Sutro tunnel was completed the water had to be
pumped to the surface, a distance in some cases
of 3,000 feet. The pump rod is balanced every
two hundred feet by balance bobs loaded with
railway iron, which take all the weight of the
rod off the engine. E. C. H.

How Bicycles are Made at Hartford.

One of the interesting places visited by the
Sigma Mu Epsilon Society on their trip last winter
was the Weed Sewing-Machine Works, at Hartford, Conn. The company long ago acquired a
reputation for sewing-machines and metallic
screws, but recently the buildings have been en-
larged until they cover five acres, and a new
interest has centred in the largest bicycle fac-
tory in the world, which it has become under
the auspices of the Pope Manufacturing Com-
pany.

The "Columbia," constructed after the Eng-
lish model of the "Duplex Excelsior," was the
first machine turned out four years ago, and at
once met with success. In 1880 the lighter
"Special Columbia" appeared, and now the new
"Expert" presents still further improvements,
especially in the front wheel and its driving
mechanism.

Perhaps the most interesting department of
the works is the forge-shop, since so many
parts of the bicycle are drop-forgings, made of
different qualities of steel to resist the different
strains of bending or breaking to which they
may be subjected. There are a dozen drop-
forges besides power hammers of different sizes.
In England the anvil is still used; but here the
wheel flanges of soft steel, as well as the cranks,
head, handle bar, and all other forgings, are
made in steel dies, some of which are very large
and costly. For instance, in the forging of the
open head, four or five sets of dies are used, one
of which costs $500. These forges and dies are
said to be the largest in the country. By this
means the forgings have a fine finish and homo-
geney of metal is secured. The backbone and
forks are drawn from weldless steel tube in the
"Expert," the former having a circular and the
latter an elliptical section. Experience has
shown that these forms are most rigid and best
calculated to resist lateral and torsional strains.
In another room the forks are welded to the
arms extending downward from the head; and
the rear forks are also welded in like manner.
The rims of the wheels are forged with rollers
and welded with dies U-shaped so as to hold the
tire firmly.

Passing on, we saw the turning and milling of
the cylindrical parts, to which afterwards emery
wheels impart the polish. Our attention was
called to the steering head of the "Expert." After
the invention of the centre-steering open
head came the cylindrical head with conical
bearings, and finally, in this new machine this
is still further improved by making the spindle
longer and the bearings hemispherical. The
accuracy and sphericity of the balls for the
"Columbia" ball bearing are insured by grinding
them, after case-hardening, in grooves between
two horizontal disks, one of which is driven by
power. In the wheel-room, the wheels are set
up and trued by tightening or loosening the
spokes. The latest improvement here is the
using of three sizes of wire for the spokes,
which are "direct acting" and are "upset" in
the flanges. The machine for drilling the holes
in the latter at the proper angle is ingenious.
The rubber tires are made in moulds and are
baked after being stretched and cemented on
the rims.

In the assembly-room the wheels, forks, and
backbones are put together and marked. Then
the various parts are inspected and tested and
all imperfect pieces rejected. They next go to
the painting or nickelling rooms, according as
the machine is to be painted or plated. If the
former, they receive several coats and stripes
and are left for a considerable time in the dry-
ing-room. The pieces to be nickelled are first
cleaned and coated with copper, and then a thick
plate of nickel is deposited by the electricity
during an hour. The tank can receive the
largest rims as well as the smallest nuts. Fi-
ally, the completed machines pass to the store-