL OBSERVATIONS ON MULE-SPINNING.

Mule-spinning is by far the most perfect spinning process, and the one by which the most perfect yarn is produced. The mule completes the series of spinning-machines now in use, and is the only important discovery which has been made in the art of spinning since the invention of the rollers, and also of the other machines employed in the different preparatory processes. Some idea may perhaps be formed of the perfection to which the mule has attained, when it is stated, that a pound of cotton has been spun on the mule into 350 hanks, each hank measuring 840 yards, and forming together a thread 167 miles long.

CORRECTING A MULE WHEN IN DISORDER.

We have put down the various speeds at which different parts of both twist and filling mules may be driven, and we shall now proceed to give some instructions as to the regulation of a mule. When the roller-beam, carriage, spindle-box, and faller, or builder, are out of order, or when, in fact, the whole machine is in disorder, place the roller-beam straight by the aid of a line, and level it perfectly by a spirit-level. With a gauge, set the surface of the carriage railways at the same distance exactly from the under side of the front under roller—it having been first duly levelled. When that is done, take a true spirit-level, or carpenter's long level and plumb-bob, and by it set all the railways level and parallel. The rails may be set a half or three-fourths of an inch higher in front than at the back, or near the rollers. This will enable the spinner on a large mule to put up the carriage more easily;

but care must be taken not to raise the rails so high as to prevent the carriage from coming out in a regular manner. After this, proceed in setting the ends of the spindle-box bottoms, at the same distance from the ends of the carriage-board. Run a line along the bottom of the spindle-box, and fasten this line about a fourth of an inch from each end; the best mode of doing this is, by driving a small nail at each end of the spindle-box, and lapping the line around them. Pull the carriage square by the squaring bands, so that the line will be clear in the middle as well as at both ends. Set the bottom of the spindle-box straight, and put in the bevel intended for the spindles at each end; then run a line along the top of the spindles, and set them perfectly straight.

THE FALLER.

The faller may now be set in such a manner, that when the building-wire is parallel with the tops of the spindles, it will be about three-eighths of an inch distant from them; it should be set perfectly level and straight. When the faller is put down, that is, when the axis is turned round by the hand so that the wire descends to the bottom, it will be equidistant from the spindles a half or three-eighths of an inch. The firmness of the cop depends very much upon setting the faller fingers and wire properly. If the wire is not straight, and does not run tolerably near to both the top and bottom of the spindle, the spinner cannot make a fair, well-finished cop; the top and bottom will be soft, kinked, and ragged. Such things must be avoided, as any of these faults will prevent the yarn from running off as it should, and will cause waste to be made at the reels, spooling-machines, or looms. Set the back stops, for stopping the carriage when it is run up as close as possible to the roller-beam, in their proper places, which may be from 2½ to 3 inches from the top of the spindle to the bite of the two front rollers.

INCLINATION OF THE SPINDLE.

The bevel of the spindles may be from 3 to 4 inches, when tried by a spindle bevel; that is, the spindles should stand so much out of the perpendicular, that their tops will have an inclination of 3 or 3½ inches towards the rollers. When spinning twist, there should be less bevel in the spindles than for filling, and the ends must stand more upright, or else the threads will fly off the tops of the spindles, and catch on each other. If the spindles are intended to run steady, they should not be more than 6½ or 6¾ inches above the collar brasses. The spindles should be stout and heavy below the collars, and be made of good steel. The collars should not be less than five-eighths of an inch wide.

CLEANING THE MACHINE.

Keep good top rollers in the mules, and good bands on the spindles. Keep the warves clean, and free from dirt. The rollers and spindles should be clean and regularly oiled. In using roving without twist, there should not be a difference of more than one or two teeth between the middle and back rollers. The rollers should be taken down every four weeks, well scoured and cleaned, and well oiled when put up again. Keep the skewers, creel steps, and all the moving parts, very clean and in good order. Make as little waste as possible, and have all the soft and roving waste taken away every evening. Clean the beam and carriage every two hours, and keep the floor clear of waste, as also the roving wires. When spinning twist, the steps of the spindles should be oiled twice each day, the spindle collars three or four times, and the front rollers once or twice in the same time.

TO REGULATE THE SPEED OF A CARRIAGE.

When starting a new mule, it is necessary to regulate the speed of the carriage in proportion to that of the front rollers. This may be done in the following manner. Let one person run a piece of tape about three-eighths of an inch wide between the two front rollers, putting the carriage up as close as it will go. Another should then take hold of the other end of the tape, while the first guides it through the rollers. The mule being then put in motion, the person holding the front end of the tape should keep it to the point of a spindle, and be very careful not to pull the tape in the least. When the carriage has run out the full distance, the space between the end of the tape and the top of the spindle may be measured, to ascertain how much the tape falls short of reaching the spindle, and this distance will be the number of inches which the carriage has gained upon the rollers. If the tape reaches beyond the spindle, then the rollers gain upon the carriage.

When spinning twist, the carriage should, in order to make good yarn, gain several inches in coming out; but in putting in the head twist, the carriage should go in towards the roller-beam a little, the twisting of the thread causing it to shorten. In spinning filling, there must be a little draught and stretch between the carriage and the rollers.

DIFFERENCE BETWEEN MULE AND THROSTLE TWIST.

Mule twist is used for weaving muslin and the finest kinds of cotton goods. The essential difference between this and water-twist is, that the mule produces much finer articles than can possibly be made upon throstles, at the same time that they make a softer thread. As it requires much less power to run the same number of mule spindles than of throstles, the manufacturer spins every kind of yarn which he can upon the mule; but it will produce only the soft kinds of thread. It will spin all numbers, from the lowest up to 300 hanks to the pound.

When getting mules made, have the stud-carrier and change-pinion placed up at the mule-head, instead of having them at the other end. The play of the roller-couplings will always cause the rollers to cut; this is more commonly the case with a large mule than with a small one,—but any mule will cut every draw that is started, if not geared as directed.

SIZE OF SHUTTLE COPS.

Diameter of shuttle cops	$1\frac{1}{16}$	inches.
Length of shuttle cops....................	$5\frac{1}{2}$	"
Eleven cops laid close together, measure across,	12	"

Shuttle cops should be provided with short tin tubes, with a rim to catch below the cop. This tube is but one inch long, and fits close to the spindle and the spindle collar, and may be taken with the cop to the looms or to the reels. The lower end of the cop is in this way prevented from unwinding and making waste.

BANDING.

Mule Rim Banding.—Three strands, each 450 ends of No. 21 or 22 chain; 1350 ends in all.

Drum Banding.—Three strands, 350 ends each, 1050 ends in all, of No. 21 or 22 chain.

Mule Spindle Banding.—Forty threads of No. 25 filling. It is also made of thirty threads of No. 21 or 22 filling.

Throstle Banding.—Three strands, forty threads each, 120 threads in all, of No. 21 or 22 yarn.

Many mule spinners prefer banding made in single strands to that made of two or three strands. They say that it lasts longer, and is easier on the spindles and at the knot. They assert that three strand banding always strands off the warve, and gives more trouble than the single strand banding.

TO FIND THE DRAUGHT OF ANY SPINNING MACHINE.

The draught of spinning-machines may be tried by the plan previously laid down in this book for testing the draught of drawing-frames; but, in most cases, it is necessary to calculate the draught by figures. For this reason, we furnish some examples of such calculations, in addition to those which have already been furnished.

RULE.

Write down the number of teeth in all the driving-wheels, or pinions, and multiply them together. Then write down the number of teeth in all the wheels that are driven, and multiply them together in like manner. If there is any difference in the diameter of the rollers, multiply the least, or drivers' product, by the diameter of the back roller, which is also a driver; and the largest product, or that of the driven wheels, by the diameter of the front roller, which is also driven. Divide the sum of the driven wheels by that of the drivers, and the quotient will be the draught of the machine.

EXAMPLE OF A DRAWING-FRAME.

Drivers.	Driven.
20	64
18	30
160	1920
20	8
360	2520)15360($6\frac{1}{10}$ draught of frame, nearly.
7	15120
2520	240 remainder $= \frac{1}{10}$ nearly.

TO FIND THE DRAUGHT OF A MULE.

Suppose the driving-pinion on the front roller is 20; stud-carrier, 74; change-pinion attached to the carrier, 32; this drives the back roller by a wheel of 68. The diameter of the front roller is one inch, and that of the back roller seven-eighths of an inch.

RULE.

Multiply the change-pinion, 32, by the front roller pinion, 20, and that product by 7—the diameter of the back roller being seven-eighths of an inch. Multiply the number of teeth in the stud-carrier, 74, by the number in the roller-wheel, 68, and that product by 8, the diameter of the front roller, which is eight-eighths of an inch. Divide the greater number by the lesser, and the quotient will be the draught of the mule.

EXAMPLE.

```
Drivers.                    Driven.
 32                          74
  20                          68
 ----                        ----
 640                         592
    7=diam. back roller.    444
 ----                       -----
4480                        5032
                               8=diam. of front roller.
                          -------
               4480)40256(9   Ans.
                    40320
                    -----
```

The draught is nearly 1 into 9.

METHOD OF FINDING THE TWISTS PER INCH.

The following is an easy method of finding the number of turns or twists in an inch of yarn spun on a mule, without taking the trouble to calculate by the wheels and pulleys. Put the carriage close up, then give the rim about half a turn by hand, to bring all the couplings and pulleys to the starting point; mark the under roller at the corner of a front roller stand, and then stick a pin in a cop on a spindle, opposite to the marked front roller; now turn the rim by hand until the roller comes round exactly to the same place, at the same time counting the revolutions of the spindle very carefully, to ascertain how many it makes to the one revolution of the roller: the latter, divided by 3, will give the number of turns or twists to the inch, provided the front roller is one inch in diameter. For No. 20 and 21 yarn filling, the spindles should make 41 or 42 turns, for every revolution of an inch front roller; for No. 25 filling, 50 or 52 turns. For No. 21 or 22 twist, the spindles should make 54 to 56 turns; for No. 25

twist, 60 or 64 turns of the spindles, without calculating the head twist. This is less twist than is put in throstle-twist; but it is always made softer on mules. This is an easy method of finding the twists, and is nearly correct. If the twist is found to be too much or too little, it may be regulated by the size of the pulley or the bevel.

TO FIND HOW MANY REVOLUTIONS THE SPINDLE MAKES TO ONE OF THE FLY; AND HOW OFTEN THE SPINDLE REVOLVES PER MINUTE.

RULE.

If the warves are 1 inch in diameter, multiply the diameter of the fly by the diameter of the drum or groove in the twist-pulley, and divide the product by the diameter of the fly, or rim-band groove.

Suppose the diameter of the fly-wheel, or rim, to be 36 inches; the rim-band groove in the rim-band pulley, 20 inches; drum-band groove, 14 inches; the drum grooves, 10 inches; and that of the drum to be 10 inches: how many revolutions will the spindle make to one of the fly?

EXAMPLE.

	Inches.	
Diam. of fly-wheel or rim =	36	
Twist or drum-band pulley =	14	
	144	
	36	
Diam. of rim-band pul.	20)504(25 $\frac{1}{5}$	revolutions of spindle to one of fly-wheel.
	40	
	104	
	100	
	4	

The spindle revolves $25\frac{1}{5}$ times to the one revolution of the fly; this, multiplied by the revolutions of the fly per minute, will give the revolutions of the spindle per minute.

Revolutions of the fly = 183 per minute.
Revolutions of the spindle = $25\frac{1}{5}$ for one of the fly.

$$
\begin{array}{r}
183 \\
25\frac{1}{5} \\
\hline
915 \\
366 \\
36\frac{3}{5} \\
\hline
4611\frac{3}{5}
\end{array}
$$

The spindle makes $4611\frac{3}{5}$ revolutions per minute.

TO FIND THE NUMBER OF TWISTS PER INCH IN THE YARN.

RULE.

Multiply the number of revolutions of the front roller by its circumference, and divide the number of revolutions of the spindle per minute, by that product.

EXAMPLE.

