

## Reading 1

Here's a story about the legendary Paul Bunyan that shows how the Möbius strip has some "practical" applications.

### Paul Bunyan versus the Conveyor Belt

by William Hazlett Upson

One of Paul Bunyan's most brilliant successes came about not because of brilliant thinking, but because of Paul's caution and carefulness. This was the famous affair of the conveyor belt.

Paul and his mechanic, Ford Fordsen, had started to work a uranium mine in Colorado. The ore was brought out on an endless belt which ran half a mile going into the mine and another half mile coming out—giving it a total length of one mile. It was four feet wide. It ran on a series of rollers, and was driven by a pulley mounted on the transmission of Paul's big blue truck "Babe". The manufacturers of the belt had made it all in one piece, without any splice or lacing, and they had put a half-twist in the return part so that the wear would be the same on both sides.

After several months' operation, the mine gallery had become twice as long, but the amount of material coming out was less. Paul decided he needed a belt twice as long and half as wide. He told Ford Fordsen to take his chain saw and cut the belt in two lengthwise.

"That will give us two belts," said Ford Fordsen. "We'll have to cut them in two crosswise and splice them together. That means I'll have to go to town and buy the materials for two splices."

"No," said Paul. "This belt has a half-twist—which makes it what is known in geometry as a Möebius strip."

"What difference does that make?" asked Ford Fordsen.

"A Möebius strip," said Paul Bunyan, "has only one side, and one edge, and if we cut it in two lengthwise, it will still be in one piece. We'll have one belt twice as long and half as wide."

"How can you cut something in two and have it still in one piece?" asked Ford Fordsen.

Paul was modest. He was never opinionated. "Let's try this thing out," he said.

They went into Paul's office. Paul took a strip of gummed paper about two inches wide and a yard long. He laid it on his desk with the gummed side up. He lifted the two ends and brought them together in front of him with the gummed sides down. Then he turned one of the ends over, licked it, slid it under the other end, and stuck the two gummed sides together. He had made himself an endless paper belt with a half-twist in it just like the big belt on the conveyor.

"This", said Paul, "is a Moebius strip. It will perform just the way I said—I hope."

Paul took a pair of scissors, dug the point in the centre of the paper and cut the paper strip in two lengthwise. And when he had finished—sure enough—he had one strip twice as long, half as wide, and with a double twist in it.

Ford Fordsen was convinced. He went out and started cutting the big belt in two. And, at this point, a man called Loud Mouth Johnson arrived to see how Paul's enterprise was coming along, and to offer any destructive criticism that might occur to him. Loud Mouth Johnson, being Public Blow-Hard Number One, found plenty to find fault with.

"If you cut that belt in two lengthwise, you will end up with two belts, each the same length as the original belt, but only half as wide."

“No,” said Ford Fordsen, “this is a very special belt known as a Möebius strip. If I cut it in two lengthwise, I will end up with one belt twice as long and half as wide.”

“Want to bet?” said Loud Mouth Johnson. “Sure,” said Ford Fordsen.

They bet a thousand dollars. And, of course, Ford Fordsen won. Loud Mouth Johnson was so astounded that he slunk off and stayed away for six months. When he finally came back he found Paul Bunyan just starting to cut the belt in two lengthwise for the second time.

“What’s the idea?” asked Loud Mouth Johnson.

Paul Bunyan said, “The tunnel has progressed much farther and the material coming out is not as bulky as it was. So I am lengthening the belt again and making it narrower.”

“Where is Ford Fordsen?”

Paul Bunyan said, “I have sent him to town to get some materials to splice the belt. When I get through cutting it in two lengthwise I will have two belts of the same length but only half the width of this one. So I will have to do some splicing.”

Loud Mouth Johnson could hardly believe his ears. Here was a chance to get his thousand dollars back and show up Paul Bunyan as a boob besides. “Listen,” said Loud Mouth Johnson, “when you get through you will have only one belt twice as long and half as wide.”

“Want to bet?”

“Sure.”

So they bet a thousand dollars and, of course, Loud Mouth Johnson lost again. It wasn’t so much that Paul Bunyan was brilliant. It was just that he was methodical. He had tried it out with that strip of gummed paper, and he knew that the second time you slice a Möbius strip you get two pieces—linked together like an old fashioned watch chain.

Source: Upson, W. H. (date unknown) Paul Bunyan versus the Conveyor Belt, From: Johnson, D. A. and Glenn, W. H. (1964) *Topology: the rubber-sheet geometry*, London: John Murray, p. 12–13. (First published, 1960, USA, McGraw-Hill.)