FULLING, the art or act of cleansing, scouring, and
preparing cloths, stuffs, and fletchings, to render them stronger,
closer, and firmer; called also milling. See BLEACHING.

Pliny, lib. vii. cap. 56, assures us, that one Nicias, the
son of Hermias, was the first inventor of the art of fulling:
and it appears by an inscription quoted by Sir G. Wheeler,
in his travels through Greece, that this same Nicias was a
 governor in Greece in the time of the Romans.

The fulling of cloths, and other stuffs, is performed by
a kind of water-mill; thence called a fulling or scouring-mill.

These mills, excepting in what relates to the mill-tones
and hopper, are much the same with corn-mills. And there
are even some which serve indifferently for both purposes;
corn being ground, and cloths fulled, by the motion of the
same wheel.

Hence in some places, particularly France, the fullers
are called millers; as grinding corn, and milling stuffs, at
the same time.

FULLING MILL, in the Manufactures, is a machine em-
ployed for washing, scouring, or fulling of cloth, either
with a view of cleaning it, in which case it is termed scour-
ing, or for the purpose of thickening woollen cloth, worsteds,
&c., when it is termed milling; in either case the fulling-
mill employed is the same; its operation is to constantly
agitate and expose a new surface to the action of water or
other menstrua, with which the goods to be operated upon
are constantly supplied; this is performed by two beaters
or mallets, which are successively raised by the action of
a water-mill, or steam-engine, and let fall upon the cloth,
which they strike and turn over in the trough where it is
placed; a continual stream of water passing through it,
carries away the dirt and impurities which are loosened
from the cloths by the agitation of the mallets, or mallets,
as they are termed.

An inspection of Plate XXIX. Mechanics, will give a
clearer idea of the construction of this machine. Here fig. 4.
is a perspective view of a pair of stuffs, or fulling-mills, in
the action of scouring a piece of goods; the other figures are
explanations of the parts of the machine by a section,
fig. 5, and elevation, fig. 6. A fulling-mill generally con-
tains four, six, eight, or ten pair of stuffs, according to
the quantity of work it is required to perform; these are all
moved by the same water-wheel, or steam-engine; in the
former case, the axis of the water-wheel is employed to move
two or three pair, whilst the others receive their motion
from one of two similar and parallel shafts, turned by cog-
wheels from the shaft of the water-wheel. A portion
of this shaft is represented at A in the plate, beneath the
floor of the mill; and the cog, which gives it motion, is
denoted by N, fig. 4; it revolves upon gudgeons at its ends, which
are supported on brackets resting on the frame work or ma-
lonary, as shown in fig. 6. Four levers or liftsers, B, B, D, D,
are fixed upon the shaft which alternately, as they pass the
beaters E and F, lift them up, and they descend by their
own gravity: these beaters are formed from a large block
of wood E and F, affixed to a long stem G, moving on a
centre at g, which is supported at the top of the frame H K
of the whole machine; the principal part of this is a large
block of wood H I, hollowed out into a large cavity a a,
for the reception of the cloth; this is termed the trough.
K are pieces of wood fixed to the piece H I, and curved to
a segment of a circle struck from the centre g, on which the
beaters move; in the spaces between these beams the stems G
of the beaters project so as to be intercepted by the liftsers
B, D, as they revolve; the beaters are also curved at the
lowest side to the same circle as the beams K, so that
they apply as close as possible to each other without touch-
ing; this is necessary to prevent the cloth getting between
them, and being pinched or cut thereby. The ends of the
beaters, which act upon the cloth, are armed with thin small
boards at i, i, and k, fig. 5, which project like teeth, and act
more effectually to bend and disturb every portion of the
cloth placed in the trough a a. The beaters act very close to
each other sideways, so that the cloth may not introduce itself
between them; and in the manner they fit the sides of
the trough, formed by boards nailed to the block H I, and
the beams K, which also give a great strength to the machine.
At one side these boards are not so high, for the con-
venience of taking the cloth out of the trough; but when
the machine is in action a moveable board M, fig. 4, is placed
on the top of the lowest side, to raise it to the fame height
with the other, and prevent any danger of the cloth getting
over. R is a pipe bringing water to the trough, and fur-
nished with a slip cock to regulate the supply; the pipe passes
through the back of the block H I, and the water striking
against a board s, placed before the aperture, it falls down
in a sheet upon the cloth, and keeps it constantly saturated.
When the cloth is to be put into the machine, a workman
with a lever supported on an iron hook k receives the beater
when at the highest point of its motion, and prevents its
defect; he then thrusts a long iron bolt r, fig. 6, through
a hole in the beams K, and by that means retains it; the
other beater is then taken up in the same manner, and re-
tained.
tained by the same bolt, being pulled farther forwards; the
loose board M is now removed, and the cloth thrown into
the trough a; the beaters are then set in motion by re-
moving the bolt r, which held them up. As the shaft A re-
volves, the lifters alternate engage one or other of the
beaters which falls against the cloth, and, striking it at the
under side, thrusts it up into the curved part of the trough a,
and by that means it falls down upon the head of the beater;
when the lifter raises the beater another time, the cloth falls
into the space left by its being raised; in this manner it con-
tinues turning the cloth over in the trough, and striking it
by its teeth b, i, k, I, so as to wash it thoroughly. As the two
beaters fall alternately, that is, one is up when the other is
down, the cloth is also turned round diagonally in the trough:
by this means, after milling a piece of cloth for some hours,
there is little chance but that every part shall be subjected to
the action of the beaters, though a whole piece is in action
at once, and consequently folded in innumerable creases.
The water which enters at the upper end of the trough be-
neath the loose board x, (which is intended to spread the
water out into a thin sheet, that it may fall equally upon
the whole of the cloth,) escapes slowly through the grooves
between the beam K, in which the items M move, carrying
with it all the filth contained in the cloth; it falls into a pit repre-
fenting H 1, in the dark space in fig. 5, and 6, in which the shaft
revolves. This pit usually has a communication with the
water of the mill, to wash away the sediment which accumu-
lates in the pit, from the foul water continually falling into it.
The machine is fixed over this pit by a tenant at the lower
part of the block H L, which is bolted between two beams
L, L, supported on masonry; M are two braces to sustain
the ends of the beams K, and keep the whole machine
firmly in the same position; the beams L, L, are extended to
a considerable length, and have three or four machines
placed parallel to each other between them.