90 revolutions of front roller per min.
$3\frac{1}{7}$ inches, circumference of roller.

$$
\begin{array}{r}
270 \\
13 \\
\hline
283
\end{array}
$$

Rev. of spin.

Inches per minute, 283)4611(16.29 twists to 1 inch.

$$
\begin{array}{r}
283 \\
\hline
1781 \\
1698 \\
\hline
830 \\
566 \\
\hline
2640 \\
2547 \\
\hline
93
\end{array}
$$

93 remainder.

These 16 twists are suitable for yarn No. 22. In No. 22 filling, the twists are 13.71 to the inch, which is about right.

TO FIND THE NECESSARY TWIST IN AN INCH OF YARN.

The following rule for finding the proper number of twists per inch, by the square root, has been adopted by many spinners, and they assert that it is the most correct method.

RULE.

For throstle warp-yarn, No. 21, allow 21 twists to the inch, and for mule filling, No. 21, 13 or 14 turns to the inch. By taking the above for the data, or fixed numbers, we may find the twists per inch in any other No. of yarn. The twist in different numbers of yarn, is as the squares of the twists to the Nos. of the yarn.

EXAMPLES.

How many twists per inch are required in No. 25 chain, if there are 21 twists in No. 21 chain?

```
          No.  Twists.   No.
          21 : 21 : : 25 : Ans.
               21
               --
               21
              42
              ---
              441
               25
             ----
             2205
             882
           ------
         21)11025(525        √525(23  twists to the in.
           105                4          nearly.
            ----             ---
             52          4.3)125
             42              129
            ---              ---
            105
16 *        105
            ---
```

How many twists are required in No. 30 filling, if No. 21 requires 14 twists?

```
No.  Twists.    No.
21  :  14  : :  30  :  Ans.
       14
       --
       56
      14
      ---
      196
       30
    ------
 21)5880(280
    42
    ---
    168
    168
    ---
```

$\sqrt{280} = 16$, and a fraction.

No. 30 filling will, therefore, require a little more than 16 twists to the inch.

There is another short and simple rule, which meets with the approbation of some managers, for finding the number of twists per inch, which any given size or number may require.

RULE.

Multiply the square root of the given number by $4\frac{1}{2}$, if for chain; but, if for filling, by $3\frac{1}{4}$; the result of either will be the number of twists per inch which the given size of yarn requires.

EXAMPLES.

To find the twist for No. 25 filling.

$$\sqrt{25} = 5$$
$$\begin{array}{r} 3\tfrac{1}{4} \\ \hline 15 \\ 1\tfrac{1}{4} \\ \hline 16\tfrac{1}{4} \end{array} \text{ turns per inch.}$$

No. 25 filling therefore requires $16\frac{1}{4}$ twists per inch.

To find the twist for No. 25 chain.

$$\sqrt{25} = 5$$
$$\begin{array}{r} 4\tfrac{1}{2} \\ \hline 20 \\ 2\tfrac{1}{2} \\ \hline 22\tfrac{1}{2} \end{array} \text{ turns per inch.}$$

No. 25 twist therefore requires $22\frac{1}{2}$ twists to the inch.

TO FIND THE SPEED, OR THE NUMBER OF REVOLUTIONS PER MINUTE, OF ANY MACHINE, CYLINDER, OR SHAFT.

RULE.

Multiply the diameters of the driving-pulleys together, and that product by the speed of the first pulley, or the number of revolutions which the main shaft makes per minute. Multiply the diameters of the driven pulleys together, and divide the product of the driving, by that of the driven pulleys: the quotient will be the number of revolutions per minute.

Suppose a main shaft, with 22 inch pulleys, makes 100 revolutions per minute, and drives a mule-fly, or any other machine, by pulleys 12 inches in diameter, what will be the speed of the machine per minute?

EXAMPLE.

Speed of main shaft = 100 revolutions.
Driving-pulley = 22 inches in diameter.

Diam. of sm. pulley = 12)2200

183¼ = revolutions of mule-fly.

THE SAME RULE, APPLIED TO THE COUNTER-SHAFT.

Suppose the main shaft performs 78 revolutions per minute, with an 18 inch pulley, and drives the counter-shaft by a pulley 12 inches in diameter, the driving-pulley on the counter-shaft being 18 inches, and the pulley on the fly-axle of the mule, 12 inches in diameter, what number of revolutions will the fly make per minute?

EXAMPLE.

Drivers.		Driven.	
78	rev. of shaft.	12	diam. of driven pulley on c. shaft.
18	diam. of pulley.	12	diam. of driven pulley on mule.
1404		144	
18	driving-pulley on counter-shaft.		
11232			
1404			

144)25272(175½ revolutions of the fly-axle per minute.
144
1087
1008
792
720
72)$\frac{72}{144}$(½

TO PROVE YARN BY SCALES AND GRAINS.

RULE.

Seven thousand grains being one pound avoirdupois, 1000 grains are, of course, the one-seventh of a pound. One cut being the one-seventh of a hank, 1000 will therefore be the dividend, and 50 grains, the weight of one cut, will be the divisor. The quotient will be the size or number of the yarn.

EXAMPLES.

Suppose one cut, or 80 threads, weighs 50 grains, what is the number of yarn required?

Grains.
5,0)100,0
20

Ans. No. 20, or twenty hanks to the pound.

Suppose one cut weighs 40 grains, what is the number required?

```
   Grains.
4,0)100,0
   ------
     25       Ans. No. 25 yarn.
```

Trying but one cut would not give a proper and fair trial; because it might happen that this cut would be taken from a fine or a coarse cop. Therefore, reel seven cuts, or one hank, from seven different cops. The number of grains they weigh will be the divisor to the dividend, 7000, or the number of grains in one pound.

Suppose one hank, or seven cuts, weighs 280 grains, what number is the yarn?

```
    Grains.
280)7000(25   Ans. No. 25 yarn.  w
    560
    ----
    1400
    1400
    ----
```

Suppose one hank weighs 350 grains, what is the required number of the yarn?

```
    Grains.
350)7000(20   Ans. No. 20 yarn.
    700
    ---
```

Suppose one hank weighs 304 grains, what will be the number of the yarn?

```
    Grains.
304)7000(23   Ans. No. 23 yarn,
    608           and a little over.
    ----
     920
     912
     ---
       8 remainder.
```

A TABLE,

SHOWING THE SIZE OF YARN, FROM NO. 8 UP TO NO. 33, BY SCALES AND GRAINS, CALCULATED BY ONE HANK, OR SEVEN CUTS.

Hanks.	Grains.	No. of Yarn.	Hanks.	Grains.	No. of Yarn.
1	875	8	1	333	21
"	777	9	"	318	22
"	700	10	"	304	23
"	636	11	"	292	24
"	583	12	"	280	25
"	538	13	"	269	26
"	500	14	"	259	27
"	467	15	"	250	28
"	437 ...	16	"	242	29
"	412	17	"	233	30
"	389	18	"	226	31
"	368	19	"	219	32
"	350	20	"	212	33

TO CALCULATE THE NUMBER OF YARN FROM THE NUMBER OF HANK ROVING.

The draught of a mule or throstle, multiplied by the numbers of the hank roving, will give the size of the yarn spun.

Thus, suppose a mule has a draught of 9 to 1.

The hank roving is, $2\frac{1}{2}$

$$\begin{array}{r} 9 \\ 2\frac{1}{2} \\ \hline 18 \\ 4\frac{1}{2} \\ \hline 22\frac{1}{2} \end{array}$$

No. of yarn to the pound, $22\frac{1}{2}$ hanks.

A METHOD OF MAKING A SETT OF SMALL WEIGHTS, FOR TRYING YARN BY HANK OR SKEIN.

The following directions will be found to be of much advantage, where there is no yarn quadrant or no grains. A small pair of correct scales will be necessary.

The pound avoirdupois should be divided into 512 parts: 16 ounces being one pound, each ounce will, therefore, represent 32 of these parts; a half ounce, 16; a quarter ounce, 8; an eighth of an ounce, 4; a sixteenth of an ounce, 2; and the thirty-second part of an ounce, 1, or $\frac{1}{512}$th part of one pound. Yarn may be tried by this kind of weight. Grains are certainly much better, but it is sometimes impossible to procure them; and, as any person who will take the necessary care, can make these home-made weights out of small pieces of sheet brass or tin, with the aid of small shot, and stamp each one with the number of parts which it represents, it is a great convenience, not to be dependent upon grains alone, for determining the weight of the yarn. In grains, the pound is divided into 7000 parts; but, in the home-made weights, it is divided into but 512 parts. The exact size of stuff and roving cannot, therefore, be determined; but they answer very well for trying yarn by the skein. The foreman in every carding-room should have a fine pair of scales, and a complete sett of grains, by which to try his roving and stuff.

A TABLE,

SHOWING THE SIZE OF YARN, FROM NO. 8 UP TO NO. 34 HANKS IN THE POUND, BY A POUND AVOIRDUPOIS, DIVIDED INTO 512 PARTS.

Hanks.	Parts of $\frac{1}{512}$	Nos. of Yarn.	Hanks.	Parts of $\frac{1}{512}$	Nos. of Yarn.
1	.... 64	8	1	.... 30	17.
"	.... 57	9	"	.... 29	17.50
"	.... 51	10	"	.... 28	18.28
"	.... 46	11	"	.... 27	19.
"	.... 43	12	"	.... 26	19.69
"	.... 42	12.20	"	.... 25	20.50
"	.... 41	12.50	"	.... 24	21.33
"	.... 40	12.75	"	.... 23	22.33
"	.... 39	13.12	"	.... 22	23.25
"	.... 38	13.50	"	.... 21	24.33
"	.... 37	13.87	"	.... 20	25.40
"	.... 36	14.75	"	.... 19	27.
"	.... 35	14.82	"	.... 18	28.50
"	.... 34	15.	"	.... 17	30.12
"	.... 33	15.50	"	.... 16	32.
"	.... 32	16.	"	.... 15	33.
"	.... 31	16.50	"	.... 14	34.

TO FIND THE CHANGE-PINION OF A MULE, AND TO SPIN ANY REQUIRED NUMBER FROM A GIVEN ROVING.

RULE.

Multiply the driven wheels, the diameter of the front roller, and the number of the hank roving, into each other, and the product will be the dividend. Take the proportionate gain of the carriage from the number to be spun; the remainder, multiplied by the driving-pinion on the front roller, and that product by the diameter of the back roller, will be the divisor: the quotient will be the change-pinion required.

EXAMPLE.

If No. 25 is to be spun from a $2\frac{3}{4}$ hank roving, and the carriage is gaining 3 inches on the rollers, or, putting it up to 60 inches, it is gaining 1 in 20. The stud-carrier has 74, the back roller wheel 68, and the driving-pinion on the front roller, 20 teeth; the diameter of the back roller is seven-eighths of an inch, and that of the front roller, one inch. What change-pinion is required for the above number?

No. 25		74	stud-carrier.
$1\frac{1}{4}$	draught of carriage,	68	back roller wheel.
$23\frac{3}{4}$		592	
20	teeth of wheel on front roller.	444	
460		5032	
15		8	front roller.
475		40256	
7	diam. of back roller.	$2\frac{3}{4}$	hank roving.
3325		80512	
		30192	

```
3325)110704(33.29 pinion.
       9975
      -----
      10954
       9975
      -----
        9790
        6650
       -----
       31400
       29925
       -----
        1475
```

TO FIND THE NUMBER OF TURNS PER STRETCH, AND TWISTS PER INCH.

EXAMPLE.

If a mule spindle makes $25\frac{1}{5}$ revolutions for 1 of the rim, and the rim makes 43 turns in a stretch, and the length put up is 60 inches, how many twists are there in 1 inch?

43 turns of the rim.
$25\frac{1}{5}$ revolutions of the spindle.

215
86
8.60

Stretch, 60)1083.60(18.60 twists to the inch.
60

483
480

360
360

Ans. Nearly $18\frac{3}{4}$ twists to the inch.

TO FIND THE PINION FOR A GIVEN NUMBER.

EXAMPLE.

