Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year postage included.................................... $3 20
One copy, six months postage included 1 60

Clubs.—One extra copy of THE SCIENTIFIC AMERICAN will be supplied gratis for every club of five subscribers at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

Remit by postal order. Address

MUNN & CO., 361 Broadway, corner of Franklin street, New York.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, postage paid, to subscribers. Single copies, 10 cents. Sold by all news dealers throughout the country.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year postage free, on receipt of *seven dollars*. Both papers to one address or different addresses as desired.

The safest way to remit is by draft, postal order, or registered letter.

Address MUNN & CO., 361 Broadway, corner of Franklin street, New York.

Scientific American Export Edition.

The SCIENTIFIC AMERICAN Export Edition is a large and splendid periodical, issued once a month. Each number contains about one hundred large quarto pages, profusely illustrated, embracing: (1.) Most of the plates and pages of the four preceding weekly issues of the SCIENTIFIC AMERICAN, with its splendid engravings and valuable information; (2.) Commercial, trade, and manufacturing announcements of leading houses. Terms for Export Edition, $5.00 a year, sent prepaid to any part of the world. Single copies 50 cents. ☞ Manufacturers and others who desire to secure foreign trade may have large, and handsomely displayed announcements published in this edition at a very moderate cost.

The SCIENTIFIC AMERICAN Export Edition has a large guaranteed circulation in all commercial places throughout the world. Address MUNN & CO., 361 Broadway, corner of Franklin street, New York

NEW YORK, SATURDAY, DECEMBER 13, 1884.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 467,

For the Week ending December 13, 1884.

Price 10 cents. For sale by all newsdealers.

BELT MATERIAL.

The first idea of a belt for machine purposes is a leather band, but other materials have been used for many years; the writer remembers seeing a six inch or an eight inch belt that had run for more than a year in a wood working establishment, which was made of cotton cloth—sail duck. The belt connected two pulleys of three feet and two feet diameter respectively, the shafts of which were on the same level. To compensate for the shortening and lengthening of the belt by the changes in humidity of the atmosphere, a pivoted idler was used. This change of length appeared to be the only serious drawback to the employment of cotton as belt material; for the adhesion of the material to the face of the pulley was excellent.

Rubber belting is simply cloth and rubber united by being pressed between heavy rollers; its strength depends on the fibrous portion—the cloth. There has recently been another cloth belt put upon the market, that depends for its adhesiveness to the pulley face on cotton. This a woven belt, the woof or warp of which is of a series of continuous steel wires, the filling being coarse cotton yarn or twine. No preparation is given the cotton, either before or after the weaving, and the "shed" in weaving is so arranged that the steel wires, on which the strength of the belt depends, are entirely covered. One of these belts has been noticed by the writer for more than two years—a twelve inch belt leading from the fly wheel of an engine—and it shows no sign of destructive wear yet, and has absolutely no stretch. From these examples it would appear that under some circumstances (those of a dry atmosphere, equable temperature, and an unshipable belt), cotton might prove to be an excellent substitute for leather for belting purposes.

There appears to be only one sort of leather that is properly applicable to belt making—that from the skin of the ox or *Bos* tribe. During a residence of several years in one of the British American provinces, the writer was compelled by circumstances to make his own belts, of such material as could be obtained. Moose hide leather was tried, but it had a quality of indefinite stretch; to obtain a six inch wide belt, strips not less than ten inches wide were required, and these were wetted and stretched by powerful winches for several days before they were fit to cut to width. The leather was very thin for the width of belt, but it was wonderfully tenacious and adhesive. Raw hide (untanned skin) will do fairly well as a belt if kept soft by oil, but it lacks the hug of leather, and has little elasticity.

Ox leather belts stand at the head of those of all other materials for the satisfaction of all demands on belts. No other belts will stand the wear of the shipper; cotton belts are weakened when wet; rubber belts are rotted when oiled, but leather will stand wet and dryness, cold and heat, and lasts a long time even when oil saturated.

GOLD LEAF.

If a sheet of gold leaf is held up against the light, it appears to be of a vivid dark green color; this means that the light is transmitted through the leaf. When it is considered that this leaf is a piece of solid metal, a better idea of the extreme tenuity of thickness of the leaf can be comprehended than by any comparison by figures; nothing made by the hand of man equals it in thinness. This extreme thinness is produced by patient hammering, the hammers weighing from seven to twenty pounds, the lighter hammers being first used. When the true method of this beating is understood, the wonder expressed sometimes that gold leaf beating should not be relegated to machinery ceases; the art belongs to the highest department of human skill and judgment. Apprentices have served a term, and have been compelled to abandon the business, because they never could acquire the requisite skill and judgment combined necessary to become successful workmen.

The only pure gold leaf is that used by dentists for filling carious teeth, and it is called foil. It is left much thicker than the gold leaf for gilding—indeed, it could not be beaten so thin; for thin or leaf gold an alloy of silver and copper is required to impart the requisite tenacity. Dentist's foil weighs six grains, five, four, and three grains per sheet, or leaf, according to its thickness. The last operation on the leaf is annealing. This is done over a charcoal fire, the leaf being laid singly in a sort of corn popper—a square receptacle with wire bottom at the end of a handle—over which is held a similar cover to prevent the flame from carrying the leaf away. An instant's exposure to the flame induces a red heat, when the leaf is laid on a sheet of a book.