The true method of fulling with soap is delivered by
Monseigneur Colmet in an authentic memoir on that subject,
supported by experiments made by order of the marquis de
Louvois, then superintendent of the arts and manufactories
of France. The substance of which we shall here subjoin.

**FULLING, Cloth and woolen Stuff, with Soap, Method of.**
A coloured piece of cloth, about forty-five ells, is to be laid
in the usual manner, in the trough of a fulling-mill, without
first soaking it in water, as is commonly practised in many
places.

To fill this trough of cloth, fifteen pounds of soap are
required; one half of which is to be diffused in two pails of
river or spring-water, made hot as the hand can well bear
it. This solution is to be poured by little and little upon the
cloth, in proportion as it is laid in the trough; and thus it
is to be filled for at least two hours; after which it is to
be taken out, and stretched.

This done, the cloth is immediately returned into the
same trough, without any fresh soap; and there filled two
hours more. Then taking it out, they wring it well, to ex-
press all the grease and filth.

After the second fulling, the remainder of the soap is
melted, as the former, and cast, at four different times, on
the cloth; remembering to take out the cloth every two
hours, to stretch it, and undo the plaits and wrinkles which
it has acquired in the trough. When they perceive it suffi-
ciently filled, and brought to the quality and thickness re-
quired, they scour it out for the laud time in hot water, keep-
ing it in the trough till it be quite clean.

As to white cloths; because these full more easily, and in

F U L L I N G.

left time, than coloured ones, a third part of the soap may be
spared.

**FULLING of Stockings, Caps, &c.** may be performed some-
what differently; viz. either with the feet or the hands;
on a kind of rack, or wooden machine, either armed with
teeth of the same matter, or else with horns or bullocks'
heels.

The ingredients made use of herein are urine, green soap,
white soap, and fuller's-earth. But water softened with chalk
is far preferable.

Note, woven flockings, &c. should be full with soap alone;
for those that are knitted, fuller's-earth may be used with
the soap.

Indeed, it is frequent to full these kinds of works with the
mill, after the usual manner of cloths, &c. But that is
too coarse and violent a manner, and is apt to damage the
work, unless it be very strong.