Suppose No. 22 yarn be spun with a pinion of 32 teeth, what will be the size of the pinion required to spin No. 25 yarn?

```
No.  Pinions.   No.
22  :  32  : :  25  :  Ans.
       22
       --
       64
      64
    -------
  25)704(28.16 pinion.
      50
      --
      204
      200
      ---
        40
        25
        ---
        150
        150
        ---
```

Ans. A pinion of 28 teeth.

A 28 toothed pinion will make the yarn too fine, and one of 29 teeth will make it too coarse.

TO FIND THE HANK ROVING FOR A GIVEN NUMBER OF YARN.

EXAMPLE.

If No. 20 yarn requires $2\frac{1}{4}$ hank roving, what hank roving will No. 28 yarn require?

```
No.  Hank roving.   No.
20  :  2.25  : :  28  :  Ans.
          28
       -----
        1800
        450
       ------
20)6300(3.15  hank roving.
    60
    ---
     30
     20
    ----
Remainder of work, 20)100
                      100
                      ---
```

Ans. Nearly $3\frac{1}{6}$ hank roving.

TO FIND THE NUMBER OF HANKS IN A POUND OF YARN.

EXAMPLE.

Suppose a mule is so arranged, that the draught of the wheels is 8; the diameter of the back roller, $\frac{7}{8}$ of an inch; the diameter of the front roller, 1 inch; that it spins from $2\frac{1}{2}$ hank roving; the carriages drawing 20 into 21: what will be the numbers of the yarn spun?

Draught by wheels,	8	9,14	
Diam. of front roller,	8	2,50	hank roving.
Diam. back roller,	7)64(9,14 whole draught by rollers.	45700	
	63	1828	
	10	22,8500	
	7	21	carriage draws 20 into 21.
	30	228500	
	28	457000	
	2	20)4798500(23,9925	
		40	
		79	
		60	
		198	
		180	
		185	
		180	
		50	
		40	
		100	
		100	

TO CHANGE FROM ONE NUMBER TO ANOTHER, ON A MULE OR A THROSTLE, WHEN THE DRAUGHT AND ROVING HAVE BOTH TO BE ALTERED.

Suppose No. 20 yarn is being spun with a 2 hank roving, and a change-pinion of 28 teeth, which it is necessary to alter, so that it will spin No. 28 yarn, with $2\frac{3}{4}$ hank roving: what sized change-pinion will be required?

RULE.

Multiply the 28 change-pinion by the 2 hank roving, for a divisor; then multiply the No. 20 by the 2.75 hank roving, and that product by the 28 change pinion, for a dividend: the quotient will show the change-pinion required.

EXAMPLE.

```
No.                      No.
28                       20
 2 hank roving.           2.75 hank roving.
--                      -----
56                      55.00
                           28 change-pinion.
                       ------
                        44000
                       11000
                      -------
                   56)154000(27.50      Ans. 27½ or 28
                       112                   toothed pinion.
                       ---
                        420
                        392
                        ---
                         280
                         280
                         ---
```

TO FIND THE NUMBER OF DRAWS OR STRETCHES ON A COP OF MULE YARN.

Suppose a cop runs 8 cuts, with 80 turns of the reel to each cut, and 54 inches to each turn of the reel; the length of the draw put up is 60 inches: what number of draws or stretches is required?

RULE.

Multiply the 8 cuts by 80 threads in 1 cut, that product by 54 inches in 1 thread, and divide the sum of these multiplications by 60 inches, the length of the stretch put up: the quotient will be the number of stretches on a sett of cops.

EXAMPLE.

```
                        80 threads, or one cut.
                         8 cuts on each cop.
                       ---
                       640
                        54 inches in each thread.
                      ----
                      2560
                     3200
                     -----
Inches in a draw, 60)34560(576 stretches or draws in cop.
                     300
                     ---
                      456
                      420
                      ---
                       360
                       360
                       ---
```

TO FIND THE AVERAGE NUMBERS OF A SETT OF COPS.

Suppose a mule to have 312 spindles, and 1 cop runs 8 cuts; the weight of the whole sett being 14 pounds: what will be the average numbers of yarn in the cops?

RULE.

Multiply 312, the number of spindles, by 8, the number of cuts, for the dividend; then multiply 14, the weight of the sett of cops in pounds, by 7, the number of cuts in one hank, for a divisor: the quotient will be the average numbers of the yarn.

EXAMPLE.

	Pounds.
Weight of sett,	14
Cuts in a hank,	7
	98

```
      312 spindles.
        8 cuts.
      ---
98)2496(25.46
   196
   ---
    536
    490
    ---
     460
     392
     ---
      680
      588
      ---
       92 remainder.
```

Ans. Nearly No. 25½ yarn.

TO CHANGE FROM ONE NUMBER TO ANOTHER, WITHOUT CHANGING THE ROVING.

Suppose a mule is spinning No. 22 yarn, with a change-pinion of 34 teeth, and a change to No. 28 yarn becomes necessary, what sized change-pinion will be required?

RULE.

As No. 28 yarn will require a smaller change-pinion than No. 22, the proportions are consequently inverse: 34, the number of teeth in the change-pinion, and 22, the number of the yarn, must be multiplied together for a dividend; this product, divided by 28, the desired number of yarn, will give the change-pinion which is required.

EXAMPLE.

```
No.  Pinion.   No.
22  :  34  : :  28  :  Ans.
       22
       ——
       68
      68
     ————
  28)748(26.71   Ans.
      56
      ——
      188
      168
      ———
       200
       196
       ———
         40
         28
         ——
         12
```

A change-pinion of 27 teeth will be required.

TO FIND THE WORK DONE BY A MACHINE IN ONE WEEK.

If a mule, containing 312 spindles, turns off $3\frac{3}{4}$ hanks per day to each spindle, how many skeins will that be per week, and how many pounds of No. 24 yarn?

EXAMPLE.

	312	spindles in a mule.	
	3.75	hanks to each spindle.	
	1560		
	2184		
	936		
Skeins per day.	1170.00		
	6		
	7020	skeins per week.	

If wages are, 17 cents per 100 skeins.

49140
7020

$11,93.40 spinners' wages.

Skeins.

No. 24)7020(292½ lbs. No. 24 yarn per week.
48
222
216
60
48
$\frac{12}{24}$, or $\frac{1}{2}$

At this rate, each spinner will earn $11 93 cents per week, from which he has to pay $3 per week to a boy; this leaves $8 93 cents as his nett weekly earnings.

WEAVING.

The loom is the machine on which weaving is performed. The simplest form of a loom is the hand-loom, of which we have but little to say, because its use in this country is very limited. The power-loom, which is operated by machinery, without any human assistance, may be considered to be the only loom which excites any practical interest in our community. It has now arrived at such a state of perfection, that all the fabrics which our population requires may be readily manufactured by it; plain weaving is done by it more perfectly than it can be done on the hand-loom, and it can be so adjusted as to weave the heaviest goods to advantage; any number of shuttles — at least as many as six — may be used with ease; and damask figured goods, such as table-cloths, &c. may be produced in great perfection, with the assistance of the Jacquard machine.

Weaving is always preceded by warping; the object of which is, so to arrange all the longitudinal threads which are intended to form the chain or warp of the web, as to form, when spread out, a plane of parallel threads. In forming the warp, a sufficient number of bobbins, filled with yarn, must be taken, to furnish the number of threads of the required length of the piece of cloth intended to be woven. As the number of bobbins necessary for the formation of a large piece of fine cloth, would be unhandy to operate with, the warp is usually divided into six or eight parts, and as many bobbins are used to form one of the strands, as there are threads in such part. These strands are then united on the reel, and form the complete web. The spools of thread are mounted horizontally upon a square frame, and revolve upon wire skewers, so that the yarn may pass off them as freely as possible.

There are two distinct forms of warping machines, one of which, the reeling machine, is used chiefly in the formation of chain for the hand-loom. This reel is of a vertical shape, from five to nine feet in diameter, seven feet high, and is moved by hand. The strands of thread are wound upon this reel in a screw line, and the winding is repeated six times, or oftener, or, in fact, until the required number of threads for the chain is laid upon it. The threads are run singly through a steel plate, called a heek, which forms the lease of the warp, and serves for the weaver to put his lease-rods in.

In weaving formerly done on the power-loom, the dressing of the warp was a serious obstacle, and required a frequent stoppage of the loom, and unwinding of the beam. This difficulty was overcome by the dressing-machine, which led to the invention of the warping-machine. On the latter, the warp is wound directly upon a beam; six or eight, or even a greater number of these beams, are mounted upon the dressing-machine, and, on being unwound, form the warp. These machines are very simple and ingenious. Such a warp-mill, with its numerous threads and spools, would require much attention, and would work but slowly, if the motion of the machine was not checked by a very simple contrivance, in case one of the threads breaks. This object is attained by the drop-wires: a hook, made of iron wire, is hung upon each thread, or, rather, the thread passes through it; this hook has a long stem, which moves in the frame of the machine, and, as soon as the thread breaks, it drops down and arrests the motion of an iron rod, which then leads the strap upon the loose pulley.

Another important machine in the system of power-loom weaving, is the dressing-machine. This is a voluminous machine, on which the warp-beams are placed; these are unwound slowly, and their contents united upon a single beam. During its transit to the single beam, the yarn passes over brushes, which move backwards and forwards, from which it receives a dressing, and is again dried before it reaches the main warp-beam. The drying is done by a current of heated air, which is forced upon the warp by a revolving fan, and, in passing through the moist threads of the warp, it dries them, and makes the warp fit for winding and weaving. The heated air is generated by the waste steam, and is conveyed in iron pipes under the machine.

The power-loom is such a complicated, yet ingeniously constructed machine, that it is beyond our power to furnish a proper description of it without the aid of diagrams: we do not, therefore, pretend to give any important information concerning it. Recent improvements on the power-loom have made it not only a useful, but an absolutely indispensable machine. Looms are now in operation, which are driven at the rate of 140 revolutions per minute, and some on plain goods reach 160. A. Jenks offers looms for sale, which will make 200 revolutions per minute. Common sheetings and shirtings require about seventy or eighty picks, or threads, to the inch, which would make, at 200 picks per minute, five yards of goods per hour. Coarse goods, such as pantaloon-stuffs, fustians, &c. can, of course, be woven much faster than this. There are looms manufactured now, which work six treadles with great perfection and ease, the machinery being very simple. As many shuttles can be worked on these looms as there are treadles, and with perfect security. The Jacquard machine is also applied with great success.

It is the first business of the weaver in all cases, to adapt those parts of his loom which move the warp, to the formation of the various kinds of ornamental figures which the cloth is intended to exhibit. This operation, called the draught, drawing or readying-in, is done by men who make a business of it, and follow no other occupation. In every kind of weaving, whether direct or cross-weaving, the whole difference of the pattern is produced, either by the order of succession in which the warp is introduced into the heddles, or by the order of succession in which the heddles are moved. When the heddles have been thus far adjusted, it is the weaver's next business to connect the leaves, or heddles, with the levers, or treadles, by which they are moved, in such a manner as to form the desired pattern. When this operation is performed correctly, there is no further difficulty in obtaining the pattern wanted in the goods; the only thing necessary is, to move the treadles in the order in which they have been placed. The motion of the treadles is performed with the greatest accuracy on one of Jenks' power-looms; they are moved by two revolving iron cylinders, placed in the lower part of the machine. These cylinders are furnished with holes along their whole length, and extending completely around them at regular distances, the number of which is in proportion to the square of the number of heddles used. Into these holes as many steel tappets are screwed as there are treadles; six holes being allowed for each tappet, it follows that either heddle may be moved at each pick of the loom. This is certainly a perfect and safe piece of mechanism for moving the heddles, and giving the draught to the loom.

It is beyond our limits to furnish the operator with such instructions as to enable him to ready-in for a particular pattern. This operation, in plain work, is too generally known to require description. The method of operation in ornamental weaving is, first to draw the pattern upon a paper, which has been previously laid out into small rectangular spaces, each line or space representing one thread of the warp as well as of the filling. The pattern thus drawn represents in its enlarged size, the figure as it will appear in the cloth, when reduced to the size of the number of threads contained in it. The paper pattern thus forms a double scale, by which to judge of the effect, and to determine with great precision the readying-in, and all the subsequent operations.

