## Three Speed Gearing and Some Interesting Comparisons

As people labored up the Bay City Hill during the 2007 Lake Pepin Three Speed Tour, many found that their first gears weren't all that low. As it happens, English three-speeds, unchanged, are geared kind of high. In this document I will discuss the Sturmey-Archer AW hub, compare the usual AW gearing to the gearing I used on the 2007 Lake Pepin Three Speed Tour and then, continuing the comparisons, show the same bike with a Nexus Premium 8-Speed Redband hub, my 1970s Motobecane Grand Record as a stand-in for 1970s ten-speeds in general, and finally to my circa-2005 Rivendell Atlantis 27-speed derailleur bike which has custom-chosen close-range gearing using a modern 9-speed cassette hub.

Poring over tables of gear-inches figures is just about as boring as can be, so instead, I demonstrate the comparisons on an Excel graph. This graph plots the gearing by chain-ring (one each for the two 3-speeds and the 8-speed, two for the 10-speed and three for the 27-speed) and bicycle. The numbers on the graph are the actual gear inches; the positions are precisely plotted relative to one another so gaps and chainring comparisons are clearly evident. I'm fond of this graph and think it's ideal for evaluating ratios, showing both the actual gear inches and the relative gearing between chainrings and bicycles.

**The Three Speeds.**

The most common Sturmey-Archer hub, and the one I use on the big 27" bicycle I refer to as the Chatsworth (it was previously a mid-1980s Schwinn World Sport), is the AW model. This uses a planetary gear mechanism to give gear ratios of 75%, 100% (direct drive), and 133%. Thus, second gear will be the gearing exactly as calculated from the chainring/cog combination. On traditional English three-speeds, these gears tend to be kind of high. These bicycles commonly came with 48-tooth chainrings and 18-tooth cogs, for a direct-drive gear of 69 inches (48 chainring divided by 18 cog times 27 inch wheel) (I know, gear inches are stupid, but so is Fahrenheit, and I'm used to both of them, so gear inches it is).

From that 69 inch direct drive gear you multiply up to third (91.8 inches) and down to first (51.8 inches). Wow. Even in my younger days touring on the ten-speed, my low low gear was 43.6 inches and that was barely adequate for loaded hilly riding. And 91.8 inches is a pretty serious high gear, nearly as high as the highest of my Atlantis's 27 gears, a gear I hardly ever ride. It's one thing for racers to have gears in the 90s and 100s, but for your average pipe-smoking 1930s utility-cycling Englishman, these seem kind of aggressive. These lows, which in the 50s are pretty high as well, are what hurt so much on the Bay City Hill and other Three Speed Tour climbs.

Acknowledging my own feebleness and the high stock gearing, I switched the Chatsworth to a 46 tooth chainring and 22 tooth cog. Both moves, the smaller chainring and larger cog, lower the gearing. The ratios between gears of 75/100/133 remain the same, but the whole range drops. Now, as you can see on the graph, the Chatsworth's at 75.1/56.5/42.3. The low gear is low enough to puff up the Bay City Hill and the high is a good cruising gear

for slight descents or tailwinds, beyond which I'd spin out (wearing dress shoes on rubber block pedals—SPDs would allow faster pedalling). In the 2006 Three Speed Tour, I actually rode a 40/21 for gearing of 68.4/51.4/38.6 and just managed to lug the low gear up the County AA Maiden Rock climb.

**The Eight Speed**

Once the Tour is over, the Chatsworth reverts to its usual gearing, a Shimano Nexus Premium (Redband) 8-speed internally geared hub. This was something of an experiment and I discovered I like it quite a lot. Using the same chainring and cog (and the Shimano Nexus cogs are interchangeable with classic Sturmey-Archer cogs and are dished to boot, to allow you to flip them to hit a good chainline), the gearing opens up as you can see on the graph. Again, the percentage changes are set between the gears, with 5th being direct drive in this case, identical to the AW's second gear. Now I get a range from 29.8 to 91.2 inches. It's a wider range than the three-speed hubs provide and has finer changes between gears. The really lovely things about this hub are that, unlike derailleur bicycles, 1) you can change gears while not moving, 2) there are no duplicate gears, and 3) there are no combinations that are essentially unusable due to chainline considerations. I rode this hub in 2006 and, once I got over the annoyance of the backward-shifting twist grip shifter, came to really like it. Look at the graph; the Nexus 8-speed hub gives almost the same range as the Atlantis's 27-speeds, leaving off only the two lowest granny gears and just missing on the top end. There ought to be more bikes with this puppy.