**FULLING, in the Manufacture of Hats,** is the completion of
felting (which see), and has for its objects the intimate
connection of the fibres, and a more perfect and durable
cohesion of the whole mass. For this purpose the mere
mechanical act of fulling is insufficient. In this way the
result would be a formless mass, without cohesiveness.
Experience (says Chauffier, cited in Nichollum's Journal,
Th. 1.) has long shown, that for the fulling it is necessary
to make use of a bath of water heated nearly to ebullition,
into which are put 10 or 15 pounds of lees of wine, for
each hundred pounds of water. The heat is kept up
during the whole time of working, and every three or four
hours a new quantity of lees is added. Into this bath the
workmen plunge their feet, and begin their second procees.
The felt is dipped in, and immediately again taken out
and squeezed, bended and rolled, by pressure in different direc-
tions, sometimes with the hand defended by leather, and
sometimes by means of a roller or other similar instrument.
The immersion and working of the felt are repeated, and the
operation continued, till the stuff is well condensed, and has
acquired the requisite solidify.

Since the operation of fulling is employed to form a
dense and compact stuff with the fibres or hairs, and to
determine the intimate cohesion of its component parts;
and since the mere mechanical operation is not sufficient for
this purpose, even with the assistance of a water-bath at the
boiling heat, without the addition of lees as a necessary con-
dition;—this stuff must be considered as a chemical solvent,
which acts directly on the substance of the hairs themselves,
and produces, either by softening or swelling them, an
alteration necessary to infuse the cohesion of the different
fibres of the stuff. But the lees being composed of the
mucilaginous and colouring parts, which are separated, to-
gether with a great quantity of tartar, or the acellular
tartar of pot-ash, it became necessary to ascertain, in a
positive manner, what might be the principle of its action.
The editor of the Encyclopédie affirms without hesitation,
that it is the alkali or pot-ash of the lees which determines
the fulling. But in order to shew (says Mr. C.) how
eronous this assertion is, nothing more is necessary than to
dip a piece of blue paper into the bath, by which the former
becomes infinitely red; and if, after several hours' work,
the state of the bath be again examined, it is found that the
acellular tartar of pot-ash is partly exhausted, and the
workmen soon perceive, from the difficulty of continuing
their work, that a new quantity is required to be added.
And again, if we consider the sparing solubility of the aci-
cellular tartar of pot-ash in cold water, it is easily seen why
in this process the water must be kept nearly boiling.
it is evident that it must act by the portion of acidate which it contains. Hence our author was induced to think, that the sulphuric acid might be advantageously substituted in the place of the lees; and as 12 pounds of lees are usually added to 100 of water, he estimated by approximation that one gross of sulphuric acid would be equivalent to at least one pound of the lees, and consequently that 12 gros of sulphuric acid would be sufficient for 100 pounds of water. His conjectures were soon confirmed by experiment; and after a fair trial it was ascertained that the use of the sulphuric acid is much preferable to that of wine-lees; that it is not only much more economical, but still more convenient in the use; and, what is yet more important, the health of the workmen is not injured by the excels and duration of the heat, the thick vapours, and the disgusting odour, which exhales from the bath, particularly when the lees have been altered by mouldiness and putrefaction, which is very common in these manufactories. When the sulphuric acid is employed, it is useless to keep the bath nearly boiling, as was formerly done. A degree of heat of 25 or 30 degrees (97° or 100° of Fahrenheit) is sufficient for good felting. The saving of fuel is an object of importance in manufactories; and as very little fire is necessary when sulphuric acid is used, cauldrons of lead may be substituted instead of copper-boilers, the first cost and annual repair of which are very considerable.

The felts prepared by this new process are also of a very superior quality to those which have been worked in the bath with wine-lees. In fact, the mucilaginous and colouring matters of the lees, which are suspended in the bath, penetrate the texture of the fluff, and adhere with more or less force; and when, after having passed the hats through the dye, they are beaten, a fine black dust flies off in great abundance, which not only weakens the texture of the felt, but by diffusing itself through the manufactury greatly incommodates the workmen, and frequently occasions coughs and disorders of the throat.

Hats felted in this manner, says a manufacturer who had adopted this process, are not only clear of the powder which abounds in the others, but they take the dye better, and are cleaner.
MECHANICS.

FRICITION AND FULLING MILL.

Note, those Stocks are for scouring; for Milling cloth the trough a a is differently formed. - see Woolen.

Published as the Act directs, 1850, by Longman, Hurst, Rees, Orme & Brown, Paternoster Row.

Lowry & Co.