If great strength and thickness is to be given to the cloth, the common, plain weaving will not do it. For this purpose, two different modes of weaving are resorted to; one of these makes double cloth, or weaves two webs and joins them together in one operation, as is the case in carpets. The great strength and prominent advantages of twilled fabrics, has caused the second kind of heavy cloth to be manufactured on a very extensive scale. The difference of this mode of weaving consists chiefly in laying three or more threads upon the face of the cloth, with such intervals between as the pattern requires, instead of crossing each thread, as is done in plain weaving. In this manner a large amount of yarn may be compressed into a very small space.

TO FIND THE WEIGHT OF A WARP.

Suppose a warp to be 450 yards long, and to contain 1700 ends, and the number of the yarn to be 25 hanks to the pound, what is the weight of the warp?

RULE.

Multiply 1700, the number of ends, or any other number that the warp contains, by 450, the number of yards; the product will be the number of yards of all the ends contained in the warp. Divide this sum by 840, the number of yards in one hank, and that product again by 25: the last quotient will be the answer required.

EXAMPLE.

```
                                                  Hanks in warp.
Ends,    1700                      Hanks in 1 lb. 25)910.71(36.7
Yards,    450                                        75
        -----                                        ---
        85000                                        160
       6800                                          150
       -------                                       ---
Yds. in a hank, 840)765000(910.71 hanks.              10
                    7560                              16
                    ----                             ---
                     900                             175
                     840                             175
                     ----                            ---
                      6000
                      5880
                      ----
                       1200
                        840
                       ----
                        360
```

Ans. Weight of the warp nearly 36 lbs. 7 oz.

TO FIND THE NUMBERS OF A WARP.

Suppose a warp of 450 yards in length contains 1700 ends, and weighs 36 lbs. 7 oz., what is the total number of hanks it contains, and what is the number of hanks to the pound?

RULE.

Multiply 1700, the number of ends, by 450, the number of yards, and divide the product by 840, which will give the number of hanks in the whole warp; this product, divided by 36 lbs. 7 oz., the weight of the warp, will give the number of hanks in the pound.

EXAMPLE.

		lbs. oz.	Hanks in the warp.
Ends,	1700	36 7	910.71
Yards,	450	16 oz.	16 oz
	85000	583 oz.	546426
	6800		91071
Yds. in a hank,	840)765000(910.71 hanks.		583)1457136(24.99
	7560		1166
	900		2911
	840		2332
	6000		5793
	5880		5247
	1200		5466
	840		5247
	360		219

Ans. $910\frac{3}{4}$ hanks in the warp, and nearly 25 hanks to a pound.

REELING, AND SIZE OF A REEL.

In reeling, 1½ yards, or 54 inches, make 1 thread,
80 threads make 1 cut,
7 cuts, or 560 threads, make 1 hank,
840 yards make 1 hank.

TO FIND THE LENGTH OF A DRIVING-BELT.

Suppose the distance from the centre of the driving-shaft to the centre of the pulley-axle, of any machine to be driven, is 10 feet, the diameter of the pulley on the driving-shaft is 16 inches, and the diameter of the card-frame or mule pulley is 12 inches; what length of belt will be required?

RULE.

Double the distance, which is here 10 feet, and multiply the amount by 2; then add the diameter of the two pulleys together, and multiply the product by 3, or, more correctly, 3¼; this product, divided by 2, and added to the double of the distance between the shafts, will be the length of belt required.

EXAMPLE.

Ft. In.		Feet.
1 4 driving pulley.		10 from centre to centre of shafts.
1 0 driven pulley.		2
2 4		20 double.
3	Add	3½
2)7 0		23½ length of belt.
3½ feet around the pulleys.		

TO FIND THE LENGTH OF A CROSS-BELT FOR THE SAME PLACE.

RULE.

Proceed in the same manner as with the other, with this difference: add the diameters of the 2 pulleys together, and multiply the product by 3, and that product again by 2; divide the sum of these multiplications by 3: this last product, added to 20, will give the required length of the cross-belt.

EXAMPLE.

Ft. In.	Feet.
1 4	10
1	2
2 4	20
3	4 8
7 0	24 8 length of a cross-belt.
2	
3)14 0	
4 8	

Ans. 24 feet 8 inches, length of the cross-belt.

BELTING.

The following table shows the required width of large belts to drive different numbers and kinds of spindles with looms —the columns marked "Mules," "Mules and Frames," and "Frames," show the number and kind of spindles to be driven; the column marked "No. Yarn," shows the number of yarn which the spindles are supposed to spin; and the column marked "Diameter," shows the diameter of the smaller drum.

EXAMPLE.

Required the width of a belt to drive 5000 frame spindles with looms, the number of the yarn being 35, and the diameter of the smallest drum being 6 feet. Find 5000 in the column marked "Frame Spindles;" opposite to this number in the table, and under 6 in the column marked "Diameter," will be found 32 inches, or two belts 16 inches wide.

No. 1.

Frame Spindles.	No. Yarn.	Diameter. 3	4	5	6	7	8
1000	30 to 40	13	10	8	6½	5½	4¾
2000	" "	26	20	16	13	11	9
3000	" "	39	30	24	19	16	14
4000	" "	52	40	32	26	22	18
5000	" "	65	50	40	32	27	23
6000	" "	78	60	48	39	33	28

No. 2.

Mule Spindles.	No. Yarn.	Diameter. 3	4	5	6	7	8
1000	10 to 20	13	10	8	7	6	5
2000	" "	27	20	16	13	11	10
3000	" "	40	30	24	20	17	15
4000	" "	54	40	32	27	23	20
5000	" "	67	50	40	34	28	25
6000	" "	81	61	49	40	34	30

EXAMPLE.

Required the width of a belt to drive 2000 mule spindles with looms, the number of the yarn being 28, and the diameter of the smallest drum being 3 feet. Find 2000 in the column marked "Mule Spindles;" opposite to this number in the table, and under 3 in the column marked "Diameter," will be found 25 inches, or two belts 12½ inches wide.

No. 3.

Mule Spindles.	No. Yarn.	Diameter. 3	4	5	6	7	8
1000	20 to 30	12	9½	7½	6	5	4¾
2000	" "	25	19	15	12	10	9½
3000	" "	38	28	23	19	16	14
4000	" "	50	38	30	25	21	19
5000	" "	63	47	38	31	26	23
6000	" "	76	57	45	38	32	28

No. 4.

Mule Spindles.	No. Yarn.	Diameter. 3	4	5	6	7	8
1000	30 to 40	11½	9	7	5½	4¾	4¼
2000	" "	23½	17	14	11	9½	8½
3000	" "	35	26	21	17	14	13
4000	" "	47	35	28	23	19	17
5000	" "	58	44	35	29	24	21
6000	" "	70	52	42	35	29	26

No. 5.

Spindles, Mule and Frame.	No. Yarn.	Diameter. 3	4	5	6	7	8
1000	10 to 20	15	12	11	8	6½	6
2000	" "	30	24	21	15	13	11½
3000	" "	45	36	32	23	20	17
4000	" "	60	48	43	30	26	23
5000	" "	75	60	54	38	33	29
6000	" "	90	72	64	45	40	35

No. 6.

Spindles, Mule and Frame.	No. Yarn.	Diameter. 3	4	5	6	7	8
1000	20 to 30	13	10	8	6½	5½	5
2000	" "	26	20	16	13	11	10
3000	" "	39	29	24	20	17	15
4000	" "	52	39	31	26	22	20
5000	" "	65	49	39	33	28	25
6000	" "	78	58	47	39	33	30

No. 7.

Spindles, Mule and Frame.	No. Yarn.	Diameter. 3	4	5	6	7	8
1000	30 to 40	12	9	7	6	5	4½
2000	" "	24	18	14	12	10	9
3000	" "	36	27	21	18	15	13
4000	" "	48	36	29	24	20	18
5000	" "	60	45	36	30	25	22
6000	" "	72	54	43	36	31	27

No. 8.

Frame Spindles.	No. Yarn.	Diameter. 3	4	5	6	7	8
1000	10 to 20	16	12	10	8	7	6
2000	" "	32	24	19	16	14	12
3000	" "	48	36	29	24	21	18
4000	" "	65	48	39	32	27	24
5000	" "	81	61	48	40	34	30
6000	" "	97	73	58	49	41	36

No. 9.

Frame Spindles.	No. Yarn.	Diameter. 3	4	5	6	7	8
1000	20 to 30	14	11	8½	7	6	5
2000	" "	29	21	17	14	12	11
3000	" "	43	32	26	21	18	16
4000	" "	57	43	34	29	24	21
5000	" "	72	54	43	36	31	27
6000	" "	86	65	52	43	37	32

The following tables show the required width of counter-belts to drive the counter-shafts, which drive the different machines represented in the following tables.

EXAMPLE.

Required the width of a counter-belt to drive a picker with two beaters, the diameter of the smallest pulley being 18 inches. Find 2 in the column marked "Beaters;" opposite to this number in the table, and under 18 in the column marked "Diameter," will be found 7 inches, the width of the required belt.

No. 10.

PICKERS.

Beaters.	Diameter. 10	12	14	16	18	20	22	24	26	28	30
1	6½	5½	4½	4¼	3¾	3¼	3	..	..	..	
2	13	11	9	8½	7½	6½	6	5½	5	4¾	4½
3	18	16	13	12¾	11	9½	9	7¼	7½	7	6½

EXAMPLE.

Required the width of a counter-belt to drive 6 cards, the diameter of the smallest pulley being 20 inches. Find 6 in the column marked "Cards;" opposite to this number in the table, and under 20 in the column marked "Diameter," will be found 8 inches.

No. 11.

THIRTY-INCH CARDS.

Cards.	Diameter. 10	12	14	16	18	20	22	24	26	28	30
2	5¼	4¼	3¾	3¼	3	2½					
3	7¾	6½	5½	4¾	4½	4	3½	3¼	3		
4	10½	8½	7½	6½	6	5¼	4¾	4½	4¼	3¾	3½
5	13	10¾	9	8	7¼	6½	6	5½	5¼	4¾	4¼
6	15½	13	11	9½	8¾	8	7	6½	6¼	5½	5
7	18½	15¼	12¾	11¼	10	9	8½	7¾	7¼	6½	6
8	20	17½	14½	12½	11½	10½	9½	9	8½	7½	7
9	23½	19½	16½	14½	13¼	12	10½	10	9	8¼	7½
10	26	21½	18	16	14½	13	12	11	10¼	9¼	8¼

No. 12.

DRAWING FRAMES, (THREE HEADS EACH).

Drawing.	Diameter. 10	12	14	16	18	20	22	24	26	28	30
1	4	3¼	3	2½							
2	8	6½	6	5	4½	4	3½	3¼	3		
3	12	9¾	9	7½	6½	6	5½	4¾	4⅓	4¼	4

No. 13.

TWIST SPEEDERS.

Speeder.	Diameter. 10	12	14	16	18	20	22	24	26	28	30
48	6¼	5½	4½	3¾	3½	3					
72	9¼	7¾	6½	5½	5¼	4½	4¼	4	3½	3¼	3
96	12½	10½	8¾	7½	6¾	6	5½	5¼	4¾	4½	4¼
120	15½	13	11¼	9½	8½	7½	7	6½	6	5½	5
144	18¾	15½	13¼	11½	10¼	9	8½	7¾	7¼	6½	6¼
168	21¾	18¼	15¼	13¼	12	10½	9¾	9	8½	7¾	6¼
192	24¾	20¾	17½	15¼	13½	12	11¼	10¼	9½	8¾	8¼
216	29	23½	19¾	17	15¼	13½	12½	11¾	10¾	10	9

EXAMPLE.

Required the width of a counter-belt to drive 1500 mule spindles, the diameter of the smallest pulley being 20 inches. Find 1500 in the column marked "Mules;" opposite to this number in the table, and under 20 in the column marked

"Diameter," will be found 15 inches, the required width, (or two belts 7 and 8 inches wide).

No. 14.

MULE SPINDLES.