**The Ten Speed**

There are plenty of folks in the Three Speed Tour around my age who first got seriously into bicycles during the 1970s Bike Boom. Ten speeds were the choice of enthusiast cyclists, and mine was a 1975 Motobecane Grand Record. It was too small for me (as are most bikes, hence the towering 68cm (27 inch) Chatsworth and Atlantis bicycles I ride now) but I loved it so. I have plotted the stock gearing for this bicycle; in actual operations my usual large cog was 24, not 26, and in later years I put on a 40 tooth chainring to replace the 42. Still, this graph shows typical ten-speed gearing.

Things to note: the range isn't that wide—230% overall, quite a bit less than the Nexus 8-speed; there are near-duplicate gears in there between chainrings—the 51.5 second gear and the 54 sixth, for instance; shifting through the range in order would require several double-shifts; and, finally, one gear (large chainring to large cog, shown in red) is basically unusable due to chainline considerations.

Some of this was style-driven—the Bike Boom ten speeds were patterned after lightweight European racing bicycles, so many had light frames, sew-up tires and big chainrings. Chainrings like 36/46 might have been smarter and this Grand Record came with a Campagnolo Nuovo Record derailleur, the same as the Tour de France riders used, very manly, but which limited the big cog to 26 teeth on most bikes. Thus, gearing biased high, I almost never rode the top two gears and often wished for lower.

**The Rivendell Atlantis**

I got the Atlantis because it would fit and I decided I'd had enough of riding too-small bikes. I built it out with nice components, nothing flashy, but picked everything on the bike for various reasons. Among the things I chose was the gearing.

Generally, people buy a cog by the small and large size (14-28) and take whatever's in the middle without further thought. I thought about this a lot and in fact it was for this purpose that I initially wrote the spreadsheet that produced the graph. I decided to try really close gearing through the middle of the 9-speed cassette with an outlying large cog for a granny gear and an outlying small cog for an overdrive. My cycling buddy Paul brought along a box of gears and knew how to take apart clusters. I made my choices and built the cassette:

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13    15 16 17 18 19    21       24          28
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Here's a stock Campy Veloce 14-28 cluster:

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   14 15 16 17    19    21    23    25       28
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*(I'm rather fond of this way of showing gears on cassettes—you need a fixed font like this Courier, but it gives the actual gears while spacing them appropriately apart)*