The material for gold leaf and dentist's foil is coin gold. The gold is precipitated by muriatic and nitric acids over a fire to separate the gold and silver, the copper of the alloy passing off in the heat. The silver from gold coin amounts to about seven pennyweights to $800 worth of coin—the amount usually treated at a time. This reduction and separation of the metals is the usual method, and does not require special description.

The pure gold is then melted in sand crucibles with the proper proportions of silver and copper to produce the color of leaf desired, very fine ornamental effects being produced in gilding with leaf of differing shades. The fluid metal is poured into iron moulds, making bars seven inches long, one and an eighth inches wide, and one-fourth of an inch thick. These bars are forged, like iron, between anvil and hammer, to even the edges, and then rolled in powerfully geared rolls to a ribbon not thicker than writing paper and one inch wide. Of course, in the rolling as in all the processes, there must be occasional annealings.

Now comes the first of the beating processes. These squares of gold (one inch square) are placed in a pile alternating with larger squares (four inches or more) of "kutch" paper, a material made from a pulp of animal membrane—raw hide, intestines, etc.—and the outside of the pile receives a square of parchment. The hammering then begins with a seven pound hammer on a block of marble that rests on a solid foundation. After one hour's beating the pile is warmed at a fire to anneal the gold, a process requiring care, so that the kutch paper be not burned. Four hours of beating suffices for this preliminary process, 180 squares of gold being treated in one pile. The final process requires great skill. The partially beaten squares are packed as before, but with alternates of gold beater's skin, until the pile contains 900 sheets. The beating is continued with increasingly heavier hammers until the final finish with the twenty pound hammer. The gold beater's skin comes from England, and the best of it—and the most of it—is made by one family—Frederick Perkins. The skin is so thin as to be almost transparent, and yet it is double, two thicknesses. It is prepared from the larger intestine of the ox. Each sheet of the skin is rubbed on each side, before the pack is made and whenever the pack is rearranged (placing the outer gold in the center and *vice versa*), with a powder made from calcined gypsum of a very pure sort, imported from Germany. This is to prevent the gold from sticking to the skin.

In beating, the work of spreading the gold is from the center of each square of gold out toward the edges, and the finished squares are thicker at the edges than in the center. A contrary spreading would split the edges and ruin the squares. In rearranging the squares in the process of beating they are sometimes torn, but another piece laid on as a patch, lapping over the torn place, will be firmly welded in the after beating.

The finished squares are cut to a size of three and three-eighths inches, and packed in a "book" holding twenty-five sheets, the paper leaves being rubbed with red ocher to prevent sticking. These books of twenty-five sheets are sold at from thirty to forty cents each. The cutting of the leaf is done by knives, which are simply slips of the outer shiny shell or skin of the Malacca cane such as is used for walking sticks. The outer rind contains silex or flint in minute, invisible particles, forming a peculiar edge. Steel will not answer the purpose.

CRIMINAL IGNORANCE.

The October number of *The Locomotive* has an editorial article on the foolish carelessness of engineers of stationary engines that ought to be generally read, because it tells the truth where subterfuge and pretense has sometimes blinded judgment. Engineers are not, as a class, pretenders and cheats; but there are many who pretend to know their business who are simply and only swindlers; who do not know the manual of their business even, and never thought of knowing its chemical and mechanical reality.

The Locomotive says:

The carelessness sometimes displayed by engineers (?) who have charge of boilers is simply criminal, and deserves the severest penalties. A recent occurrence will illustrate this. Visiting an establishment where we had boilers insured, our attention was attracted by the suspicious actions of the engineer. Watching for what he supposed was a favorable opportunity, he climbed up on top of the boilers and headed toward the safety valve, always keeping as nearly between it and us as he could, but not, however, succeeding in always keeping from view. Reaching the valve he busied himself a few moments about it, and then returned with a nonchalant air to where we were. The following conversation then occurred:

Inspector: "Tired of living, are you?"
Engineer: "No; what do you mean?"
Inspector: "I thought perhaps you were."
Engineer: "What makes you think so?"
Inspector: "Why, from the use you make of that wedge you now have in your overalls pocket. I see that you had the safety valve fastened down with it. Now, if you want to die, why don't you go out and jump into the river, and drown yourself; then nobody's life but your own would be endangered?"
Engineer: "Those boilers are all right. I don't believe a boiler can blow up so long as there is plenty of water in it. I have been running boilers twenty years." And so on to the end of the chapter.

This fellow had actually made an iron wedge, and driven it into the forked guide above the lever, so that it was impossible for the valve to lift, in order to "bottle up the steam," as he expressed it. And this in spite of the fact that the pressure was all that could be safely allowed; and he had also moved the weight out on the lever fifteen pounds beyond the limit allowed. This is an actual occurrence.

PULLEYS AND GEARS.

In American practice, pulleys have led gears for more than thirty years. There was a time when no large establishment driven by power could be arranged to run except by gearing; all the main shafting was geared to the prime mover, and if that was a steam engine a jack wheel instead of a belt imparted motion from the fly wheel or crank shaft. The writer remembers a set of cards in a cotton mill; the cylinders, licker-ins, doffers, and even the doffer combs, were all connected by gear wheels. Years after the grinding, wearing, noisy main gears were superseded here by the smoothly running pulleys and belts, the English adhered to the toothed wheel system. It had its value; it has its advantages, and the gear wheel is taking its place as a valuable adjunct to machinery of all kinds. One of these advantages is its absolute security; "give a tooth take a tooth" is an old adage in mechanics, and is an absolute law in gear-