Mules.	Diameter. 10	12	14	16	18	20	22	24	26	28	30
600	12¼	10¼	8¾	7¼	6½	6	5½	5	4½	4¼	4
900	18½	15½	12¾	11¼	9¾	9¼	8¼	7½	6¾	6¼	6
1200	24½	20½	17¼	14¾	13¼	12¼	10¾	10¼	9¼	8½	8¼
1500	30¾	25¾	21½	18½	16½	15	13½	12½	11½	10½	10¼

No. 15.

FRAMES, (LIVE AND DEAD) SPINDLES.

Frame.	Diameter. 10	12	14	16	18	20	22	24	26	28	30
100	8	6½	5¾	5	4½	4	3½	3¼	3		
200	16¼	13¼	11½	10¼	8¾	8¼	7¼	6½	6¼	5½	5¼
300	24½	19¾	17¼	15½	13¼	12½	10¾	9¾	9¼	8½	7¾
400	32¾	26½	22¾	20½	17½	16½	14½	13¼	12¼	11¼	10½
500	40¾	33½	28½	25¾	22¼	20¾	18¼	16½	15¼	14	13¼

No. 16.

DRESSERS, (THREE FANS TO EACH DRESSER).

Dressers.	Diameter. 10	12	14	16	18	20	22	24	26	28	30
1	7¼	5¾	5¼	4¼	3¾	3½	3¼	3			
2	14½	11½	10½	8½	7½	7	6¼	5¾	5¼	5	4½
3	21½	17½	15½	12¾	11¾	10½	9¼	8¾	8¼	7½	6¾
4	28¼	23¼	20¼	17¼	13¼	14¼	12½	11½	10¼	10	9¼

No. 17.

LOOMS.

Looms.	Diameter. 10	12	14	16	18	20	22	24	26	28	30
2	5¼	4¼	3¾	3¼	3						
4	10¼	8½	7¼	6½	5¾	5½	5¼	4¾	4½	4¼	3¾
6	15½	13¼	11¼	9½	8½	7¾	7¼	6½	6	5½	5¼
8	20¾	17½	14¼	12¾	11½	10½	9½	8¾	8¼	7¼	7
10	26¼	21½	17¾	16¼	14¼	13¼	11¾	10¾	10¼	9¼	8¾
12	31¼	26¼	22¼	19¼	17¼	15½	14½	13¼	12¼	11¼	10½

MISCELLANEOUS MATTERS.

SPOOLING MACHINES.

The spooling machines in general use, both for throstle bobbins and mule cops, are those with a cylinder, or series of drums, upon a horizontal shaft, running in the centre of a frame about 2 feet 10 inches wide. These machines are of various lengths, according to the number of ends or spools they contain. Those of 32 spools, or 16 spools to each side, are about 12 feet 6 inches long; and those of 48 spools, or 24 to each side, are 16 feet 6 inches long. Cast-iron arches are raised in the centre of the frame, over the drums, which form the stands for the spools: each drum turns two spools; one on each side. The drums which turn the spools are driven at a speed of from 200 to 220 revolutions per minute, when their diameter is 8½ inches: this speed will suit either bobbins or cops. The traverse motion on these machines must be properly regulated, and kept in good order.

PRICES OF MACHINERY.

	$ cts.		$ cts.
Patent willey, or opening machine......	70 00	to	75 00
Patent spreader	500 00	"	00
Cards, thirty inches wide, (wooden doffers,)	220 00	"	250 00
Cards, thirty inches wide, (iron doffers,) .	250 00	"	260 00
Card clothing, in best calf-skin, per square foot*...................... ...	1 20	"	1 38

* A discount of five per cent. for cash is allowed on these prices.

	$ cts.		$ cts.
Card clothing, in good, neat leather, per square foot*	1 10	to	1 15
Hand-stripping cards, per dozen	3 00	"	5 00
Drawing-frames, with steel front rollers, per head	65 00	"	70 00
Condensing-strap speeder of twelve ends	275 00	"	300 00
Brewster speeder, double beam	250 00	"	275 00
Mules, per spindle	2 00	"	2 25
Card-grinding machine	75 00	"	100 00
Slide-rest for turning up cards	50 00	"	60 00
Live-spindle throstles, per spindle	5 00	"	6 00
Cap-spindle throstle	6 00	"	6 50
Spooling machines, 32 and 48 spools	96 00	"	130 00
Warping mills, from 11 to 12 feet diam.	45 00	"	50 00
Mule spindles, made of spindle steel, with iron warves	20	"	25
Throstle spindles, with steel fliers, per doz.,	10 00	"	11 00
Cast-steel throstle fliers	2 75	"	3 00
Comb-plate, per foot	40	"	50
Narrow cotton looms, each	45 00	"	50 00
Wide cotton looms, each	65 00	"	70 00
Shuttles for cotton looms, each	45	"	50
Pickers for cotton looms, per dozen	1 25	"	1 50
Shuttle eyes, for cotton looms, per dozen,	12	"	50
Throstle bobbins, per thousand	22 50	"	25 00
Glass creel steps, per thousand	6 00	"	8 00
Roller-skins (sheep), per dozen	6 00	"	7 00
Roller-skins (calf), per dozen	24 00	"	30 00
Emery of various sizes, per pound	8	"	10
Russia calf-skins, per dozen	13 00	"	24 00

* A discount of five per cent. for cash is allowed on these prices.

	$ cts.		$ cts.
Glue, per pound....................	12	"	15
Card-plyers, for stretching sheets, each ..	1 50	"	2 50
Belt leather, per pound	26	"	28
Water-wheel or steam-engine governors..	50 00	"	110 00
Roller cloth, per yard................	1 00	"	1 10
Washer cloth, for throstles, per yard	80	"	1 00
Iron washers, per hundred............	70	"	2 00
Patent wrenches, each	2 00	"	3 00
Tack, and other hammers	50	"	87

There is, owing to the difference in the quality, workmanship, style, and finish of machinery, a considerable variation in the price. In the foregoing list, the prices are given for the best kind.

PRICES OF MACHINERY MADE BY ALFRED JENKS.

We insert here the prices of the various descriptions of cotton-spinning and weaving machinery, manufactured in Bridesburg, near Philadelphia, by Alfred Jenks, as they contain all the most recent improvements, are of excellent workmanship, and can be conscientiously recommended.

	$ cts.
Whipper, or willow..........................	75 00
Cotton picker	100 00
Lap machine; one beater....................	250 00
Lap machine; two beaters	400 00
Thirty-inch cards; twenty-one flats...............	140 00
Thirty-inch cards; two workers, two strippers, and fourteen flats—an improved card	200 00
Thirty-inch card; three workers, three strippers, six flats	210 00

	$ cts.
Thirty-inch card; four workers, four strippers, five flats	220 00
Thirty-inch card; five workers, four strippers, no flats,	230 00
Drawing-frame; two heads, four lengths of rollers, each with four coilers on each head, and stop motions; each head	87 50
Drawing-frame; three heads, three lengths of rollers, each having three coilers on each head, stop motions, and four rows of rollers — improved — per head	87 50
Railway drawing-head; single rollers, double rollers, with plungers and graduating wheels—patent	200 00
Counter-twist speeder; sixteen bobbins—improved	270 00
Counter-twist speeder; twelve bobbins	230 00
Slubbin-frame; forty-eight spindles, ten inch bobbins; per spindle	12 50
Fly-frame; 100 spindles, six inch bobbins; per spindle	10 00
Throstles; two inch bobbins, live spindles	4 75
Throstles; two and a half inch bobbins, live spindles,	4 75
Throstles; four inch bobbins, twist ring frame, per spindle	3 75
Throstles; four inch bobbins, twist ring frame, filling; per spindle	3 75
Jenks' improved ring-frame throstle; spindles make 10,000 revolutions per minute; front roller, cast steel, 160 revolutions per minute; to spin without bobbins; per spindle	3 75
Mules; 240 to 600 spindles, half self-acting; per spindle	2 00
Reels, for cops	30 00

	$ cts.
Reels, for bobbins, forty spindles	40 00
Yarn press—improved	30 00
Spooling-frame; twenty-four spools	100 00
Spooling-frame; thirty spools	110 00
Warping-mill and hack; 120 eyes	55 00
Sizing troughs, with iron squeezers	60 00
Dressing machines and section beams	350 00
Warping-mills, with drop wires	100 00
Beaming machine	70 00
Frame and slide-rest for cards	80 00
Railway for cards—mahogany—per card	8 00
Card grinder, with iron cylinder	80 00
Doubler and twister; forty spindles, four inch bobbins, three inch heads; per spindle	5 00
Doubler and twister; ninety-six spindles, four inch bobbins, three inch heads; per spindle	4 00

LOOMS.

	$ cts.
Looms, thirty-five or forty inch, for plain goods	50 00
Looms, forty inch, with two, three, four, five, and six treadles, and thread protectors	50 00
Looms, forty inch, with two, three, four, and six treadles, and thread protectors; make 200 revolutions per minute	65 00
Loom, forty inch, for satinetts, sliding heddles	70 00
Loom, forty inch, for satinetts, top mounting	90 00
Loom, forty inch, with two, four, six, and eight treadles, and two, four, and six shuttle drop boxes, for pantaloons and vestings—Jenks' patent	90 00
Jacquard's fancy table-cloth loom	60 00

WAGES OF HANDS EMPLOYED, AND COST OF RUNNING 8064 MULE SPINDLES, WITH PREPARATION, BY STEAM-POWER, PER MONTH, OF FOUR WEEKS.

Hands.		$ cts.
29	In preparatory department, picking and carding room	86 75
1	Carrying bobbins to mules; part paid by Company	2 00
	Amount of wages per week	88 75
		4
	Amount of wages per month in the first department*	355 00
14	Fourteen mules, spinning 373,980 skeins of chain, at 17 cents per 100 skeins	645 76
10	Ten mules, spinning 373,980 skeins of filling, at 16 cents per 100 skeins	598 36
48	Boys are also required for these twenty-four mules, which run 8064 spindles, and spin 747,960 skeins of No. 22½ yarn, weighing 33,260 pounds.	
11	Spoolers, spooling 373,980 skeins per month, at 3½ cents per 100 skeins	125 89
6	Warpers, warping 373,980 skeins per month, at 4½ cents per 100 skeins	168 29
3	Manager, clerk, and watchman, per month	116 00
2	A carpenter and a jobber, occasionally	24 00
2	Engineer and fireman, per month	56 00
	Forty-eight tons of coal per month, at $3 75.	180 00
126	Hands, in all. Total expense per month,	$2269 00

* This department contains one willey, one spreading-machine, twenty-eight thirty-inch cards, four drawing-frames, with three heads, and eight belt-speeders, of twelve ends each.

	Per lb. cts.		Per 100 skeins. cts.
The preparation costs	1.07	..	4.75
Spinning, per pound	3.74	..	16.50
All other items, including coal, &c.	2.01	..	9.00
Total cost of wages and fuel	6.82	..	30.25

There are no mechanics' wages, hauling, or other incidental expenses, included in the foregoing estimate: if these were added, it would raise the average cost to 8.50 cents per pound.

WAGES OF HANDS, AND EXPENSE OF RUNNING 9332 SPINDLES, WITH PREPARATION, PER MONTH OF FOUR WEEKS, BY WATER-POWER.

Hands.		$ cts.
36	Hands in picking room and carding room, per week	116 25
1	Carrying speeder-bobbins to spinning room	4 00
	Amount of wages per week	120 25
		4
	Amount of wages per month in this department*	481 00
33	Twenty-nine throstles, running 3304 spindles, and spinning 277,536 skeins, or 11,564 lbs. of No. 24 yarn	308 00
70	Amount carried forward,	789 00

* This department contains one willey, two spreaders, thirty-six cards, five of which are thirty-six inches, and the others twenty-four inches wide, four drawing-frames, eleven speeders, two plates, and nine condensing-strap speeders.