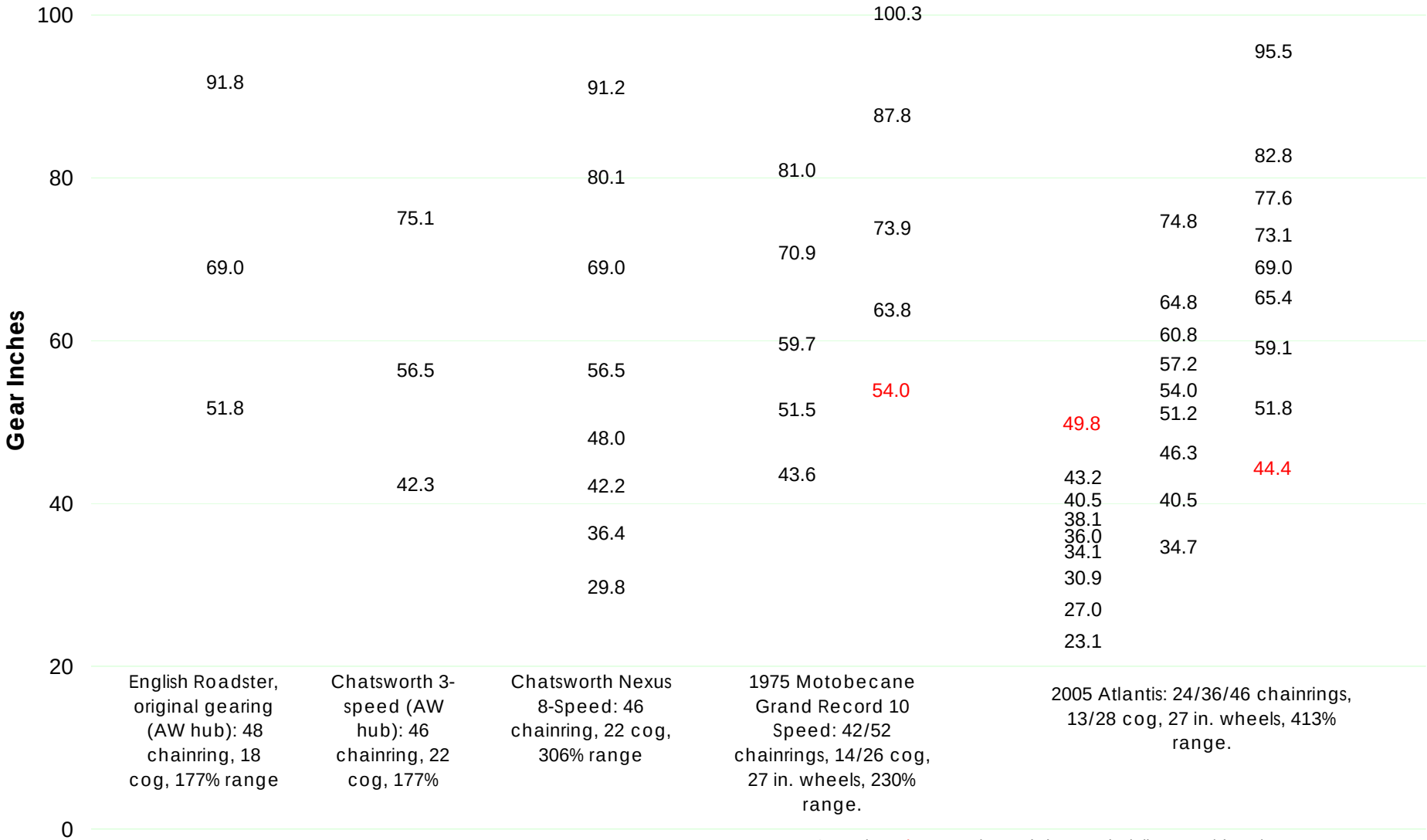
My goal was to have finely-adjustable gears through the middle of range. You can see on the graph how tightly they cluster, a result of the one-tooth jumps from 15 through 19. You can also see the large 413% overall range the Atlantis gives. Was all this necessary? Probably not, but I do like the fine-tuning through the three distinct ranges I have on that bike, compared to which the jarring 33% jumps on the three-speed AW hub seem pretty primitive. The Atlantis's 23.1 inch low gear is a real stump-puller; the 95.5 high is rarely-used but, with the SPD pedals, gives me all the pedaling speed I'm ever likely to need. Sure, there are exact (40.5) or near (51.2/51.8) duplicates in here, but that's bound to happen with 27 gears.

**Summary**

So there it is; English stock gearing from the 1930s-design AW hub; fiddling with that gearing by dropping the range; the modern Nexus 8-speed; the classic 1970s ten-speeds that drew many of us into cycling; the hand-picked 9-speed cluster with a large range. It's interesting that the stock AW gearing is not much different from the large chainring on the Atlantis, that my lower three-speed gearing is not much different than the middle ring of the Atlantis (though missing the lowest gear), or that the Nexus 8-speed's range covers nearly as wide a set of gears as the Atlantis's 3-ring setup, with wider jumps but no duplicates. From a three-speed point of view, if you do the Lake Pepin Three Speed Tour, you might want to lower your three-speed's gearing a tad and cruise happily up the Bay City Hill. From a general utility cycling point of view, you might want to give that Nexus Premium 8-speed some consideration. Until then, Cheers!

Matthew Cole May 2007 matt@uscoles.com

## Comparative Gear Ratios for Selected Bicycles




Gears in red are rarely used due to chainline considerations.