Hands.		$ cts.
70	Amount brought forward,	789 00
11	Twenty-one mules, running 6028 spindles, and spinning 506,232 skeins, or 21,093 lbs. of No. 24 yarn.	
38	Boys are required for these twenty-one mules.	
	The whole number of mules and throstles run 9332 spindles, and spin 783,768 skeins, or 32,657 lbs. of No. 24 yarn.	
	Six of these mules run on shuttle cops, and spin 157,248 skeins, which is, at 14 cents per 100 skeins	220 14
	Fifteen mules run on reel cops, and spin 348,984 skeins, which, at 12½ cents per 100 skeins, amounts to	436 23
14	Reelers, reeling 8724 doffs, at 2 cents each.	174 48
6	Bobbin reelers, reeling 3000 doffs, at 2½ cts.	75 00
4	Bobbin spoolers, spooling 157,536 skeins, at 3 cents per 100 skeins...............	47 26
3	Warpers, warping 157,536 skeins, at 5¼ cts. per 100 skeins	82 70
2	Mechanics, per month	72 00
2	Apprentices to mechanics, per month	28 00
1	Carpenter, jobbing, &c., per month	24 00
3	Clerk, yarn baler, and watchman.........	84 00
154	Hands. Total wages per month, full time,	$2032 81

	Per lb. cts.	Per 100 skeins. cts.
The preparation of 32,657 lbs. costs.....	1.17 ..	6.13
Throstle spinnings, 11,564 lbs. cost	2.65 ..	11.09
Mule spinnings, 21,093 lbs. cost.........	3.11 ..	12.96
Total cost in wages	6.22 ..	26.00

In the foregoing estimate, no allowance has been made for other incidental expenses, such as hauling, castings, paper, twine, nails, brushes, oil, leather, cloth, bobbins, lumber, &c., which will advance the cost to 8.09 cents per pound.

WAGES IN THE NEW ENGLAND STATES.

The rate of wages paid at present in the New England States, may be said to be, on an average, as follows. The tariff of prices agreed upon by the different manufacturers at Fall River, Mass., in December, 1850, allows the subjoined prices for making 60 × 64 printing cloth, 28 inches wide:—

	Cts.	Mills.
Weaving, thirty-five yards	15	0
Dressing, thirty-five yards	2	5
Warping, per beam	25	0
Spooling, per pound		5
Drawing-in, per beam	13	0
Spinning warp, per 100 skeins	3	0
Spinning No. 27 filling, per 100 skeins	10	0

The filling is spun by self-acting mules, and the warp is spun by throstles.

A CORRECT ACCOUNT OF THE WEIGHT OF YARN SPUN EACH WEEK, IN A FACTORY CONTAINING 8212 SPINDLES, DURING SIX MONTHS, OR TWENTY-SIX WEEKS. ALSO, OF THE WASTE PER WEEK.

Weight of Yarn. lbs.	Weight of Lap Waste. lbs.	Picker Waste. lbs.	Weight of Sweepings. lbs.
5766½	130	270	357
6341	200	393	250
6475¾	200	132	310
6313¾	300	388	363
6588¼	600	325	322
6486¼	300	284	331
6641¼	227	311	300
4927¼	329	250	243
6417	327	304	275
4864¼	268	312	251
6381	362	260	304
5753½	244	275	275
3375¼	300	262	349
2996	160	131	152
3312	60	183	217
6533½	319	353	247
7215½	400	456	475
7028	506	220	322
7476	300	500	222
8581	371	306	362
6825¼	355	316	261
7449	384	456	461
7253¾	525	214	235
7306½	300	357	393
6186¼	400	125	158
7258½	314	316	323
161,752¼	7981	7699	7758

The diminution of quantity in some weeks was owing to time lost by back-water: the increase, to an increased number of spindles.

It appears from this account, that the waste and wrappers amounted to 16.59 per cent. of the yarn produced, in addition to the sand that falls out in picking and carding, which would raise it to 17 per cent. This shows that 100 pounds of raw cotton will only produce 83 pounds of yarn; and that, when cotton is 10 cents per pound, 2 cents may be added to each pound for the loss. If screens were added to the cards, they would save a great deal of this waste.

The waste of this factory is in the following ratio:

Laps......	7.981
Picker waste	7.699
Sweepings .	7.758
Bales & ropes	3.400
	26.838

WAGES, EXPENSES, AND PROFITS OF A COTTON FACTORY, FOR ONE MONTH.

Dr.		*Factory.*	*Cr.*
To wages paid hands in picking and carding rooms..............	$481 00	By 783,768 skeins, 32,657 lbs. of No. 24, at 3 cents above the number, that is 27 cents per lb.	$8817 39
" Throstle room, 11,564 lbs. No. 24	308 00	" 1400 lbs. flyings, at 4 cents ...	56 00
" Mule spinning, 21,093 lbs. " 24	656 37	" 2800 lbs. of picker waste and sweepings, at 1 cent per lb. ..	28 00
" Other items of wages as per list,	587 44	" 500 bales and ropes, at 2 cents.	10 00
Total wages per month,	$2032 81		
" 38,207 lbs. raw cotton, at 11 cts.,	4202 77		
" Contingent expenses, for hauling, fuel, oil, leather, castings, paper, lumber, roller covering, &c. ..	400 00		
" Clerk's salary, and rent of counting house and store, or ware-room in the city, per month..	60 00		
" Insurance and taxes, per month,	150 00		
" Balance and profits for 1 month,	2065 81		
	$8911 39		$8911 39

The total cost of each pound of yarn, in wages and general expenses, is 8.09 cents. The noted price of cotton is about the average. The amount charged for wages is correct, and an ample allowance is made for contingent expenses. The price of yarn in the market being subject to continual fluctuation, the estimate is of course fictitious in this particular. With all these disadvantages, there is a profit upon the yarn produced, of 6.33 cents per pound, including the $94 worth of waste. Such a profit should pay, even in the dullest times. The estimate made here is for full time; when there is a loss of time, or a smaller quantity of yarn is spun, the profits will, of course, be proportionately smaller.

MODE OF CONSTRUCTING A FACTORY CLOCK.

These clocks have two hands and a dial, like a common clock, and are always placed beside one of the latter. The factory clock has "Mill time," painted on the dial; the dial of the other clock has "Clock time" inscribed upon it.

Suppose a shaft makes sixty revolutions per minute, with a worm on one end of it, what wheels will be required to form the clock?

RULE.

Set a wheel, with 60 teeth, to work in the worm on the shaft above mentioned. Let a worm also be fixed on the shaft of the latter wheel, to work into another wheel of 60 teeth; this wheel will make one revolution per hour. There are now four wheels to be found, to cause a hand to move around once in twelve hours: any two driving wheels will answer this purpose, one being one-fifth smaller than the other. The largest of these should work into another wheel, having three times the number of teeth; and the smallest should work into a wheel with four times the number of teeth. The smallest wheel must be fastened to the last worm shaft.

Suppose one of the two driving wheels has 12 teeth, and the other has 15 teeth; the wheel of 15 teeth working into one of 45 teeth, and the one of 12 teeth working into a wheel of 48 teeth. Multiply the 12 and 15 together for a divisor, and the 45 and 48 together for a dividend: the quotient will show that the hand goes round once in 12 hours; provided the engine or water-wheel loses no time, or has not too slow a motion. In either case, the machinery of the mill must be kept in motion until the hands of the mill clock arrive at the proper time. The key of this clock is usually kept by the manager, whose duty it is to see that it is truly and properly set every morning.

EXAMPLE.

Drivers.	Driven.
15	48
12	45
180	240
	192

180)2160(12 Ans.
    180
    ———
    360
    360
    ———

It requires twelve hours for this hand to make one revolution.

For the motion of the minute hand, see the rule, where a shaft performs sixty revolutions per minute, with a worm on the end, working into another wheel of sixty teeth, and moves the hand around the dial once in twenty-four hours.

A CONCISE DESCRIPTION OF THE VARIOUS KINDS OF COTTON.

COTTON is the most valuable, by far, of the exports of the United States, and one that has grown up with a rapidity altogether unprecedented. No country, in any previous era, ever possessed so valuable an export; and no material for manufacture ever spread so rapidly and so widely as this has done, within the last forty years. In this there is something very remarkable, as neither the material nor the manufacture is of recent date; the plant being common to the tropical regions of both the Old and New Worlds, and native to the loom. It was among the first of the raw materials used in the manufacture of cloth; and it is enumerated among those of India, by Herodotus, the earliest of the profane historians. It was one of the valuables found by the Spaniards among the Mexicans and Peruvians, and one of the first taken notice of by Europeans in their southern colonies. Yet, notwithstanding all this, the miracles it has wrought are within the memory of the present generation. Soon after the termination of the American Revolution, in 1783, a small quantity of raw cotton was shipped from Georgia; but, until the year 1793, the export was confined to the "Sea Island," commonly called "black seed," or long staple cotton, the cultivation of which was necessarily very limited. In 1770, there was exported to Liverpool from New York, three bags of cotton wool; from Virginia and Maryland, four bags; and, from North Carolina, three barrels. The "green seed," "short staple," or "upland," as it is now called, which will grow anywhere, was at that time comparatively worthless, owing to the difficulty of separating the staple from the seed.

INVENTION OF WHITNEY'S COTTON-GIN.

The genius of Mr. Whitney, however, at last invented a machine, which has done for the planters of America, what the genius of Arkwright effected for the cotton manufacturers of England and the whole world. From this time, cotton assumed a position equal to printing and steam, in revolutionizing the world. Of Mr. Whitney, the benefactor of his age and of his country, it is painful to add, that neglect and penury was his portion. Fifty thousand dollars, given to him by the States of Virginia, and North and South Carolina, for his machine, was all expended in maintaining his patent-right in Georgia, where it was chiefly needed. A tardy decision at length secured his right against these encroachments, but not until thirteen out of the fourteen years which is allowed to each patentee had expired. After a few ineffectual struggles to obtain an extension of his patent, he died a broken-hearted man; poor in the midst of the wealth he had himself created. Alas! such is often the fate of scientific genius! with all the protection of the law, it is hard to guard what nature has not guarded: an invention once known is equally the property of all; it is gone from its possessor for ever. Previous to the year 1790, the supply of raw cotton for the British manufacturers was principally derived from the West Indies and the Levant; but since the invention of the cotton-gin, its production has increased so rapidly in the United States, that it now ranks among the most valuable of its exports.

DIFFERENCE IN COTTON

Cotton is a fibrous down, which invests the seeds of a peculiar plant, called gossypium by Linnæus. It has a cup-shaped calix, with five obtuse teeth, enclosed in an exterior calix, having three clefts. Botanists describe thirteen species of this plant, which furnish the very dissimilar staples found in commerce. The length, flexibility, tenacity, and thickness of the fibres of the different descriptions of cotton, form the basis for estimating the value of the article. When examined through a good microscope, the fibres of cotton are seen to be more or less flat and twisted, and to have a breadth varying from $\frac{1}{800}$ of an inch in the Smyrna, or candle-wick cotton, to $\frac{1}{2500}$ of an inch in the finest Sea Island. The fineness of the cotton, where No. 500 is spun, is apparent from the following circumstance. It is said that a house in Manchester, England, is preparing a fabric for the Great Industrial Exhibition of London, which is to be spun from a pound of cotton, and to extend in length 238 miles and 1120 yards. There are, in the warp, eighty layers of a yard and a half each, with seven warps to the hank, and five hundred hanks in the pound of cotton. This is a thread which is finer than the finest silk, and cannot contain more than three or four fibres of the finest Sea Island cotton.

The main distinction between the various kinds of cotton in the pod, is the black seeded and the green seeded. The first separate from the fibre very easily; while the latter adhere to it with great tenacity, and require the aid of the gin to separate them from it. After the cotton is separated from the seed, it is packed in strong presses, and formed into bales of from 200 to 500 pounds each. Bales of American cotton generally weigh about 500 pounds each.

THE CAUSE OF SHORT CROPS.

Since the introduction of cotton into the United States, its price has been very variable. A few years since, cotton was as low as six cents a pound, and at present (1851,) it is as high as fourteen cents. This fluctuation is partially caused by the short crops, but principally by the increased demand. As short crops have some influence upon the domestic consumption of cotton, we shall here insert a table, showing the cause of short crops. This table has reference only to cotton grown in America; it is a valuable compilation, giving the date at which the cotton bloomed, that of the appearance of frost, and the amount of the crop in bales. It may be made very useful to our cotton spinners and cotton brokers.

Year.	Date of Bloom.	Date of Frost.	Crop in Bales.
1836	June 4,	October 14,	1,432,000
1837	May 7,	October 27,	1,800,000
1838	June 14,	October 7,	1,360,000
1839	May 24,	November 7,	2,117,000
1840	June 6,	October 17,	1,630,000
1841	June 10,	October 15,	1,683,000
1842	May 17,	November 1,	2,379,000
1843	June 12,	October 15,	2,030,000
1844	May 31,	October 30,	2,394,000
1845	May 30,	November 3,	2,100,000
1846	June 10,	November 1,	1,800,000
1847	May 29,	November 27,	2,348,000
1848	May 30,	November 20,	2,700,000
1849	June 15,	December 10,	2,100,000

From this, it appears that a late bloom is invariably succeeded by a short crop.

A DESCRIPTION OF THE COTTON PRODUCED IN NORTH AMERICA, AND OTHER PARTS OF THE WORLD.

Cotton is manufactured so extensively, and into such a variety of cloths of different qualities, that a short account of the several kinds used in making cotton yarn, with some remarks upon their qualities, the estimation in which they are held by cotton spinners, the countries where they grow, together with other interesting subjects, cannot fail to prove interesting to managers, and carding and spinning masters. It is, in fact, so intimately connected with the plan of the work, that it might be considered incomplete, if this subject were not included in it.

COLOUR OF RAW COTTON.

Cotton is distinguished in commerce by its colour, the length of its staple or fibre, and its strength and fineness. A white colour is generally considered to be characteristic of an inferior quality. The cotton of Smyrna, Cyprus, Salonica, and all parts of the Levant, is distinguished by its white colour. The chief part of the North American cotton is also white, viz.: New Orleans, Tennessee, Alabama, and Georgia upland. Yellow, when not the effect of accidental wetting, or the result of an inclement season, is an indication of fineness and strength. The cotton of the West Indies and South America is called yellow; but its colour is not quite yellow, and inclines more to a cream colour. The East India cotton has a slight tinge of orange. The fine Georgia Sea Island, though not properly a yellow cotton, has a faint, but decided tinge of yellow, which distinguishes it from the white short staple cotton of America.

We subjoin a description of nearly all the varieties of cotton used, with short notices of their quality and value.

SEA ISLAND COTTON

Is produced on the coast of the State of Georgia, and on the small sandy islands contiguous to it. It also grows in both North and South Carolina. It is a fine silky cotton, of a yellowish tinge, and both long and strong in the staple. The finest kind of this cotton is used only for spinning the finest qualities of yarn used in the manufacture of lace. Some qualities of Sea Island are used in spinning power-loom warps for superior shirtings. It mixes, cards, and spins well with upland cotton, and a sixth or eighth part of it, mixed with New Orleans, very much improves the quality of the yarn. The staple is from $1\frac{1}{2}$ to $1\frac{5}{8}$ inches long; therefore, in working this cotton, the middle and front rollers in drawing-frames, speeders, and spinning machines, must be placed at a greater distance from each other than they are usually, in order to make it draw well. Good qualities of this cotton command a higher price than the upland.

UPLAND COTTON

Is a different species from the Sea Island, and is produced in the inland districts of the States of Virginia, North and South Carolina, Georgia, Tennessee, Alabama, Mississippi, Louisiana, Texas, and other States. This is generally a light flimsy cotton, of a weak and very unequal staple, and having an intermixture of long fibres.

NEW ORLEANS COTTON.

This is a superior cotton to the upland, and has the preference on account of its clean, soft, and glossy appearance. It is rather short in the staple, but is even and strong, and is easily incorporated with other cottons of a longer staple. It is grown on the banks of the Mississippi and Red rivers, and is exported in very large quantities to the British and French markets, where it ranks in price and quality equally with the Brazil cotton. Upland, Alabama, and Tennessee rank next to New Orleans; they are soft, short, and weak in the staple.

CLEANING COTTON BY THE GIN.

Various methods of cleaning cotton have been adopted at different periods. In the West Indies, and on the Continent of America, what is called the roller gin has been long in use. It consists of a pair of fluted rollers, about five-eighths or three-fourths of an inch in diameter, and ten inches in length. These are fitted up in a frame, and made to revolve by the application of power: the cotton is passed between the rollers, and the seed separated from it; the diameter of the rollers being so small that the gins cannot be drawn in between them. This is but a slow operation, and therefore very expensive; it is consequently used only for the best qualities of cotton. The process of switching was tried, but disapproved of by the manufacturers, on account of its injurious effect upon the staple.

BOWED GEORGIA COTTON.

The cotton called "bowed Georgia," takes its name from a mode of cleaning which has been long in use. This operation was performed by the use of a bow-string, which, being raised by the hand, and suddenly released, struck upon the cotton with considerable force, and thereby served both to separate the gins and to open the cotton, so as to render it more fit for the processes which followed. But, whatever advantages this mode of cleaning may have possessed, so far as the quality was concerned, it has long since been abandoned for other and more rapid methods of cleaning.

THE SAW GIN.

What is now called "bowed Georgia," has, in reality, been cleaned for a long time by a machine denominated a saw-gin. This machine consists of a series of circular saws, forming a cylinder about the size of a weaver's beam; it has teeth cut out like a coarse saw, at equal distances from each other, from which it derives its name. The machine originally had wires like card teeth in place of these saws; but they were found to make what is called white naps upon the cotton, and the saws were substituted in their place. The saws pull the cotton through an iron grating, which has such narrow apertures, that the seeds or gins cannot pass through. The grating has a horizontal inclination, and the cotton is thrown upon it by the person attending the machine, when the teeth of the saws take hold of it, and pull it through the openings of the grate; the gins, being pressed out, roll down the surface of the grating, and escape by an opening in the side of the machine. The cotton is thrown backwards by the centripetal force of the cylinder, aided by a brush cylinder or roller, which also serves for cleaning the cotton from the saws.

Though this machine does little injury to cotton of a short staple, yet it is seldom used for the best Sea Island, or any other long-stapled cotton. It is remarkable, that when the Upland Georgia was first brought to the English market, it commanded a higher price, by about two pence per pound, when cleaned by the roller gin, than when cleaned by the saw gin; but, contrary to all expectation, the saw gin has been found to be superior to, and much better adapted for cleaning this species of cotton than the other gin, and the cotton cleaned by it is preferred by those who understand the process of spinning cotton. The saws separate the gins from the cotton more effectually than the rollers, and, at the same time, give it a kind of teasing which is found to be highly beneficial to its quality.

SOUTH AMERICAN COTTON.

Pernambuco cotton has a fine, long staple, is clean and pretty, of a uniform quality, and is much esteemed by carders and spinners. It is principally used for hosiery.

Maranham cotton is rather inferior to the Pernambuco, is not of such an even quality, nor so clean; it is very similar to good Demerara, and is used for the same purposes.

Bahia cotton is very much like the Maranham, and obtains the preference sometimes on account of being cleaner, and more even in the length of the staple.

Rio cotton.—This is a very inferior cotton, having a brown colour, and containing much shell; it is generally used for the same purposes as the low West Indian.

Surinam cotton has a long, fine staple; it is clean, has a yellowish colour, and is a superior cotton. It is used in the manufacture of hosiery.

Cayenne cotton has a fine, good, clean staple, and is preferable to the Surinam cotton; it is used for the same purposes.

Demerara cotton.—This cotton has deteriorated very much in quality since the colony has been in the possession of the English. The best has a fine, strong, silky staple, and is much esteemed: the inferior kinds are rather brown, dirty, and much mixed.

Berbice cotton.—The quality of this cotton has fallen off very much within the last few years. The best descriptions of it have a good staple, and are fine, silky, and clean; but latterly there is a great deal of it brown, dirty, and mixed.

Carthagena cotton has a very long staple; but it is weak, stringy, and rather dirty.

Giron cotton is of a brown colour, has a fair staple, and is generally pretty clean.

Cumana cotton is inferior to the Giron in its staple, and not so clean.

Caraccas cotton is also inferior to the Giron, and contains more dirt.

La Guayra cotton is not as good as the Cumana, but better than the Caraccas, and not so dirty.

WEST INDIA COTTON.

The cotton which comes from the numerous islands composing the West Indies, is of various qualities; but, in general, it is a strong, coarse article, irregular in the staple, and only adapted to the manufacture of the stouter fabrics of cloth, to which it is mostly applied. It is totally unfit for the manufacture of fine goods.

Amongst the various islands, the best cotton is raised in some of the Bahamas, Barbadoes, Hayti, Curacoa, Grenada, St. Vincent, Guadaloupe, and Tobago. In these islands, however, there is not so much cotton raised now as formerly;

the attention of the planters being now principally directed to the raising of sugar. In the year 1789, there was more cotton produced in San Domingo, now Hayti, than is now grown in the whole of the West Indies. The crop of that year amounted to 7,000,000 of pounds.

EAST INDIA COTTON.

Bourbon cotton is the most even and uniform in its quality of any of the different varieties, has a fine, silky staple, and is very clean. It is, with the exception of the Sea Island, the most valuable cotton brought into the market.

Surat cotton has a very fine, but exceedingly short staple. It is generally very dirty, containing leaves and sand. It is the lowest priced cotton in the market, and is used in the manufacture of coarse, low-priced goods.

Bengal cotton is very much like the Surat, but still shorter in the staple. It is generally cleaner, and sells for about the same price as the Surat.

Madras cotton.—There is not much imported from this place. It is mostly raised from Bourbon seed, and is sometimes not unlike it in staple. It is generally dirty, and contains much shell, which diminishes its value. It is worth but little more than the Surat, though some very good kinds will bring the price of West India.

In the years 1818 and 1819, when cotton rose to a very high price, being from thirty-one to thirty-four cents per pound, there were large quantities of East India cotton imported; but the machinery was not suited to such a short staple. Numbers of the English manufacturers now turned their attention to it, and had machinery made or altered to suit the short staple, with quite small rollers, so as to bring their centres closer together. If the machines are prepared for it, good No. 50 filling may be spun from Bengal and Surat cotton; but it is used principally for fustians, jeans, grandurells, and beaverteens.

TURKEY AND LEVANT COTTON.

The Smyrna, Cyprus, and Salonica cottons, are of a short, mossy character, and rather dirty. At one period it was the only cotton to be met with in the British market, with the exception of a few bags from the West Indies, which were occasionally imported. Although it has a soft, silky appearance, yet it is neither well suited to the endurance of the necessary operations of manufacturing into yarn, nor does it, when finished, make a strong, beautiful, or durable article. But a small quantity of it is now imported, which is chiefly used in making candle-wick; this description of cotton being more inflammable than any other.

EGYPTIAN COTTON.

The first importation of Egyptian cotton into the English market was made during the year 1823. Since that time, considerable quantities of it have been imported every year. It is a very superior cotton, of a yellowish colour, not so fine and silky as the Sea Island, and ranks next to it in price and quality. It is somewhat irregular in the staple, and prepared in a bungling, slovenly manner. No description of cotton loses less in carding, and it incorporates freely with cotton of a shorter staple, such as New Orleans, Upland, Maranham, Bahia, and others. The best and cleanest of the cotton is generally used by the manufacturers for spinning a superior quality of fine yarn.

PROPORTIONATE COMMERCIAL VALUE OF THE DIFFERENT KINDS OF COTTON.

In estimating the commercial value of the different kinds of cotton, they may be placed in the following order, viz. :— Best Sea Island, Egyptian, Bourbon, Pernambuco, Cayenne, Bahia, Maranham, Surinam, Demerara, Berbice, Bahama, Grenada, Curacoa, Barbadoes, and the West Indies generally; Giron, and the best Spanish; New Orleans, Upland, Tennessee, Alabama, Smyrna, Cyprus, Salonica, Jamaica, St. Kitts, and the inferior West Indies; Carthagena, Caraccas, and the inferior Spanish; Madras, Bengal, and Surat. The relative value of cotton in this series is tolerably permanent, and is here expressed with considerable accuracy: it is deduced from the average prices of the different kinds during a long period.

THE CULTIVATION OF COTTON

Is by no means a difficult operation. It is planted very much in the same manner as Indian corn, during the month of March, or in the early part of April, depending upon the northern or southern inclination of the land. It is kept free from weeds during the summer by constant ploughing and hoeing. When seen at a short distance, during the earlier stages of its growth, it has a great resemblance to what are termed bunch beans, growing in hills or rows. In autumn, the slaves pick the cotton out of the opening pods, and deposit what they collect along the rows, in baskets. This is a mode of separating the cotton from the husk or pod which contains it. When it is collected in the cotton house, it is then cleaned from the seeds by the operation of the gin, which is a simple process. It is next pressed into bales by a machine somewhat resembling a cider-press, and is then ready for market. A few good hands will cultivate several acres of cotton. From one to two bales, and sometimes three, are produced on an acre of ground, according to the quality of the land. The prices of cotton lands are various, and range from $10 or $20, to $30 per acre, and, sometimes, as high as $60, according to the quality of the land, its situation, and the character of the buildings and machinery upon it.

THE PRODUCTION OF COTTON

In America, was, from January, 1845, until December, 1849, a period of five years, 14,150,000 bales; during which period the consumption exceeded the product by nearly 700,000 bales; which amount was necessarily abstracted from the market, and contributed greatly to the present inflated prices of cotton. The cotton crop of the Southern States was much smaller in 1849 and in 1850, than it was in 1848; still, it sold for $30,000,000 more than that raised during the latter year. The small crops during the last two years have been the apparent cause of the present high prices; but it would be difficult to account for them on this ground alone. There is no doubt but that an increased demand for raw cotton is the chief agent in bringing about this result, which is very encouraging to the cotton growers, as there is a prospect of the present prices being sustained for a long period. The rapid increase of the cotton manufacture in England, which has now arrived at the enormous number of 17,000,000 spindles, overreaches the production of all other parts of the world so much, as to cause them to shrink into insignificance. England paid $71,984,616 to the United States, last year, for raw cotton; which sum is exclusive of that paid to other cotton-growing nations.

The magnitude of the cotton trade, and the dependence of England upon foreign nations for its supply of the raw material, has been a just cause of alarm to the manufacturers of Great Britain, who have repeatedly tried, and are at present trying to rid themselves of this state of dependence on other countries, but particularly on America, for their supply. All these experiments, however, have proved to be abortive; they will be so again, so far as cotton is concerned. Europe and England will have to depend upon America, and particularly upon the United States, for their supply of cotton, so long as they cannot cultivate and civilize the nations inhabiting those parts of the world where cotton will grow. It is not a particular kind of soil, nor is it a particular treatment, which makes the cultivation of cotton profitable; it is the union of a high degree of intellect and business qualities in the cotton planter, which contribute most to his prosperity. The blustering habits of the South Americans, the dishonesty of the Asiatic Indians, and the avarice of the African rulers, are a safeguard to the North American cotton planter.

Though our cotton and our cotton planters are so far safe against foreign competition; yet, it is perhaps possible that flax may be brought into successful competition with our staple. Very recently, the announcement was made in Manchester, England, that flax had been prepared in such a manner, as to enable it to be spun on cotton machinery. A similar announcement was made some fifteen or twenty years since, at which time it was considered ridiculous, to cut the long fibre of flax short, merely to suit it to the capacity of the throstle and mule. At present, the same thing has a different appearance; what was ridiculous twenty years ago, will now be grasped at with eagerness, if what it promises can be realized. Flax, in its natural state, with its long fibre, is hardly fit to be spun on machinery; at least, the process is too expensive; and, so far, nothing is to be feared from its competition with cotton. But, if the flax fibre can be shortened, without any injury to its texture and strength, there is a reasonable prospect of its becoming a successful rival to cotton. The announcement of the accomplishment of this operation may have a sensible effect on the cotton grower and cotton broker; but there is a possibility of the realisation of this object. The process upon which the shortening of the fibre of flax depends, is a chemical one; and, as the means of chemistry are inexhaustible, we are justified in believing in the possibility of the announced invention. If flax continues to be spun in its natural long staple, the cotton culture has nothing to fear from its competition.

From Hunt's Merchant's Magazine, December, 1850, we copy the following data, respecting the production of, and commerce in cotton. The average cotton crop of the United States is, 2,351,000 bales per annum. The combined exportation of all other countries on the globe, is but 440,000 bales. The bales of the United States are larger than those of other countries, which makes the relative yield still greater. Of the crop produced in the United States during the last year, (1850,) the ratio of the different States was as follows: Texas, 31,000 bales; New Orleans, 782,000 bales; Mobile, 351,000 bales; Florida, 181,000 bales; Georgia, 344,000 bales; South Carolina, 384,000 bales; other places, 24,000 bales.

THE CONSUMPTION OF COTTON

Shows some very remarkable facts, worthy of our attention. Our home consumption is at present 539,000 bales, that of England, 1,472,000 bales, and that of France, 363,000 bales;

the other European States together, consume about as much as France. England is, therefore, by far the largest consumer of raw cotton; she uses more than one-half of all the raw cotton brought into market. The amount of cotton goods used by all the people of Great Britain, and her dependencies, does not reach the amount of manufactured goods used in the United States: our home consumption is greater in quantity than that of all Europe.

A remarkable feature in the cotton trade is, that the consumption of raw cotton is greater than its production. The increase of manufactures has been much more rapid than the increase of cotton plantations, which is the natural cause of the advance in the prices of cotton; the manufacturers have been drawing on the surplus stock, and have diminished it considerably within the last five years. The average amount taken by the manufacturers, from 1840 to 1845, was 2,414,000 bales, showing a considerable increase during the latter period; the supply in these respective periods was, 2,561,000 bales, and 2,791,000 bales. The surplus stock of cotton in Europe, in 1844, was 1,101,000 bales; at the end of the year 1849, it was only 646,000 bales.

The above facts show that the advance in cotton is natural, and not the result of a speculative movement: there is no prospect of a decline in prices, and our manufacturers may as well make up their minds to move on slowly, until the stock of goods in the market is so much reduced as to command higher prices. If the crops of the next and the following year are more than average crops, of which there is no present prospect, it would not materially lower the price of cotton. England is, in this respect, in a worse predicament than the United States, for bulky goods, which are remunerating, she cannot manufacture; these will be left entirely to home production, in the manufacture of which the Southern States will take a prominent part.

The conditions under which cotton plantations laboured during the period of their over-production, which so much reduced the price of raw cotton, as to make cotton planting unprofitable, may be considered as the cause of the rapid growth of the cotton factories in the vicinity of the cotton plantations. The present higher value of raw cotton has removed that cause; and, as the culture of cotton is more profitable than the spinning of it, the capital which would otherwise flow into the factories, will be invested in the extension of plantations. The cotton growing and thinly populated States cannot produce the finer descriptions of goods, for want of the means and skill; these productions can never be taken from the Eastern States; and the sooner the manufacturers of the New England States, and the States along the Atlantic coast, confine themselves to the production of fine goods, the better it will be for their interests. England will use all her endeavours to increase the cultivation of cotton in India, and particularly in Egypt, in order to keep down the price of the raw material. But we have nothing to fear from these quarters. The only competition which threatens to be dangerous to our cotton, is from the use of flax; if the English manufacturers succeed in working it cheaply on their cotton machinery, there is no doubt that we shall have to use most of the cotton ourselves; for, not only England, but also the whole European continent, will prefer the use of linen goods to those made of cotton. This will, of course, deprive our cotton planters of an extensive market for the produce of their plantations.

The expenses of the Eastern mills for coarse goods, such as common heavy sheetings, may be estimated as follows:—

Middling fair cotton, per pound....	13.50 cents.
Waste	1.48 "
Labour........................	3.80 "
General expenses	2.08 "
2.80 yards are one pound; this, divided in	20.86=7.45 cts.

A yard of these sheetings, therefore, costs nearly 7½ cents. If, on such heavy goods, freight and commission from and to the Southern States can be saved, it will be sufficient to pay reasonable profits.

The foregoing considerations do not tend, in the smallest degree, to depreciate the value of our cotton interest. If Europe does not choose to buy a pound of our raw cotton, we can and will be prepared to work it all ourselves, and Europe will be compelled to buy our manufactured cotton. All we need is, the fostering care of beneficial enactments, to bring our manufactures to a high state of cultivation. We need only means and artistical skill, to enable us to compete in any European or other market, with any other nation, notwithstanding the apparent disadvantage arising from the higher wages which our operatives enjoy, comparatively with those of other parts of the world. The inexhaustible mineral resources of the country will furnish abundant means for investments, and the skill of our mechanics is proverbially superior to any others. Let us cultivate the production of metals, and furnish a liberal education to all, and we may safely challenge the world to a competition with our cheap manufactures.

Cotton, above all other products, is our natural source of wealth, and will prove to be a more potent agent in promoting our welfare, than it will be to any other nation: it is our natural force, and must finally defy all the artificial exertions of our neighbours. We are only beginning to manufacture; but our expanding markets, pacific and serene government, light taxes, abundant food, cheap materials in all respects, genial climate, and, above all, the untiring progress of our artisans, are all combining to make us the chief cotton manufacturers of the world. We now control the market in raw cotton, and it will not be many years before we shall also control the market in manufactured cottons. The argument of cheap labour, so often alluded to by short-sighted economists, is inadmissible in our case; if historical evidences to the contrary could be applied, they would show conclusively that success must follow our contest for the supremacy. But we need no historical facts to prove our advantageous position. The European States are the only competitors which the United States has to fear in a contest of this nature. We have already gained on the cotton manufactures of England in a ratio that is sufficient to prove the truth of our assertion. In the year 1830, the consumption of raw cotton in this country was 19 per cent. of that of Great Britain; now, it is 37 per cent. Our manufactories advanced during that period 325 per cent., while those of England only advanced 125 per cent. The next period of twenty years will show this more conclusively than the past. France has been, for some time, and is now, stationary; the amount of cotton goods she now produces, is actually less than it was five years since. The cotton manufactures of the other European States have improved, but by a slow progress; and the amount of cotton used is so small, that we are justified in neglecting their rivalry.

If we consider the natural, social, and political positions of those nations which are, or may possibly become competitors with our cotton manufacturers, there are overwhelming advantages in our favour. In our natural relative position to our staple, we have a decided advantage; men and money are easily moved. If cotton cannot be manufactured cheap enough in the Northern or Eastern States, there will be no difficulty in removing that branch of industrial art to the Western or Southern States. We can, for home consumption at least, move all the materials for manufacturing, more easily than England and the European States can move the cotton and all materials necessary for manufacturing, food for operatives, &c. Our peaceful social condition, in giving scope to the full development of the human faculties, is very congenial to the perfection of industrial pursuits; while, on the other hand, the troubled condition of European society is not likely to afford that rest and peace of mind necessary to the free operations of the intellect. Recent political disturbances have demonstrated that the state of European society is such, that it cannot be restored to a peaceful condition for some time to come. Our political institutions are still more beneficial to the manufacturer than even our natural and social condition. Our merchants are not hampered by a government whose aim is political superiority, and our mercantile operations are not impeded by military enactments and arbitrary legislation.

We possess every element that enters into the manufacture of cotton fabrics. We have iron in superabundance, and of such a quality as to defy all competition; we have mineral coal, in such quantities and at such prices, as must appear fabulous to the inhabitants of other parts of the world; and we have a sufficiency of gold, copper, and other metals, to supply the wants of all nations. Our natural and unrestricted highways afford means of communication not equally enjoyed elsewhere; our climate is highly favourable to life and labour; and, above all, we have food enough to supply the whole human race, if needed, and a free, honest, and hospitable population, with hearts open to all mankind, heads which comprehend, and an untiring energy, which shrinks before no difficulty.

THE END.

STEREOTYPED BY J. FAGAN.........PRINTED BY T. K. & P. G. COLLINS.